# The Applied Model of Imagery Use:

# Examination of Moderation and Mediation Effects

**Abstract**

The applied model of mental imagery use proposed an interaction effect between imagery type and imagery ability (Martin et al., 1999). This study had two aims, (i) the examination of imagery ability as a moderating variable between imagery type and dispositional flow, and (ii) the testing of alternative mediation models. The sample consisted of 367 athletes from Scotland and Australia, who completed the Sport Imagery Questionnaire, Sport Imagery Ability Questionnaire, and Dispositional Flow Scale-2. Hierarchical regression analysis showed direct effects of imagery use and imagery ability on flow, but no significant interaction. Mediation analysis revealed a significant indirect path, indicating a partially mediated relationship (*p* = .002) between imagery use, imagery ability, and flow. Partial mediation was confirmed when the effect of cognitive imagery use and cognitive imagery ability was tested, and a full mediation model was found between motivational imagery use, motivational imagery ability and flow. The results are discussed in conjunction with potential future research directions on advancing theory and applications.

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Running head: IMAGERY ABILITY, IMAGERY USE, AND FLOW

**Introduction**

The relevance of imagery in sport has been reflected in a number of theoretical frameworks and applications that aim to enhance skill learning and performance, and to modify cognitions and regulate arousal. Researchers and practitioners frequently refer to the use and benefits of imagery in exercise and sport settings (e.g., Gregg, Nederhof, & Hall, 2005; Nordin & Cumming, 2008). Although previous research accrued empirical evidence about the importance of imagery in a theoretical and applied context, there appears to be a gap in the literature as to how researchers can effectively interpret and incorporate theory-based findings into a successful intervention program. One approach that appears to be promising is the testing of relevant models yielding results that are transferable into and applicable to a competition setting. The literature on this topic indicates a number of individual difference factors that can impact on the effectiveness and quality of imagery use and specific outcomes, for instance, experience and gender have been examined as potential moderating factors (Gregg, et al., 2005; Weinberg, Butt, Knight, Burke, & Jackson, 2003). Previous studies produced ambiguous results on potential moderating effects (cf. Murphy, Nordin, & Cumming, 2008 for an overview), which could be due to conceptual and operational limitations. Based on theoretical contentions, Martin, Moritz, and Hall (1999) suggested imagery ability is a critical individual difference variable that could moderate the effectiveness with which athletes use imagery. The applied model of mental imagery use in sport (Martin et al., 1999) has received some attention, as it provides a pertinent starting point for theoretical and applied research. The purpose of this study was to examine imagery ability as a moderator between imagery type and flow frequency.

The applied model of mental imagery use consists of four main parts, based on (i) the sport situation, (ii) imagery type, (iii) imagery ability, and (iv) outcome (Martin et al., 1999). Martin et al. (1999) proposed that imagery is generally applied in three contexts, such as rehabilitation, competition, and training situations. The context of the situation affects the type of imagery being used. The heart of the model is the imagery type that is conceptually based on Paivio’s (1985) analytic framework of imagery effects. Paivio proposed two orthogonal types of imagery, cognitive and motivational, which can be further distinguished into specific and general functions. The cognitive function consists of images of particular motor skills (cognitive specific) and match strategies (cognitive general), and the motivational function represents images of specific goals (motivational specific), optimal arousal (motivational general-arousal), and successful coping and confidence (motivational general-mastery) (Martin et al., 1999). According to Martin et al. (1999), the imagery outcomes and whether there are beneficial effects do not solely rely on imagery types, but on individuals’ imagery ability that can moderate the intended outcome. Imagery outcomes are generally distinguished into learning and performance, regulation (e.g., anxiety), and cognitive modifications.

**Issues and Limitations in Testing the Imagery Model**

There are a number of critical points and potential limitations raised in previous research that can affect the use and testing of the applied model of mental imagery. Specific issues have been addressed on a conceptual, empirical, and operational level. Martin et al. (1999) based their framework of applied imagery use on Baron and Kenny’s (1986) theoretical contentions on moderation effects. One of the key assumptions is that without the moderating variable a zero-correlation exists between the independent and dependent variables (Baron & Kenny, 1986; Martin et al., 1999). A number of previous studies examining imagery as a moderator did not meet this zero-correlation assumption. For instance, Nordin and Cumming (2008) assessed whether imagery ability moderated the relationship between imagery effectiveness and imagery frequency. Similarly, Gregg et al. (2005) examined imagery ability as a moderating variable in the imagery use-performance relationship. Both studies did not detect the hypothesized moderation effects. Gregg et al. (2005) argued that the absence of a moderation effect could be attributed to the lack of sensitivity of the performance measure as an outcome variable. Although, the authors did not report any correlations, it is possible that strong associations among key variables lead to large amounts of shared variance, which could have contributed to masking or suppressing the effect of the moderating variable. Previous research (e.g., Gregg et al., 2005; Nordin & Cumming, 2008) outlined the relationship between imagery type and imagery ability on a conceptual level, but these variables have not been aligned on a measurement level. For instance, Gregg et al. (2005) administered the Sport Imagery Questionnaire (SIQ; Hall, Mack, Paivio, & Hausenblas, 1998) to examine imagery type, whereas imagery ability has been operationalized as visual and kinesthetic imagery through the revised version of the Movement Imagery Questionnaire (MIQ-R; Hall & Martin, 1997). The lack of empirical evidence in detecting moderation effects could be partly due to the selection of imagery measures. A stronger methodological approach has been used by Nordin and Cumming (2008) who aligned the measurement of imagery type, through the SIQ, with the assessment of imagery ability by adding two companion scales to the original SIQ scale measuring visual and kinesthetic imagery abilities. Using two validated measures with a similar subscale structure for imagery type (e.g., SIQ) and imagery ability (e.g., Sport Imagery Ability Questionnaire, SIAQ; Williams & Cumming, 2011) would allow researchers a methodologically sound approach in detecting moderation effects, and, on a more detailed level, to differentiate between cognitive and motivational imagery interactions.

Baron and Kenny (1986) stated that a moderation model should be used “when there is an unexpectedly weak or inconsistent relation between a predictor and a criterion variable (e.g., a relation holds in one setting but not in another)” (p. 1178). Interpreting results on a conceptual level, moderators indicate *when* specific effects occur, whereas mediators help explain *why* specific effects occur (Baron & Kenny, 1986). For instance, a moderator can influence the effect of the independent variable on the dependent variable in a stepwise manner (Baron & Kenny, 1986), which is reflected in discussions on years of experience, indicating that more experienced athletes in comparison to less experienced ones use imagery more frequently (Gregg et al., 2005).

Baron and Kenny’s (1986) definition of mediation is based on the influence of a variable (C), the mediator, on the significant relationship between two variables (e.g., A and B). When C is considered, the A-B relationship is either rendered not significant (i.e., full mediation) or the amount of variance is reduced (i.e., partial mediation). In this case, C, the mediator, significantly predicts B, while controlling for variable A. Testing a mediation model is preferable when predictor and criterion variables are associated by a strong relationship (Baron & Kenny, 1986). Therefore, the decision on testing moderation or mediation models will affect the interpretation of accuracy in conceptual models and the development of applied research. Martin et al. (1999) noted in a critical reflection of the applied model of mental imagery that imagery ability has been proposed as a potential mediator (Murphy, 1990; Whelan, Mahoney, & Meyers, 1991), but due to a lack of empirical support the theoretical implications of a mediation model have not been pursued further. Recently, Williams and Cumming (2012) provided evidence for a full mediation model, indicating that strategy and skill imagery ability mediated the relationship between mastery imagery ability and performance. In light of inconsistent empirical support for Martin et al.’s (1999) original model, and conceptual and strategic discussions, researchers should consider if the moderation model of applied imagery use would be more accurate and effective as a mediation model, with imagery ability mediating potential relationships between imagery use and specific outcome variables.

**Conceptual and Empirical Support for the Imagery Use-Flow Relationship**

Examining the applied model of imagery use requires careful deliberation of tested variables. Conceptually, Martin et al. (1999) incorporated five types of imagery use, based on the differentiation between cognitive and motivational imagery functions (Paivio, 1985). This means the outcome variable requires high sensitivity (Gregg et al., 2005) toward cognitive and motivational imagery. A key variable that incorporates both cognitive and motivational aspects is flow (Jackson & Csikszentmihalyi, 1999). Motivational imagery relates to optimal experiences as flow is closely associated with intrinsic motivation (Nakamura & Csikszentmihalyi, 2002). Jackson and Csikszentmihalyi (1999) proposed a nine-dimensional construction of flow in sport, including challenge-skills balance, action-awareness merging, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, time transformation, and autotelic experience.The use of cognitive imagery can be helpful for the experience of specific flow dimensions, such as clear goals (Jackson & Csikszentmihalyi, 1999) or concentration on the task (Munroe, Giacobbi, Hall, & Weinberg, 2000).

Empirically, imagery has great potential to enhance flow state in a sport context. Researchers have provided evidence, for instance through intervention studies, indicating that imagery use enhanced flow state in training (Pates, Karageorghis, Fryer, & Maynard, 2003) and competition (Koehn, Morris, & Watt, 2014) settings. More specifically, in a sample of 261 junior tennis players Koehn, Morris, and Watt (2013) found moderate-to-strong associations between dispositional flow (i.e., how frequently athletes have been able to experience flow) and cognitive and motivational imagery use, as measured by the SIQ. The results of the imagery-flow relationship guided the development of an intervention, incorporating cognitive specific, cognitive general, and motivational-general mastery imagery types in order to increase key dimensions of flow, such as challenge-skills balance, clear goals, and concentration, in tennis competition (Koehn et al., 2014). With all participants scoring high on imagery ability, Koehn et al. (2014) found that the six-week intervention program had a positive effect on athletes’ flow state. Previously, Pates et al. (2003) corroborated the positive effect of imagery on flow state in a netball task. Collectively, the empirical findings provide support for the imagery-flow relationship.

**Hypotheses**

In this study, we assessed the interaction between imagery use and imagery ability in a competition context, and how imagery affects athletes’ cognitions reflected in optimal competition experience and operationalized by dispositional flow. We included a flow measure because of conceptual similarities and empirical associations between imagery and flow (Jackson & Csikszentmihalyi, 1999; Koehn et al., 2014; Pates et al., 2003).

The purpose of this study was to assess the applied model of imagery use as proposed by Martin and colleagues (1999). There were two specific aims, (i) the examination of imagery ability as a moderating variable between imagery use and dispositional flow, and (ii) the testing of an alternative mediation model with imagery ability as mediating variable. Although there is a strong focus on theoretical aspects, the results have relevance for applied research indicating key relationships that allow the construction of evidence-guided imagery interventions, e.g., to enhance flow in competition. For this study we formulated four hypotheses reflecting specific expectations that were based on theoretical and empirical findings. In accordance with Martin et al.’s (1999) model, we hypothesized a positive relationship between imagery use and imagery ability (H1). Furthermore, based on previous findings in cross-sectional (e.g., Jackson, Thomas, Marsh, & Smethurst, 2001; Koehn et al., 2013) and intervention (Koehn et al., 2014; Pates et al., 2003) studies we expected a positive relationship between both imagery functions and flow (H2). In accordance with the main contention of the applied imagery use model, we assessed the moderating effect of imagery ability between imagery type and flow in competition (H3). Alternatively, a mediation model was tested. Mediation effects occur when strong relationships exist between predictor and mediating variables and between mediating and outcome variables (Baron & Kenny, 1986). Due to the inconsistent findings of moderation effects, and discussions on strategic considerations and assumptions for the effective application of mediation models, we alternatively examined if imagery ability is a mediator between imagery use and flow.More specifically, we expected mediation effects for cognitive and motivational imagery on flow (H4).

# Method

### **Participants**

The sample consisted of 367 athletes between 17 and 32 years of age (*M* = 20.14; *SD* = 2.95) from various sports. The majority of athletes were involved in team sports, such as football (UK) and soccer (Australia) (*n* = 89), Australian rules football (*n* = 71), and basketball (*n* = 31). The main individual sport was swimming (*n* = 11). Male (*n* = 252) and female (*n* = 115) athletes had been participating in their sport on average for 10.79 years (*SD* = 4.05) and competing for a mean of 8.77 years (*SD* = 4.14). On average participants trained for 6.11 hours per week (*SD* = 4.51) and joined 18.88 competitions per year (*SD* = 10.76). All participants were undergraduate students. Participants had not been selected based on sport background, but on years of competition. In order to test the main propositions of the applied model of imagery, we included male and female athletes from both team and individual sports. Collecting data from a diverse sample should have no bearing on testing key aspects of the general contentions of the model. Although Martin et al. (1999) differentiated between sport situations (e.g., training or competition setting), we decided to focus solely on a competition setting, and we set a lower limit of two years involvement in competition to ensure that participants had sufficient experience to reflect on their competition experiences.

### **Measures**

The measures of this study were purposefully chosen to test the model of applied imagery use (Martin et al., 1999). In accordance with the model, we selected the SIQ (Hall et al., 1998) as a measure of imagery type. In order to examine cognitive and motivational functions across the main components of the model, we decided to apply the SIAQ (Williams & Cumming, 2011). The SIAQ has the same subscale structure as the SIQ, which allows specific analysis for each imagery function (e.g., moderation analysis of CSuse X CSability). As an outcome variable, we selected the Dispositional Flow Scale-2 (DFS-2; Jackson & Eklund, 2002) as a measure that, based on previous evidence (e.g., Koehn et al., 2013), should be sensitive enough to detect direct linear relationships or potential moderation or mediation effects.

**Sport Imagery Questionnaire (SIQ; Hall et al., 1998)**. The SIQ was employed to assess how often athletes use five different types of imagery. The SIQ measures five types of imagery use, cognitive specific (CS; item example “I can consistently control the image of a physical skill”), cognitive general (CG; item example “I imagine alternative strategies in case my event/game plan fails”), motivational specific (MS; item example “I image myself winning a medal”), motivational general-arousal (MG-A; item example “I imagine the stress and anxiety associated with my sport”), and motivational general-mastery (MG-M; item example “I imagine myself appearing self-confidence in front of my opponents”), which were identified by exploratory factor analysis. The SIQ consists of 30 items with 6 items per subscale. Thus, items are rated using a Likert response format, scaled from 1 (*rarely*) to 7 (*often*). SIQ subscale scores have been computed by adding up the six items of each subscale, and the total score divided by the number of items to create a mean score that can be evaluated and interpreted in relation to the response format. The alpha coefficients for the five scales ranged from .70 to .89 (Hall et al., 1998). The SIQ has been frequently used in sport (e.g., Gregg, Hall, McGown, & Hall, 2011; Koehn et al., 2013). In a sample with similar athlete characteristics (e.g., male and female athletes participated in various team and individual sports) the alpha coefficients ranged between .78 and .85 (Nordin & Cumming, 2008), and in a sample with competitive junior tennis athletes the range was .83 to .89 (Koehn et al., 2013). Koehn et al. (2013) used individual cognitive and motivational imagery type scores to evaluate the relationship between imagery and flow. Some studies (e.g., Koehn et al., 2014) employed total scores of the SIQ to present the direction and strength of the relationship of conceptually related variables. Beside reports of high reliability of the SIQ, none of the previous studies reported any limitations related to its use or validity.

**Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011)***.* The SIAQ was developed to examine athletes’ imagery ability. The SIAQ consist of five subscales labeled skill, strategy, goal, affect, and mastery imagery ability. Williams and Cumming developed the questionnaire based on Paivio’s (1985) imagery model, distinguishing between measures of cognitive (skill and strategy imagery ability) and motivational (goal, affect, and mastery imagery ability) aspects. In terms of subscale structure, the SIAQ is essentially a parallel version of the SIQ (Hall et al., 1998), which, in combination, makes it an ideal operationalization for testing Martin et al.’s (1999) applied imagery model. Each item starts with the stem “in relation to my sport, how easy is it for me to image.” Sample items of the SIAQ read “making corrections to physical skills” (skill), “making up plans/strategies in my head” (strategy), “myself winning” (goal), “the excitement associated with performing” (affect), and “remaining confident in difficult situations” (mastery). The scale consists of 15 items, each utilizing a 7-point Likert scale anchored by 1 (*very hard to image*) and 7 (*very easy to image*). Williams and Cumming (2011) reported acceptable Cronbach’s alpha coefficients of .93 for the scale in total, and between .78 and .86 for the five subscales. In this study the SIAQ was employed as an operationalization of imagery ability. The SIAQ has undergone a rigorous 4-study validation phase (Williams & Cumming, 2011). Williams and Cumming (2011) collected data from diverse samples, similar to the current sample in this study, including male and female athletes from team and individual sports, with a mean age in the early- to mid-twenties. The presentation of SIAQ subscales included the computation of mean subscale scores, i.e., the authors added up three items per subscale, and the total score was divided by the number of items to create a mean score that allows interpretations in relation to the response format. The concurrent validity of the SIAQ, a measure of imagery ability in sport, has been compared to movement imagery ability (MIQ-3; Williams, Cumming, & Edwards, 2011). Small-to-moderate correlations emerged between SIAQ and MIQ-3 subscales.

**Dispositional Flow Scale-2 (DFS-2; Jackson & Eklund, 2002)**. The DFS-2 assesses the frequency of flow and consists of 36 items representing nine subscales, each comprising four items assessing one of the nine dimensions of flow. Thus, the nine subscales represent the nine flow dimensions. Item examples of the nine subscales are reflected in “My abilities match the high challenge of the situation” (challenge-skills balance; csb), “Things seem to happen automatically” (action-awareness merging; aam), “I know clearly what I wanted to do” (clear goals; cg), “I am aware of how well I am performing” (unambiguous feedback; uf), “My attention is focused entirely on what I am doing” (concentration on the task at hand; cth), “I have a sense of control over what I am doing” (sense of control; sc), “I am not concerned with how others may be evaluating me” (loss of self-consciousness; lsc), “It feels like time goes by quickly” (time transformation; tt), and “I really enjoy the experience” (autotelic experience; ae). The response format is a 5-point Likert scale anchored by 1 (*never*) and 5 (*always*), assessing respondents’ frequency of flow experiences. Subscale scores are computed by adding up responses for the four items reflecting the respective subscale, divided by the number of items to create a mean score that can be evaluated and interpreted in relation to the response format. Early studies by Jackson and colleagues (Jackson, Kimiecik, Ford, & Marsh, 1998; Jackson et al., 2001) provided support for the concurrent validity of flow with various constructs, such as motivation, imagery, and anxiety. Following further revision and refinement of flow measurement, the subscales showed acceptable Cronbach’s alpha values, ranging between .81 and .90 (Jackson & Eklund, 2002). Koehn, Pearce, and Morris (2013) used a sample with similar sample characteristics to the one in the current study and found acceptable reliability scores for all DFS-2 subscales, ranging from .73 to .83. Researchers have frequently used the DFS-2, including analysis on a global and subscale level of flow (e.g., Jackson & Eklund, 2002; Koehn et al., 2013).

### **Procedures**

Following standard ethics procedures, sport and exercise science and sport psychology students from Universities in Scotland and Australia were approached to participate in this study. Information statements and consent forms were handed out. Participants who volunteered, and provided informed consent, completed the three questionnaires within 15 to 20 minutes at the end of a University lecture. All participants received oral and written information regarding the measures. First, the researchers explained to the participants what the questionnaires were about and how to complete them. Second, the researchers asked the participants to read the introductory section, before moving on to the test items. Written information on how to complete the measures included an introductory part on top of each questionnaire. All responses were based on athlete’s general experiences in sport competitions. Finally, the researchers encouraged participants to ask questions both immediately after hearing and reading instructions, and at any time during the session.

### **Design**

The study employed a correlational, cross-sectional design, using imagery ability, imagery use, and dispositional flow as main variables. The relationships among these variables were measured by the SIQ, SIAQ, and DFS-2. The SIQ and SIAQ have been chosen for two reasons. First the two measures have undergone rigorous validation procedures and appear to be appropriate scales for operationalizing imagery use and imagery ability. Second, the SIQ and SIAQ show a parallel subscale structure, both measures are based on Paivio’s (1985) imagery framework and address cognitive and motivational aspects. Operationalizing the testing procedures with these two measures appear to be appropriate in order to examine moderating and mediating effects between imagery ability and flow experiences. Data was entered into SPSS Version 21.0 with no missing values.

# Results

### **Reliability**

Acceptable Cronbach alpha values higher than .70 (Nunnally & Bernstein, 1994) were found for global measures of SIAQ (.88), SIQ (.94), and DFS-2 (.95). On a subscale level, Cronbach alpha values ranged from .78 to .84 for imagery ability, from .80 to .91 for imagery use, and from .75 to .82 for dispositional flow.

**Normality and Multicollinearity**

In order to examine the normality of the data, we assessed distributional properties including skewness and kurtosis. The univariate skewness of the items tested ranged from -1.23 to -0.04, and univariate kurtosis varied between 1.61 and -0.96. Based on West, Finch, and Curran’s (1995) cutoff values, all items indicated a normal distribution with skewness values fewer than 2 and kurtosis values under 7. Assessing multicollinearity for imagery use and imagery ability variables, the Variance Inflation Factor (VIF) scores varied between 1.466 and 3.047, and were within acceptable limits (Hair, Black, Babin, & Anderson, 2010).

**Correlational Analyses between Imagery Ability, Imagery Use, and Flow**

The results showed a moderate-to-strong positive relationship between the global constructs of imagery ability and imagery use (*r* = .55, *p* < .001). The relationships between flow and imagery variables were also moderate to strong (imagery ability *r* = .57, *p* < .001; imagery use *r* = .53, *p* < .001). The subscale correlations between imagery use and imagery ability ranged from *r* = .20 to *r* = .50 (*Mcorr* = .33), between imagery use and dispositional flow from *r* = .10 to *r* = .48 (*Mcorr* = .30), and between imagery ability and dispositional flow from *r* = .04 to *r* = .45 (*Mcorr* = .31). All subscale correlations are presented in Table 1.

**Moderation Effects between Imagery and Flow**

Using hierarchical regressions to test for moderating effects as discussed by Baron and Kenny (1986) and Frazier, Tix, and Barron (2004), and applied by Gregg et al. (2011), the equation consisted of flow state as the criterion variable, imagery ability and imagery use as predictor variables to measure direct effects (Step 1), and an interaction term (Step 2: SIAQ x SIQ). Standardized z-scores were used for the regression analysis. *F*(3, 363) = 79.47, *p* < .001, accounting for 39.6% of the variance in flow. The majority of the variance, adjusted *R2* = .394 was explained by the direct effects of imagery ability (*B* = .41, *SE* = .05, *β* = .41, *p* < .001), and imagery use (*B* = .31, *SE* = .05, *β* = .31, *p* < .001). The interaction between imagery ability and use explained an additional 0.2% of the variance in flow (*B* = .40, *SE* = .03, *β* = .05, *ns*), suggesting there was no moderation effect.

**Mediation Effects between Imagery and Flow**

Baron and Kenny (1986) proposed that the following conditions need to be met to provide support for mediation effects. First, variations in the independent variable (IV) significantly account for changes in the mediating variable. Second, variations in the mediator significantly account for changes in the dependent variable (DV). Third, a formerly significant relationship between IV and DV is no longer significant. A number of studies have evaluated the best statistical approaches to assess mediation effects, including partial correlation, hierarchical regression models and structural equation modeling (Cheung & Lau, 2008). In contrast to conventional regression analysis, it has been suggested that structural equation modeling (SEM) would be a superior analysis technique because is accounts for measurement errors (MacKinnon, 2008), whereas results based on conventional hierarchical regression analysis are affected by measurements errors and potentially underestimate the mediation effect (Kenny, Kashy, & Bolger, 1998). Furthermore, bootstrapping techniques are useful, particularly in small and moderate samples (Cheung & Lau, 2008), and to define confidence intervals of the mediation effect (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). We followed the suggestions and procedures proposed by Cheung and Lau (2008), which extends previous work by MacKinnon and colleagues (2002). Using SEM in AMOS 21.0, data was assessed in terms of direct and indirect effects, in conjunction with bootstrap methods. On the basis of Cheung and Lau’s (2008) propositions, we selected the bias-corrected (BC) bootstrap confidence interval with a 95% confidence level and 1000 bootstrap samples. The BC bootstrap calculations produce more accurate confidence limits and greater power in order to detect mediation and suppression effects over alternative approaches, such as the bias-corrected and accelerated method (BCa; Cheung & Lau, 2008). We applied this approach for mediational analysis as previously used by Koehn et al., (2013).

On a subscale level, we assessed each flow dimension separately. Therefore, the outcome variable needs to be defined as a single indicator latent variable. Hayduk and Littvay (2012) conceptually supported the use of single latent variables, emphasizing that single indicators provide more precision in latent theory testing. Before model testing, we specified the regression coefficient and measurement error variance in sport confidence as a single indicator latent variable. Munck (1979) described the process for specifying single indicators by using the following formulae for the calculation of the regression coefficient, (λ) = SD, and measurement error variance, MEV = SD2 (1 - α). The same formulae were used for testing potential cognitive (Table 2) and motivational (Table 3) mediation effects.

The results showed that imagery use was a significant predictor of imagery ability (*β* = .65; *p* < .001) and imagery ability significantly predicted flow (*β* = .51; *p* < .001). The main analysis showed that imagery ability partially mediated the relationship between imagery use and flow, *p* = .002 (Lower Bounds = .209; Upper Bounds = .512). The association between imagery use and flow was weaker when the mediating variable was included in the model (*β* = .30; *p* < .001), whereas a stronger relationship between imagery use and flow was found when the mediator was taken out of the model (*β* = .63; *p* < .001). On the basis of Paivio’s (1985) analytic framework, proposing two orthogonal imagery functions, we examined whether cognitive imagery or motivational imagery is a better predictor and mediator of flow and its dimensions. Reliability of the new latent variables was examined through Cronbach’s alpha and construct reliability, *ρη*, using the formulae provided by Fornell and Larcker (1981). Cronbach’s alpha coefficients showed acceptable values for imagery use (*α cognitive* = .92; *α motivational* = .92) and imagery ability (*α cognitive* = .85; *α motivational* = .83) variables. Yi and Davis (2003) proposed that values above .70 reflect appropriate construct reliability. The results showed generally acceptable scores for imagery use (*ρη* cognitive = .92; *ρη motivational =* .77*)* and imagery ability (*ρη* cognitive = .75; *ρη motivational =* .66*)*. Testing the same model with cognitive imagery variables only, the results corroborated partial mediation on a global and subscale level of flow (Table 2). Re-running the model with motivational imagery variables, the findings supported full mediation between the main variables (Table 3).

**Discussion**

The purpose of this study was to examine theoretical contentions of the applied model of mental imagery use. More specifically, the study set out to find evidence for imagery ability being a potential moderator in the relationship between imagery use and flow experiences in sport competition. No significant support was found for a moderation model, but the results provided substantial evidence for a mediation model. The three key variables of this investigation, i.e. imagery use, imagery ability, and dispositional flow, incorporate motivational and cognitive aspects. The findings showed partial mediation between cognitive imagery and flow, and full mediation between motivational imagery and flow. Based on the literature review we formulated four specific hypotheses. The results provided support for positive associations between the variables under investigation (H1 and H2), no evidence for a moderation effect (H3), and evidence for imagery ability mediating the relationship between imagery use and flow in competition (H4).

In accordance with Baron and Kenny (1986) and Martin et al. (1999) we hypothesized a positive relationships between key variables of imagery use and imagery ability (H1). The results showed moderate-to-strong relationships between both variables on a global level, generally supporting the predictions of the applied mental imagery model, as well as previous findings (e.g., Gregg et al., 2011). The substantial relationship between the two variables is a precondition for a mediation model (Baron & Kenny, 1986). From an operational point of view, the results indicated that the SIQ and SIAQ shared some amount of variance, but the measures seemed to be sufficiently different in assessing various aspects of imagery. This finding is important for the measurement of imagery, because Williams and Cumming (2011) developed the SIAQ based on the SIQ structure and item contents. Furthermore, correlation coefficients as well as appropriate numbers of collinearity diagnostics lower concerns that multicollinearity could have impacted on following analyses.

Correlation coefficients confirmed a strong, positive relationship between flow and imagery variables (H2). Mean correlations on a subscale level ranged between .30 and .39, indicating that the relationship between imagery type, imagery ability, and flow were similarly strong. Current findings have been partly supported by previous studies from Jackson et al. (2001) and Koehn et al. (2013). The third hypothesis examined whether imagery ability is a moderator between imagery use and flow experiences in competition (H3). The moderated hierarchical regression model showed significant direct effects of both imagery variables on flow, but failed to provide a significant interaction effect between imagery ability and use. Although, careful consideration has been given to the methodology of this study, using a non-probability sample (e.g., all participants were competitive athletes with at least two years of competition experience at the time of data collection) and selected measures (operationalization of scales reflected theoretical constructs in that cognitive and motivational imagery functions were aligned for imagery use and ability measures), the results yielded no interaction effect. We proposed that flow is an appropriate outcome variable to test the applied model of imagery use as the experience is associated with motivational and cognitive processes (Jackson & Csikszentmihalyi, 1999; Munroe et al., 2000). The results of linear analyses supported this proposition, as well as previous research findings (e.g., Koehn et al., 2013). Evidence that provides substantial support for a non-linear relationship between imagery use and imagery ability still needs to be established. In light of the used method and findings outlined in the previous sections, it can be concluded that the applied model of imagery use is not best viewed and interpreted as a moderation model.

In contrast, the results of H4 showed support for imagery ability mediating the relationship between imagery use and flow. From a theoretical perspective, additional research could be conducted on extending the applied imagery model. There might be, at least, three relevant options, (i) rigorous re-tests of the moderation model as it is currently proposed, (ii) examining imagery ability as a mediator between imagery use and potential outcome variables, or (iii) an integrated approach aiming to assess a combination of models, i.e. a moderated mediation effect. The current study provided evidence for approach (ii) as a partial mediation effect was found on a global imagery level. Although the analyses did not detect a moderating effect the findings indicated potential differences in the use of motivational and cognitive imagery functions. Motivational imagery use was represented by a full mediation model, whereas cognitive imagery only revealed partial mediation. Research on imagery in sport has become more complex, which has led to substantive debate about the relationship of various constructs, e.g. imagery type, imagery ability, imagery effectiveness, or imagery function (Callow & Hardy 2001; Hall et al., 1998; Martin et al., 1999; Murphy et al., 2008). One way forward would be the testing of advanced models that reflect the complexity of key variables on a conceptual level. For instance, Edwards and Lambert (2007) as well as Fairchild and MacKinnon (2009) provided models that strategically aim to integrate moderation and mediation analyses.

These findings have practical implications for future research and applications on the use of imagery in sports. Cognitive imagery use revealed direct and indirect effects (ie. partial mediation) on flow, whereas motivational imagery use was fully mediated by imagery ability. This finding might be of relevance for future imagery interventions in different sport types. For instance, endurance athletes (e.g., cyclists, long-distance runners) could benefit from imagery interventions that focus on motivational aspects. In this case the interplay between imagery use and imagery ability can be particularly important, as athletes with higher imagery ability might benefit more from potential intervention effects. The findings of this study also showed that cognitive imagery use is directly associated with flow, and only partially mediated through imagery ability. This finding could be relevant for sports requiring lower levels of motivation and higher levels of cognitive performance (e.g., shooting, archery). Future research need to establish in more detail the importance of imagery use and imagery ability for particular sport types. For future intervention programs, researchers should not only base their decisions on the frequency of imagery use, but if athletes are proficient, and confident, in applying imagery.

General limitations of testing the applied model of imagery use have been addressed in the introduction of this study. There are at least two main limitations specific to this study, one in reflection of the conceptualization of imagery and flow constructs and their interpretations, and one in regard to the use of cross-sectional designs. Several studies have proposed that a specific imagery type can be related to several outcomes, for instance cognitive imagery types could aid in motivational functions (Callow & Hardy, 2001; Hall, et al., 1998). Despite the theoretical independence between cognitive and motivational functions (Paivio, 1985), the potential overlap between cognitive and motivational imagery functions might compound analysis and clear interpretation of results, and the development of future interventions. A second limitation is linked to the methodology. This study employed a cross-sectional design in conjunction with athletes from various sports to examine the applied model. Using an applied setting with a stronger design, for instance randomized intervention groups as applied by Elbe, Strahler, Krustrup, Wikman, and Stelter (2010) to investigate the intensity of flow, would provide stronger evidence for model-based contentions.

**Perspective**

The first aim of this study provided no evidence that imagery ability is a moderator between imagery use and flow in competition. The second aim partly supported the alternative hypothesis that the imagery use-flow relationship is mediated by imagery ability. This result is encouraging for extending future research on a theoretical and applied level. Due to the lack of substantive evidence for a non-linear moderated relationship in this and previous studies (e.g., Gregg et al., 2005; Nordin & Cumming, 2008), a conceptual redirection of the applied model of imagery use (Martin et al., 1999) could advance future research. For instance, the mechanism underlying the imagery use-imagery ability relationship could advance conceptual and applied work. Future studies should be aware of conceptual, analytical, and operational challenges that can affect outcome variables when testing the applied imagery model. One moderating variable that could be tested in more detail is sport type (e.g., imagery use in technical vs. endurance sports). Furthermore, future imagery interventions should incorporate a screening process on athletes’ imagery ability to ensure the effectiveness of the intervention, or provide additional training in how to use imagery effectively and enhance confidence in using imagery, thus allowing athletes with lower imagery ability to gain similar benefits.

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Table 1

*Correlation matrix, means, standard deviations, and Cornbach’s Alpha (in brackets)*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Imagery Ability** | | | | |  | **Imagery Use** | | | | |  | **Dispositional Flow** | | | | | | | | |
|  |  | 1 | 2 | 3 | 4 | 5 |  | 6 | 7 | 8 | 9 | 10 |  | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Imagery Ability** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | Skill | (.82) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 | Strategy | .54 | (.83) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 | Goal | .40 | .37 | (.78) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | Affect | .42 | .42 | .38 | (.84) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 | Mastery | .37 | .40 | .32 | .45 | (.82) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Imagery Use** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | CS | .37 | .35 | .42 | .29 | .29 |  | (.88) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7 | CG | .31 | .40 | .41 | .33 | .35 |  | .73 | (.86) |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 | MS | .20 | .20 | .50 | .22 | .17 |  | .50 | .57 | (.91) |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | MG-A | .29 | .26 | .37 | .37 | .29 |  | .57 | .61 | .58 | (.80) |  |  |  |  |  |  |  |  |  |  |  |
| 10 | MG-M | .29 | .29 | .38 | .41 | .39 |  | .59 | .67 | .48 | .51 | (.88) |  |  |  |  |  |  |  |  |  |  |
| **Dispositional Flow** | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11 | csb | .38 | .30 | .33 | .34 | .40 |  | .45 | .43 | .31 | .37 | .40 |  | (.75) |  |  |  |  |  |  |  |  |
| 12 | aam | .40 | .28 | .28 | .28 | .35 |  | .40 | .32 | .17 | .28 | .29 |  | .60 | (.77) |  |  |  |  |  |  |  |
| 13 | cg | .26 | .29 | .31 | .41 | .40 |  | .38 | .41 | .24 | .27 | .44 |  | .52 | .48 | (.75) |  |  |  |  |  |  |
| 14 | uf | .26 | .21 | .25 | .33 | .28 |  | .36 | .34 | .19 | .34 | .34 |  | .45 | .40 | .53 | (.82) |  |  |  |  |  |
| 15 | cth | .26 | .32 | .28 | .37 | .46 |  | .39 | .41 | .18 | .26 | .44 |  | .48 | .51 | .58 | .43 | (.79) |  |  |  |  |
| 16 | sc | .34 | .31 | .25 | .41 | .39 |  | .43 | .42 | .21 | .29 | .42 |  | .56 | .55 | .58 | .51 | .67 | (.78) |  |  |  |
| 17 | lsc | .25 | .26 | .11 | .10 | .33 |  | .27 | .25 | .04 | .16 | .23 |  | .34 | .30 | .26 | .31 | .33 | .41 | (.79) |  |  |
| 18 | tt | .21 | .16 | .25 | .15 | .22 |  | .30 | .30 | .20 | .31 | .25 |  | .33 | .36 | .24 | .25 | .36 | .35 | .31 | (.79) |  |
| 19 | ae | .27 | .25 | .15 | .48 | .38 |  | .31 | .33 | .16 | .28 | .42 |  | .54 | .40 | .50 | .38 | .47 | .49 | .19 | .33 | (.78) |
|  | *M* | 5.20 | 5.11 | 4.89 | 5.88 | 5.17 |  | 5.02 | 5.02 | 4.91 | 4.86 | 5.51 |  | 3.87 | 3.80 | 4.09 | 3.98 | 3.86 | 3.91 | 3.46 | 3.64 | 4.23 |
|  | *SD* | 1.01 | 1.10 | 1.27 | 1.00 | 1.10 |  | 1.03 | 1.01 | 1.32 | 1.03 | 0.99 |  | 0.58 | 0.64 | 0.59 | 0.67 | 0.67 | 0.62 | 0.85 | 0.77 | 0.60 |

*Note*. Scores ≥ .11 are significant at *p* = .05; scores ≥ .15 are significant at *p* = .01; scores ≥ .19 are significant at *p* = .001.

Table 2

*Mediation Effects between Cognitive Imagery Use and Cognitive Imagery Ability on Flow Dimensions*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Use → Flow | | Use → Ability | Ability →  Flow | Mediating Effects on Flow | | |
|  | *βw/o* *M* | *βw* *M* | LB | UB | *p* |
| Global flow | .64\*\*\* | .46\*\*\* | .57\*\*\* | .31\*\*\* | .093 | .321 | .001\*\* |
| Challenge-skills balance | .59\*\*\* | .43\*\*\* | .56\*\*\* | .30\*\*\* | .061 | .317 | .003\*\* |
| Action-awareness merging | .48\*\*\* | .28\*\*\* | .54\*\*\* | .39\*\*\* | .117 | .369 | .001\*\* |
| Clear goals | .54\*\*\* | .43\*\*\* | .57\*\*\* | .19\* | .007 | .245 | .039\* |
| Unambiguous feedback | .45\*\*\* | .37\*\*\* | .57\*\*\* | .13 | .039 | .214 | .178 |
| Concentration on the task at hand | .52\*\*\* | .40\*\*\* | .56\*\*\* | .22\*\* | .014 | .255 | .031\* |
| Sense of control | .56\*\*\* | .41\*\*\* | .57\*\*\* | .27\*\* | .062 | .261 | .002\*\* |
| Loss of self-consciousness | .34\*\*\* | .18\* | .57\*\*\* | .29\*\* | .055 | .333 | .003\* |
| Time transformation | .39\*\*\* | .35\*\*\* | .57\*\*\* | .07 | .045 | .156 | .367 |
| Autotelic experience | .42\*\*\* | .28\*\*\* | .57\*\*\* | .24\*\* | .033 | .286 | .009\*\* |

*Note*. \**p* < .05; \*\**p* < .01; \*\*\**p* < .001. Bootstrap, BC 95% Confidence Interval with 1000 bootstrap samples. *βw/o* *M* = Regression Weight without Mediating Variable; *βw* *M* = Regression Weight with Mediating Variable. LB = Lower Bounds; UB = Upper Bounds reflect scores of 95% Confidence Interval. → indicates path direction between variables within the model.

Table 3

*Mediation Effects between Motivational Imagery Use and Motivational Imagery Ability on Flow Dimensions*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Use → Flow | | Use → Ability | Ability →  Flow | Mediating Effects on Flow | | |
|  | *βw/o* *M* | *βw* *M* | LB | UB | *p* |
| Global flow | .59\*\*\* | .04 | .76\*\*\* | .73\*\*\* | .320 | 1.378 | .002\*\* |
| Challenge-skills balance | .56\*\*\* | .16 | .77\*\*\* | .53\*\*\* | .192 | 1.034 | .002\*\* |
| Action-awareness merging | .38\*\*\* | -.08 | .77\*\*\* | .62\*\*\* | .238 | 1.317 | .002\*\* |
| Clear goals | .49\*\*\* | -.05 | .76\*\*\* | .73\*\*\* | .291 | 1.353 | .003\*\* |
| Unambiguous feedback | .44\*\*\* | .15 | .77\*\*\* | .40\*\* | .053 | .919 | .014\* |
| Concentration on the task at hand | .45\*\*\* | -.11 | .76\*\*\* | .76\*\*\* | .343 | 1.498 | .001\*\* |
| Sense of control | .47\*\*\* | .00 | .75\*\*\* | .64\*\*\* | .286 | .553 | .003\*\* |
| Loss of self-consciousness | .21\*\* | -.04 | .77\*\*\* | .34\* | .029 | .690 | .037\* |
| Time transformation | .39\*\*\* | .26 | .77\*\*\* | .18 | .083 | .569 | .198 |
| Autotelic experience | .44\*\*\* | -.04 | .73\*\*\* | .69\*\*\* | .248 | 1.069 | .002\*\* |

*Note*. \**p* < .05; \*\**p* < .01; \*\*\**p* < .001. Bootstrap, BC 95% Confidence Interval with 1000 bootstrap samples. *βw/o* *M* = Regression Weight without Mediating Variable; *βw* *M* = Regression Weight with Mediating Variable. LB = Lower Bounds; UB = Upper Bounds reflect scores of 95% Confidence Interval. → indicates path direction between variables within the model.