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Impact of Differing Frequencies of PETTLEP Imagery on Netball Shooting Performance

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Impact of Differing Frequencies of PETTLEP Imagery on Netball Shooting Performance*

Caroline J. Wakefield and Dave Smith

Abstract

This study examined the effects of differing frequencies of PETTLEP imagery on netball shooting performance. Thirty-two female participants were divided into four groups: PETTLEP imagery once per week (1x/wk), PETTLEP imagery twice per week (2x/wk), PETTLEP imagery three times per week (3x/wk) and a control. During the pre-test and post-test participants were required to complete a total of twenty shots from five different points within the shooting zone. They were awarded points (out of five) for each shot, giving a possible total of 100 points. The numbers of shots scored was also recorded. Following the pre-test, the imagery participants imaged the twenty shots the required number of times per week. The control group completed some netball specific stretching. Transfer tests were also completed to assess the transferability of the intervention to related tasks. Group x test ANOVAs for performance score and shots scored revealed a significant interaction effect ($p<.01$). Tukey tests revealed that the 3x/wk imagery group improved performance on both measures, whereas the 2x/wk, 1x/wk and control group did not. These results support the notion that PETTLEP imagery may be more effective if completed at least three times per week.

KEYWORDS: imagery, PETTLEP, netball, shooting, frequency

*Caroline Wakefield was formerly known as Caroline Wright.

Imagery is one of the most widely-researched topics in sport psychology (Smith & Wright, 2008), and during the past two decades we have begun to understand much about how imagery works and how best to apply it to enhance performance. Of particular interest in recent years have been the findings from the field of neuroscience, where it has been well established that imagery and physical performance share some common neural mechanisms, a phenomenon termed 'functional equivalence' (Jeannerod, 1997). Drawing on this line of research, as well as findings from cognitive psychology and sport psychology, Holmes and Collins (2001) developed the PETTLEP model (*P*hysical, *E*nvironment, *T*ask, *T*iming, *L*earning, *E*motion and *P*erspective), which provides practical guidelines to enhance the effectiveness of imagery interventions. For brevity, we refer readers to Holmes and Collins (2002), Smith, Wright, Allsopp and Westhead (2007) and Smith, Wright and Cantwell (2008) for a detailed description of the different components of the model and their practical applications. Initial studies are strongly supportive of the model. For example, Smith et al. (2007) found that a greater performance increase was apparent in hockey and gymnastics tasks when more components of the model were included. Smith et al. (2008) produced similar findings using a golf bunker shot task. Wright and Smith (2006) found that PETTLEP imagery interventions produced greater improvements in computer game performance than more traditional imagery methods.

Whilst the above studies clearly show that PETTLEP imagery can have powerful effects on motor performance, it is still unclear how much PETTLEP imagery is required to produce optimal results. Blair, Hall and Leyshon noted over a decade ago that "we can offer few specific answers to such basic questions as when, where, how and how often should athletes be encouraged to use imagery" (1993, p.95). The development of the PETTLEP model, and the related research, is beginning to answer the specifics of when, where and how imagery should be performed, but the quantity of imagery required to have a positive effect on performance is yet to be investigated. Therefore, this is the aim of the present study: to test the effects of different frequencies of PETTLEP imagery on a specific motor task. In line with the notion of deliberate imagery practice (Cumming & Hall, 2002), we hypothesise that the more frequent the imagery intervention, the greater the performance improvement will be.

Method

Participants

32 female university students were recruited (mean age = 20.00, SD = 2.00) following approval by the University's Research Ethics Committee. None of them

had previously received imagery training or competed in netball competitions. All participants provided informed written consent prior to participation.

Measures

Movement Imagery Questionnaire – Revised (MIQ-R; Hall & Martin, 1997).
The MIQ-R is an eight-item inventory that assesses an individual's ability to perform visual and kinaesthetic imagery. Participants are required to read through each statement and perform the movement described. Then they must image the movement, with an emphasis on either the visual or kinaesthetic modality. The participants then rate the ease or difficulty of imaging the movement on a 7-point Likert scale ranging from 1 (very hard to see/feel) to 7 (very easy to see/feel). The MIQ-R has been found to have acceptable concurrent validity when correlated with its earlier version, the MIQ, with r values of -.77, -.77 and -.87 for the visual subscale, kinaesthetic subscale, and overall score respectively (Hall & Martin, 1997). The negative correlation is due to a reversal in the scale since, in the original MIQ, the higher the rating, the harder a movement was to imagine for the respondent. Participants scoring lower than 16 (the mid-point, indicating moderate imagery ability) on either MIQ-R subscale would have been excluded from the studies due to an apparent lack of ability to image, as per the procedure in previously published imagery research (Smith & Collins, 2004; Smith, Collins & Holmes, 2003). However, no participants scored under 16.

Task

The participants completed the MIQ-R to assess their imagery ability. They were randomly assigned to one of four groups, each consisting of eight participants: Once per week group (1x/wk), twice per week (2x/wk), three times per week (3x/wk) or a control group.

Prior to the administration of the intervention, a pre-test was carried out. Participants completed a warm-up consisting of a five practice shots. They then completed twenty attempts at the shooting task (four shots from five different points), which were scored using a points system (Missing the net = 0 points, Hitting the ring = 2 points, Scoring with the ring being hit = 5 points). Using different angles increased ecological validity, and an international level player confirmed the distances and angles as being appropriate. The height of the ring was 3.05 metres throughout the study, as this is the height of a regulation netball post (See Figure 1. for a diagrammatical representation of the task). The points from each of the twenty attempts were added together to form the pre-test performance score, with a maximum possible score of 100. The number of shots scored was also recorded (outcome score).

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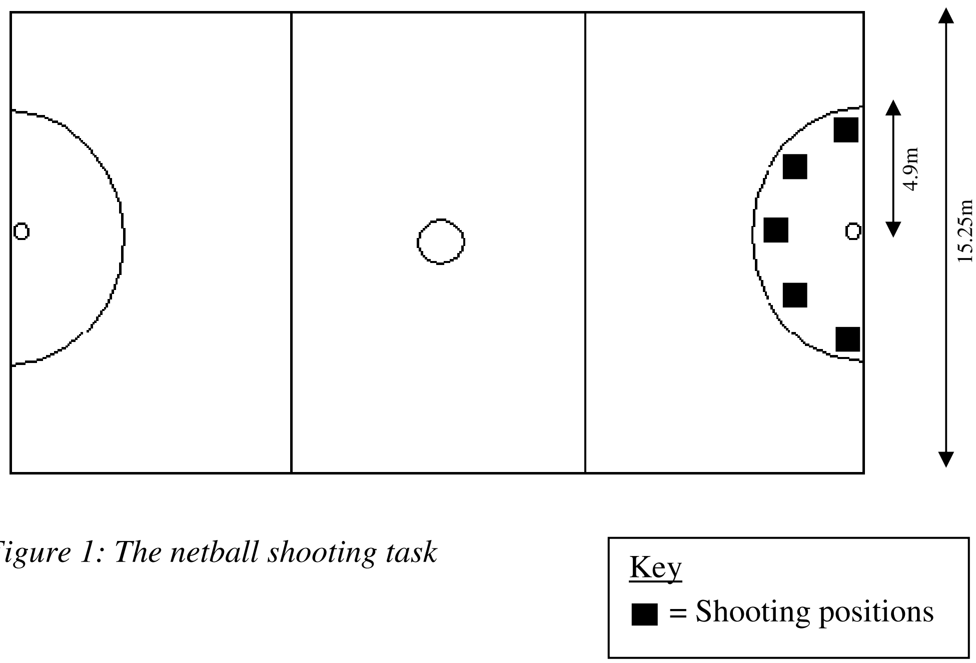

Figure 1: The netball shooting task

All participants were made aware of the scoring system prior to the testing. Immediately after both the pre-test and the post-test, the participants had a short rest. They then completed another two sets of twenty shots at the target, with different conditions imposed, as transfer tests. These were included to test whether any changes in performance would generalise to different shooting situations. These were person pressure and time pressure. The first transfer test involved a defender who stood in front of the participants with one arm up as they were shooting (marked shot). This allowed person pressure to be added. In the second transfer test, the ball was passed into the participants (passed shot). As per the rules of the game, they were then given three seconds to line up their shots and shoot. They completed twenty shots in each of these conditions: four from each of the five markers. Assessing the transferability of the intervention was essential as, within an invasion game situation, it is unlikely that a specific skill will be carried out continuously in the same manner. Therefore, an improvement in that skill alone is unlikely to be very useful to players, unless it generalises to other similar skills. These tests were also advised by a player with international playing experience in order to ensure that they were more difficult to complete and ecologically valid.

Participants performed their intervention for four weeks, with each session consisting of twenty imaged shots at the target, four from each of the five different angles, with a short break in between each shot. After the four weeks of interventions the post-test, which was identical to the pre-test, was completed. Manipulation checks took place in the form of brief interviews, conducted after the experiment by the experimenter to ensure that the imagery instructions were followed correctly and to assess any difficulties that may have occurred during the interventions. Forms were kept by the control group that they signed each time they performed their stretching to monitor adherence. However, this was not necessary for the PETTLEP imagery groups, as the participants completed their interventions with the experimenter present. Any problems with the imagery were discussed at the intervention sessions.

Interventions

Following the pre-test, the imagery interventions were introduced to the participants. All of the imagery groups were given response training (cf. Lang, Kozak, Miller, Levin & McLean, 1980). The imagery groups performed their imagery in line with the PETTLEP guidelines (Holmes & Collins, 2001). This involved completing the imagery on the netball court (Environment), holding the netball (Physical) and imaging the specific task (Task), incorporating the kinaesthetic sensations felt in the pre-test. Participants were instructed to image from an internal perspective (Perspective), in real time (Timing), and include any emotions that they experienced in the pre-test (Emotion). They were instructed to image themselves performing twenty shots at the net, with a short rest in between. This was completed once, twice or three times per week. The transfer tests were not imaged at any point in the study. The control group completed a placebo task of netball related stretching exercises twice per week. On conclusion of the study, control participants were offered the chance to have personalised imagery training if they wished.

Results

Self-report data

One-way ANOVAs were performed on the MIQ-R data. These revealed no significant between-group differences in MIQ-R visual F (2, 23) = .429, p>.05 and kinaesthetic subscale scores, F (2, 23) = 3.21, p>.05. Therefore, participants assigned to the groups did not differ in visual and kinaesthetic imagery ability scores. In the post-test interviews, all participants reported that they had performed their intervention as instructed.

Most participants in the imagery groups stated that they believed that the imagery had been beneficial in aiding the shooting task. However, the participants

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in the 3x/wk group reported the most positive thoughts about the usefulness of the imagery and responses included items such as "I found the straight shot to be more successful in the post-test because I was more confident with it because of the imagery" and "I think I improved most at the marking condition because it was exactly the same action as the imagery, but was also realistic". The imagery diaries indicated that all the control group participants adhered to the stretching programme (missing no more than one session over the four weeks) and no major problems were reported with completion of the imagery intervention.

Performance data

As can be seen in Figure 2, the mean points scored (out of 100) was higher in the three imagery groups in the post-test than in the pre-test. This was not true of the control group, who showed little change in their performance. A repeated measures ANOVA revealed a significant group x test effect, F (3, 28) = 7.84, p<.01. Tukey HSD follow-up tests showed that the 3x/wk group improved significantly from pre-test to post-test (p<.01) whereas the 2x/wk group, the 1x/wk group and the control group did not (p>.05). Effect sizes (d) for the performance scores of the 1x/wk group and 2x/wk group and 3x/wk group were .84, .71 and 1.82 respectively. The control group had an effect size of –0.03.

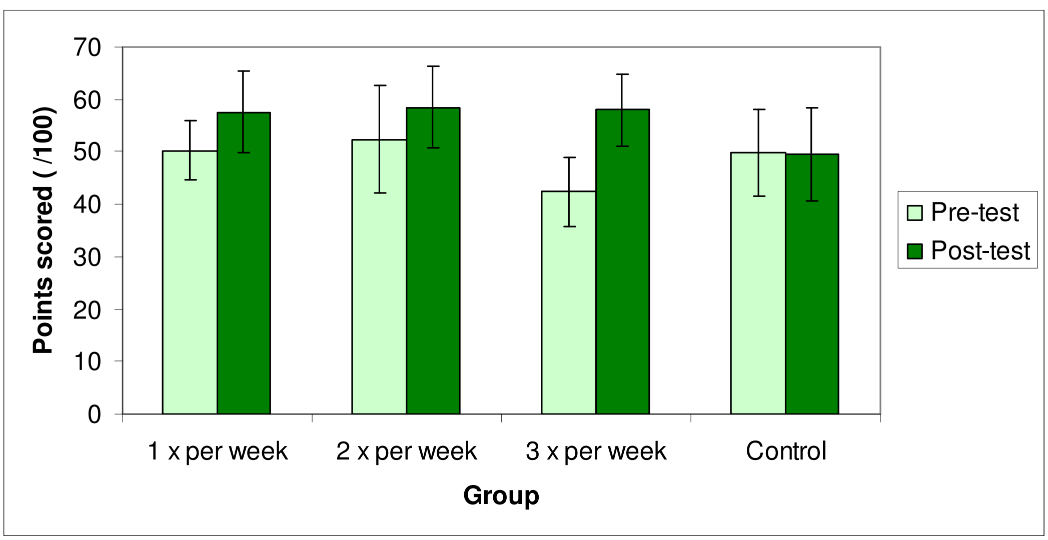

Figure 2: Pre- and post- test mean performance scores

With regard to the outcome score, a repeated measures ANOVA also revealed a significant group x test effect, F (3, 28) = 7.84, p<.01. Tukey HSD tests showed that the 3x/wk group scored significantly higher in the post-test than in the pre-test ($p<.01$). This was not true of the 1x/wk group, 2x/wk group and the control group ($p>.05$) (See Figure 3). Effect sizes (*d*) for the number of shots scored on the straight shot condition for the 1x/wk group, 2x/wk group and 3x/wk group were .88, .49 and 1.43 respectively. The effect size for the control group was .16.

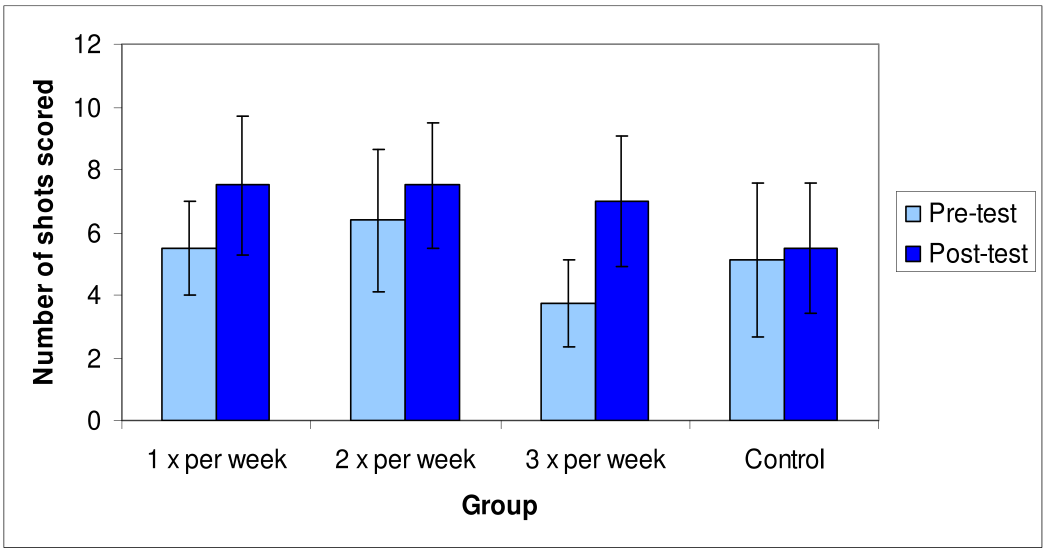

Figure 3: Pre- and post- test mean scores for number of shots scored

Marked shot

On the marked shot, a repeated measures ANOVA revealed a significant group x test effect, F (3, 28) = 4.50, $p<.05$. Tukey HSD follow-up tests showed that the 3x/wk and 2x/wk group improved significantly from pre-test to post-test ($p<.05$) (See Figure 4). However, there was no significant difference in the magnitude of their improvements ($p>.05$). The 1x/wk group and control group did not improve significantly from pre-test to post-test ($p>.05$). Effect sizes (*d*) for the performance score on the marked shot condition for the 1x/wk group, 2x/wk group and 3x/wk group were .37, 1.55 and 1.20 respectively. The effect size for the control group was .13.

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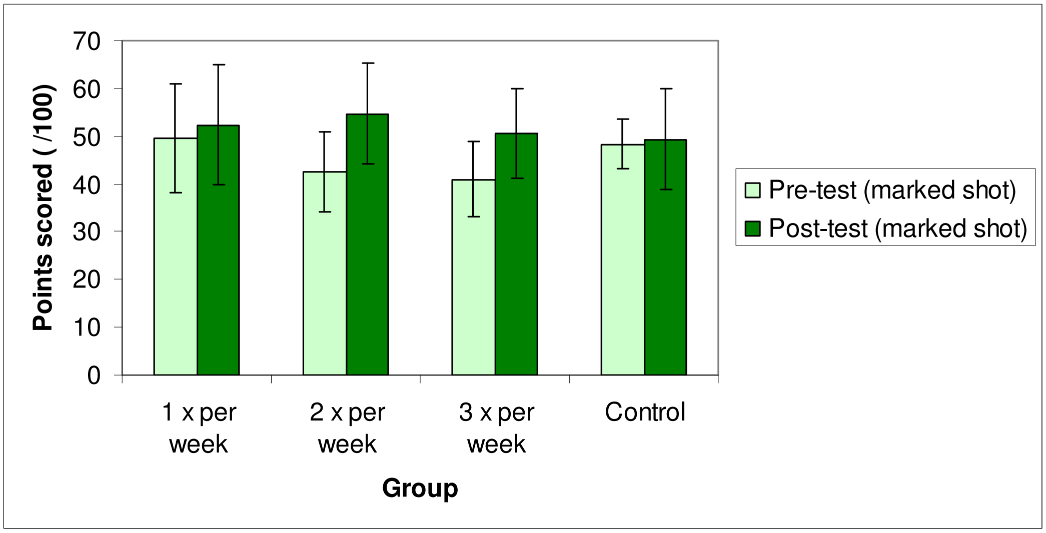

Figure 4: Pre- and post-test mean performance scores in the marked shot condition

When focussing on the number of shots scored on the marked condition, a repeated measures ANOVA revealed a significant effect for time, $F(1,28) = 9.83$, $p<.01$. However, there was no significant group x test effect, $F(3,28) = 1.94$, $p>.01$ (See Figure 5). Effect sizes (d) for the number of shots scored on the marked shot condition for the 1x/wk group, 2x/wk group and 3x/wk group were .35, 1.24 and 1.10 respectively. The effect size for the control group was 0.00.

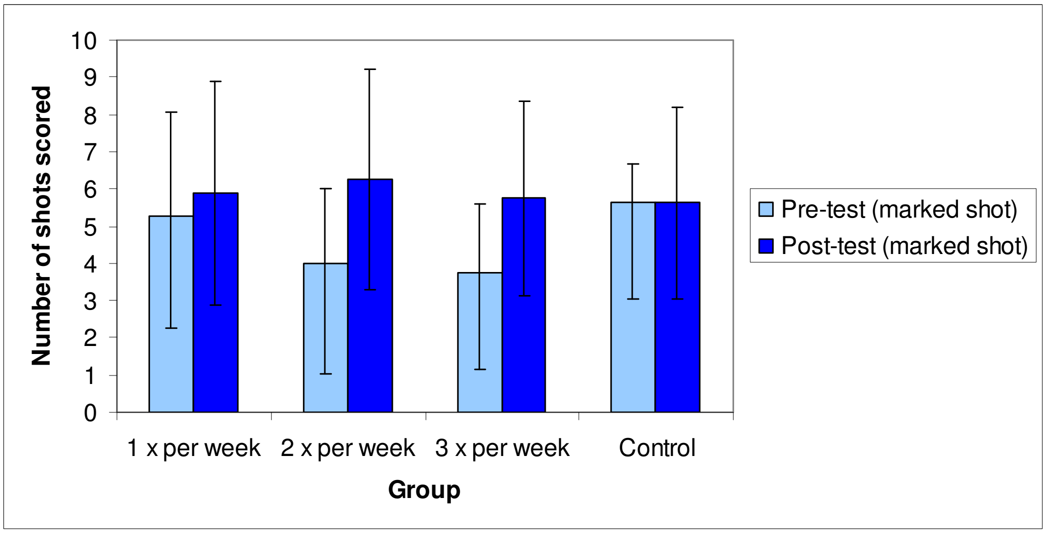

Figure 5: Pre- and post-test mean scores for number of shots scored in the marked shot condition

Passed shot

As can be seen in Figure 6, on the performance score of the passed shot condition, a repeated measures ANOVA revealed a significant group x test effect, $F(3,28) = 3.88$, $p<.05$. Tukey HSD follow-up tests showed no significant between-group differences ($p>.05$). However, between group post-test differences were found ($p<.05$). The 3x/wk group and 2x/wk group scored significantly higher in the post-test compared to the pre-test. Additionally, there was no significant difference in the magnitude of their improvements ($p>.05$). The 1x/wk group and the control group did not improve from pre-test to post-test ($p>.05$).

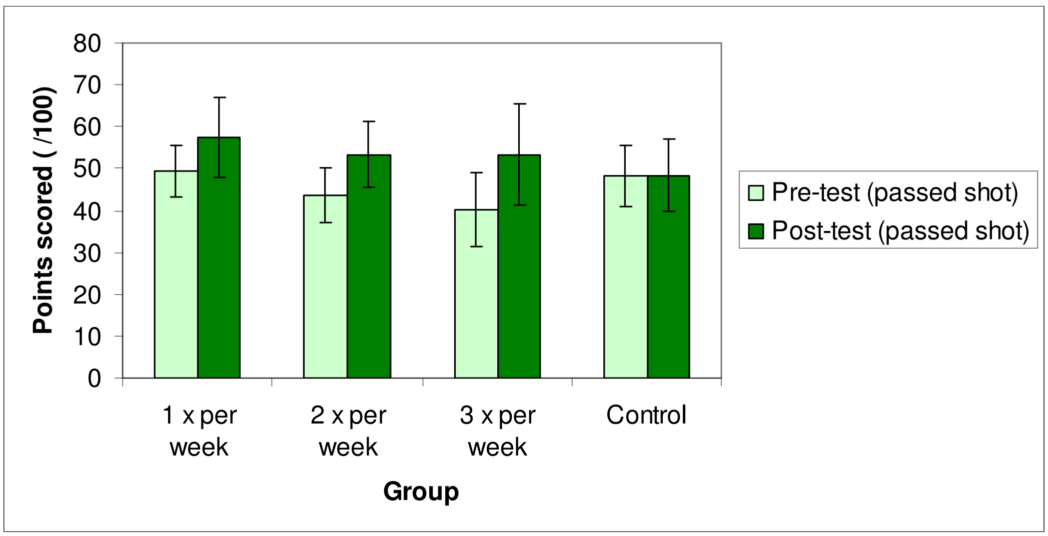

Figure 6: Pre- and post-test mean performance scores in the passed shot condition

Effect sizes (*d*) for the performance score on the passed shot condition for the 1x/wk group, 2x/wk group and 3x/wk group were 1.00, 1.22 and 1.66 respectively. The effect size for the control group was .03.

With regard to the number of shots scored, a repeated measures ANOVA showed a significant effect for time, $F(1,28) = 32.325$, $p<.001$. Only marginally non-significant between-group post-test differences were revealed, $F(3, 28) = 2.85$, $p=.055$. Due to the result being marginal, Tukey HSD tests were still conducted, as we concur with the many statisticians who believe that the arbitrary *p*-value is over emphasised in data analysis (cf. Abelson, 1997). These post-hoc tests revealed that the 3x/wk group improved significantly from pre-test to post-test ($p<.01$), as did the 2x/wk and 1x/wk groups ($p<.05$). However, the control group did not show an improvement from pre-test to post-test ($p>.05$).

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Additionally, there were no significant differences in the magnitude of improvements exhibited by the three imagery groups (p>.05; see Figure 7).

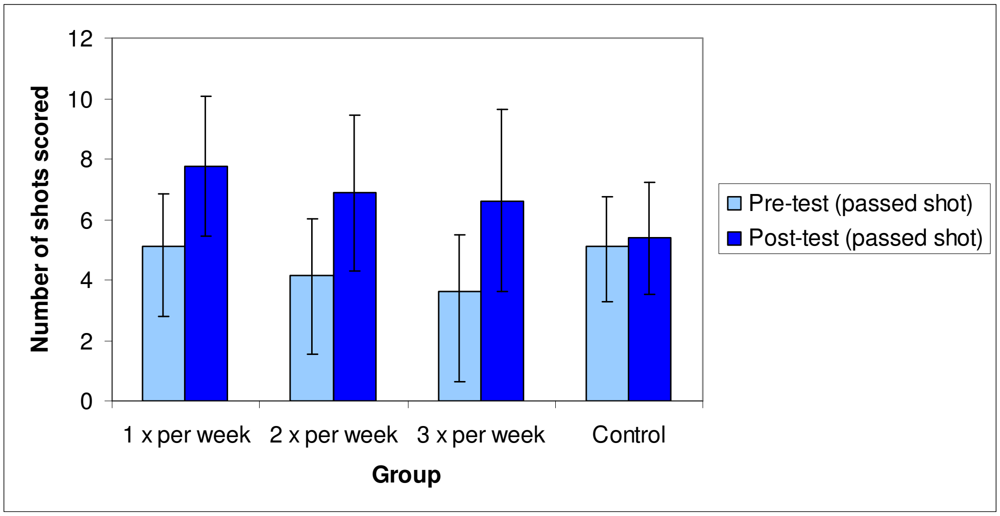

Figure 7: Pre- and post-test mean scores for number of shots scored in the passed shot condition

Effect sizes (*d*) for the number of shots scored on the passed shot condition for the 1x/wk group, 2x/wk group and 3x/wk group were 1.49, 1.56 and 1.70 respectively. The effect size for the control group was .14.

Discussion

The results of this study partially supported the first hypothesis. The largest improvement in the straight shot condition was exhibited by the 3x/wk group. This was not surprising as it seems logical that imagery completed more frequently would result in the largest performance increase, in line with the concept of deliberate practice (Cumming & Hall, 2002). However, the 1x/wk group and 2x/wk group did not show an improvement in performance. With regard to the outcome score (used as an indication of the effect that it may have in a match situation), the 3x/wk group showed an 86.66% increase in number of shots scored and this improvement was significant. This is a large improvement for a four-week intervention period, producing a large effect size of 1.43, and highlights the effectiveness of PETTLEP-based interventions.

The second hypothesis was not supported. The 3x/wk group did improve significantly from pre-test to post-test, but the 2x/wk and 1x/wk groups did not. Therefore, the 3x/wk imagery group was the only group to improve from pre-test to post-test on the performance score. This is surprising as, in previous research, studies have administered smaller doses of imagery and found it to be effective (Blair et al., 1993; Smith & Holmes, 2004). This performance score was taken as a measure of consistency as, by gaining a higher score, it indicated that participants were improving their aim at the target. This was also true of the number of shots scored, with only the 3x/wk group improving from pre-test to post-test. This indicates that performers need to complete PETTLEP imagery at least three times per week in order to significantly improve on this task. However, it remains unclear whether adding further imagery sessions would lead to a larger performance improvement, or whether a plateau would be apparent. This is an area that warrants future research both within netball and other types of sporting and non-sporting tasks.

One of the secondary aims of the present study was to assess the effectiveness of the PETTLEP imagery interventions in enhancing performance in more game-like situations, including adding person pressure and time pressure to the task. On the marked shot condition (person pressure) the 2x/wk group and 3x/wk group showed significant increases in performance score, whereas the 1x/wk group and control groups did not. This indicates that completing imagery twice or three times per week over a four week period can improve the consistency of performance (i.e. the shots getting closer to the ring). On the outcome score in the marked condition, no significant differences were apparent between the improvements of the groups, indicating that, although non-specific imagery can aid the consistency of performance, it does not have an effect on actual number of shots scored over a four-week intervention period as all of the intervention groups improved to the same degree. However, given that they were clearly improving, more practice time may have translated into an improvement in shots scored. Future investigation of this issue would be useful.

On the passed shot condition (time pressure) the 3x/wk group improved significantly from pre-test to post-test, as did the 2x/wk group. This was not true of the 1x/wk group and control group. This indicates that PETTLEP imagery of a slightly different task can improve the consistency of performance (e.g. number of points scored) as long as it is performed twice or three times per week. Further performance increases may have been seen with groups completing their imagery 4x/wk and 5x/wk, and this could be examined in future research. With regard to the outcome score, all three imagery groups improved significantly from pre-test to post-test, whereas the control group did not. Additionally, there were no significant differences in the magnitude of improvements exhibited by the three imagery groups. This indicates that, whilst needing to complete imagery more than once per week to improve performance score, completing imagery once per week may be enough to have a beneficial effect on shots scored; thus influencing match results. This indicates just how powerful a performance-enhancing

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technique imagery is: Just one session of imagery per week can have a performance-enhancing effect on this task.

The transfer tests indicate that the performance-enhancing effects of PETTLEP imagery seem to be transferable to more game-like situations. In both of the transfer tasks, the skill remained essentially the same, and the environment was manipulated. It is, therefore, important to image the skill specifically, as endorsed by the PETTLEP model, but it may be that this imagery will then aid with variations of the same skill. This issue of transferability is an area that warrants in-depth further research.

A point to note is that the significant effects may have been caused by imagery frequency rather than amount of imagery conducted. That is, completing the imagery more frequently may have produced the greater effect on performance than increasing the amount of imagery completed. For example, it may be that the 3x/wk group showed the most positive results because they attended three times per week (imaging sixty shots per week). However, these results may have also been achieved by having a group complete the same amount of imagery (imaging sixty shots) but on one occasion per week. This would give an indication of whether volume or frequency is the key factor. Further research on the dose-response relationship within netball could focus on this issue.

Developments of the study could include incorporating a 4 x per week imagery group and a 5 x per week imagery group. This would allow us to determine whether the trend continues with a greater frequency of imagery. Generally, future PETTLEP research focussing further on the relationship between amount of imagery completed and subsequent performance effects, but with different and varied tasks, would be a useful addition to the literature.

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