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To cite this article: Bianca A. Simonsmeier & Susanne Buecker (2016): Interrelations of Imagery Use, Imagery Ability, and Performance in Young Athletes, Journal of Applied Sport Psychology, DOI: 10.1080/10413200.2016.1187686

To link to this article: http://dx.doi.org/10.1080/10413200.2016.1187686

Accepted author version posted online: 10 May 2016.
Published online: 10 May 2016.

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Interrelations of Imagery Use, Imagery Ability, and Performance in Young Athletes

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The present study aimed to provide a better understanding of the relationship between imagery use, imagery ability, the interrelation between these two constructs, and athletic performance for young athletes. Participants were 80 gymnasts between 7 and 16 years of age. We assessed 5 different functions of imagery use and imagery ability regarding cognitive and motivational imagery. Cognitive specific imagery use, motivational general-mastery imagery use, and goal imagery ability significantly predicted performance at competition, independent of the athletes’ age. Consequently, it is useful to support young athletes’ imagery use and imagery ability systematically in order to improve their learning processes and sports performance.

Mental imagery is an established psychological strategy in sport, to enhance individual performance and to improve motivation, as well as emotional competence (e.g., Feltz & Landers, 1883; Hinshaw, 1991; Weinberg, 2008). Imagery is a psychological process through which an athlete is able to see an image; feel a movement as an image; or experience an image of smell, taste, or sound without experiencing the real thing (White & Hardy, 1998). Mental imagery can differ along at least three dimensions: the sport situation in which imagery is used (training, competition, rehabilitation), the type of imagery used (cognitive vs. motivational, general vs. specific content), and the desired outcome (improvement of skills and strategies vs. modification of cognition vs. regulation of arousal and anxiety; e.g. Martin, Moritz, & Hall, 1999). To this extent, previous research found evidence that imagery use facilitates performance improvements through skill and strategy learning, as well as the regulation of emotions, arousal levels, and thoughts (Cumming & Williams, 2012; Martin et al., 1999). Due to the benefits of imagery, it is now integrated in many mental skills training programs (e.g., Fournier, Calmels, Durand-Bush, & Salmela, 2005; Sheard & Golby, 2006; Thelwell & Greenlees, 2003), where it is commonly used by coaches and athletes in addition to regular physical practice.

The definition of the term imagery is, however, not consistent in literature, where various overlapping terms have been used (Collet, Di Rienzo, El Hoyek, & Guillot, 2013; Cumming & Ramsey, 2009). In the context of sports, imagery has been defined as

the creation and re-creation of an experience generated from memorial information, involving quasi-sensorial, quasi-perceptual, and quasi-affective characteristics, that is under the volitional control of the imager, and which may occur in the absence of the real stimulus antecedents normally associated with the actual experience. (Morris, Spittle, & Watt, 2005, p. 19)
Furthermore, the two constructs imagery ability and imagery use must be distinguished. Imagery ability is “an individual’s capability of forming vivid, controllable imagery and retaining them for sufficient time to effect the desired rehearsal” (Morris et al., 2005, p. 37) and is an important variable when employing imagery systematically in the context of sports. Imagery use is defined as the “use of imagery to achieve a variety of cognitive, behavioral, and affective changes” (Murphy & Martin, 2002, p. 418).

Various models examining how imagery works have been developed within the field of imagery in sports and exercise. First insights in how imagery works were provided through the psychoneuromuscular theory (Jacobson, 1930). The theory postulates that imaged events produce similar innervation in muscles as compared to the actual physical execution of the movement. Another early theory was symbolic learning theory (Sackett, 1934), resulting in the assumption that imagery serves as a cognitive coding system that helps athletes to acquire movement patterns. Later, the information processing model of imagery (Farah, 1984) outlines how brain injuries affect imagery ability. The most distinctive characteristic among patients without imagery ability was damage to occipital, parietal, and temporal brain areas. Therefore, these brain areas seem to be relevant for imagery. Other approaches, which see imagery as a highly personalized experience, are the image somatic meaning model (Ahsen, 1984) and the bio-informational theory (Lang, 1978). The image somatic meaning model postulates three relevant components: the image with its multisensory cues; the somatic reaction with both emotional and physiological aspects to the image; and the meaning of the image, including verbal, cognitive, and experiential interpretations. The bio-informational theory assumes that a mental image is stored in long-term memory as an organized set of stimulus propositions linked to response propositions. For example, although the stimulus propositions describe the stimulus content (e.g., feel of a racquet in the hand), the response proposition describes the response to the stimuli in the imaged situation (e.g., the muscle tension in the hand). By repeating the process of recalling response propositions and modifying the responses for perfect control and execution, performance is enhanced over times. Being able to repeatedly image the perfect response, the links between the stimulus proposition and response are strengthened.

To describe how and why athletes use imagery, the conceptual framework of imagery (Paivio, 1985) highlights that imagery serves the distinct functions cognitive and motivational, operating on either general or specific levels. Therefore, distinctions in the use of imagery emerge: cognitive specific (e.g., movements), cognitive general (e.g., strategies), motivational specific (e.g., goals), and motivational general (e.g., motivation, anxiety). Later, Hall, Mack, and Paivio (1998) extended this classification in further distinguishing between motivational general–affective (e.g., arousal and anxiety) and motivational general–mastery (e.g. mental toughness, self-confidence).

Later, the PETTLEP approach (Holmes & Collins, 2001) emerged as a theory-based model pertaining to neuronal equivalence between motor imagery and motor execution. PETTLEP is an acronym for physical, environment, timing, task, learning, emotion, and perspective. The term physical relates to the physical component of the imagery, for example, the relevant sports equipment. The term environment pertains to the environment or the setting of the imaged movement, for example, the sport venue. Task includes the skills needed for the imaged movement, such as body tension. Timing describes two things: first, the duration of the imaged movement execution in relation to the execution of the actual movement, and second, the relation in time/succession between the different components of the movement. The term learning relates to the adaption of the imagery to the current learning stage. Emotion describes the inclusion of emotional sensations in motor imagery, which leads to enhanced information processing and information storage. Perspective pertains to the distinction between
an internal and external perspective during the imagery. Similar to the PETTLEP model, the imagery integrative model in sport (Guillot & Collet, 2008) serves as a guide for the practical implementation of imagery in sports. The model suggests that imagery in sport can serve distinct purposes: motor learning and performance enhancement, enhancement of motivation and self-efficacy, reduction of anxiety, strategy use, and problem solving, as well as improvements in the recovery of previously learned skills in case of injury. The imagery integrative model in sports includes empirical results and theories such as the conceptual framework of imagery (Paivio, 1985), the sport imagery ability model (Watt, Morris, & Anderson, 2004), and the PETTLEP model (Holmes & Collins, 2001).

The models suggest the importance of imagery use and ability for enhancement of the outcomes, such as improvement of skills and strategies or regulation of emotions, thoughts, and anxiety. Thus, understanding the relationship between both constructs and the outcomes deeply seems to be relevant for high returns. Considering the two variables of imagery ability and imagery use, literature outlines a positive relationship between both (e.g., Gregg, Hall, & McGowan, 2011; Robin et al., 2007; Vadocz, Hall, & Moritz, 1997; Williams & Cumming, 2012). For example, previous research found that imagery ability explained 20%–41% of the variance in the imagery use of the five types of imagery for adult athletes (Gregg et al., 2011). Furthermore, imagery use and imagery ability can both contribute to the purported outcome variables of imagery (e.g., Guillot & Collet, 2008; Martin et al., 1999). For example, the use of imagery has been found to be positively associated with performance (Hall, 2001; Morris et al., 2005; Weinberg, 2008), representation structure of complex action (Frank, Land, & Schack, 2016), and regulation of competitive anxiety (Vadocz et al., 1997). Pertaining to imagery ability, a study conducted with tennis players found that athletes with good imagery ability showed greater performance improvement through imagery intervention as compared with those athletes having poor imagery ability (Robin et al., 2007). Furthermore, imagery ability also has proven to be directly associated with motivational outcomes such as trait confidence, as well as challenge and threat appraisal tendencies (Williams & Cumming, 2012).

To investigate the relationship between imagery use, imagery ability, and performance in particular, Gregg, Hall, and Nederhof (2005) examined whether imagery ability moderates the relationship of imagery use and performance as an outcome. Contrary to expectations, the results demonstrated no moderating effect of imagery ability on the relationship between imagery use and performance. The authors assumed that this result was due to a lack of sensitivity in their measurement of the performance outcome. However, their data supported a positive relationship between imagery ability and imagery use, similar to results found in previous research. Furthermore, in a study conducted with athletes from 32 different sports, Nordin and Cumming (2008) investigated the influence of imagery ability as a moderator on the relationship between imagery frequency and individually perceived effectiveness of imagery. Similar to Gregg et al. (2005), the results did not show a moderator effect, suggesting that imagery ability does not moderate the impact of imagery frequency on the perceived effectiveness of imagery.

**IMAGERY ABILITY AND IMAGERY USE OF YOUNG ATHLETES**

Previous research on imagery has primarily focused on adult athletes. With regard to the proposition that imagery use can facilitate learning and enhance motivation levels of athletes (Weinberg, 2008), it is also important to have a closer look at the imagery ability, as well as use of imagery among younger athletes (i.e., 14 years of age and younger). To date, few studies have engaged with this athlete population (e.g., Estes, 1998; Munroe-Chandler, Hall,
Fishburne, O, & Hall, 2007; Munroe-Chandler, Hall, Fishburne, & Strachan, 2007; Parker & Lovell, 2009, 2012), as compared to the literature existing for adult athletes. Imagery interventions are a useful tool for performance improvement in adult athletes (Hall, 2001; Morris et al., 2005). Similarly, imagery intervention with young athletes showed positive results on performance (e.g., Li-Wei, Qi-Wei, Orlick, & Zitzelsberger, 1992; Zhang, Ma, Orlick, & Zitzelsberger, 1992), strategy use (Munroe-Chandler, Hall, Fishburne, Murphy, & Hall, 2012; Munroe-Chandler, Hall, Fishburne, & Shannon, 2005), and motivational outcomes (Munroe-Chandler & Hall, 2004–2005).

Although some studies have investigated the positive effect of systematic imagery training with young athletes, fewer studies have examined the development of imagery ability and imagery use in the youthful athlete population. Previous findings have indeed indicated that imagery ability does not develop fully until 7 years of age and greatly improves between 5 and 17 years of age (e.g. Ashby, 1983; Henderson & Duncombe, 1982). Studies with athletes between 7 and 17 years of age have also found great improvement of imagery ability during this age period (Hall & Pongrac, 1983; Wolmer, Laor, & Token, 1999). With respect to imagery use, previous research has demonstrated that young athletes indeed naturally use all five functions of imagery (Munroe-Chandler et al., 2007; Parker & Lovell, 2009). For example, in a study conducted with 16- to 18-year-old athletes, from various kinds of sports competing at different levels, showed that the youth athletes stated to use motivational general–mastery imagery most frequently, followed by cognitive specific imagery, motivational specific imagery, cognitive general imagery, and motivational general–affective imagery last. Furthermore, the use of imagery was positively associated with the athletes practice volume (Parker & Lovell, 2009). In addition, in qualitative and quantitative studies, young athletes reported to use imagery in both training and competition situations, and for both cognitive and motivational purposes (e.g., Munroe-Chandler et al., 2007; Rodgers, Hall, & Buckolz, 1991). Also, a close relationship between imagery ability and imagery use was evident in the youth athletes (Parker & Lovell, 2009). However, findings are still rare. Concerning the interrelation between imagery use, imagery ability, and performance, the authors are not aware of any study examining this relationship in youth athletes.

The Present Study

As prior research has mainly focused on adult athletes, little is known about the relationship between imagery use, imagery ability, and performance in young athletes. The main goal of the present study was to extend the understanding of the relationship between the constructs. As young athletes are still in their development phase, understanding the relationship between the constructs provides information necessary to optimally support the athletes, based on their developmental level. As few empirical results exist up to now, we had the following explorative research question: Does imagery use, imagery ability, and the interaction of imagery use and imagery ability significantly predict performance for athletes 16 years of age and younger?

METHOD

Participants

We recruited 80 gymnasts from 18 teams to voluntarily take part in the study. For the recruitment, we either contacted the coaches prior to competition or addressed the gymnasts on the day of a competition. In the first case, we asked the coaches for their permission to conduct the data collection at the gym during training hours. If the coach approved of his or her
team’s participation, the gymnasts performed the assessment 1 week prior to the competition. In the second case, we asked for participants during the warm-up phase of the competition, and volunteering participants completed the assessment prior to the competition. Because gymnasts’ competition results data were available for only 75 of the 80 gymnasts, we excluded five gymnasts from the study. The gymnasts’ age ranged from 7 to 16 years ($M = 10.87$, $SD = 2.76$). Gymnasts participated in their sport for an average of 5.91 years ($SD = 3.15$). Their hours of training per week ranged from 3.0 to 25.5 hr ($M = 8.39$, $SD = 4.41$). All athletes and their parents provided written informed consent prior to the study.

**Measures**

The study used three measurements to assess the gymnasts’ imagery use, imagery ability, and their performance at competition. We used the Sport Imagery Questionnaire–Children (SIQ-C; Hall, Munroe-Chandler, Fishburne, & Hall, 2009) to assess the athletes’ imagery use. This questionnaire is designed specifically for athletes between 7 and 14 years of age. It is divided into the five subscales: cognitive specific (four items), cognitive general (four items), motivational specific (four items), motivational general-affective (four items), and motivational general–mastery (five items), based on the applied model of imagery use in sport (Martin et al., 1999). The questionnaire has 21 items in total and uses a 5-point Likert scale for answers. Hall et al. reported a sufficient convergent and discriminant validity for the SIQ-C questionnaire. In addition, the internal consistencies ranged from $\alpha = .62$ to $\alpha = .77$ for the five different subscales (Hall et al., 2009). For the present sample, internal consistencies were $\alpha = .60$ for the Cognitive Specific subscale, $\alpha = .60$ for the cognitive General subscale, $\alpha = .77$ for the motivational specific subscale, $\alpha = .62$ for the motivational general–affective subscale, and $\alpha = .78$ for the motivational general–mastery subscale.

The gymnasts also completed the Sport Imagery Ability Questionnaire (Williams & Cumming, 2011) to assess their imagery ability. It consists of 15 items and is divided in the five subscales skill (three items), strategy (three items), goal (three items), affect (three items), and mastery (three items). The theoretical foundation for the questionnaire is the Applied Model of Imagery Use in Sport (Martin et al., 1999). As a slight change in the present study, we used a 5-point Likert scale instead of a 7-point Likert scale. As young athletes completed the questionnaire in our study, we chose to use a smaller scale to enable less complex response, as we anticipated the young athletes would not be able to differentiate as accurate as adult athletes (for which the questionnaire was originally conceived). In addition, the response format was the same as was used for the SIQ-C questionnaire. Additional justification for a reduction in response complexity is provided by previous research (cf. Maurer & Pierce, 1998; Pajares, Hartley, & Valiante, 2001), as a 5-point Likert scale is considered to be more practical and providing a better prediction of external variables. Williams and Cumming (2011) reported a good internal reliability for all subscales and demonstrated concurrent validity with composite reliability values ranging from .76 to .86 and average variance extracted values ranging from .51 to .68. For the present study, internal consistencies were $\alpha = .82$ for the Skill subscale, $\alpha = .74$ for the Strategy subscale, $\alpha = .77$ for the Goal subscale, $\alpha = .66$ for the Affect subscale, and $\alpha = .74$ for the Mastery subscale.

We assessed performance via the gymnasts’ competition results of the year of data collection. To be able to effectively compare final results, the competition results of all four disciplines (vault, bars, beam, and floor) were calculated as percentages, as gymnasts participated in different competitive levels. In gymnastics, the athletes’ final score includes a combination of the difficulty score (D-score) and the execution score (E-score). For the final score, the executions score was subtracted from 10 points, and the difficulty score was
added afterward. Percentage scores were calculated by dividing the individually reached final score (10 points minus E-score plus D-score) through the possible individual maximum of the gymnast (10 points plus D-value). The mean of the performance percentages was found to be 81.80% ($SD = .12$) and ranged from 46% to 95%.

**Procedure**

We had two assessment waves, one in spring 2013 and the other in spring 2015. We contacted the athletes through their coaches (spring 2013) or at the day of the competition (spring 2015). All athletes received an information letter. After agreeing to participate in the study, they completed both the SIQ-C and the Sport Imagery Ability Questionnaire in the gym either in the week before the competition (spring 2013) or at the competition venue (spring 2015). We collected the competition scores from the official competition results released by the respective institution. The spring cohort was also part of a larger intervention study.

**Analyses**

For the analyses, the significance criterion was set at $\alpha = .05$ for all reported results. Three types of statistical analyses were performed with the data, as described in the following. Descriptive statistics were calculated for all five subscales of the two questionnaires. Correlations were calculated pertaining imagery use and imagery ability for all of the five subscales, respectively. Multiple regression analyses were performed, predicting the gymnasts’ performance by their imagery use, imagery ability, and the interaction of imagery use and imagery ability. As suggested by Tabacknick and Fidell (2001), the variables were z-standardized for all regression analyses.

**RESULTS**

**Imagery Use, Imagery Ability, and Performance Relationship**

Following previous research (Gregg et al., 2005; Nordin & Cumming, 2008) and Baron and Kenny’s (1986) recommendations for moderator analyses, we predicted performance by imagery use, imagery ability, and the product of imagery use and imagery ability. Consequently, we performed five multiple-regression analyses for each of the matching subscales of imagery use and imagery ability (cognitive specific with skill, cognitive general with strategy, motivational specific with goal, motivational general-arousal with affect, motivational general—mastery with mastery). Significant predictors for the gymnasts’ performance at competition were the use of cognitive specific content and the use of motivational general–mastery content, and the ability to image motivational specific content. Cognitive specific imagery use predicted performance significantly with $\beta = .24$, $t(73) = 2.03$, $p < .05$. Performance was also predicted significantly by the use of motivational general–mastery imagery content with $\beta = .30$, $t(73) = 2.36$, $p < .05$. Imagery ability of motivational specific content predicted performance significantly with $\beta = .30$, $t(73) = 2.50$, $p < .05$. The interaction between imagery use and imagery ability was not a significant predictor for any of the five matching subscales. The results are presented in Table 1. Inserting age to the regression analysis as a control variable did not affect any of the presented results significantly.

**Imagery Use and Imagery Ability**

Table 2 shows descriptive statistics for imagery use and imagery ability. The gymnasts used cognitive specific imagery content most frequently, followed by motivational general–mastery
content, cognitive general content, motivational specific content, and finally motivational general–affective content. For the Imagery Ability subscales, gymnasts indicated to be able to image affective content best, followed by skills and strategies, mastery content, and goals. Correlation analyses revealed small to medium positive correlations between the Imagery Use and Imagery Ability subscales. Cognitive specific imagery use and skill imagery ability correlated with \( r = .23, p < .05 \), the subscales Motivational Specific and Goal with \( r = .35, p < .01 \), and the subscales Motivational General-Mastery and Mastery with \( r = .31, p < .01 \) (see Table 3).

Post Hoc Analysis

For further post hoc analyses, we investigated the relationship between cognitive specific imagery use, motivational general–mastery imagery use, goal imagery ability, and the more

<table>
<thead>
<tr>
<th>Subscale</th>
<th>M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imagery use</td>
<td>CS 2.48 (0.69)</td>
</tr>
<tr>
<td></td>
<td>CG 2.20 (0.84)</td>
</tr>
<tr>
<td></td>
<td>MS 2.11 (1.01)</td>
</tr>
<tr>
<td></td>
<td>MG-A 2.03 (0.96)</td>
</tr>
<tr>
<td></td>
<td>MG-M 2.23 (0.85)</td>
</tr>
<tr>
<td>Imagery ability</td>
<td>Skill 2.65 (0.72)</td>
</tr>
<tr>
<td></td>
<td>Strategy 2.43 (0.80)</td>
</tr>
<tr>
<td></td>
<td>Goal 2.38 (0.89)</td>
</tr>
<tr>
<td></td>
<td>Affect 2.90 (.70)</td>
</tr>
<tr>
<td></td>
<td>Mastery 2.43 (.80)</td>
</tr>
</tbody>
</table>

Note. n = 75. CS = cognitive specific; CG = cognitive general; MS = motivational specific; MG-A = motivational general–affective; MG-M = motivational general–mastery.
Table 3
Interrelations Between Imagery Use and Imagery Ability

<table>
<thead>
<tr>
<th>Subscales</th>
<th>7–15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS - Skill</td>
<td>.23*</td>
</tr>
<tr>
<td>CG - Strategy</td>
<td>.21</td>
</tr>
<tr>
<td>MS - Goal</td>
<td>.35**</td>
</tr>
<tr>
<td>MG-A - Arousal</td>
<td>.13</td>
</tr>
<tr>
<td>MG-M - Mastery</td>
<td>.31**</td>
</tr>
</tbody>
</table>

Note. $n = 75$. CS = cognitive specific; CG = cognitive general; MS = motivational specific; MG-A = motivational general–-affective; MG-M = motivational general–-mastery.

*d$p < .05$, **$p < .01$.

detailed performance measures D-score and E-score. Regarding the E-score, all three variables were significantly, negatively associated with E-scores. For cognitive specific imagery use, the relationship was $r = -0.23$, $p < .05$; for motivational general-arousal imagery use, $r = -0.28$; and for goal imagery ability, $r = -0.29$, $p < .01$. Both functions of imagery use and goal imagery ability were thus associated with fewer executions at competition. For the difficulty score, no significant relationship could be found.

DISCUSSION

The goal of the present study was to examine the characteristics of the relationships between imagery use, imagery ability, and performance in young athletes. In our sample, imagery use and imagery ability were found to be significant, unique predictors for the gymnasts’ performance at competition, independent of age. We did not find moderation between imagery use and performance through imagery ability. The results of the present study lead to a variety of implications, which are discussed in the following section.

Cognitive specific imagery use, motivational general–mastery imagery use, and motivational specific imagery ability could significantly predict performance at competition. There are various possible explanations for these findings. First, the gymnasts may facilitate productive learning processes through cognitive specific imagery use. Consequently, the performance difficulty at competition is more likely to be high with fewer executions through imagery use. Further analysis revealed a significantly negative relationship between the gymnasts’ executions (as an indicator of the quality of performance) and cognitive specific imagery use, which supports the proposed explanation. In summary, the use of cognitive specific imagery is associated with less execution (i.e., higher quality of performance) at competition. Future research should engage with the mechanism in more detail by, for example, examining the relationship between cognitive specific imagery use and learning progression of athletes. Here, the development of imagery use, imagery ability, and performance could be determined using a longitudinal design. The relationship between the variables could, for example, be observed through latent growth modelling (see, e.g., Conroy & Coatsworth, 2004; Duncan & McAuley, 1993; Kort-Butler & Hagewen, 2011). As well, the relationship between motivational general–mastery imagery use and achieved performance may be mediated by self-confidence and self-efficacy, which may in turn have positive effects on performance at competition through maintaining a positive attitude and facilitating mental toughness (e.g., Bull, Shambrook, James, & Brooks, 2005). Motivational general–mastery imagery helps the athletes to stay focused and concentrated, which may also have positive effects on performance.
at a competition. It can consequently support the successful recall of prior performance in a challenging situation. Furthermore, motivational specific imagery ability may influence the gymnasts’ performance at competition through the generation of goals and the associated outcomes of training or participating at a competition. Being able to definitely image goals and accomplishments to be achieved in detail and being able to maintain such images is likely to influence the process of training and competition (e.g., Locke & Latham, 1985). Further research could investigate the relationship between the ability to image goals well and performance in more detail, also including possible mediating or moderating variables such as the use of goal setting, the type of goals (i.e., performance goals, goals of action), or the use of specific action plans.

We did not find moderation between imagery use and performance through imagery ability. However, this finding is consistent with earlier results of similar studies with adult athletes (Gregg et al., 2005), conducted with track-and-field athletes investigating the interrelation between imagery use, imagery ability, and their performance. Future research could consider the moderation hypothesis by examining the interaction between imagery use and imagery ability and the effect on other performance outcomes but also for motivational or emotional outcomes. The importance of motivational and emotional outcomes is evident, as both aspects stand in close relationship with performance (e.g., Hammond, Gregg, Hrycaiko, Mactavish, & Leslie-Toogood, 2012; Woodman & Hardy, 2003).

Even at the young age of the athletes, imagery use and imagery ability are already significantly related. Thus, both of these psychological skills need to be developed in early years of sports participation. Furthermore, previous research has presented evidence that imagery ability already improves as children progress through ages 7 to 14 (Fishburne, Hall, & Franks, 1987, as cited in Munroe-Chandler et al., 2007; Hall & Pongrac, 1983). As imagery ability increases, it is likely that imagery use will increase as well, as imagery use is more likely if the creation and maintenance of imagery is easy.

In consideration of the encouraging results of the current study, there are also limitations to overview. First, we used performance at competition only as an outcome measure indicating the overall competence of the gymnasts. Another performance measure, which could be used in gymnastics, would be the results of the special competitions qualifying for a squad, which include a variety of sport-specific performance measures such as athletic measures and measures of the technical aspects of complex motor performance besides the regular competition routines. In addition, further outcome measures were not considered in the present study. However, it would be useful if future research will also include other outcome variables such as goal setting, self-efficacy, mental toughness, anxiety, and its relationship with the corresponding type of imagery. Furthermore, we used self-report questionnaires only to capture imagery use and imagery ability. However, recent literature promotes the use of a combination of different indices such as questionnaires, mental chronometry, and physiological indices (Collet, Guillot, Lebon, MacIntyre, & Moran, 2011). Future research should follow this suggestion and use a combination of different measures to ensure the best possible measurement of the construct. Last, the study included athletes competing only in gymnastics. To capture possible differences among different types of sports, future research could extend the sample athlete population, for example, for open sports or team sports.

In conclusion, imagery use and imagery ability, but not the interaction of the two variables, were associated with performance. Gymnasts’ performance was mainly associated with imagery use of cognitive specific content, which directly addresses successful movement execution, and motivational general-mastery imagery, which may help to handle a challenging situation such as a competition. In addition, the ability to image goals also seems to be helpful to compete at an optimum. The findings are especially noteworthy, as none of the gymnasts
considered in the study have yet experienced sport psychology interventions. Imagery seems to be an intuitive psychological skill, which develops in early years of life. This finding supports those of previous studies, which indicated that children frequently use imagery to learn skills (Weiss, 1991) in a spontaneous natural manner (Munroe-Chandler, Hall, Fishburne, O, et al., 2007). Consequently, it seems fitting to systematically support young athletes’ imagery use and imagery ability (Weinberg, Butt, Knight, Burke, & Jackson, 2003) to promote learning, performance, and other outcomes associated with imagery, such as cognition, and anxiety regulation. To further improve the positive effect of intuitively used imagery, athletes, coaches, parents, and sport psychologists should help foster the systematic use of imagery in their training programs.

REFERENCES


IMAGERY USE, IMAGERY ABILITY, AND PERFORMANCE


