Introducing the revised applied model of deliberate imagery use for sport, dance, exercise, and rehabilitation

Jennifer Cumming, University of Birmingham
Sarah E. Williams, University of Birmingham
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Jennifer Cumming and Sarah E. Williams

School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Edgbaston, West Midlands, B15 2TT, United Kingdom

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Abstract. This article reviews literature on cognitive and motivational imagery use in the sport, exercise, dance, and rehabilitation domains and outlines a revised applied model of imagery use. The original model by Martin, Moritz, & Hall, 1999 guides practitioners and researchers in determining what cognitive and/or motivational imagery to use in a particular situation for achieving a desired outcome. The revised model proposed builds on the original version by retaining its empirically-supported “where”, “when”, and “why” components. Incorporating recent advancements in imagery research, the model distinguishes between what is imaged (i.e., the content) from why it is imaged (i.e., the function). The revised model also acknowledges the importance of the individual and how they interpret an image by including “who” and “meaning” components, as well as expanding on how imagery ability is likely to influence the relationship between imagery use and outcomes. Based on imagery’s increased usage beyond the sport setting, this review explains how the revised model can also be applied to individuals in the exercise, dance, and rehabilitation settings. Finally, recommendations of how imagery can be effectively used and some predictions of the revised model are provided to encourage future research and application.

Key words: Motor imagery, cognitive imagery, motivational imagery, exercise, dance, rehabilitation

1 Introduction

Imagery is one of the most popular mental techniques used by athletes and coaches to enhance performance and frequent use of imagery is a characteristic of those most successful in sport. Take for example Manchester United and England striker Wayne Rooney who described to FourFourTwo Performance how he uses imagery when preparing for a big match (“Rooney: Big match preparation”, n.d.):

“I always like to picture the game the night before: I’ll ask the kitman what kit we’re wearing, so I can visualise it. It’s something I’ve always done, from when I
was a young boy. It helps to train your mind to situations that might happen the following day. I think about it as I’m lying in bed. What will I do if the ball gets crossed in the box this way? What movement will I have to make to get on the end of it? Just different things that might make you one per cent sharper”

It is therefore unsurprising that imagery has been described as a “centre pillar of applied sport psychology” research (Morris, Spittle, & Perry, 2004, p. 344). However, it is also continuing to gain popularity in other movement domains including dance, exercise, and rehabilitation for its role in the self-regulation of thoughts, feelings and behaviors. Based on the evidence of some shared activation in neural substrates involved with imagery of movement and those of motor planning (for a detailed discussion on this issue, see Moran, Guillot, MacIntyre, & Collet, 2011), Holmes and Calmels (2008) define imagery as a top-down, knowledge driven process involving the generation or regeneration of parts of a brain representation or neural network. They further explain that imagery is primarily under the conscious control of the individual. This allows individuals to experience or re-experience situations in their mind by retrieving information from long-term memory. Once generated in working memory, the image may undergo inspection (e.g., detect details of the image), transformation (i.e., modify the image), and maintenance (e.g., sustain the image for a period of time). These sub-processes occur to ensure that the generated image matches the intended image, in both content (i.e., what is imaged) and characteristics (i.e., how it is imaged) (Cumming, Williams, Weibull, & Cooley, 2012).

Imagery content can typically be classified within the 2 x 2 conceptual framework proposed by Paivio (1985). That is, imagery is cognitive in nature but can have motivational value, and operates at specific or general levels. This results in four major types of imagery: 1) cognitive specific (CS; i.e., images of skills); 2) cognitive general (CG; i.e., images of strategies and routines); 3) motivational specific (MS; i.e., images of goals and their achievement); and 4) motivational general (MG; i.e., images of arousal and mastery). Through the development of the Sport Imagery Questionnaire (Hall, Mack, Paivio, & Hausenblas, 1998) and early investigations into patterns of athletes’ imagery use (Salmon, Hall, & Haslam, 1994), MG imagery was further subdivided into motivational general- arousal (MG-A; i.e., images of arousal and affect) and motivational general-mastery (MG-M; i.e., images of cognitions including confidence, mental toughness, and staying positive following setbacks). It is also important to point out that CS imagery is akin to the well known term of motor imagery; that is, both involve the internal representation of action without any corresponding body movement occurring (Guillot & Collet, 2008). Furthermore, although Paivio’s framework was initially explored in sport, this framework has also been successfully applied to dance, exercise, and rehabilitation (e.g.,

![Fig. 1. Applied model of imagery use. Adapted from “An applied model of mental imagery use in sport” in Martin, K.A., Moritz, S.E., & Hall, C. (1999). Imagery use in sport: A literature review and applied model. The Sport Psychologist, 13, 245–268.](image-url)
how effective their imagery will be in producing the intended aims.

Notable is that the original applied model considers what athletes imaged (i.e., the type or content of what is imaged) to be the same as why they image (i.e., the reasons or function of this imagery). For effective imagery to occur, the original model encourages individuals to closely match imagery content to the intended outcome. There is diverse evidence to support this proposition (for a review, see Cumming & Ramsey, 2009). Cognitive imagery leads to improved retention and transfer of a novel skill (Spittle & Kremer, 2010; VaezMousavi & Rostami, 2009) and tactical movements (Guillot, Nadrowska, & Collet, 2009). By comparison, motivational imagery benefits pre-performance anxiety (Mellalieu, Hanton, & Thomas, 2009), confidence (Callow, Hardy, & Hall, 2001), collective efficacy (Shearer, Thomson, Mellalieu, & Shearer, 2007), and is associated with greater mental toughness (Mattie & Munrow-Chandler, 2012). It therefore appears beneficial to follow the model’s hypothesis of “what you see really is what you get” (Martin, et al., 1999, p. 260).

However, some research has challenged the applied model with growing evidence that imagery will bring about other unintentional outcomes (Nordin & Cumming, 2005a; Short, Monsma, & Short, 2004). Indeed, more than one outcome can result from using a type of imagery (e.g., Callow & Hardy, 2001; Callow & Waters, 2005; Evans, Jones, & Mullen, 2004; Nordin & Cumming, 2005a, 2008). Moreover, individuals interpret the content of images in different ways suggesting that what is experienced may mean different things to different people (Short, et al., 2004). Sufficient evidence on imagery has now accumulated to warrant an update to Martin et al.’s (1999) applied model. For all of these reasons, we propose a revised model that builds on the strengths of the original and takes into consideration the most recent advancements in imagery research.

2 Revised applied model

The revised model of deliberate imagery use (Fig. 2) is designed to reflect major developments in imagery research since the original model was conceptualized over a decade ago (Cumming & Williams, 2012b). We have chosen to focus on deliberate imagery, which is generated with a specific purpose in mind, as opposed to spontaneous images, which are unintentionally experienced. Due to the empirical support the applied model has received from the literature (Cumming & Ramsey, 2009), the updated model has retained the “where”, “when”, and “why” components. To address findings that have emerged in the last 10 years, it distinguishes between the type of imagery (i.e., its content and characteristics) and the function of the imagery use. The importance of personal meaning is also recognized in the revised model, and represented by a bridge between “what” is imaged and “why”. Moreover, the revised model elaborates on the original by proposing that characteristics of the individual will also influence the imagery function. Consequently, the “who” and “what” components now highlight these additional factors to be considered with regards to imagery use. The revised model also more clearly describes the role of imagery ability in determining what and how individuals image, as well as influencing the relationship between imagery use and the outcomes received.

Finally, as people other than athletes use imagery, the revised model also applies to individuals from a wide range of domains (e.g., dancers, exercisers, rehabilitation patients). The revised applied model of imagery use has several possible applications. For example, imagery is gaining in popularity as supplementary treatment strategy for those recovering from stroke as well as individuals with movement disorders, cerebral damage, or Parkinson’s disease (for reviews see Dickstein & Tamir, 2010; Dijkerman, Ietswaart, & Johnston, 2010; Page, 2010). Although the desired outcomes in a rehabilitative setting may differ from a training or performance setting, it is likely that injured individuals or patients recovering from a stroke will use imagery for similar cognitive and motivational functions. A stroke patient may use skill-based imagery during a rehabilitation session to improve performance of a particular exercise or confidence-based imagery when they are about to perform a daily task they have not been capable of doing since experiencing a stroke. Therefore, the specific imagery content and desired outcomes may differ between populations. But, the revised model will nevertheless serve as a simple guide to more effective intervention design and offer key considerations to make. An overview of the different revised imagery types is shown in Table 1.

1 Although this recommendation pertains to visual imagery, it is also likely to be relevant for other imagery modalities including kinesthetic (i.e., “what you feel is what you get”).

![Revised applied model of deliberate imagery use](image-url)
model components along with an example for each is provided in Table 1. Each section of the model and its main propositions will now be described in turn.

<table>
<thead>
<tr>
<th>Component</th>
<th>Example</th>
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<tr>
<td>Where</td>
<td>Location</td>
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<td>When</td>
<td>Situation</td>
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<tr>
<td>Who</td>
<td>Individual</td>
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<td>Why</td>
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<td>What</td>
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<td>How</td>
<td>Characteristics</td>
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<td>Meaning</td>
<td>Content should serve function</td>
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<td>Imagery ability</td>
<td>Vividness &amp; controllability of what and how</td>
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<td>Outcome</td>
<td>End-product</td>
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2.1 Where (location) and when (situation)

Descriptive research informs us that athletes will tend to image in a number of locations, but mainly in practice and competition, as well as at home, when traveling, or injured (Driediger, et al., 2006; Munroe, Giacobbi, Hall, & Weinberg, 2000; Salmon, et al., 1994). Dancers most often use imagery at rehearsal or performances (Nordin & Cumming, 2005a) whereas regular exercisers usually image within the exercise environment (Giacobbi, Hausenblas, Fallon, & Hall, 2003). By comparison, individuals recovering from stroke will more likely image at home (Schuster, Glässel, Scheidhauer, Ettlin, & Butler, 2012). Where one images (e.g., the location) is also tied to when one images (e.g., the timeframe). For example, athletes will more frequently image during practice compared to before or after practice. In contrast, most imagery occurs just prior to competing than during or after (Munroe, et al., 2000). Furthermore, imagery is most often reported in the later part of the competition season, when the most important events take place, compared to earlier in the season or during the off-season (Cumming & Hall, 2002a).

Taken together, these findings suggest that imagery may vary in function according to the situation. Although direct empirical support is limited, it does make intuitive sense that athletes will consider the demands of a particular situation when planning their imagery. During practice, for example, imagery might be carried out to reinforce learning and improvements whereas imagery prior to competing might serve to prepare the athlete both mentally and physically. Within the off-season imagery might be used to recover and plan for the upcoming season, whereas later on in the season, imagery may function to help the individual compete at their very best (Cumming & Hall, 2002a). The revised applied model therefore encourages researchers and applied practitioners to consider both where and when the imagery occurs when designing interventions or training programs to maximize imagery’s effectiveness. Holmes and Collins (2001) suggest that the optimal imagery situation is when the imagined environment closely matches that of the actual environment where the behaviour occurs (also see Wakefield, Smith, Moran, & Holmes, 2012). In other words, if a dancer would like to use imagery to overcome their stage fright they should image standing on the stage where his/her performance will take place. Within rehabilitation settings, it is also important to consider the stage of treatment (Evans, Hare, & Mullen, 2006). Evans, et al. (2006) found that not all injured athletes are ready to use imagery at an early stage of rehabilitation, but those who did image used it predominately to cope with pain and promote healing. In contrast, imagery was used at a later stage of rehabilitation by those athletes to maintain a positive attitude and develop self-confidence in preparation for their return to competition.

2.2 Who (individual)

In addition to the “situation”, the revised applied model also proposes that the “individual” can influence imagery use and its effectiveness. Relevant characteristics to consider are gender, competitive level, age, experience, and the individual’s disposition or personality. Gender differences in imagery use appear minimal but depend on the activity type. Within sport, male and female athletes typically report similar patterns of use (e.g., Cumming & Hall, 2002a, 2002b; also see Hall, 2001), whereas differences are more often found within exercise (e.g., Cumming, 2008; Gammage, et al., 2000). For example, Cumming found that female exercisers more frequently report images of their appearance and health whereas males report more images of exercise technique. More robust differences are found for skill, competitive and/or participation level, with more accomplished athletes and dancers using imagery more frequently for both cognitive and motivational functions than their lower level counterparts (e.g., Cumming & Hall, 2002a, 2002b; Nordin & Cumming, 2006b; Salmon, et al., 1994). More physically active individuals similarly use more imagery
than less physically active individuals, regardless of its function (Cumming, 2008; Gammage, et al., 2000). This finding appears to remain consistent despite situational changes, which may reflect a greater amount of commitment that higher level athletes, dancers, and exercisers devote to their activity (Hall, 2001). For example, differences in imagery use due to skill level during the competition season have been replicated for athletes in the off-season (Cumming & Hall, 2002a).

Greater knowledge and experience of using imagery are also likely to influence its use and effectiveness. Termined “meta-imagery” (Moran, 2002) this is not only an athlete’s understanding of the type of imagery he/she finds best but also includes knowing when and how to maximize his/her imagery experiences (for review, see MacIntyre & Moran, 2010). A dancer may know when to use imagery for a particular function and know to adopt a particular angle when viewing this image to obtain the desired outcome. Similarly, the amount of confidence an individual has in their ability to use a certain image also seems to affect the extent to which they use it (Short, Tenute, & Feltz, 2005).

Finally, dispositional characteristics including trait anxiety or confidence, perfectionism, and motivational tendencies may also influence imagery use. Thomas, Hanton, and Maynard (2007) demonstrated that athletes who viewed anxiety as more facilitative than debilitating to performance report using imagery one or two days prior to competition to help manage their anxiety symptoms. Recently, Nordin-Bates, Cumming, Aways, & Sharp (2011) found that dancers with greater perfectionistic tendencies reported experiencing more debilitating cognitive and motivational images than dancers with fewer perfectionistic tendencies. Alternatively the quantity and quality of an individual’s motivation may also impact upon the types of images employed (e.g., Harwood, Cumming, & Fletcher, 2004; Wilson, Rodgers, Hall, & Gammage, 2003). Athletes high in ego orientation report using more outcome goal images such as winning a medal (Harwood, et al., 2004), whereas exercisers who are active for introjected reasons experience more appearance images (Wilson, et al., 2003).

While this list of individual characteristics is not exhaustive (also see Murphy, et al., 2008), it does highlight the need to carefully consider the “who” element when devising imagery interventions. This element also provides a starting point for researchers to develop testable predictions surrounding imagery use and individual differences.

2.3 Why (function)

A main proposition of the revised model is that imagery function will directly influence the outcomes obtained from its usage and that this will be achieved via the content generated. For the sake of clarity, imagery function pertains to the reasons why an individual is imaging whereas imagery content refers to what is being imaged (Murphy, et al., 2008).

Martin, et al.’s (1999) applied model originally postulated that “what you see really is what you get” (p. 260). In other words, imagery content should closely match the intended outcome for best effect. Whilst this simple rule of thumb has been helpful in guiding intervention design for both research and applied work, a number of anecdotal studies and experiments have since demonstrated that it should not be rigidly adhered too. Indeed, the relationship between imagery content and function does not appear to be as straightforward as originally believed. While in many instances support has been found for Martin, et al.’s claim (e.g., Robin, et al., 2007; Short, et al., 2004), imagery content also can serve different or multiple functions to that intended (e.g., Bernier & Fournier, 2010; Evans, et al., 2004; MacIntyre & Moran, 2010; Murphy, et al., 2008; Nordin & Cumming, 2005a, 2008).

Furthermore, when taking into consideration both the “who” and “where & when” elements of the revised applied model, it is likely that characteristics of both the individual and the situation will influence what imagery content is most effective for serving particular functions. For example, imaging a perfect dive might be done to improve competitive performance for one athlete and to reduce symptoms associated with anxiety in another. Similarly, imaging a difficult section of a beam routine may be done at training with the aim of helping a gymnast mastering that routine. But prior to competition, this same image might be used to maintain confidence and focus. Consequently, we distinguish between content and function in the revised model with a “what & how” element that is separate from the “why”. This principle has been similarly proposed in other imagery models and frameworks (Fournier, et al., 2008; Guillot & Collet, 2008; Murphy, et al., 2008).

2.4 Meaning

For many years some imagery theorists (e.g., Ahsen, 1984; Lang, 1979) have postulated that imagery is a highly personalized experience that can mean different things to different individuals. This point has been particularly emphasized in Ahsen’s (1984) triple code model, Lang’s (1979) bioinformational theory, and more recently, in Holmes and Collins’ PETTLEP model (2001; also see Wakefield, et al., 2012). We similarly believe that the personal meaning associated with a particular image is essential for determining what content is most appropriate to facilitate a particular function. A good tennis player who images himself serving a ball 5 cm outside the service box may view this image as unhelpful for improving confidence. By comparison, the same content imaged by a novice tennis player may be interpreted as facilitative due to not yet being capable of serving that close to the service box. In other words, such an image would represent a
To address this previously omitted concept from the applied model, we have inserted meaning as a bridge between function and content. The model suggests that imagery will be more effective when it is personalized and meaningful to the athlete. This proposal is based on evidence that athletes rate different types of images as generally effective for achieving a range of affective, behavioral, and cognitive outcomes (Nordin & Cumming, 2008). However, when placed in a specific situation, individuals may indicate a preference for experiencing an image that is meaningful to them (e.g., Evans, et al., 2004). There is also research to suggest that when participants provide information to form the bases of an individualized imagery script, greater physiological activity occurs and higher imagery ability self-ratings are given compared to when the scripts have been generated by the researcher (Wilson, Smith, Burden, & Holmes, 2010).

We define meaningful imagery as a match between what is being imaged and its intended function so that the imagery fits both the individual and the situation. Interventions should therefore be customized to meet the needs of those involved to be maximally effective; that is, the reasons for imaging match the outcomes achieved. We therefore agree with Callow and Hardy (2001) that the benefits of an imagery intervention are driven mainly by the function and not the content. However, the content must be personalized and meaningful for the individual and appropriate for the situation to be effective. It is also likely that the individual will find it enjoyable and easier to perform such personalized and meaningful imagery (Cumming & Ramsey, 2009).

These hypotheses regarding the meaning component of the revised applied model still remain to be systematically tested. Nevertheless, there is sufficient evidence from the extant imagery literature to provide some guidance for practical application. As originally proposed by Short and Short (2005), the imagery function should first be decided before determining what type of imagery content will be most effective (for similar recommendation, also see Fournier, et al., 2008; Murphy, et al., 2008). The revised applied model builds on this proposal by also recommending that the imagery function precedes decisions regarding how the imagery should be carried out.

2.5 What (type) and how

Treating the imagery function (“why”) as separate to the content or type of imagery (“what”) suggests that whilst the content is likely to be reflective of the function (e.g., content = performing a skill well; function = to improve physical performance of that skill), this is not always necessarily the case (e.g., content = performing a skill well; function = to increase confidence levels). A further implication is that the type of imagery chosen does not have to fit exclusively within Paivio’s (1985) framework of cognitive and motivational imagery. Indeed, there is broad a range of imagery types for athletes to draw from including anatomical images (Nordin & Cumming, 2005b), appearance and health images (Gammage, et al., 2000; Giacobbi, Tuccitto, Buman, & Munroe-Chandler, 2010), healing and injury images (Evans, et al., 2006; Driediger, et al., 2006), role and character images (Nordin & Cumming, 2005b), and images depicting places and people (Giacobbi, et al., 2003; Munroe, et al., 2000).

Another consideration is that different types of imagery content can be effectively combined to serve a particular function or multiple functions. A recent guided imagery intervention with patients recovering from surgery to repair their anterior cruciate ligament adopted such a multi-function approach to achieve a range of rehabilitative outcomes (Maddison, et al., 2012). Within the scripts, participants were encouraged to use cognitive imagery to rehearse specific exercises (e.g., contracting the quadriceps), motivational imagery to image successfully dealing with feelings of discouragement and experience total confidence in the rehabilitative process, and healing imagery to image strength increasing and the tissues returning to normal. The intervention appeared to augment the effects of physical rehabilitation by reducing stress levels and improving knee laxity. Similarly, a combination of cognitive and motivational imagery used alongside physical practice enabled a 38-year-old woman who was ten years post left subarachnoid hemorrhagic stroke to improve her motor imagery ability, walking speed and endurance, balance, and confidence (Deutsch, Maidan, & Dickstein, 2012).

The revised model focuses on deliberately generated imagery; that is, the use of imagery to intentionally achieve a specific outcome or set of outcomes. Research has already established that more successful individuals will use imagery in the same structured and systematic fashion with which they approach physical practice (Barr & Hall, 1992; Cumming & Hall, 2002b; Nordin & Cumming, 2006b). Moreover, and meeting the requirements of deliberate practice, they perceive imagery to be highly relevant to making improvements and requiring mental concentration to perform (Cumming & Hall, 2002b). Spontaneous images (i.e., images experienced for no apparent reason) are commonplace in everyday life (Kosslyn, Seger, Pani, & Hilger, 1990; Murphy, et al., 2008). For imagery benefits to be maximized, however, not only should images be consciously created but individuals should also be mindful of the reasons why they are imaging and what content will best help them to achieve their aims. It is also for this reason that we recommend that the content of an imagery intervention is selected after establishing what function(s) it should serve.

When deciding on what to image, it is important to consider the characteristics of the imagery process. Imagery characteristics refer to how the image is experienced such as its speed (e.g., slow motion, real time), duration, frequency, and color (Fournier, et al., 2008;
Munroe, et al., 2000; Nordin & Cumming, 2005b). We also include sensory modalities (e.g., visual, kinesthetic, auditory, tactile, gustatory), visual perspective (1PP vs. 3PP), viewing angle (e.g., from the front or side), and agency (e.g., self or other) as imagery characteristics (Cumming & Williams, 2012b). Because there is likely to be a close relationship between what is imaged and how this is done, these are both represented in the same element within the revised model. As well as deciding on what content to image (e.g., performing the routine in an upcoming competition venue), a gymnast who is using imagery to rehearse a difficult section of his floor routine, also needs to determine how he is going to image this content. This might include a combination of visual and kinesthetic imagery whilst observing the routine from a 3PP side-on view. He may also decide to speed up easier elements of the imaged routine and then slow down to focus on particular difficult movements.

We also propose that how the image is experienced can refer to internal or external cues used to facilitate components of the imagery process, including generation, inspection, transformation or maintenance of the image. It is already established that employing elements of the PETTLEP model, such as having individuals wear the appropriate clothing and stand in the appropriate stance (physical element) in the environment in which the task is performed (environment element), can facilitate imagery use and make it more effective for achieving the desired outcomes (e.g., Guillot, Collet, & Dittmar, 2005; Smith, Wright, Allsopp, & Westhead, 2007; Smith, Wright, & Cantwell, 2008). Another way to cue imagery is to provide individuals with a model to observe, either live or on video tape. This helps the individual to more easily generate vivid, accurate or complex images (Calmels, Berthoumeaux, & d’Arripe-Longueville, 2004; Evans, et al., 2004; Nordin & Cumming, 2005b; Rymal & Ste-Marie, 2009; Williams, Cumming, & Edwards, 2011). Finally, the degree to which the imagery is structured and planned can be considered another aspect of how the imagery is used (e.g., how many sessions they will have in the run up to a competition, what they will image in each session, and how long each session will last).

2.6 Imagery Ability

Similar to its predecessor, the revised model proposes that imagery ability will influence the extent to which imagery use is effective for achieving desired outcomes. Imagery ability can be defined as “an individual’s capability to form vivid, controllable images and retain them for sufficient time to effect the desired imagery rehearsal” (Morris, 1997, p. 37). Paivio (1986) explained that virtually everyone has the ability to image but to varying extents. He further proposed that imagery ability is likely to differ depending on the content being generated. Williams and Cumming (2011) recently confirmed this notion by demonstrating that athletes differ in their ability to image cognitive and motivational imagery content. Images of affective content are typically reported to be the easiest to generate compared with skill images, which are in turn, significantly easier to image than strategy, goal, and mastery content.

Numerous studies have also demonstrated that individuals with a better imagery ability experience more benefits (e.g., Goss, Hall, Buckolz, & Fishburne, 1986; McKenzie & Howe, 1997; Robin, et al., 2007). Robin, et al. (2007) showed that although all athletes in their study improved their tennis service return accuracy following imagery combined with physical practice, those who reported higher imagery ability experienced the greatest improvements. Despite individual differences existing, however, imagery ability can be improved with invested time and effort (for review see Cumming & Williams, 2012b). This can be done via imagery practice (Cumming & Ste-Marie, 2001; Rodgers, Hall, & Buckolz, 1991), combining observation in with imagery (Rymal & Ste-Marie, 2009; Williams, et al., 2011), and incorporating response propositions into an image already containing stimulus propositions (Lang, Kozak, Miller, Levin, & McLean, 1980; Williams, Cooley, & Cumming, 2013).

Within the revised model, imagery ability is proposed to directly influence what is imaged and how; that is, individuals are likely to select imagery content and characteristics that they find easier to generate and maintain. Gregg, Hall, McGowan, and Hall (2011) similarly suggested that imagery ability can reinforce and modify imagery use. In support of this idea, Williams and Cumming (2012a) demonstrated that the ability to image certain types of content (e.g., skill imagery ability) positively predicts how frequently individuals use imagery of that content (e.g., skill images). Moreover, greater imagery ability is also directly related to certain outcomes. The ability to generate images of a motivational nature (i.e., goals, affect, and mastery) positively predicts athletes’ trait sport confidence and anxiety responses and challenge and threat stress appraisal tendencies (Cumming & Williams, 2012a; Williams & Cumming, 2012b).

Extending beyond imagery content, we also suggest that imagery characteristics will be influenced by imagery ability. If an individual finds it difficult to image how a movement feels in third person perspective, for example, they will be less likely to adopt this visual perspective when imaging kinesthetically. Few studies have examined this idea directly, which is mostly likely due to the lack of appropriate measurements. But, initial support can be gleaned from Callow and Roberts’ (2010) findings that a small correlation exists between an individual’s preference for a visual perspective and the ability to image in this perspective. However, no relationship was found between athletes’ third person visual imagery ability and the viewing angle used. More research is therefore needed to clarify this issue and extend investigations to other imagery characteristics (e.g., having better controllability over the timing of an image may lead an individual
to combining real time with slow motion to maximize the benefits of each).

Not only will imagery ability directly influence what and how individuals image, it will also likely exert indirect effects on the outcomes achieved. That is, imagery will both mediate (represented by the solid line in Fig. 2) and moderate (represented by the dashed line in Fig. 2) the relationship between imagery use and the desired outcomes. Whether this occurs for some or all types of imagery and/or imagery characteristics is yet to be extensively investigated. Past research has mainly focused on imagery associated with skills and performance outcomes using measures of movement imagery ability (Gregg, et al., 2011). As newer methods have become available such as the valid and reliable Sport Imagery Ability Questionnaire (Williams & Cummings, 2011), there is now the scope to expand testing to a broader range of imagery content and outcomes. The SIAQ is specific to athletes and measures their ability to image cognitive and motivational content. However, similar measures are still needed for exercise, dance and rehabilitative settings.

Imagery ability is also not just limited to what individuals’ image, but how. For this reason, we also believe that other components of imagery ability should gain more attention in the future. While some dimensions and characteristics (e.g., visual and kinesthetic imagery ability; first person and third person perspective imagery ability) are already somewhat assessed by existing measures, additional tools are needed to fill in the gaps and tap other aspects of imagery ability. For example, better imagers are more accurate in estimating the duration of their images (Guillot & Collet, 2005; Guillot, et al., 2008). A recently recommended approach to capture the multidimensional nature of imagery ability has been to combine different types of measures to form an index (Collet, Guillot, Lebon, MacIntyre, & Moran, 2011). For example, Collet, et al. (2011) have calculated a motor imagery index (MII) based on self-report motor imagery ability, mental chronometry and physiological recordings. This approach may prove to be a promising step to more fully capturing an individual’s imagery ability.

Regardless of these methodological issues, there is sufficient evidence to suggest that individual differences in imagery ability will confound the effectiveness of interventions. In other words, an individual’s ability to image is a key factor determining the effectiveness of imagery interventions and should not be overlooked. Not only does this point reinforce the need to measure imagery ability as part of screening procedures, but also encourages researchers to be mindful of matching the type of imagery ability measure to what the individual will image (Williams & Cummings, 2011, 2012a).

2.7 Outcome

The outcomes or goals of imagery use have generally been categorized as affective, behavioral or cognitive in nature, but vary depending on the specific domain of application. Within sport, the recent motor imagery integrative model (MIIMS; Guillot & Collett, 2008) suggests four distinct categories: 1) motor learning and performance; 2) strategies and problem solving (e.g., memorization, planning, creative thought, reviewing, evaluating); 3) psychological outcomes (e.g., attention, arousal, motivation, self-confidence, emotions, and anxiety); and 4) injury rehabilitation (e.g., healing, strength, flexibility, and pain management) (also see Bernier & Fournier, 2010; Munroe, et al., 2000; Cumming & Williams, 2012b; Cupal & Brewer, 2001; Martin, et al., 1999; Nordin & Cummings, 2008; Ranganathan, Siemino, Liu, Sahgal, & Yue, 2004; Sodorni, Hall, & Forwell, 2000). Within dance, these same outcomes apply along with those of a more artistic nature (Nordin & Cummings, 2005b) whereas exercise and rehabilitation participants would also have a focus on achieving health-related goals (Giacobbi, et al., 2003; Schuster, et al., 2012).

Although the revised model concerns itself with deliberate imagery practice whereby imagery is employed to serve a particular function, the outcomes achieved from its use may be intentional or not. That is, the individual may experience additional outcomes that were not part of the initial purpose (Nordin & Cumming, 2005a; Short, et al., 2004). Various studies have demonstrated the potential for achieving multiple outcomes from using one type of imagery (e.g., Callow & Hardy, 2001; Callow & Waters, 2005; Evans, et al., 2004; Nordin & Cumming, 2005a, 2008).

As well as experiencing positive outcomes, incorrect or inappropriate use of imagery may elicit negative outcomes or no outcome (i.e., the imagery is debilitating or unhelpful) (Nordin & Cumming, 2005a; Short, et al., 2002). In support, Nordin and Cumming showed that imaging missing the dart board not only led to decreased performance at a dart throwing task, but also reduced participants’ self-efficacy levels. Moreover, research has demonstrated that using imagery to suppress negative images could ironically result in behavior reflective of these negative images. Beilock, Afremow, Rabe, and Carr (2001) demonstrated that participants hit a golf ball past the target mark when using imagery to suppress negative thoughts of overshooting the putt. Similarly, Ramsey, Cumming, and Edwards (2008) found that positively worded imagery scripts instructing participants not to putt towards a sand bunker resulted in significantly fewer successful putts. In sum, these findings indicate that “what you see is not always what you get” (Nordin & Cummings, 2005b), and emphasizes the need for researchers to consider the meaning a particular image may have for the individual(s) using it.

3 Conclusions and future research directions

The revised applied model of deliberate imagery use (Cumming & Williams, 2012b) is intended to build on
Table 2. Example predictions of the revised applied model of deliberate imagery use.

<table>
<thead>
<tr>
<th>Where &amp; When</th>
<th>Who</th>
<th>Why</th>
<th>What</th>
<th>How</th>
<th>Predicted primary effects/outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before training</td>
<td>Skilled/ unskilled athlete</td>
<td>Enhance motivation to train (MG-M)</td>
<td>Achieving a sporting goal</td>
<td>1PP/3PP, real time</td>
<td>Improve motivation and focus</td>
</tr>
<tr>
<td>During training</td>
<td>Skilled athlete</td>
<td>Improve performance of task where timing important (CS)</td>
<td>Performance of the task</td>
<td>1PP, real time</td>
<td>Facilitate performance of task, enhance confidence</td>
</tr>
<tr>
<td>During practice</td>
<td>Novice dancer</td>
<td>Learn how to perform a new dance move (CS)</td>
<td>Performance of the movement</td>
<td>3PP, slow motion</td>
<td>Facilitate learning, enhance confidence</td>
</tr>
<tr>
<td>In own time</td>
<td>Athlete, dancer</td>
<td>Devise new strategies/routines (CG)</td>
<td>Various skills and sequential movements</td>
<td>3PP slow motion</td>
<td>Create new strategy/routine/game plan</td>
</tr>
<tr>
<td>During training/</td>
<td>Skilled/ unskilled athlete</td>
<td>Improve self-efficacy (MG-M) or regulate anxiety (MG-A)</td>
<td>Performance of a skill</td>
<td>3PP or 1PP, kinesthetic imagery</td>
<td>Improve self-efficacy, improve self-confidence, regulate anxiety, facilitate performance of skills</td>
</tr>
<tr>
<td>competition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During the build</td>
<td>Highly anxious individual</td>
<td>Reduce anxiety (MG-A)</td>
<td>Performing skills or strategies well, positive feelings, feeling confident</td>
<td>Visual and kinesthetic imagery</td>
<td>Reduce anxiety, Increase self-confidence</td>
</tr>
<tr>
<td>up to competition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During performance</td>
<td>Skilled athlete</td>
<td>Ensure correct skill execution (CS) and/or facilitate/maintain focus (MG-M)</td>
<td>Correct skill execution</td>
<td>1PP, kinesthetic imagery, real time</td>
<td>Correct performance, maintained focus</td>
</tr>
<tr>
<td>During exercise</td>
<td>Beginner</td>
<td>Improve technique (CS)</td>
<td>Specific exercise skill/activity</td>
<td>3PP</td>
<td>Improve performance, enhance motivation, psych up</td>
</tr>
<tr>
<td>class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When exercising</td>
<td>Extrinsically motivated exerciser</td>
<td>Motivate themselves to continue exercising (MG-M)</td>
<td>Achieving a weight loss goal</td>
<td>1PP, kinesthetic imagery</td>
<td>Increase motivation, maintain focus</td>
</tr>
<tr>
<td>During pre-season</td>
<td>Ego-orientated athlete</td>
<td>Motivate themselves to complete fitness program (MG-M)</td>
<td>Performing worse than other athletes during the competitive season</td>
<td>3PP, real time</td>
<td>Increase motivation</td>
</tr>
<tr>
<td>During rehabilitation session</td>
<td>Athletes, exercisers, dancers</td>
<td>Improve performance of rehabilitation exercises (CS)</td>
<td>Rehabilitation exercises</td>
<td>Real time</td>
<td>Improve performance</td>
</tr>
<tr>
<td>When injured</td>
<td>Athletes, exercisers, dancers</td>
<td>Motivate self to conduct rehabilitation exercises (MG-M)</td>
<td>Performing well when not injured</td>
<td>Visual and kinesthetic imagery</td>
<td>Increase motivation</td>
</tr>
</tbody>
</table>

Imagery ability may moderate the relationship and imagery content may mediate the relationship between imagery ability and outcome.
the strengths of the original version by considering recent empirical and conceptual developments within imagery research. Consequently the revised model has been elaborated to include characteristics of the individual (“who”), and differentiate between “what” is imaged and “why” it is imaged by recognizing the importance of personal meaning. Indeed, adding meaning as a bridge between imagery function and content is a novel contribution of the revised model to the imagery literature. The concept of meaningful imagery had been discussed within different theories, but until now it had not yet found a home within contemporary imagery models that guide both research and application.

Another contribution of the revised model is the clarification that imagery function will directly impact the affective, behavioral, and cognitive outcomes achieved through imaging. As well, the model encourages researchers and practitioners to consider how the different components of the model should interact for effective imagery to occur. When an individual generates deliberate and purposeful imagery, they will do so with a specific outcome or range of outcomes in mind (i.e., they will have a specific reason or more than one reason why they are imaging). Whether these outcomes are achieved will depend on several factors: (a) if what is imaged and how it is imaged is appropriate for the individual and the situation (i.e., meaningful imagery); and (b) the individual’s ability to image. Effective imagery is considered to occur when the outcome(s) achieved match the intended imagery function(s).

Despite initial support for the revised model, as outlined in the present review, a growing evidence base is still needed to test its propositions particularly for non-athlete populations. The model can either be considered as a whole or specific relationships tested within it. Despite the differences that may be exhibited between individuals using imagery, some predictions of the revised applied model that could be tested by researchers are highlighted in Table 2. It would be of particular interest to examine the interactions between different elements and how they may alter the achieved outcomes. These findings will help researchers and practitioners establish more effective imagery interventions for athletes, exercisers, dancers, and individuals in the rehabilitation setting to bring about greater affective, behavioral and cognitive outcomes.

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Bibliography


