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SPORT-RELATED DIFFERENCES IN TYPE AND AMOUNT OF MENTAL IMAGERY USE BY ATHLETES

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ABSTRACT

This study investigated differences between athletes of different sport types in the amount type of mental imagery used. The theoretical framework for the study was provided by Paivio's (1985) Analytic Framework of Imagery Effects, and Martin et al.'s (1999) applied model of mental imagery use in sport. A sample of 120 university club athletes from team contact and non-contact sports (rugby and softball respectively), and individual contact and non-contact sports (karate and squash respectively) was used. Each participant completed the Sport Imagery Questionnaire (Hall et al., 1998), a self-report measure of amount and type of mental imagery used, the Vividness of Movement Imagery uestionnaire (Isaac et al., 1986), a measure of mental imagery ability, and the Marlowe-Crowne Social Desirability Scale. A number of differences between participants from the different sport types emerged from the analysis of the data. The study also provided evidence of the role of mental imagery ability and social desirability in reported use of mental imagery. The findings are discussed with reference to the existing literature on the use of mental imagery in sport and implications for the practice of sport psychology.

Key words: Mental imagery; Sport; Differences; Athletes.

INTRODUCTION

In recent research on the amount and type of imagery used by athletes (Hall *et al*., 1998; Martin *et al.,* 1999), findings have pointed to the mediating roles of variables such as the time of the year (Cumming & Hall, 2001), practice or competition phases, as well as the possible mediating role played by the type of sport that the athlete plays (Munroe *et al*., 1998). Although Martin *et al*. (1999) have suggested that the type of sport may well form part of their complex model of type of imagery used, few studies have systematically investigated differences in the use of mental imagery by athletes competing in different sports. The present study attempts to provide evidence to support the role of sport type in the type of mental imagery used by athletes, while addressing some of the shortcomings of research in the use of mental imagery articulated by Moran (1993).

Paivio's (1985) analytical framework of imagery effects has been the theoretical model used in the above studies. This model proposes that imagery plays both cognitive and motivational roles in mediating behaviour, with each of these roles operating at either a general or a specific level. Hall *et al*., (1998) used this framework to develop a taxonomy of mental imagery types that has been operationalised in a sport specific measure of mental imagery type, the Sport Imagery Questionnaire (SIQ).

Four types of imagery emerge from this taxonomy, namely motivational specific (MS), motivational general (MG), cognitive specific (CS) and cognitive general (CG) imagery. Hall *et al*. (1998) subsequently found that the motivational general factor should be further divided into two distinct types of mental imagery, namely motivational general-arousal (MG-A) and motivational general-mastery (MG-M) imagery.

Motivational specific imagery is imagery of goal-oriented responses and rewards associated with successful performances, such as winning a trophy for a performance. Motivational general imagery involves physiological arousal and the affect or emotion that may accompany competition in sport (Paivio, 1985). Specifically, motivational general-mastery (MG-M) imagery represents mastery of challenging situations, such as remaining focused on a game plan despite being in a losing position, while motivational-general arousal (MG-A) imagery represents physiological and emotional arousal associated with competing, e.g., remaining calm during competitions (Martin *et al.*, 1999). Cognitive specific imagery relates to *skills* such as a certain type of kick in karate or catching the ball in softball, while cognitive general imagery is imagery of *strategies* such as the defensive alignment of a rugby team or an attacking style of play in squash. This type of imagery is aimed at actually improving skills and strategies through mental rehearsal (Paivio, 1985).

Martin *et al.*'s (1999) applied model of imagery use in sport (see Figure 1) suggests a guiding framework of athletes' use of imagery in order to achieve a range of performance and skill outcomes in their sport. These outcomes include the acquisition and improved performance of skills and strategies, modification of cognitions and regulation of arousal and anxiety, which are all moderated by imagery ability. The model predicts that different types of imagery are associated with different expected outcomes. Learning and rehearsal of skills and strategies are predicted to be associated with cognitive specific and cognitive general imagery, while regulation of arousal and competitive anxiety are predicted by the use of motivational general-arousal imagery. Modification of cognitions, such as an individual's self-efficacy and self-confidence, are predicted to be associated primarily with motivational general-mastery imagery (Martin *et al.*, 1999).

The amount and types of imagery used are predicted to be a function partly of the sport situation (Martin *et al.*, 1999). Therefore, imagery use differs according to whether the athlete is involved in a competitive event, training for a competitive event, or rehabilitating an injury. A study by Basson (2004) supported this prediction, finding that a sample of rowers reported differing amounts of imagery use at four different time periods prior to the day of a competition. Studies by Munroe *et al.* (1998) and Cumming and Hall (2001) suggest that the time of season (i.e., during different competitive time periods or in the off-season) may also affect the amount and types of imagery used by the athlete.

Imagery ability acts as a moderator of imagery outcomes in Martin *et al.*'s (1999) model, affecting the strength and direction of the relationship between the outcomes of imagery use and the other components of the model. Athletes with high imagery ability may thus be more likely to experience the predicted outcomes of imagery use than those with low imagery ability.

Martin *et al.* (1999) suggest that sport type may ultimately find a place in their model, but that there is insufficient evidence at this time to warrant its inclusion. The present study was thus aimed at providing evidence to determine whether sport type should become an additional component in Martin *et al.*'s (1999) model.

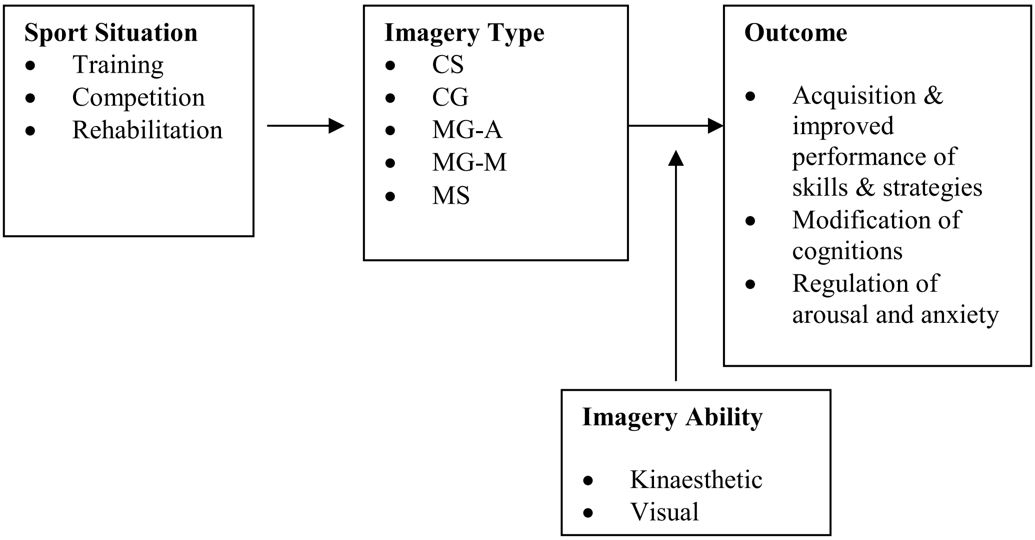

FIGURE 1. **MARTIN *ET AL.*'S APPLIED MODEL OF IMAGERY USE IN SPORT (1999: 248)**

Following from Martin *et al.*'s (1999) suggestion that different types of imagery lead to different outcomes, it seems likely that the unique physical and psychological demands of different sports may result in variations in the use of specific types of imagery across sports. For example, athletes competing in sports involving the use of greater physical strength as opposed to complex skills may be expected to use more motivational general-arousal imagery, which serves arousal control functions that may be employed to prepare for extreme physical exertion (Martin *et al.*, 1999). Similarly, athletes involved in sports in which technical skills are more important may make extensive use of cognitive specific and cognitive general imagery (imagery of skills and strategies). Furthermore, athletes who are involved in team sports may use different types of goal setting (team and individual goals) than athletes involved in individual sports (individual goals only), and may thus use different amounts of motivational specific (goal setting) imagery.

The duration of competitive contests in particular sports may also affect the amount and types of mental imagery used by competitors. Athletes involved in longer contests are likely to have different demands on them in terms of maintaining motivation and focus than those involved in shorter contests. This may be expected to lead to differential use of motivational types of imagery. Contest duration may also influence the use of cognitive imagery, as contests of longer duration may require the athlete to make more adjustments in terms of the skills and strategies they employ at different points in the contest.

Finally, certain sports may inherently place greater emphasis on mental toughness and the use of mental skills. For example, martial arts (karate, judo, taekwondo, etc.) strongly emphasise the development of mental as well as physical discipline as part of their training schedules (Chung & Lee, 1994; Gebashe, 2002).

A number of studies have provided some evidence that differences in imagery use by participants of different sports do exist. Hall *et al.* (1998) found statistically significant differences in imagery use between individual and team sport athletes, with team sport athletes reporting significantly more use of the motivational specific and motivational general-mastery functions of imagery. Munroe *et al.* (1998), however, found no clear systematic differences in imagery between team and individual sport athletes, although they did find that participants of different sports used differing amounts of imagery. In a study of imagery use in the off-season by participants of 10 different sports, Cumming and Hall (2001) found that football players reported significantly more use of all five types of imagery than participants of the other sports, although they did not find significant differences in reported imagery use between participants of any of the other sports.

As a pilot to the present study, an analysis was conducted on Sport Imagery Questionnaire (Hall *et al.*, 1998) data collected during the course of previous unpublished studies (Barnes, 1997; Tschudin & Basson, 1997; da Silva, 2000; Sluis-Cremer, 2000; Whitehead, 2000). The data consisted of SIQ scores for athletes from six sports, namely squash, rowing, Taekwondo, basketball, canoe polo and soccer. The analysis showed that squash players reported the least use of all five types of mental imagery. However, since the data collection procedures and competitive levels of participants were not standardised across all of these studies, it is necessary to view these findings with caution.

There is thus some evidence that sport-related differences in imagery use do exist, but it is necessary to investigate these differences more systematically and rigourously. A number of weaknesses in these studies also make it difficult to interpret their findings with confidence. These weaknesses include the lack of a systematic method for classification of sport types, and failure to control for the possible effects of imagery ability and social desirability on self-reports of mental imagery use (Moran, 1993). Although Moran's (1993) criticisms were made a decade ago, no studies of mental imagery in sport that we are aware of have systematically addressed all of them in the same study.

This study thus aimed to investigate sport-related differences in imagery use, while improving on the design of previous similar studies by providing a systematic classification of sports and controlling for imagery ability and social desirability. A better understanding of this issue would assist sport psychologists in designing more effective interventions that are tailor-made to the specific sport concerned, as well as improving our understanding of how the use of mental imagery may lead to specific outcomes. The findings of this study thus have potential importance in improving the theoretical understanding of mental imagery in sport, as well as contributing to the enhanced effectiveness of practical sport psychology interventions.

METHODS

The study involved a non-experimental, survey research design (Mertens, 1998), in which semi-structured questionnaires and standardised tests were used to measure the variables.

Participants

A non-probability, purposive sample (Neuman, 1997) consisted of 120 participants of four different sports, namely rugby, softball, karate and squash, with 30 participants from each sport being included in the sample. The sports were chosen, following Cratty's (1983) guidelines, on the dimensions of team-individual and contact-non-contact sports, as shown in Figure 2.

	Individual	Team
Contact	Karate	Rugby
Non-contact	Squash	Softball

FIGURE 2. **CATEGORIZATION OF SPORT TYPES FOR THE SAMPLE ACCORDING TO CRATTY (1983)**

Another dimension, namely the use of open or closed skills (Cratty, 1983), can also be used to classify sport types, where closed skills are those requiring little external feedback for their execution, such as pitching in softball, while open skills are those requiring adjustments to ever-changing external conditions, such as defending oneself in karate (Cratty, 1983). However, it is difficult to classify many sports as open or closed, since most involve a combination of both open and closed skills. The sports in this study were thus classified according to the team/individual and contact/non-contact dimensions, while the choice of which sports to include involved an effort to include sports requiring both open and closed skills.

The gender breakdown of the sample was 72.5% male and 27.5% female. Specifically, 67% of the karate sample, 63% of the squash sample, 100% of the rugby sample, and 60% of the softball sample were male (female proportions were 33%, 37%, 0% and 40% respectively).

By virtue of being drawn from university-based sports clubs, the sample was largely homogeneous in terms of age and education. The mean age of the sample was 22 years. The mean ages for the specific sports were 22 years for karate, 21 years for squash, 23 years for rugby and 20 years for softball. All participants had at least completed high school, and none had completed more than four years of tertiary education.

Although all participants were competing at a similar level (for university-based clubs), those who had previously gained any type of representative selection (regional, provincial or national) were classed as elite, while those who had competed only at club level were classed as non-elite. Using this classification system, 47.5% of the present sample were elite athletes, while 52.5% were non-elite. Specifically, 27% of the karate sample, 53% of the squash sample, 73% of the rugby sample, and 37% of the softball sample were elite (non-elite percentages were 73%, 47%, 27% and 63% respectively).

PROCEDURE

Coaches of the sport clubs were contacted to request permission to solicit volunteer participants from their clubs. After gaining permission from the coaches, the athletes were addressed at the beginning of a training session to provide them with information about the study and what would be required of them should they agree to participate. Those athletes who subsequently volunteered to participate were required to complete a set of pencil-and-paper questionnaires before the start of the training session. The researcher was present during the completion of questionnaires in order to assist with any difficulties that subjects encountered.

Psychometric instruments

Biographical Questionnaire

A biographical questionnaire was used to gather information about participants' gender, age, length of time playing their sport and highest representative level attained.

Vividness of Movement Imagery Questionnaire (VMIQ)

The VMIQ (Isaac *et al*., 1986) was selected to measure the ability to use movement-related imagery. The VMIQ contains 24 items and produces scores for three subscales: one for external (imagining someone else performing an action), and another for internal (imagining oneself performing an action), imagery perspectives, as well as an overall total. The test-retest reliability of this test is estimated at 0.76 for a 3-week interval. This test has satisfactory internal consistency and its convergent validity is supported by a correlation of 0.81 with the Vividness of Visual Imagery Questionnaire (Isaac *et al*., 1986). The Cronbach alpha coefficients for the current sample were 0.90 for the external subscale, 0.92 for the internal subscale and 0.93 for the overall scale and were thus all well above the minimum acceptable level of 0.70 (Rust & Golombok, 1999).

Sport Imagery Questionnaire (SIQ)

Type and amount of mental imagery use was measured using the SIQ (Hall *et al*., 1998), which consists of 30 items and five subscales with six items for each type of imagery. The subscales include Motivational Specific (MS), Motivational General-Mastery (MG-M), Motivational General-Arousal (MG-A), Cognitive Specific (CS), and Cognitive General (CG). Participants were required to rate the amount that they use each type of imagery on a 7-point Likert scale ranging from *Rarely* (1) to *Often* (7). Cronbach alpha reliability coefficients calculated during the development of the SIQ were favourable for all five subscales (MS=.88, MG-M=.83, MG-A=.70, CS=.85 and CG=.75), and initial tests concerning the construct validity of the SIQ have produced favourable results (Hall *et al*., 1998). The alpha coefficients for the present sample were 0.86 (MS), 0.81 (MG-M), 0.70 (MG-A), 0.76 (CS) and 0.73 (CG). These alpha coefficients are similar to those reported by Hall *et al.* (1998).

Marlowe-Crowne Social Desirability Scale

The Marlowe-Crowne Social Desirability Scale was selected as it measures both the self-deceptive positivity and impression management factors of social desirability (Paulhus, 1991). Subjects were asked to complete a short form of the scale, developed by Reynolds (1982), in order to control for any possible social desirability effects on their reports of mental imagery use, imagery ability and perceived effectiveness of imagery, as suggested by Moran (1993). The instrument consisted of 13 true-or-false items. Reynolds (1982) reported a mean of 5.67 (SD=3.20) for this scale. A reliability coefficient of .76 was obtained during its development, while concurrent validity was supported by a correlation of .93 (p<.001) with the original scale (Reynolds, 1982). The Cronbach alpha coefficient for the present sample was 0.71 and was thus lower than the alpha coefficient reported by Reynolds (1982), but still above the minimum acceptable level of 0.70 (Rust & Golombok, 1999).

RESULTS

Histograms and boxplots were generated to examine the distributions of all the variables measured in the study, and showed that no major violations of assumptions were present, and thus that all variables could be retained for further analysis (Hinkle *et al.*, 1994).

One-way ANOVA analyses revealed that there were no significant differences between the males and females in the sample on any of the five SIQ subscales. Furthermore, none of the previous studies reviewed in the literature identified gender differences on any of the variables measured in this study (e.g., Hall *et al.*, 1998; Martin *et al.*, 1999). It was thus decided to collapse the gender dichotomy in the sample for all further analyses.

Further one-way ANOVA analyses were conducted with the SIQ subscales as dependent variables and the elite/non-elite dichotomy as the independent variable. These analyses showed that elite athletes reported significantly more use of motivational general-arousal imagery than non-elite athletes (df=119; F=5.386; p=.030). No significant differences were found between elite and non-elite athletes on any of the other measured variables.

TABLE 1. **VARIABLES SIGNIFICANTLY CORRELATED WITH SIQ SUBSCALES**

SIQ Subscale	Significant Correlates	n	Pearson *r*
MS	None	119	
MG-A	VMIQ Self	119	0.195*
MG-M	VMIQ Self	119	0.236**
CS	VMIQ Self	119	0.236**
	MCS – Social Desirability	119	0.265**
CG	VMIQ Self	119	0.284**
	VMIQ Total	119	0.207*
	MCS – Social Desirability	119	0.255**

* Significant at p=.05
** Significant at p=.01

Bivariate correlation procedure

Pearson correlations were generated to investigate the relationships between the SIQ subscales and the other variables. The significant correlations that emerged are summarized in Table 1.

The motivational specific subscale was not significantly correlated to any of the other measured variables. The motivational general-arousal subscale was significantly positively correlated to the VMIQ Self subscale. The motivational general-mastery subscale was also significantly positively correlated to the VMIQ Self subscale. The cognitive specific and cognitive general subscales were both positively correlated to the VMIQ Self subscale and to scores on the Marlowe-Crowne measure of social desirability. The cognitive general subscale was also weakly positively correlated with the VMIQ Total subscale. Although all these correlations were all comfortably significant at α=0.05, they were also all weak, with correlation coefficients ranging from 0.195 to 0.284 (Hinkle *et al.*, 1994).

Sport differences in mental imagery use

The descriptive statistics for the team, individual, contact and non-contact sports on the five subscales of the SIQ are shown in Table 2. Furthermore, the descriptive statistics for each of the four specific sports on the five SIQ subscales are shown in Table 3.

TABLE 2. **DESCRIPTIVE STATISTICS FOR SIQ SUBSCALES FOR TEAM, INDIVIDUAL, CONTACT AND NON-CONTACT SPORTS**

SIQ Subscale	n	Mean	SD	Min	Max
Individual (karate and squash)					
MS	60	4.89	1.29	1.33	7.00
MG-A	60	4.86	1.04	1.40	6.80
MG-M	60	5.14	1.04	2.33	7.00
CS	60	4.62	1.09	1.17	6.67
CG	60	4.68	1.13	1.50	7.00
Team (rugby and softball)					
MS	60	5.26	1.34	1.17	7.00
MG-A	60	5.13	1.11	2.20	7.00
MG-M	60	5.51	1.02	3.33	7.00
CS	60	5.02	0.95	2.50	7.00
CG	60	4.86	0.99	2.67	6.67
Contact (karate and rugby)					
MS	60	5.18	1.21	1.17	7.00
MG-A	60	5.47	0.89	2.80	7.00
MG-M	60	5.59	0.88	3.83	7.00
CS	60	5.16	0.86	3.17	7.00
CG	60	4.99	1.06	2.50	7.00
Non-contact (squash and softball)					
MS	60	4.98	1.43	1.33	7.00
MG-A	60	4.53	1.05	1.40	6.80
MG-M	60	5.07	1.15	2.33	7.00
CS	60	4.48	1.09	1.17	6.50
CG	60	4.55	1.04	1.50	6.50

TABLE 3. **DESCRIPTIVE STATISTICS FOR SIQ SUBSCALES FOR DIFFERENT SPECIFIC SPORT TYPES**

SIQ Subscale	n	Mean	SD	Min	Max
Individual contact (karate)					
MS	30	5.41	1.19	2.67	7.00
MG-A	30	5.30	0.92	2.80	6.80
MG-M	30	5.62	0.93	3.83	7.00
CS	30	5.10	0.94	3.17	6.67
CG	30	5.10	1.06	2.50	7.00
Individual non-contact (squash)					
MS	30	4.38	1.20	1.33	6.67
MG-A	30	4.43	0.97	1.40	6.00
MG-M	30	4.66	0.94	2.33	6.17
CS	30	4.14	1.03	1.17	5.83
CG	30	4.26	1.06	1.50	6.00
Team contact (rugby)					
MS	30	4.96	1.22	1.17	6.83
MG-A	30	5.64	0.83	3.40	7.00
MG-M	30	5.56	0.83	3.83	7.00
CS	30	5.22	0.78	4.00	7.00
CG	30	4.88	1.06	2.67	6.67
Team non-contact (softball)					
MS	30	5.57	1.40	2.50	7.00
MG-A	30	4.63	1.12	2.20	6.80
MG-M	30	5.47	1.20	3.33	7.00
CS	30	4.82	1.07	2.50	6.50
CG	30	4.83	0.94	3.33	6.50

A series of 2x2 analyses of covariance (ANCOVA's) were conducted in order to test for significant main effects (i.e. differences between individual/team, and contact/non-contact sports), as well as for interaction effects (i.e. differences between the distinct four sport types) on the SIQ subscales. The choices of variables to enter as covariates in each analysis were based on the results of the multiple correlation procedure described above. The results of the ANCOVA analyses are summarised in Table 4.

A number of significant differences between the four sport types on the SIQ subscales emerged from these analyses. On the motivational specific subscale, no main effects emerged, but a significant interaction emerged. Scheffe post hoc tests showed that the individual contact (karate) and team non-contact (softball) groups both scored significantly higher than the individual non-contact (squash) group. No covariates were entered for this analysis.

TABLE 4. **SIGNIFICANT SPORT DIFFERENCES ON SIQ SUBSCALES**

Significantly Differing Sport Types		Mean Difference	*df*	*F*	Covariates Entered
MS					
Indiv. Contact	Indiv. non-contact	1.022	59	5.334^{**}	None
Team non-contact	Indiv. non-contact	1.183	59	5.334^{**}	
MG-A					
Contact	Non-contact	0.930	119	28.250^{***}	VMIQ Self (df=1; F=5.118^{*})
MG-M					
Team	Individual	0.422	119	5.882^{*}	VMIQ Self (df=1; F=11.068^{***})
Contact	Non-contact	0.516	119	8.818^{**}	
Team contact	Indiv. non-contact	0.937	59	7.934^{***}	
Indiv. contact	Indiv. non-contact	1.057	59	7.934^{***}	
Team non-contact	Indiv. non-contact	0.963	59	7.934^{***}	
CS					
Team	Individual	0.419	119	6.395^{*}	VMIQ Self (df=1; F=10.216^{**}), MCS (df=1; F=9.458^{**})
Contact	Non-contact	0.683	119	16.968^{***}	
CG					
Contact	Non-contact	0.477	119	7.265^{**}	VMIQ Self (df=1; F=13.214^{***}), MCS (df=1; F=7.940^{**})
Team contact	Indiv. non-contact	0.674	59	4.743^{**}	
Indiv. contact	Indiv. non-contact	0.905	59	4.743^{**}	
Team non-contact	Indiv. non-contact	0.625	59	4.743^{**}	

(Key: Individual = squash and karate; team = rugby and softball; individual contact = karate; individual non-contact = squash; team contact = rugby; team non-contact = softball)

* Significant at p=.05
** Significant at p=.01
*** Significant at p=.001

On the motivational general-arousal subscale, a main effect for contact/non-contact emerged, with athletes competing in the contact sports reporting significantly more use of this type of imagery than those competing in the non-contact sports. There was no significant main effect for individual/team, and no significant interaction. The VMIQ Self (internal) subscale emerged as a significant covariate in this analysis.

On the motivational general-mastery subscale, both main effects were significant, with athletes from team sports reporting significantly more use of this type of imagery than those from individual sports, and athletes from contact sports reporting significantly more use of this type of imagery than their non-contact counterparts. A significant interaction also emerged, with Scheffe post hoc tests showing that individual non-contact (squash) participants reported significantly less use of motivational general-mastery imagery than participants from all three of the other sports. The VMIQ Self subscale again emerged as a significant covariate in this analysis.

On the cognitive specific subscale, both main effects were significant, but the interaction was not significant. Specifically, athletes from team sports reported significantly more use of cognitive specific imagery than those from individual sports, while participants of contact sports reported significantly more use of this type of imagery than those of non-contact sports. The VMIQ Self and Marlowe-Crowne Social Desirability scale were both significant covariates in this analysis.

On the cognitive general subscale, both main effects, as well as the interaction, were significant. Once again, athletes from team sports and contact sports reported significantly more use of this type of imagery than those from individual sports and non-contact sports respectively. Furthermore, the participants from the individual non-contact sport (squash) reported significantly less use of this type of imagery than the participants from all of the other three sports. The VMIQ Self and Marlowe-Crowne Social Desirability scale were again significant covariates in this analysis.

DISCUSSION

A number of differences between the sport groups in reported use of mental imagery emerged from this study. The most consistent finding across different types of mental imagery was that participants of the individual non-contact sport (squash) reported significantly less use of mental imagery than participants of the other sport types. Specifically, the squash sample reported the lowest means out of the four sports on all of the SIQ subscales. Furthermore, the interaction effects reported above showed that the squash players reported significantly less use than all three of the other sports of motivational general-mastery and cognitive general imagery, as well as significantly less use of motivational specific imagery than the karate and rugby participants.

The significant main effects found on all of the SIQ subscales except for motivational specific imagery involved either the contact athletes reporting significantly more use of mental imagery than non-contact athletes (for MG-A, MG-M, CS and CG imagery), or the team athletes reporting significantly more use of mental imagery than the individual sport athletes (for the MG-M and CS subscales). Hence, since the squash group was either a subset of the significantly lower-scoring group, or comprised the entire lower-scoring group, in all of the significant differences that emerged, it appears that the contribution of the low means for the squash group was a primary reason for the emergence of significant sport-related differences in the present study.

These findings may reflect a trend towards differences in imagery use between competitors in both team and individual, and contact and non-contact sports. It is possible that athletes from team sports tend to use more mental imagery than those from individual sports, and similarly, that athletes from contact sports tend to use more mental imagery than those from non-contact sports. These suggestions are supported by the significant main effects mentioned above, as well as by trends in the means for the SIQ subscales. Table 2 shows that team sport athletes had higher means for all of the SIQ subscales than individual sport athletes. Similarly, athletes from contact sports had higher means than those from non-contact sports on all of the SIQ subscales. Athletes from sports such as squash, as participants of both an individual and a non-contact sport, would thus be expected to generally use the least mental imagery out of the four sport types.

Previous studies provide some support for the suggestion that team and contact sport participants tend to use more mental imagery than individual and non-contact sport participants. Hall *et al*. (1998) found that team sport athletes reported more use of motivational specific and motivational general-mastery imagery than individual sport athletes. Furthermore, the team sport in Hall *et al.*'s (1998) study was ice hockey (a contact sport), while the individual sports were track and field athletics (non-contact sports). Cumming and Hall (2001) also found that athletes from a team contact sport (American football) reported more use of mental imagery than athletes from any other measured sports. However, a number of the other measured sports in this study were also team contact sports. The authors suggested that the emergent differences may have been related to a superior investment of time and effort in their sport on the part of the football players in the sample, due to a greater desire to pursue professional careers, rather than being related to the type of sport they played (Cumming & Hall, 2001).

The finding that athletes from contact sports tended to use more motivational general-arousal and mastery imagery than those from non-contact sports may be a reflection of the physical demands of contact sports and the usefulness of "psyching up" imagery in preparing for the physical contact, and the stress and arousal, associated with sports of this nature. The use of the arousal-regulation functions afforded by motivational general-arousal imagery, as well as the self-confidence functions associated with motivational general-mastery imagery (Martin *et al.*, 1999), may assist these athletes in preparing themselves to face the risk of injury, and the pain associated with it, inherent in sports such as rugby and karate, as well as in other contact sports, such as soccer, hockey, boxing, wrestling and martial arts. This type of imagery may thus be particularly useful to athletes from contact sports in assisting them both to get psyched up, and to maintain composure, relaxation and self-confidence before competing (Munroe *et al.*, 2000).

Munroe *et al.* (1998) provide support for this argument in their findings that athletes from contact sports (American football, field and ice hockey, soccer, rugby and wrestling) tended to report more use of motivational general-arousal imagery than those from non-contact sports (badminton and basketball). In their study, however, participants of a non-contact sport (volleyball) reported comparable use of motivational general-arousal imagery to that of football and hockey players, although less than that of soccer, rugby and wrestling participants.

Contact sport participants' greater use of both cognitive specific and general imagery may also be a reflection of the demands of contact sports. A high degree of mental rehearsal of specific skills as well as general strategies may assist athletes in mentally preparing themselves for high-contact situations. Successful mental practice of such skills and strategies may be important in helping athletes re-affirm that they posses the tools to enter into potentially physically threatening sport situations without undue or debilitating concerns about the risk of serious injuries.

The findings that participants from team sports reported significantly more use of motivational general-mastery imagery and cognitive specific imagery may also be related to the characteristics of the sport types concerned. Athletes who compete in team sports rely not only on themselves, but also on their teammates and on the interaction between themselves and their teammates, for success. These complex dynamics of team sports may result in team sport competitors using motivational imagery to imagine mastery of both individual and team-related demands, building confidence (Martin *et al.*, 1999), both in their individual abilities, as well as in their abilities to combine effectively with their team mates, hence resulting in greater use of this type of mental imagery. Similarly, participants of team sports may use cognitive specific imagery to mentally rehearse both individual skills and skills used in combination with team mates, thus resulting in increased use of this type of mental imagery. However, this explanation would suggest that team sport athletes should use significantly more of other types of mental imagery in addition to the two for which significant differences were found in the present study. A possible reason why significant main effects for team/individual sports emerged on only two of the SIQ subscales, and also why interactions emerged on only three SIQ subscales, is that the sample size (60 per group for main effects; 30 per group for interactions) for these analyses was only large enough to detect medium- to large-sized effects (Hinkle *et al.*, 1994). Almost 400 participants per group would have been necessary to detect small effect sizes (Hinkle *et al.*, 1994).

A number of studies have found that elite athletes report greater use of mental imagery than non-elite athletes (Hall *et al.*, 1990; Martin *et al.*, 1999; Whitehead, 2000; Cumming & Hall, 2001). However, it is unlikely that the differences between the sport groups found in the present study could be accounted for by differences in level of competition. However, significant elite/non-elite differences were only found in the present sample on the motivational specific subscale of the SIQ, and no significant differences between elite and non-elite athletes emerged on any of the other SIQ subscales. Representative level is thus likely to partially account for observed differences between contact and non-contact athletes on the motivational general-arousal subscale. However, the proportion of elite athletes present in the contact sports sample (50%) was only slightly greater than that for the non-contact sample (45%). Furthermore, the individual non-contact (squash) group contained the second-highest proportion of elite athletes out of the four groups but obtained the lowest means on all of the SIQ subscales. These factors suggest that representative level is unlikely to significantly account for the sport-related differences on any of the SIQ subscales in the present sample.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

This study has provided some evidence supporting the inclusion of sport type in Martin *et al.*'s (1999) applied model of mental imagery use in sport. These findings have implications for the future design of mental imagery interventions in sport psychology. Specifically, interventions designed for participants of contact sports should include greater emphasis on the use of imagery relating to arousal, anxiety regulation, skills and strategies than those designed for participants of non-contact sports. Furthermore, interventions designed for team sport athletes should place greater emphasis on imagery relating to mental toughness and specific skills than those designed for individual sport athletes. However, further research is required in order to investigate whether these finding is consistent across different specific sports from those used in the present study.

It is possible that the findings of the present study were due to particular characteristics of the sample of individual non-contact (squash) participants, or of squash participants in general, that were not measured in the study. The findings may also have been related to the time of the sport season (Munroe *et al.*, 1998) or time prior to a competitive performance (Basson, 2004) at which the participants completed the SIQ, which could not be standardized across the four sports used in the present study due to practical considerations (e.g., issues of convenience for the coaches and athletes). A replication of the study, using samples from similar sport types but different specific sports, and ensuring consistency in administration across sports with respect to time of season and time interval prior to competing, would help to clarify this issue.

The results of the present study also provide support for the importance of controlling for both imagery ability and social desirability when using self-report measure of mental imagery, as suggested by Moran (1993). This is shown in the significant correlations between the SIQ subscales and the measures of imagery ability and social desirability, as well as the emergence of the VMIQ Self scale and the Marlowe-Crowne social desirability scale as significant covariates in the ANCOVA analyses (see Table 3).

Athletes who reported high ability to image themselves performing various actions tended to report more use of four of the five types of mental imagery measured by the SIQ. These findings, however, were not replicated with respect to athletes' ability to image other people performing the actions. This is not surprising, however, as the wording of the SIQ items generally refers to athletes imaging themselves, as opposed to other people, in various sporting situations.

Athletes who obtained high scores on the Marlowe-Crowne scale tended to report more use of cognitive specific and cognitive general imagery. Social desirability, however, was not significantly related to reports of use of any of the motivational types of imagery. This suggests that athletes are more likely to respond in a socially desirable manner when reporting their mental imagery of development and execution of skills and strategies than they are when reporting their use of the motivational functions of mental imagery, such as excitement, control, relaxation, mental toughness, focus and confidence (Munroe *et al.*, 2000). Further research is required in order to confirm this trend, and to clarify why social desirability affects reports of cognitive, but not motivational, types of mental imagery.

It should be noted that the significant correlations between the SIQ subscales and the measures of imagery ability and social desirability, were all with no more than around 7% of the variance in any of the SIQ subscales being accounted for by the VMIQ subscales or by scores on the Marlowe-Crowne scale. Thus, while Moran's (1993) call for measures of imagery ability and social desirability to routinely be included in studies of mental imagery use, the findings of the present study suggest that a failure to control for such factors is not likely to invalidate the findings of previous studies.

As mentioned previously, a limitation of the present study was that the sample size was only sufficient to detect medium- to large-sized effects. While a larger sample size would have been optimal, this was not possible due to the limited number of university-based sports clubs in the geographical area in which the present study was conducted. We hope that this limitation will be overcome in future studies.

The inclusion of participants from only four specific sports was a further limitation of the present study. This was necessitated by time and financial constraints and the difficulty of finding available participants in a wider range of sports, but it resulted in uncertain generalisability beyond the specific sports included. The inclusion of participants from at least two to three different specific sports for each sport type in future studies would be useful in evaluating how generalisable the findings of the present study are.

Finally, Paivio's (1985) model, upon which Hall *et al.*'s (1998) SIQ is based, provides a useful framework for the conceptualisation and measurement of mental imagery in sport. However, the fixed-choice format of the SIQ may be limiting in not allowing participants to elaborate on their use of each of the types of imagery operationalised in the questionnaire. For future studies, the use of qualitative methodologies, such as those employed by Munroe *et al.* (2000), in conjunction with the SIQ, may thus be more useful than the use of the SIQ alone in exploring various aspects of mental imagery in sport.

REFERENCES

BARNES, B. (1997). Mental imagery in elite and non-elite squash players. Unpublished Honours research project. Pietermaritzburg: University of Natal.

BASSON, C.J. (2004). Mental imagery in rowers during pre-competition periods. *South African Journal for Research in Sport, Physical Education and Recreation,* 26(1): 1-7.

CHUNG, K.H. & LEE, K.M. (1994). *Taekwondo KYORUGI: Olympic style sparring*. Hartford: Turtle Press.

CRATTY, B.J. (1983). *Psychology in contemporary sport* (2nd ed.). Engelwood Cliffs, NJ: Prentice-Hall.

CUMMING, J. & HALL, C. (2001). Athlete's use of imagery in the off-season. In A. Papaioannou; M. Goudas & Y. Theodorakis (Eds.) *Proceedings of the 10th World Congress of Sport Psychology* (vol 2: 78-80). Thessaloniki, Hellas: Christodoulidi Publications.

DA SILVA, A. (2000). An analysis of mental imagery, team cohesion and competitive state anxiety in student basketball players in South Africa. Unpublished honours research project. Pietermaritzburg, University of Natal.

GEBASHE, A. (2002). Personal communication, May 2.

HALL, C.R.; MACK, D.E.; PAIVIO, A. & HAUSENBLAS, H. (1998). Imagery use by athletes: development of the sport imagery questionnaire. *International Journal of Sport Psychology,* 29: 73-89.

HINKLE, D.E.; WIESMA, W. & JURS, S.G. (1994). *Applied statistics for the behavioural sciences.* Boston, MA: Houghton Mifflin.

ISAAC, A.; MARKS, D.F. & RUSSELL, D.G. (1986). An instrument for assessing imagery of movement: the vividness of movement imagery questionnaire (VMIQ). *Journal of Mental Imagery,* 10: 23-30.

MARTIN, K.A.; MORITZ, S.E. & HALL, C.R. (1999). Imagery use in sport: a literature review and applied model. *The Sport Psychologist,* 13(3): 245-268.

MERTENS, D.M. (1998). *Research methods in education and psychology.* Thousand Oaks, CA: Sage.

MORAN, A. (1993). Conceptual and methodological issues in the measurement of mental imagery skills in athletes. *Journal of Sport Behavior,* 16(3): 156-170.

MUNROE, K.J.; HALL, C.; SIMMS, S. & WEINBERG, R. (1998). The influence of type of sport and time of season on athlete's use of imagery. *The Sport Psychologist,* 12(4): 440-449.

MUNROE, K.J.; GIACOBBI, P.R.; HALL, C. & WEINBERG, R. (2000). The four W's of imagery use: where, when, why and what. *The Sport Psychologist,* 14(2): 119-137.

NEUMAN, W.L. (1997). *Social research methods.* Boston, MA: Allyn & Bacon.

PAIVIO, A. (1985). Cognitive and motivational functions of imagery in human performance. *Canadian Journal of Applied Sport Sciences,* 10: 22S-28S.

PAULHUS, D.L. (1991). Measurement and control of response bias. In J.P. Robinson; P.R. Shaver & L.S. Wrightsman (Eds.), *Measures of personality and social psychological attitudes* (17-51). San Diego, CA: Academic Press.

REYNOLDS, W.M. (1982). Development of reliable and valid short forms of the Marlowe Crowne Social Desirability Scale. *Journal of Clinical Psychology,* 38(1): 119-125.

RICGARDSON, J.T.E. (1991). Gender differences in imagery, cognition and memory. In R.H. Logie & M. Denis (Eds.), *Mental images in human cognition* (271-303). Amsterdam: North-Holland.

RUST, J. & GOLOMBOK, S. (1999). *Modern psychometrics: the science of psychological assessment.* London: Routledge.

SLUIS-CREMER, K. (2000). A study of imagery, arousal and self-confidence in elite canoe polo players. Unpublished honours research project. Pietermaritzburg: University of Natal.

TSCHUDIN, A.J-P.C. & BASSON, C.J. (1997). Mental imagery, psychological skills and competitive anxiety and orientation in participants of Taekwondo in South Africa. Unpublished research report. Pietermaritzburg: University of Natal.

WHITEHEAD, K.A. (2000). Mental imagery, competitive state anxiety and achievement goals in male and female, elite and non-elite soccer players. Unpublished honours research project. Pietermaritzburg: University of Natal.

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