ORIGINAL ARTICLE

Imagery vividness and perspectives in women's artistic gymnastics training

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ABSTRACT

This study aimed to examine imagery vividness and different modalities and perspectives in women's artistic gymnastics. It explored athletes' imagery use in training practice and how vivid imagery is developed for different motor tasks. Forty-seven female athletes (age 19 ± 3 years), with women's artistic gymnastics expertise (12 ± 4 years) participated in this study. The *Vividness of Movement Imagery Questionnaire* (Dahm et al., 2019) was used to determine the imagery vividness of the participants for the different imagery modalities and perspectives respectively: external–visual, internal–visual, and kinaesthetic. The ANOVA results showed no differences between the most vivid imagery for age ($F[3] = 0.724$, $p = .54$) and expertise ($F[4] = 0.091$, $p = .97$). T-test results revealed differences in the imagery vividness of the kinaesthetic imagery depending on the gymnasts' activity as a coach ($F[45] = 5.280$, $p < .05$). To benefit from imagery use in training (e.g. to adjust coaching), the most vivid imagery modality and perspective must be determined individually. These results emphasise the need for skill-specific assessments of imagery modalities and perspectives to benefit from individualised imagery-adapted instructions.

Keywords: Physical education, Visual imagery, Kinaesthetic imagery, Motor tasks.

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INTRODUCTION

Psychological strategies for enhancing performance are widely used in various sports. In training and competition practices in artistic gymnastics, it is common to imagine important skills or the entire exercise program before performing them. In general, motor and visual imagery is widely accepted as a strategy to enhance learning and is effective in improving motor skill performance (Cumming & Williams, 2013; Moran et al., 2012; Simonsmeier et al., 2020). This is because, in addition to the conditional, coordinative, and sports-technical performance requirements, individual imagery use enhances performance in different sports settings (Munzert & Lorey, 2013). Research has shown that imagery is used and improves skill acquisition in (artistic) gymnastics (Moran et al., 2012; Munzert & Lorey, 2013; Simonsmeier & Frank, 2016). In artistic gymnastics, the athlete's performance depends not only on motor abilities and technical skills, but also on psychological abilities (Berisha, & Mosier, 2020).

Imagery use as one of the psychological abilities includes various strategies and is categorised differently in literature. Researchers distinguish at least two imagery modalities in which the visual and kinaesthetic aspects of movement execution were imaged. The visual modality is further separated into two visual imagery perspectives. On the one hand visual imagery can be generated from internal (first-person perspective: internal visual imagery) on the other hand from external (third-person perspective: external visual imagery) perspectives (Callow et al., 2013; Moran et al., 2012; Roberts et al., 2008). Furthermore, imagery from the internal perspective does not automatically imply a combination of the visual and kinaesthetic modalities (Roberts et al., 2008), and subjects are equally able to perform visual and kinaesthetic imagery (Guillot et al., 2004). Both visual perspectives are also described in action observation, in which movements of one's self or those of other people are usually observed by video (Moran et al., 2012). Due to the concurrence of the perspectives, a combination of action observation and visual imagery is used to improve performance (Wright et al., 2022). While observing someone performing an action that is within our motor repertoire, our brain simulates the execution of the movement (Moran et al., 2012).

The imagery modalities and perspectives can affect skill development and performance in various ways (Callow et al., 2013; Simonsmeier et al., 2020). Different sports-specific settings play important roles in imagery use. Previous research provides evidence imagery use depending on the skill level, for different sports and skills. Elite athletes tend to use mental imagery more frequently for skill rehearsal than novice counterparts (Arvinen-Barrow et al., 2007). A study with U.S. track and field athletes reported that successful athletes used more external imagery than non-successful athletes (Ungerleider & Golding, 1991). It looks different for a U.S. Olympic artistic gymnastics team, where results revealed that successful qualifiers used internal imagery more than non-qualifiers (Mahoney & Avener, 1977). According to this, for the learning of a simple gymnastics skill an external imagery perspective is considered to be effective (Hardy & Callow, 1999). In addition to the skill level, the effectiveness of the different imagery modalities and perspectives depends on the age of the athletes. Expertise and age could necessarily be related to each other (Munzert & Lorey, 2013). A study that focused on imagery in children and adolescents suggested an age effect (Dhouibi et al., 2021) and supposed that age and competition level can affect imagery use (Simonsmeier et al., 2020). However, it remains to be elucidated which aspects are decisive and whether age and competition level interact.

Different imagery modalities and perspectives can be graded in terms of their vividness. These grades can be used to observe which modality or perspective is rated as the most vivid. Studies have reported different results in imagery vividness using the *Vividness of Movement Imagery Questionnaire* comparing young and older subjects. A transfer from a visual to kinaesthetic imagery ability was observed in older subjects

compared to younger ones (Subirats et al., 2018). It can be observed that individuals differ in their vividness of the modalities and perspectives, like a trend from more internal to more external imagery perspective with aging (Liu et al., 2019).

Taking differences in skill-specific characteristics into account, Munzert and Lorey (2013) emphasised the differentiation of open and closed skills for the classification of the effects of imagery in sports. Unlike open skills which require the ability to imagine external events and environmental conditions, closed skills differ in the predictability of the environment (Schmidt & Lee 2005). However there are sports that approach both, open and closed skills. Coelho colleagues (2007) investigated the effects of imagery on performance in tennis in both the closed skill of the serve and the open skill of returning a serve. Athletes in artistic gymnastics, a sport with typically closed skills, reported kinaesthetic imagery more often than athletes in open skills sports (Munzert & Lorey, 2013).

For artistic gymnastics practice, the question concerns whether athletes use different imagery modalities and perspectives, also because imagery is suggested to use in combination with action observation to improve performance (Wright et al., 2022). With regard to gymnastics skills requiring the use of a particular technique for successful performance, the third-person visual perspective is described as beneficial for action observation because it provides a visual representation of the desired technique (Wright et al., 2022). Thus, when transferring the effects of action observation to gymnasts who are also coaches, it seems reasonable that action observation could have an effect on the imagery of the gymnast with a coaching role.

The influence of imagery on performance can also be attributed to other psychological factors. The results of a gymnastics-related study showed that internal and external visual imagery exercises improved self-confidence in performing wheel motion skills, whereas the internal visual imagery training method was preferred (Prastyawan et al., 2023). Therefore, improved performance can be achieved through the imagery perspective or increased self-confidence. At best, the image use of an athlete adapts individually (Cumming & Williams, 2013). But the current practice of imagery is often not systematised and is based on experience (Ladda et al., 2021).

Coach instructions such as "*visualise the skill in your mind before executing*" are part of everyday training. However, no attention has been paid to how this skill can be imagined. Therefore, the present study investigates whether a specific modality and perspective of imagery are more vivid, and how gymnasts' imagery use in training is characterised. The questions were whether age and expertise have an impact on the modality and perspective of imagery, and which training-specific characteristics should be considered.

Based on the effects of different modalities (visual and kinaesthetic) and visual perspectives (external and internal), the aim was to investigate if gymnasts evaluate a specific imagery modality and perspective (in the following referred to as imagery "*type*") more vivid, depending on athletes age, expertise or training specific characteristics like action observation and own coaching activities. We assumed more vivid imagery for athletes who used imagery more frequently in training. The following hypotheses were examined:

1) Imagery types differ in their rated vividness.
2) The most vivid type of imagery depends on the gymnasts' characteristics (age and expertise).
3) Gymnasts with own coaching activities differ in imagery vividness from those without.
4) Gymnasts with more frequent imagery use in training rated imagery more vivid.

MATERIALS AND METHODS

Participants

Forty-seven female athletes aged between 12 and 24 years (mean 19 ± 3 years), with women's artistic gymnastics expertise for at least 5 years (mean 12 ± 4 years) in German clubs, voluntarily participated in this study. The participants were limited to female athletes because their performance would not be comparable to that of male artistic gymnastics athletes owing to different evaluation and execution criteria. All participants competed, at least in regional competitions. Twenty of them had their own coaching activities and 27 did not. All participants were informed of the procedures and tasks before starting the experiment. All participants agreed to participate voluntarily and were informed that they could drop out at any time without providing a reason. For participants who were under 18 years old, consent was obtained from their parents. This study was conducted in accordance with the Declaration of Helsinki and was approved by the ethics committee of our university (No. 138/2021).

Measures

For data collection, an online survey was chosen to capture sociodemographic data, followed by the *Vividness of Movement Imagery Questionnaire* (VMIQ-2, Dahm et al., 2019) and sports-specific questions. The VMIQ-2 assesses the ability to form mental images of 12 motor tasks (i.e. running, kicking a stone, jumping sideways) for three imagery types: external–visual imagery (EVI), internal–visual imagery (IVI), and kinaesthetic imagery (KI). For this study, one item on artistic gymnastic-specific skills (i.e. stretched jumps with turns) was added. Participants were asked to imagine each of the 13 items in three different ways (also listed in German for the literal use of the VMIQ-2):

- EVI: "*Imagine if you are watching yourself performing the movement*."
- "*Sie sehen sich wie auf einem Video bei der Bewegungsausführung*."
- IVI: "*Imagine if you are looking out through your own eyes*."
- "Sie sehen bei der Bewegungsausführung durch Ihre eigenen Augen."
- KI: "*Imagine feeling yourself doing the movement*."
- "*Sie fühlen wie Sie die Bewegung ausführen*."

For each motor task, they rated the vividness of movement imagery on a five-point Likert scale, (1 = perfectly clear and vivid; 5 = no image at all, I only know that I am thinking about the movement). The following sport-specific part included questions about specific experiences in gymnastics. It was queried the expertise in gymnastics (current and past activity in gymnastics), the imagery use frequency and timing in training, and athlete's own coaching activity in artistic gymnastics. And all participants had to answer the question if she is or was able to perform a stretched jump with turn.

Procedure

Female gymnasts who were at the required competition level, in the appropriate age range and able to perform the stretched jump skill were asked to take part in the study. They were sent all necessary information and a link to the survey by email. They were asked to take a calm and undisturbed place. After answering the sociodemographic part, before answering the individual items of the VMIQ-2, they were asked to imagine the motor tasks. The sports-specific questions completed the survey. In total the online survey took approximately 20 minutes to complete.

Analysis

Data from 47 participants were analysed. Fifty-two of them completed the survey, but five were excluded because of prolonged inactivity in artistic gymnastics for too long. The collected data were analysed by

performing descriptive and inferential statistical analyses using the statistical analysis software SPSS (Version 29.0). Descriptive data in the figures and tables are presented as means (M) and standard deviations (SD). For inferential statistics, the significance criterion was set at $p < .05$. The assumptions for conducting analyses of variance were checked. To determine any statistical group differences for imagery vividness types, group assignment was dependent on the most vivid rated imagery type (EVI, IVI, or KI). If participants made equally pronounced ratings for two or three imagery types, they were assigned to "*Mix*" group.

To test Hypothesis 1, a one-way analysis of variance (ANOVA) was conducted to test for group differences between the imagery types regarding the vividness of the images. To verify Hypothesis 2, an ANOVA was performed to determine differences in the most vivid imagery type depending on the gymnasts' age or expertise. For hypothesis 3, T-tests were completed to determine imagery vividness differences, depending on the own coach activity (group "*coach*" n = 20; group "*no coach*" n = 27). Pearson's correlation coefficient was used to determine the possible correlations between imagery vividness and age. Spearman's rho correlation coefficient was used for correlations between imagery vividness and imagery use frequency in training (Hypothesis 4), as well as between action observation frequency in training and the vividness of external imagery.

RESULTS

This study aimed to investigate whether gymnasts rate a specific imagery type more vividly depending on age, experience, or training-specific characteristics. Further questions concerned whether imagery vividness was different for the imagery types and whether it was related to imagery use frequency in training.

Descriptive statistic

All 47 participants imagined movements before performing them during training; however, they reported different frequencies of imagery use: 12.8% (6) *always*, 48.9% (23) *most of the time*, 34.0% (16) *now and then*, 4.3% (2) *rarely*. After execution, different behaviours were reported. Descriptive statistics revealed a reduced number of gymnasts using imagery and a reduced frequency of imagery use: 39 participants imagined movements in training after they had performed them (8.5% *always*, 29.8% *most of the time*, 36.2% *now and then*, 8.5% *rarely*). They all carried out action/movement observations of themselves doing gymnastics, but with varying frequencies: 29.8% (14) *regularly*, 48.9% (23) *now and then*, 21.3% (10) *rarely*, and 0% never.

The VMIQ-2 ratings indicated similar vividness for the three imagery types surveyed (Table 1). A low score reflected a high level of vividness.

Table 1. Participants' ratings for external visual imagery (EVI), internal visual imagery (IVI) and kinaesthetic imagery (KI) vividness.

	EVI (M ± SD)	**IVI (M ± SD)**	**KI (M ± SD)**
Participants (amount)	47	47	47
Vividness (five-point scale)	1.96 ± 0.78	1.74 ± 0.59	1.81 ± 0.68

The 47 participants show varying degrees of vividness for the three imagery types. Based on the most vivid rated type, participants were assigned to the imagery type group (Table 2). Descriptive statistics show that the imagery type was most vivid rated by participants who rated EVI as the most vivid (VMIQ-2 = 1.38), and the least vivid rated when participants rated KI as the most vivid (VMIQ-2 = 1.62).

Table 2. Participant's characteristics listed all and distributed to the most vivid rated imagery type.

	All (M ± SD)	**EVI (M ± SD)**	**IVI (M ± SD)**	**KI (M ± SD)**	**Mix (M ± SD)**
Participants (amount)	47	8	12	17	10
Age (years)	18.81 ± 3.22	19.75 ± 3.41	17.75 ± 3.19	18.82 ± 3.32	19.30 ± 3.06
Expertise (years)	11.95 ± 3.79	12.13 ± 4.55	11.92 ± 3.96	11.62 ± 3.45	12.40 ± 4.06
Vividness (five-point scale)	1.55 ± 0.54	1.38 ± 0.32	1.55 ± 0.34	1.62 ± 0.43	1.57 ± 0.95

Inferential statistic

Considering the participants' ratings for all three imagery types, the ANOVA results showed no differences between the three imagery types for imagery vividness (F[2] = 1.294, p = .28). Also, if including just the vividness of the most vivid rated type groups, ANOVA results revealed no differences between the most vivid imagery type for variable "*vividness*" (Welch's F[3, 20.57] = 0.839, p = *.49*). That is, the vividness did not differ between the most vivid rated imagery type groups.

The ANOVA results indicated no differences between the most vivid imagery types for *age* (F[3] = 0.724, p = *.54*), *expertise* (F[4] = 0.091, p = *.97*). This implies that the participants in the study cannot be said to rate a particular imagery type as more vivid depending on their age or expertise.

The t-test results revealed differences in the vividness of the KI imagery types depending on athletes coaching activity (F[45] = 5.280, p < *.05*). Participants without coaching activity rated KI as more vivid (VMIQ-2 = 1.63) than did those with coaching activity (VMIQ-2 = 2.06). No differences were observed for external imagery vividness (F[45] = 1.012, p = *.65*), or internal imagery vividness (F[45] = 2.389, p = *.42*) depending on coaching activity. The most vivid rated imagery type groups are also compared here; t-test results revealed no differences for imagery vividness based on own coach activity (F[45] = 1.526, p = *.68*).

There were no correlations between imagery vividness of the most vivid imagery type and age (*r = .14; p = .93; n = 47*) or expertise (*r = -.16; p = .30; n = 47*), and no correlations between imagery vividness of the most vivid rated imagery type and frequency of imagery use in training (*r = .20; p = .18; n = 47*). There was no correlation between action observation and the vividness of the external imagery (*r = .05; p = .74; n = 47*).

DISCUSSION

This study aimed to consider the interrelation between imagery types and vividness and athletes' age, expertise, or training-specific characteristics, such as action observation or coaching activities in women's artistic gymnastics. Overall, the present results indicated no fundamental differences depending on imagery modality, perspective, or vividness. The results did not verify the assumption that imagery type or vividness differed according to age or expertise. Previous studies have indicated that the experience of imagery is unique to each individual, and athletes can emphasise certain aspects or manipulate the content of their images for specific cognitive functions. The data showed several differences between athletes' uses of imagery, reflecting the different task demands of each sport (Hardy & Callow, 1999). Corresponding to Munzert and Lorey (2013), open-skill sports require the ability to imagine externally; for gymnastics, assuming it involves predominantly closed skills, it could be concluded that internal imagery use is more vivid. Callow and colleagues (2013) explain the inconsistent results concerning previous concepts which eventually did not differentiate between internal and kinaesthetic imagery. The results of the present study indicate that imagery type and vividness are individual for gymnasts and may be determined by various aspects. Overall, no differences in the frequency of imagery use in training, action observation, or gymnast's coaching activities were observed in the present results.

Results from other studies on closed-skill sports, which were also conducted in gymnastics, are only partially transferable. As different skills were investigated, there might be differences in various studies. Some describe EVI as more effective than IVI for learning a static gymnastics skill (White & Hardy, 1995) or learning a basic gymnastics floor sequence (Hardy & Callow, 1999). A crucial difference was that the participants were randomly assigned to the groups and instructed to imagine a certain imagery type. Participants were selected based on the most vivid imagery type. Both studies examined the learning of skills, which makes them different from the present study because different levels of expertise can result in different imagery use (Arvinen-Barrow et al., 2007). The assumption, that action observation could influence the imagery type and vividness of the gymnast's imagery because it provides a visual representation of the desired technique (Wright et al., 2022), could not be observed in the present results. In gymnastics, studies suggest differences in imagery use and performance depending on competition level and age (Simonsmeier & Frank, 2016). These results include not only skill-related imagery but also general, motivational, and emotional imagery. In the present study, in which each participant was used to imagery in training, a lack of differences depending on age or expertise was observed. This is even though the age range was chosen to be wide. Considering that few studies that have focused on imagery in children and adolescents have proposed an age effect (Dhouibi et al., 2021), this investigation included participants aged 12 to 24 years. The results indicated no differences in imagery type or vividness depending of age. The imagery vividness was similar despite the wide range of ages and expertise. Alternatively, imagery use is individual and in training often not guided, which means that athletes use it individually, and a few is unclear and unstructured. Further research is required to understand the imagery used by athletes better.

The missing differences in imagery type and vividness in the present study can be explained by deficiencies in the self-reported vividness ratings of the questionnaire. It may not be reasonable to transfer VMIQ-2 with general movements to gymnastic-specific behaviours. Similarly, results showing similar imagery vividness in the VMIQ-2 for all participants could be evaluated. Perhaps the participants would rate vividness of gymnastic movements differently. Everyday movements being rated similarly vivid do not necessarily mean that all would also elicit similar results for imagery vividness in gymnastic movements. For the participants examined, it is assumed that everyone is familiar with imagery because all gymnasts use imagery in training before performing a skill, and only a few athletes show imagery use with low frequency. Therefore, there is a need for a validated sports-specific tool. Perhaps, it is purposeful to replace everyday movements with different gymnastic movements in the VMIQ-2, and not only, as in the present study, supplemented with one gymnastic-specific skill. Perhaps the missing vividness differences for the imagery types in the present results can be explained by the fact that, despite different ages and expertise, the gymnasts all used imagery in training. If the results are considered for the coaching activity, small differences can be observed. Gymnasts without coaching activity rated KI vividness as more vivid. Gymnasts with coaching activities may be used to observe movements from a third-person perspective, which is why KI may not be as vivid.

CONCLUSION

The vividness of the imagery modality and perspective seem to be very individual. In the present study, all three imagery types exhibit similar vividness. Some gymnasts do not show higher vividness for one imagery type but have equally strong ratings for two or three types. For the most vivid imagery types, gymnasts can be found with a wide range of ages, different levels of expertise, varying frequencies of imagery use, and action observation in training. The imagery modality and perspective may depend on a variable that we did not consider, and a validated sports-specific tool for imagery could be useful for training practice. Therefore, coaches should pay more attention to imagery used by gymnasts. If imagery is to be considered for training, the sports-specific imagery modality and perspective must first be tested individually to be adequately used.

Thus, improving performance through imagery-adapted instructions becomes possible. Instruction can direct attention towards the execution of a movement or one aspect of a movement. Therefore, the question arises as to whether vivid visual imagery is necessary for instruction that directs attention to movement to be effective. Can athletes direct the focus of attention internally if no internal visual imagery is developed? Do internally focused instructions make internal visual imagery more vivid? In future research, it would be interesting to determine whether a particular focus of attention is appropriate for a certain imagery modality and perspective. For imagery interventions, the athletes' imagery type should be considered and matched with the desired imagery modality for skill. Derived from this, instructions could be used to achieve the desired focus of attention, which is matched with the individual imagery preference. This could make the instructions more effective during training practice.

AUTHOR CONTRIBUTIONS

Juliane Veit. Study concept and design, data collection, statistical analysis, manuscript preparation and writing. Tobias Vogt. Study concept and design, writing and critical revision.

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