Using PETTLEP imagery to improve performance: Applying principles from sport psychology to music

Abstract

Imagery is commonly used by both athletes and musicians as an additional training aid to enhance performance. Although considerable research attention has been paid to this psychological intervention technique in sporting settings, studies investigating the beneficial effects of imagery on musical performance are less common. Imagery research that has been conducted in musical settings has tended to show that imagery is beneficial in improving performance, although few guidelines exist in the literature regarding how musicians should use imagery to improve their performance. In this article we review the research which has investigated the use of imagery as a performance enhancing technique in musical settings to date. We then outline a model for designing imagery interventions (known as the PETTLEP model) which has produced particularly beneficial performance effects when implemented in sporting settings, and discuss how it could be used by musicians to enhance performance.

Keywords

PETTLEP, imagery, mental practice, music

Introduction

Imagery is the process of using multiple senses to simulate an experience in the mind (Vealey & Greenleaf, 2010), typically in the absence of overt physical movement. Imagery is a common technique used in both sporting (Weinberg, 2008) and musical (Gregg & Clark, 2007) settings to aid learning and enhance performance. In sporting environments imagery research typically focuses on objective changes in motor skill performance from pre- to post-test in groups of participants who have either physically practiced a skill, practiced a skill using imagery, or taken in a control activity. Such research usually shows that those who practice physically improve most from pre-to post-test, whilst those in the control group show no significant improvement. Those who engage in imagery practice tend to also show significant improvements in performance, although not to the same extent as those who physically practice the skill. This indicates that, relative to no practice at all, engaging in imagery is an effective technique for enhancing performance although it is not an effective substitute for physical practice (Moran, 2012). Interestingly, however, research in sport psychology has begun to look at the effects of combining physical practice with imagery and this has been shown to bring about greater improvements in performance than either physical practice or imagery alone (e.g., Smith, Wright, & Cantwell, 2008; Wright & Smith, 2009). These typical research findings are supported by review articles (e.g., Weinberg, 2008) and meta-analyses (e.g., Driskell, Cooper, & Moran, 1994; Feltz & Landers, 1983) that have examined the effectiveness of imagery in improving sports performance. A particularly interesting finding that emerged from such meta-analyses was that the effectiveness of imagery was mediated by the type of task being performed. Tasks involving cognitive components were found to be more conducive to the beneficial effects of imagery than tasks that were mainly physical in nature (Driskell et al., 1994; Feltz & Landers, 1983). Musicians may therefore obtain particularly strong benefits from performing imagery, as musical performance to a high standard of proficiency involves completion of tasks involving complex cognitive elements (Bernardi, Schories, Jabusch, Colombo, & Altenmuller, 2013), as well as a high degree of accurate motor control (Watson, 2006). Despite this, and the suggestion that musicians regularly engage in imagery as a practice technique (Gregg & Clark, 2007), there have been relatively few empirical investigations into the effectiveness of imagery in improving performance in musical settings.

Imagery as a performance enhancement technique for musicians

One of the first investigations into imagery in musical settings was conducted by Rubin-Rabson (1941) who reported that incorporating imagery alongside physical practice facilitated learning of piano music by memory and resulted in superior performance in subsequent retention tests. Since then several other researchers have demonstrated the benefits of imagery for improving various aspects of musical performance (e.g., Bernardi et al., 2013; Cahn, 2008; Clark & Williamon, 2011; Coffman, 1990; Lim & Lippman, 1991; Ross, 1985; Theiler & Lippman, 1995). For example, Ross (1985) examined the effect of imagery on trombone playing performance in a group of collegiate trombonists. Pre- to post-test improvements in pitch, rhythm and articulation (rated subjectively by an expert blind to experimental condition) were compared between participants who rehearsed through physical practice, imagery (either alone or with simulated movements), or combined physical practice and imagery. Combined physical practice and imagery resulted in greatest performance improvements, suggesting that supplementing physical practice with imagery can be beneficial for musical performance. Further evidence for the efficacy of imagery as a performance enhancing technique in music was provided by Coffman (1990). In this study, Coffman investigated changes in performance speed, and the frequency of pitch and rhythm errors in piano playing after physical practice, imagery, or a combination of the two. All three practice conditions produced significant improvements in performance speed compared to a control group, although imagery alone was less effective than physical practice. Interestingly, however, alternating between physical practice and imagery was as effective as physical practice alone. This indicates that in some cases it may be possible to use imagery to reduce time spent in physical practice (potentially reducing pain or injury associated with repetitive movement or fatigue associated with continual practice), without performance levels being affected.

In a logical extension to music imagery research, Lim and Lippman (1991) investigated the effect of performing imagery alongside an audio recording of the musical piece being imaged. Experienced pianists learnt to perform novel pieces of music through physical practice, imagery whilst listening to an audio recording, or imagery alone. Post-test performances from memory were subjectively rated for note accuracy, rhythmic accuracy, and phrasing and dynamics by two judges. Results revealed that physical practice of the scale produced superior performances than either imagery condition, although for note accuracy and phrasing and dynamics, post-test scores were rated as higher for imagery whilst listening to an audio recording, compared to imagery alone. This indicates that imagery may be particularly beneficial for improving musicians' performances if performed alongside an auditory model of the correct performance. This finding was supported by Theiler and Lippman (1995), who reported that performing imagery alongside an auditory model improved various aspects of performance for both vocalists and guitarists. The study also provided support for the results reported by Coffman (1990), as for guitarists, combined physical practice and imagery was more beneficial than imagery alone, and was equally effective as an equivalent time spent solely engaged in physical practice.

More recently, Cahn (2008) investigated the extent to which the effectiveness of imagery was influenced by task difficulty. Jazz musicians practiced one easy and one difficult instrumental chord progression sequence through physical practice, imagery, or one of two combined imagery and physical practice conditions. One of the combined conditions was predominantly physical practice (two-thirds physical practice, one-third imagery), whilst the other was predominantly imagery practice (two-thirds imagery, one-third physical practice). Results indicated that for the easy musical piece, superior performance (i.e., fewer incorrect notes played) was produced by participants in the two conditions that involved a large amount of imagery practice (imagery alone or two-thirds imagery, one-third physical practice). For the more difficult task, however, performance was better in the two groups that engaged in predominantly physical practice (physical practice alone or two-thirds physical practice, one third imagery), compared to those who engaged in predominantly imagery practice. These results therefore indicate that imagery may be particularly beneficial when learning easier musical tasks, and as such could be particularly effective if implemented by music teachers for beginner musicians (Cahn, 2008).

In another experiment, Clark and Williamon (2011) implemented a comprehensive nine-week mental skills training programme, including imagery training, with a group of university musicians majoring in music performance. Participants were assigned to either a mental skills training group or control group. The mental skills training group received training in imagery, as well as training in a number of other psychological techniques including goal-setting, relaxation techniques, and self-talk. Upon completion of the nine-week training programme, pre- and post-test scores on a number of measures were compared between the two groups. Participants who completed the mental skills training programme reported that the programme had brought about significant improvements in their perceived technical playing proficiency and in the quantity of practice that they completed (as measured by a self-report questionnaire assessing self-perceptions of musical ability). No such perceived changes were reported for the control group. It is important to note that these results indicate only a *perceived* improvement based on self-report measures, as results related to any actual improvements in performance throughout the training programme were not reported. It is also important to point out that although imagery may have contributed to these perceived changes in performance, they cannot solely be attributed to the imagery training as multiple other psychological techniques were also used in the programme. Nevertheless, the results provide an interesting insight into how mental skills training could be beneficial for musicians.

Finally, Bernardi et al. (2013) examined the effects of physical practice and mental practice on performance of a piano piece from memory. In this study participants were free to choose their own mental practice technique, rather than having an imagery technique imposed upon them by the researcher. Mentally hearing the notes was the most common mental practice strategy used by performers, whilst simply visualising the movements was the least common technique. Regardless of the mental practice technique used, mental practice alone resulted in an improved performance on a variety of subjectively rated aspects of performance, although this improvement was less than that produced by physical practice alone. Combined physical and mental practice, however, produced improvements in performance to a level comparable to that for physical practice alone, supporting the findings of previous research (e.g., Coffman, 1990; Ross, 1985; Theiler & Lippman, 1995). It is also important to note that of the different mental practice techniques used by participants, imagery of the correct pitch of the notes was associated with better performance than visual or motor imagery. This adds further support to the findings of Lim and Lippman (1991) and Theiler and Lippman (1995), that auditory imagery may be particularly crucial in musical settings.

Collectively the imagery research that has been conducted in musical settings mirrors that reported in sport and motor skill research. Relative to no practice at all, imagery has been shown to be an effective technique for improving various aspects of music performance (Bernardi et al. 2013; Coffman, 1990). These effects are particularly strong when the imagery is performed alongside an auditory model (Lim & Lippman, 1991; Theiler & Lippman, 1995) or when the imagery is performed in combination with physical practice (Bernardi et al., 2013; Coffman, 1990; Ross, 1985; Theiler & Lippman, 1995). In addition to contributing towards improved performance, imagery may also provide a number of other functions that may be of benefit to musicians. For example, Connolly and Williamon (2004) suggested musicians may obtain a number of benefits from imagery practice, including improved memory of the musical piece, enhanced confidence on stage, and greater control over negative emotions. These suggestions were supported by the work of Gregg, Clark, and Hall (2008) who administered the Functions of Imagery in Music Questionnaire to 159 university-level classical music students. The results indicated that musicians engage in imagery for a number of functions including to increase confidence levels, maintain focus and concentration and manage both physical and mental fatigue. When used by musicians imagery therefore appears to serve a number of useful functions, in addition to performance enhancement.

Although the studies reviewed above clearly illustrate that imagery can be effective in improving musical performance, as with any musical skill, musicians need to practice imagery in order for it to be optimally effective (Clark, Williamon, & Aksentijevic, 2011). Where possible, Clark et al. (2011) recommend that this practice should involve incorporating aural, visual, and kinaesthetic aspects of performance into the imagery process, in order to create a realistic and multi-sensory experience. However, there are few guidelines in the music literature that explain how musicians might best incorporate imagery into their practice regime (Clark et al., 2011). Indeed, participant feedback on the mental skills training programme provided by Clark and Williamon (2011) indicated that more advice and guidance on how to apply mental skills training in their practice would have been beneficial. In relation to imagery, one model for creating realistic imagery experiences that has proven to be successfully in improving performance when applied in sporting settings is the PETTLEP Model (Holmes & Collins, 2001). In the following section, we will outline the PETTLEP model and research that has tested the model in sporting settings, before outlining how it might be best implemented by musicians in order to improve performance. Although the efficacy of the PETTLEP model of imagery has yet to be tested in music environments, we hope that in outlining the model here we will stimulate musicians and researchers to test and apply this model in relation to music.

The PETTLEP model of motor imagery and its application to music

The PETTLEP model was designed by Holmes and Collins (2001) as a set of practical guidelines for sport psychologists to consider when designing imagery interventions. The model was developed to address the gap between theory and practice in the delivery of imagery interventions in sport, and drew upon research from cognitive neuroscience, cognitive psychology and sport psychology (e.g., Hardy & Callow, 1999; Jeannerod, 1994; Lang, 1979) to bridge this gap. When designing the model, the authors were influenced by research from neuroimaging studies that indicated similar neural activity during imagery processes and physical movement preparation and execution (e.g., Decety, 1996; Decety & Grezes, 1999; Jeannerod, 1995; Lotze et al., 1999). This shared neural activity between imagery and motor preparation/execution processes is termed functional equivalence (Holmes & Collins, 2001; Jeannerod, 1994; Moran, 2012). It is this mechanism that may provide an explanation for the beneficial effects of imagery on performance (Ramsey, Cumming, Edwards, Williams, & Brunning, 2010), whereby imagery activates the neural pathways for a skill in a similar way to physically performing that skill, allowing for motor skills to be developed and performance to be improved through imagery (Wakefield, Smith, Moran, & Holmes, 2013). Based partly on this evidence for functional equivalence, Holmes and Collins (2001) formulated the PETTLEP model as a practical guide or checklist to aid the design of effective imagery interventions that would theoretically activate the neural systems involved in physical performance of the imaged action in an optimal manner by making the imagery experience as similar to physical performance as possible. The term PETTLEP is an acronym for seven practical issues (Physical, Environment, Task, Timing, Learning, Emotion, and Perspective) that require consideration when designing imagery interventions. We explain these issues below and highlight their relevance to musicians attempting to use imagery to enhance their performance.

The Physical element refers to the notion that the nature of the imagery experience should resemble motor preparation and execution as closely as possible (Holmes & Collins, 2001). Musicians should therefore take an active involvement in their imagery by attempting to include all the senses and kinaesthetic sensations that would be involved in actual performance. This would involve attempting to create visual images of the instrument being played, whilst also attempting to recreate the haptic sensations associated with playing the instrument, and perhaps crucially, also attempting the hear the sound of the notes or chords being played. To help maximise this experience, Holmes and Collins (2001) recommended that, during their imagery, individuals should hold any implements that they typically use, wear any clothing that they typically wear, and simulate any small movements associated with physical performance. In musical settings the physical element of PETTLEP would involve the musician adopting the same body position he or she uses when physically performing and holding the instrument whilst performing the imagery task. For example, a concert pianist would perform hir or her imagery whilst seated at the piano, wearing the same type of clothing he or she wears to perform, with hands placed on the keys. Similarly, a saxophone player would perform his or her imagery whilst holding the instrument and standing in the same posture adopted for physical performance. Simulating any small movements associated with performance (such as small hand movements or pressing the keys on a saxophone) during the imagery and/or listening to an audio recording of correct performance alongside the imagery may also aid musicians in enhancing the physical aspects of their imagery experience. Interestingly, music imagery studies have shown including these aspects in the imagery experience to be beneficial to performance (e.g., Lim & Lippman, 1991; Ross, 1985; Theiler & Lippman, 1995), whilst sports imagery studies have shown performing imagery in sport-specific clothing and holding relevant equipment to be beneficial to performance (e.g., Smith, Wright, Allsopp, & Westhead, 2007; Wright & Smith, 2009). It is also worth noting that as the key premise of the Physical component is to make the imagery as similar as possible to physical performance, Holmes and Collins also argued that imagery should not be preceded by relaxation activities as commonly advocated in the sport literature (e.g., Suinn, 1976), as this would serve to create a somatic state contrary to the heightened arousal experienced when athletes or musicians typically perform.

The Environment aspect of the PETTLEP model refers to the physical environment in which the imagery is performed. To enhance multi-sensory involvement and make the imagery experience as realistic as possible, the imagery should be performed in an environment that is identical to, or at least closely resembles, the performance environment. Musicians should therefore attempt to practice their imagery in the same location as where they physically perform. For example, an orchestral double bassist would perform his or her imagery whilst seated in the orchestra pit and holding the instrument in order to obtain maximal benefits. Where this is not possible, for example due to high venue hire costs or access to performance venues not being available, Holmes and Collins (2001) suggested that videos or photographs of the performance environment could be used to prime the imagery experience. Although this has not been empirically tested in musical settings, imagery research in sport settings has indicated that greater performance benefits may be obtained when imagery is performed in an environment similar to physical performance, compared to when the imagery is performed in a quiet room away from the performance arena (e.g., Smith et al., 2007; Wright & Smith, 2009).

The Task component of the model relates to the idea that the imaged task should be closely matched to the actual one. For optimal effectiveness the imagery intervention should be specific to the individual, who should be encouraged to focus on the same kinds of thoughts, feelings and actions typically experienced during physical performance. The importance of individualising the imagery experience, rather than using generic scripts for different individuals, is therefore emphasised in this component of the PETTLEP model. Holmes and Collins (2001) illustrate the importance of this component by highlighting differences in the focus of elite and pre-elite performers during movement preparation and execution. As the key premise of the task component is that the imagery experience should be specific to the individual, generic imagery scripts or simple instructions to 'see, feel, and hear yourself playing your instrument' that have been used in previous music imagery studies (e.g., Coffman, 1990; Ross, 1985) would therefore not be recommended based on the PETTLEP model. Instead imagery scripts for musicians should be individualised through a process of 'response training' (Lang, Kozak, Miller, Levin, & McLean, 1980). This process involves having individuals describe their physical performance and encouraging them to provide specific detail on cognitions, behaviours and physiological responses they experience during performance, as well as on the meanings they attach to these experiences. By focusing on the individual's actual responses to physical performance and incorporating the meaning of these responses into the imagery script, it allows a personally meaningful imagery script to be developed, which may provide greater access to the neural pathways that are active during physical performance. For example, if a musician is using imagery to prepare and rehearse for her first major concert then focusing on the meaning and relevance of this event in the imagery, in addition to focusing on the physical movements and sounds, may be beneficial. Research by Smith and Collins (2004) that used electroencephalography to measure event-related potentials during physical performance, response proposition-laden imagery, and stimulus only imagery (i.e., only focusing on the stimuli in the imaged scene) supports this claim. This study demonstrated that the late contingent negative variation (CNV; a low frequency shift in cortical activity that occurs prior to movement and reflects cortical activity involved in movement preparation) was more similar to that obtained during physical performance when participants engaged in response proposition-laden imagery, compared to stimulus only imagery. At a peripheral level, inclusion of response propositions into the imagery script has also been reported to result in increased heart rate (Cumming, Olphin, & Law, 2007) and increased muscular activity (Wilson, Smith, Burden, & Holmes, 2010), compared to imagery containing only stimulus propositions. In another study comparing the performance enhancing effects of response proposition-laden imagery with stimulus only imagery, Smith, Holmes, Whitemore, Collins, and Devonport (2001) found that response proposition-laden imagery produced greater improvements in performance of a simple field hockey task than stimulus only imagery. The results of these experiments therefore indicate that individualising the imagery experience through response training produces neural and physiological activity that is more similar to physical performance and enhances performance to a greater extent than using generic, stimulus only imagery scripts.

The Timing element of the PETTLEP model refers to the speed at which the imagery should be executed. If, as the functional equivalence hypothesis suggests, imagery accesses the same motor representation as physical motor preparation and execution then it is logical that the temporal characteristics of the two processes should be the same (Holmes & Collins, 2001). Performing imagery in real-time, rather than slow- or fast-motion, is therefore advocated in the PETTLEP model. This may be particularly crucial for musicians using imagery, as precise timing is essential for proficient performance. Holmes and Collins (2001) suggested that verbal or written imagery scripts, whereby individuals perform their imagery alongside written or verbal instructions, may be of limited effectiveness as they would likely confound the timing of the imagery experience. This is supported by Smith and Holmes' (2004) research examining the effect of imagery modality on golf putting performance. These authors reported greater performance improvements when imagery was performed alongside an audio or video recording, compared to when a written script was used, with many participants in the written script group reporting problems in controlling the timing of their imagery. The choice of imagery modality is therefore an important consideration when designing imagery interventions. In situations such as music playing in which the temporal nature of the task is important, auditory cues may be useful in guiding the imagery and maintaining temporal control. Both Lim and Lippman (1991) and Theiler and Lippman (1995) indicated that performance improvements were greater when imagery was performed alongside an audio recording of the musical piece being imaged. It is possible that this audio recording serves to assist the musician in keeping the timing of their imagery accurate at the same tempo as physical performance, enhancing the physical aspect of the imagery experience and matching it more closely with physical performance.

According to the Learning aspect of the PETTLEP model the content of an individual's imagery should adapt to reflect changes in skill learning. It is well documented that there are differences in the activity of various regions of the brain responsible for movement between experts and novice musicians. Research using a variety of neuroscientific techniques has shown that, compared to novices, expert musicians exhibit reduced activity in a variety of movement-related brain areas including the primary and supplementary motor cortices, cerebellum and basal ganglia during performance preparation or execution (e.g., Haslinger et al., 2004; Jancke, Shah, & Peters, 2000; Koeneke, Lutz, Wustenberg, & Jancke, 2004; Krings et al., 2000; Wright, Holmes, Di Russo, Loporto, & Smith, 2012a). Evidence exists to suggest that such structural and functional differences are the result of motor skill learning or practice (e.g., Hyde et al., 2009; Pascual-Leone, Dang, Cohen, Brasil-Neto, Cammarota, & Hallett, 1995; Wright, Holmes, Di Russo, Loporto, & Smith, 2012b). As such musicians should refine the content of their imagery as learning progresses, rather than relying on a single imagery routine throughout their development. According to leading motor control theorists (e.g., Fitts & Posner, 1977; Schmidt & Lee, 2011) as individuals learn to perform motor skills through repetition, performance requires less cognitive control and becomes more autonomous. When novices perform motor skills, movement is typically initiated in a cognitively demanding, consciously controlled, step-by-step manner. Experts, in contrast, typically initiate and perform motor skills automatically, in a fluid manner that requires little conscious control. The cognitive processes involved in initiating and controlling physical performance are therefore likely to differ depending on the skill level of the performer, and the imagery experience should reflect these developmental differences. Imagery scripts focusing on the movements required to play an instrument correctly may be more suitable for novice musicians, but as musicians' skill levels develop imagery scripts focusing more on the emotional, rhythmical and temporal aspects of performance may be more appropriate. It is worth noting that the Learning aspect of the PETTLEP model has received little research attention, and so would benefit from further empirical testing.

According to the Emotion aspect of the PETTLEP model, individuals should attempt to recreate the emotions and arousal they typically experience during physical performance when they engage in imagery. Based on suggestions made by Lang (1985), Holmes and Collins (2001) suggested in their PETTLEP model that imagery should focus on the physical and emotional responses felt during performance, as well as on the personal meaning the individual ascribes to the situation. The process of 'response training' can be used elicit these experiences. This process would help to create an individualised and personally meaningful imagery experience for musicians that should produce similar neural and physiological activity to that produced during physical performance. Although Holmes and Collins (2001) encouraged the inclusion of emotional responses during imagery, to date only one study has directly tested the effect of including emotional content on performance. Ramsey et al. (2010) compared the performance of two PETTLEP-based imagery interventions against a control group in a soccer penalty kick task. The two imagery interventions were both based on the PETTLEP model, although one intervention encouraged participants to focus on emotional aspects of their performance whilst the other did not. . Both imagery groups improved performance from pre- to post-test, further demonstrating the benefits of PETTLEP imagery, although there were no between group differences in performance. Although this indicates that focusing on the emotional aspects of performance during imagery did not facilitate performance, the study was limited by only testing participants in practice, rather than competitive, situations. In addition, the imagery scripts used in the study were generic ones rather than being individually tailored as per the PETTLEP guidelines. Further research is therefore required to examine the possible benefits of including emotional content in imagery, and this may prove especially fruitful in musical settings given the importance of emotion in high-level music performance. For musicians including emotional content in their imagery may involve attempting to imagine feelings of excitement or confidence prior to performance, or feelings of heightened arousal such as butterflies in the stomach or increased heart rate that have previously been associated with their successful performances. Individuals should however take care in ensuring they focus on positive emotions that are interpreted as being facilitative to performance, as Smith et al. (2008) have argued that a focus on negative emotions during imagery may be detrimental to performance. In addition, as the authors of the PETTLEP model argue that effective imagery should include a focus on emotions and arousal typically experienced during physical performance, the notion of completing relaxation activities prior to engaging in imagery (e.g., Suinn, 1976), should again be questioned.

The final element that requires consideration when designing imagery interventions according to the PETTLEP model is that of Perspective. Imagery can be performed from either a first-person perspective (1PP; i.e., individuals view themselves performing through their own eyes) or a third-person perspective (3PP; i.e., individuals view themselves performing from the viewpoint of someone else, as if seeing themselves performing on a video). Holmes and Collins (2001) argued that a 1PP should generally be used as this viewpoint most closely resembles that which the individual experiences during physical performance. Use of a 1PP should therefore provide a more realistic imagery experience. Despite the argument that the use of a 1PP would be most beneficial, the optimal perspective may depend on the type of task being imaged. Hardy and Callow (1999) reported that a 3PP was more effective than a 1PP in enhancing performance in a number of sporting tasks in which the form or technique of the movement is particularly important (e.g., karate, gymnastics, and rock climbing). These authors proposed that the use of a 3PP may have been particularly beneficial as it allowed the participants to ‘see’ the precise positions and movements that are required for successful physical performance. It is therefore possible that the optimal imagery perspective for musicians may depend on the instrument the musician plays. For example, a pianist may benefit from a 1PP as this view point would be identical to physical performance and would also provide a suitable position for the musician to image the accurate movements of the fingers as they play the notes. For other instruments such as the flute, saxophone, or violin, where it may be difficult to see the required hand movements due to the positioning of the instrument and hands, a 3PP may be more beneficial. Interestingly, there is limited evidence from sport science research that switching between first- and third-person imagery perspectives may be more effective than adhering to one perspective or the other (Smith, Collins, & Hale, 1998). Further research is needed to investigate this effect in music, but from the data available it is possible to speculate that using a combination of first- and third-person perspectives and encouraging musicians to switch between these may produce optimal performance benefits. Psychologists or teachers wishing to employ PETTLEP with musicians should also pay close attention to the preferences of the individual, as this may also be a crucial mediator of the effectiveness of the different perspectives (Wakefield & Smith, 2012).

Practical considerations related to PETTLEP

In addition to the seven issues (Physical, Environment, Task, Timing, Learning, Emotion, and Perspective) highlighted in the original PETTLEP model, there are a number of other factors that those designing or implementing PETTLEP-based imagery interventions in musical settings may wish to consider. Two important issues relate to the duration of the intervention period and the frequency with which the imagery should be performed. With the exception of the study by Clark and Williamon (2011), many of the experiments that have investigated the effects of imagery on music performance have typically been of short duration, with participants often completing the pre-test, intervention, and post-test in a single testing session and often engaging in between only 3 – 15 minutes of imagery practice in the whole experiment (e.g., Cahn, 2008; Coffman, 1990; Theiler & Lippman, 1995). Although these experiments have reported positive results the duration of the imagery experience may not have been optimal. As part of their meta-analysis examining the effects of imagery on performance, Driskell et al. (1994) investigated the extent to which imagery duration influenced performance. Based on the results of a regression analysis, the authors recommended a practical guideline of 20 minutes being the optimal duration for imagery interventions. However, research by Wright and Smith (2007) has shown that for a cognitive computer game task, 45 minutes of PETTLEP-based imagery immediately prior to performance resulted in a positive performance effect. As such, 20-45 minutes practice of PETTLEP-based imagery immediately prior to performance could serve as a useful warm up technique and may result in improved performance. In relation to the issue of frequency of imagery practice, Wakefield and Smith (2009) investigated the effect of manipulating the frequency of PETTLEP imagery practice on netball shooting performance. They reported that PETTLEP imagery was only effective in improving performance if practiced three times per week, with less frequent interventions failing to produce positive effects. It is therefore possible that the beneficial effects of imagery on performance may be even more pronounced if imagery is conducted in 20-45 minutes blocks (Driskell et al., 1994; Wright & Smith, 2007), with interventions being implemented at least three times per week (Wakefield & Smith, 2009), ideally for a period of around 5-6 weeks (e.g., Smith et al., 2007; Smith et al., 2008). We encourage researchers to test these suggestions in musical settings.

Another issue to consider when designing imagery interventions based on the PETTLEP model relates to the integration of imagery and physical practice. Several studies have found PETTLEP imagery to be equally as effective as physical practice in improving performance over a six-week period in sport settings (e.g., Smith et al., 2007). Although this clearly highlights the benefits of PETTLEP-based imagery, such large performance improvements in the absence of physical practice may be the result of increased motivation brought on by the implementation of a novel training technique (Wakefield et al., 2013). It is unlikely that this effect would be sustained in the long-term. As such it should be stressed that PETTLEP imagery should not be seen as an alternative to physical practice, but should be used by musicians alongside their physical practice as an additional training aid. Indeed, research has shown that a combination of physical practice and PETTLEP imagery typically produces greater performance improvements than when either practice method is used alone (e.g., Smith et al., 2008; Wright and Smith, 2007). This finding has also been reported in previous music studies using more traditional imagery interventions (e.g., Bernardi et al., 2013; Coffman, 1990; Ross, 1985; Theiler & Lippman, 1995).

A final point to consider in relation to the PETTLEP model is that the model produced by Holmes and Collins (2001) was only intended as a series of guidelines on practical issues that should be considered when designing imagery interventions. It is not necessarily the case that the more aspects of the PETTLEP model are included, the better performance will be. Instead, the key issue is that the imagery intervention should be individualised through a process of response training and should include those aspects of the PETTLEP model most pertinent to the individual musician (Wakefield & Smith, 2012).

Conclusion

The imagery research that has been conducted in musical settings has tended to show that it is an effective technique for improving aspects of musical performance, particularly if performed alongside an auditory model and in conjunction with physical practice. Despite this, few guidelines exist within the music literature regarding how musicians could incorporate imagery into their practice (Clark et al., 2011). The PETTLEP model was developed as a guide for sport psychology practitioners to use when designing imagery interventions. There is considerable empirical support for the efficacy of the PETTLEP model when applied in sporting settings (e.g., Smith et al., 2007; Smith et al., 2008; Wrigh & Smith, 2009), although its efficacy for musicians remains to be tested. We hope that by outlining the model in detail in this article, we will encourage researchers and musicians to begin to test and apply the model in music settings with the aim of improving performance.

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