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ARTICLE

The Effect of PETTLEP Imagery in a Pre-Shot Routine on Full Swing Golf Shot Accuracy: A Single Subject Design

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Imagery has been shown to be an effective tool for enhancing performance in a variety of sports, specifically in golf. The purpose of this study was to investigate the effect of a PETTLEP imagery intervention, implemented into a pre-shot routine, on a full swing golf shot. A single subjects design was used with three conditions: imagery before pre-shot routine, imagery after pre-shot routine, and withdrawal from intervention. A control condition was included for comparison with illuminate the possible effects of practice. Participants were nine undergraduate volunteers with an average age of 19.3 years and an average golf score of 82.1. Three sets of data were recorded: total score, balls in A1 (the closest area), and balls in A5 (outside of the grid). When comparing control means: the intervention phase (M = 29.15) decreased in total score from baseline (M = 33.85), and withdrawal (M = 33.8). All imagery participants improved from baseline (M = 42.25) to intervention (M= 48.1), to withdrawal (M= 47.75). There was no apparent difference in imagery time, before or after the pre-shot routine. Implications from this study may benefit golfers and sport psychology consultants working with golfers.

Keywords: PETTLEP, imagery, golf

According to Vealey and Greenleaf (2006), imagery is "the use of all the senses to re-create or create an experience in the mind" (p. 307). Imagery is one of the most popular mental training techniques used by athletes (Morris, Spittle, & Watt, 2005). During the 1984 Olympic Games, 99% of the 235 Canadian athletes reported using imagery in some capacity (Orlick & Partington, 1988). Current literature shows imagery to be an effective tool for enhancing performance in a variety of sports including basketball free throw shooting (Kearns & Crossman, 1992), pitching accuracy (Nelson, Czech, Joyner, Munkasy, & Lachowetz, 2008), tennis serving (Coelho, de Campos, da Silva, Okazaki, & Keller, 2007), and figure skating (Rodgers, Hall, & Buckolz, 1991). Research also suggests that imagery is an appropriate psychological skill for positively influencing golf performance

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(Nicholls & Polman, 2005). The previously listed variety of sports can each be classified into closed skilled or open skilled sports.

A closed skilled sport is defined as the self-paced skill execution in a static environment (Arvinen-Barrow et al., 2007). Imagery has been found to be effective when applied within closed skilled sports like tennis (Coelho et al., 2007). For example, Coelho et al. (2007) investigated the use of imagery on both closed and open skills within the game of tennis. The tennis serve was chosen as the closed skill task and the service return as the open skill task. The imagery group performed significantly better on the closed skill task than the control group. Based on previous research, it can be anticipated that the golf swing, a closed skill, could be positively influenced by an imagery intervention.

Several studies have found imagery to be effective when applied to putting in golf (Ploszay, Gentner, Skinner, & Wrisberg, 2006; Thomas & Fogarty, 1997; Woolfork, Parrish, & Murphy, 1985). Woolfolk, Parrish, and Murphy's (1985) study on positive and negative imagery provided a foundation for the effect imagery can have on putting in golf. In a pre- and postputting test, participants who used positive imagery improved 30.4% from pre- to posttest and the negative imagery participants' performance decreased by 21.2% from pre- to posttest. This study demonstrates the power both positive and negative imagery can have on performance.

While most studies within golf have focused on putting, few studies have looked at other types of golf shots. Nicholls and Polman (2005) investigated imagery's effect on golf shot percentage. Participants chose their weakest shot type and then played five rounds of golf in which their weakest area was monitored and recorded. Following the imagery intervention, participants completed four more rounds of golf while the researchers again collected data. Every golfer's shot percentage increased from the preintervention test to the postintervention test.

Although the previously described studies have incorporated various types of imagery, the framework that will guide this study is the PETTLEP model of imagery (Holmes & Collins, 2001). PETTLEP is an acronym for physical, environment, task, timing, learning, emotion, and perspective, which Holmes and Collins suggest are the seven core elements to include in an imagery intervention. The PETTLEP model is based on the principle of functional equivalence, which states that the same neurophysiological processes are used during imagery and physical movement (Jeannerod, 1999). The PETTLEP model adheres to this principle in an attempt to make imagery use as realistic as possible.

The physical element of the model refers to the physical responses within the sport context, dictating that a golfer should be holding a golf club while completing the imagery session. The environment element states that the imager should be in the same environment while using imagery as they would be during the actual completion of the task. The task element is individual to each person as it focuses on the imaged task replicating the actual task or individual's golf swing as closely as possible. The timing component entails that the imagery be used with the precise timing of the actual movements. The golf swing should be imaged in full speed just as it would look during a normal golf swing. Another important aspect to the model is adapting the imagery use to the rate of learning that takes place during the intervention. Through the study, participants will learn more about imagery and their golf swing, and it is important that the imagery be adapted to accommodate for this. Emotion has been referred to as "the missing link" in sports performance

(Botterill, 1997). All of the emotions that the imager feels during competition should be included in the imaging process. The final element of the model, perspective, refers to whether the imager sees the imaged scenario in first person view (internal) or a third person view (external).

Research has found PETTLEP imagery to be more effective than "traditional" forms of imagery (Smith, Wright, Allsopp, & Westhead, 2007). In addition, the PETTLEP imagery model has been suggested to be equally effective as physical practice in research with driving video games (Wright & Smith, 2007) and strength performance (Wright & Smith, 2009). PETTLEP imagery has also been studied within the game of golf. Smith, Wright, and Cantwell (2008) investigated the effect of PETTLEP imagery on golf bunker shot performance. In the study, all groups (i.e., imagery, imagery with physical practice, physical practice, and control) improved significantly from pre- to posttest, while the imagery plus physical practice group improved significantly more than the imagery group, the physical practice group, and the control group.

Despite the abundance of research on imagery, there seem to be several gaps in the research. First, there is little to no research investigating the effect of imagery on a full swing golf shot. Secondly, there is no literature on the best time to use imagery during a pre-shot routine. The first purpose is to investigate the effect a multisensory imagery intervention has on full swing golf shot accuracy. The secondary purpose is to investigate the appropriate time to use imagery during a pre-shot routine for the full swing golf shot.

It is hypothesized that the use of imagery will enhance performance by increasing the total score on an accuracy test, the number of balls hit into the area closest to the hole, and decreasing the number of balls hit into the furthest area from the hole. In addition, it is hypothesized that using imagery after a physical routine will enhance performance more than using no imagery or using imagery before the physical routine.

The imagery after pre-shot routine group is hypothesized to perform better than the imagery before pre-shot routine group based on the recency effect. The recency effect is the natural tendency for the brain to recall information that is most recently presented (Baddeley, 1999). Baddeley's research has participants recall lists of words, and the words on the end of the list are recalled more often than those at the beginning (Baddeley, 1999). In the current study, it is hypothesized that the recency effect will enable participants using imagery after their physical pre-shot routine to have a more powerful image, increasing performance more than the imagery before group.

Method

Participants

Participants were nine undergraduate students from a south eastern university. Advertising was done in the university's physical activity classes and local golf courses. Participants were between 18 and 22 years old with an average age of 19.3. All participants had an average golf score between 73 and 90 with an overall average score of 82.1. Average score was self-reported by the participants. Only golfers with handicaps under 18 were recruited for participation in the study (handicap range 10–17). Interviews were conducted during participant selection in which the

researcher asked each participant to describe what they did before hitting a golf shot. Participants who did not have a pre-shot routine or who used imagery as a part of their pre-shot routine were excluded from the study.

Experimental Design

An ABA (baseline, intervention, withdrawal) single subject design (SSD) was used in this study. This type of design is capable of showing changes in the individual's performance and has been proven useful in applied sport psychology research (Pates, Maynar, & Westbury, 2001). Participants were tested in a baseline phase (minimum of three sessions) until data were stabilized. Barlow and Hersen (1984) recommend a minimum of three data points for a baseline; therefore, baseline data were checked for stability after the third session (week one). Baseline data can be considered stable when 10% or less variation in performance occurs for a single subject (Kearns & Crossman, 1992). Since all participants reached baseline within the third session, the intervention could then be implemented. Following baseline, the intervention phase began and lasted between seven and nine sessions over the course of three weeks. Immediately following the intervention phase, data were measured three times over the course of one week, with the treatment removed.

Instrumentation

Imagery Script. The imagery script that was used as a part of the intervention was developed based on the PETTLEP model (See Appendix). Participants were present at the same place on the driving range where testing was conducted for the imagery session with the proper club in hand (physical and environment). Participants imaged their natural golf swing exactly as it occurs during play (task). The researcher also used response training to help increase the participant's awareness regarding the process of their individual swing. In the response training, each participant was given a notebook to write down as much as they could about how their golf swing looked and felt as they made the full swing necessary for the 120 yard shot used in testing. This exercise is designed to increase the participants' visual and kinesthetic awareness of their full swing used in testing. The participants were instructed to image their golf swing and ball flight in real time from either an internal or external perspective (timing and perspective). It was encouraged to participants that as awareness of their golf swing increased and their comfort with imagery increased, they could adapt their script in their notebook (learning). Finally, any emotions that the athletes mentioned during the response training or interviews were added as part of the script for each participant (emotion).

Accuracy Grid. To measure the accuracy of the shots hit, an accuracy grid was constructed (See Figure 1) (Shivetts, Joyner, Czech, & Zwald, 2007). The grid used in this study was adapted from Brouziyne and Molinaro (2005) in an investigation on imagery use with beginning golfers on a 55 m shot. The grid was divided into five areas. A1 was measured at 10 feet and closer and worth five points. A2 was measured from 10 to 20 feet and worth 4 points. A3 was measured from 20 to 30 feet and worth 3 points. A4 was from 30 to 40 feet and was worth 2 points. Anything hit outside of 40 feet was deemed to be in A5 and worth 1 point. Instruments used to construct the grid included a Bushnell Laser

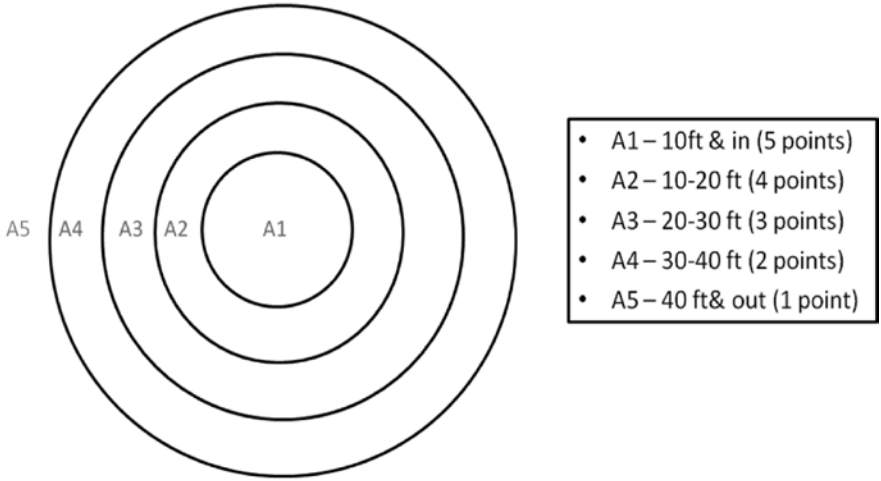

Figure 1 — Accuracy Grid

device to measure the yardage to the target and a basic tape measure to measure the grids on the target green.

Procedures

Once the participants were selected, they were randomly assigned to one of the three following conditions: imagery before shot routine, imagery after shot routine, or the control (no imagery condition). The only difference between the imagery before and imagery after shot routines was the timing of the imagery. Although control groups are not usually required in single-subject design studies, the control group in this study helped indicate whether improvement in scores was simply due to the practice effect.

At the testing site, the researcher reviewed the accuracy test describing the arrangement of the grid and how the scoring system works (outlined in the instrumentation section). Participants' baseline data were then collected during week one. The format for data collection was as follows: 20 shots taken from 120 yards from the hole. All shots were charted by the researcher, but only the best 15 shots were counted.

Once the participants' baseline data were stable, the intervention stage began. During the intervention phase, participants had an introduction session followed by nine data collection sessions over the course of three weeks. Although the time of this intervention was short, similar timeframes have been used successfully in past research (Brouziyne & Molinaro, 2005; Nelson et al., 2008; Ploszay et al., 2006; Shivetts et al., 2007; Woolfork et al., 1985). During the first introductory meeting, the participants using imagery (imagery before shot routine and imagery after shot routine conditions) were given a basic introduction to imagery and its use. They were then guided through the imagery script and any questions regarding the script were answered. Following the meeting, the participants were given time

on the range to use the imagery as part of their pre-shot routine condition. The imagery-before group practiced using PETTLEP immediately before their shot, while the imagery-after group practiced using PETTLEP immediately following their routine and before the shot. Although PETTLEP can be considered a routine in itself, all participants had other pre-shot routines they used as well. The PETTLEP was used in addition to their pre-shot routines. Before leaving the first session, the participants were given a written imagery script. It has been suggested in previous research that audio and video scripts can enhance performance more than written scripts (Smith & Holmes, 2004). With this particular study, audio and video scripts were not practical for use on the golf course. Participants were asked to go over the script for at least 20 minutes per day outside the meetings.

Following the introduction session, the rest of the sessions in the intervention phase consisted of data collection. To start all sessions, participants met to review the imagery routine. During week one (meetings one, two, and three), the researcher reviewed the script several times with the participants. During the second week (meetings four, five, and six), the researcher reviewed the script once and the rest of the time the participants practiced using imagery without the script. During week three, (meetings seven, eight, and nine) the participants used the entire session to review the imagery individually. Following the review and before data collection, the participants were given a 15 minute warm up session on the range. Three meetings per week have been suggested to be the most effective implementation of PETTLEP imagery (Wakefield & Smith, 2009).

During the time of the intervention, control participants met for the same amount of time as the imagery participants. During the introductory session, the control group was given a golf article regarding pre-shot routines. This same article was given to the intervention participants during the introductory session. Following the meeting, control participants were allowed to practice on the range for the same amount of time as the intervention group. Upon leaving the first meeting, participants were given a written copy of the article. They were asked to review the article for 20 minutes per day. The remainder of the sessions following the introductory meeting consisted of data collection. During week one of the intervention (meetings one, two, and three), the researcher reviewed the pre-shot routine article. During week two of the intervention (meetings four, five, and six), the researcher reviewed the article once and allowed the participants the rest of the time to review the article individually. During week three (meetings seven, eight, and nine), the control participants were given the entire session to review individually. Following the review and before data collection, control participants were allowed a 15 minute warm up session on the range.

The withdrawal test was administered the week following the intervention phase of the study. The same format as baseline collection was used. Each participant was given 20 shots from 120 yards from the pin. Each shot was charted and the best 15 shots counted toward data collection. The withdrawal test was conducted three times over the course of seven days.

Data Analysis

For each participant the dependent variables were graphed and analyzed individually using ocular statistics. This method is suggested as appropriate for single subject designs (Hrycaiko & Martin, 1996). Research suggests effects may be present the

sooner the effect occurs following the start of the treatment, the fewer overlapping data points between baseline and treatment, the larger the effect when compared with baseline, or a large number of effects across participants.

Results

A single subjects design was used in this study. This type of design uses visual analysis of graphed data and mean comparisons for data analysis. Each participant was coded using their group name and then a number, i.e., C1 meaning control participant 1, IA1 meaning imagery after participant 1, IB1 meaning imagery before participant 1.

Control Group

Participant C1. Through visual analysis of the data (See Figure 2), total scores for participant C1 slightly decreased throughout the study. When comparing means, the intervention phase (M = 25.4) decreased in total score from baseline (27.0), and withdrawal (M = 23.3) decreased from intervention. Participant C1 showed consistent means throughout all three phases of balls hit into A1 (See Figure 3). Participant C1 showed large fluctuations between sessions throughout the entire study and one slight variance for balls hit into A5 (See Figure 4); yet, the overall means for baseline, intervention, and withdrawal were very similar.

Participant C2. Total score for participant C2 decreased from baseline (M = 40.7) to intervention (M = 32.9), but then increased in the withdrawal phase (M = 44.3) (See Figure 5). Participant C2 saw a minor decrease in balls hit into A1

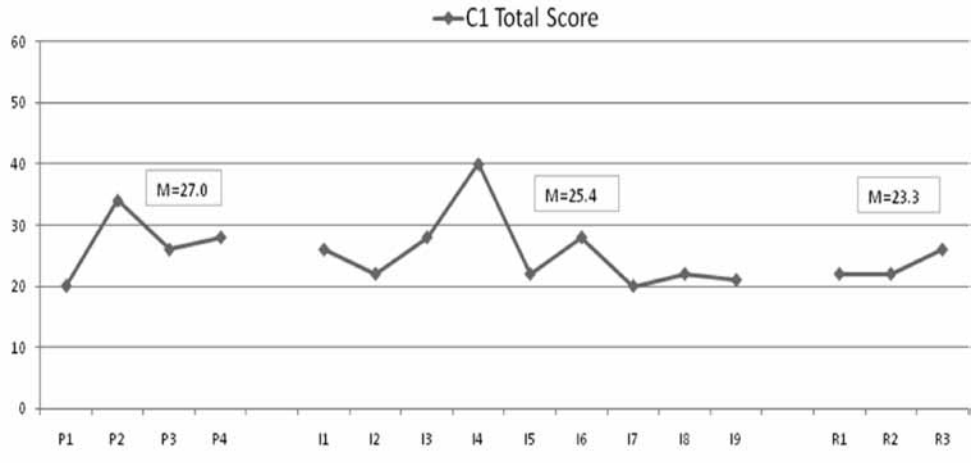

Figure 2 — Participant C1 total score

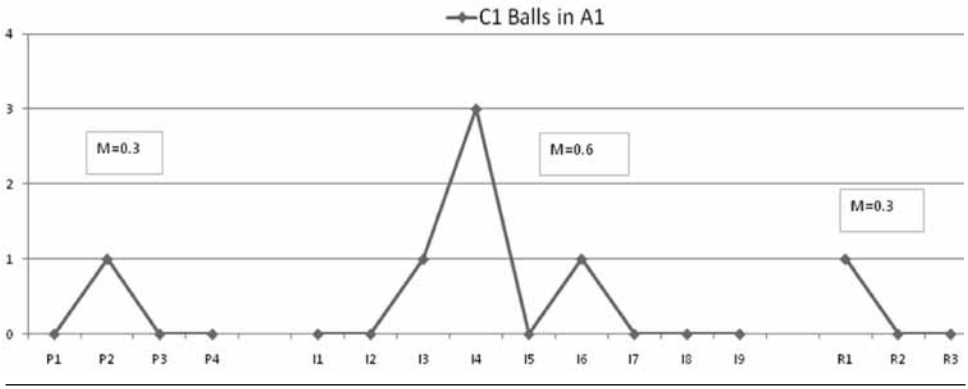

Figure 3 — Participant C1 Balls hit in A1

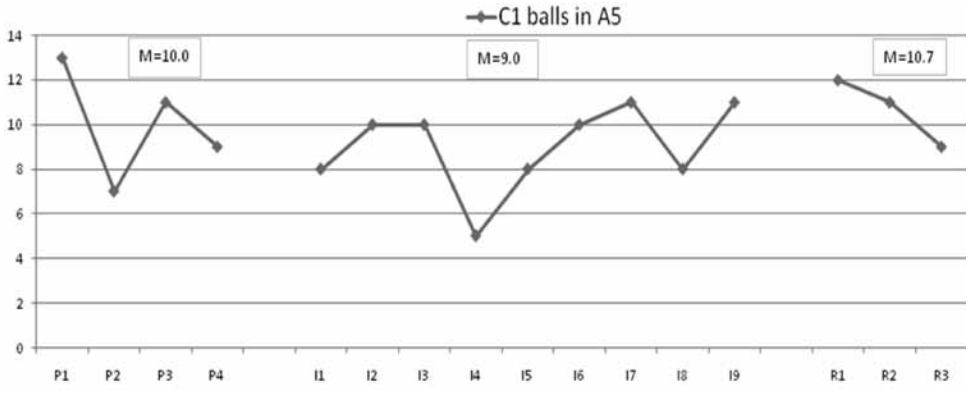

Figure 4 — Participant C1 balls hit in A5

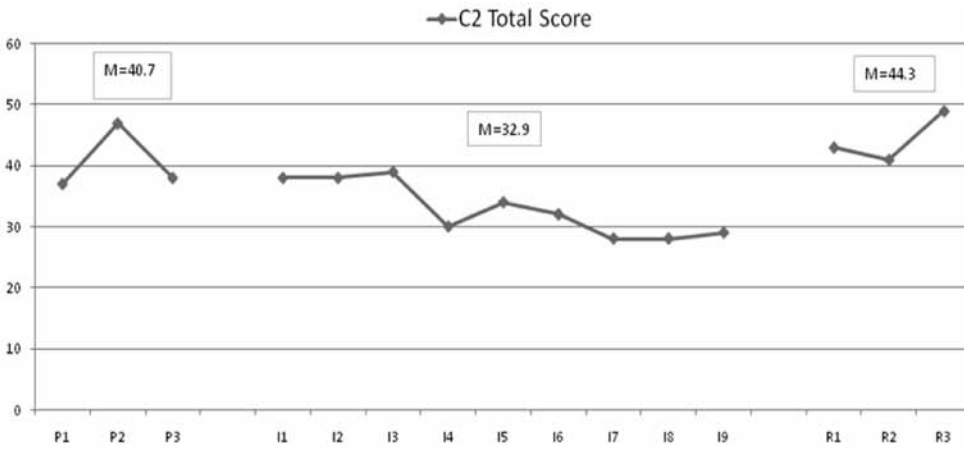

Figure 5 — Participant C2 total score

during the intervention (See Figure 6). Withdrawal scores steadily increased throughout the three sessions. Participant C2 increased the balls hit into A5 from baseline to intervention (See Figure 7).

Imagery After Group

Participant IA1. Participant IA1's performance increased from baseline to intervention (See Figure 8). When analyzing means, performance increased from baseline (M = 53.3) to intervention (M = 61.1). Participant IA1 improved in balls hit into A1 from baseline (M = 2.3) to intervention (M = 4.1) (See Figure 9). The mean for withdrawal was similar to that of baseline (M = 55). Participant IA1 did not hit any balls into A5 throughout the course of the study (See Figure 10).

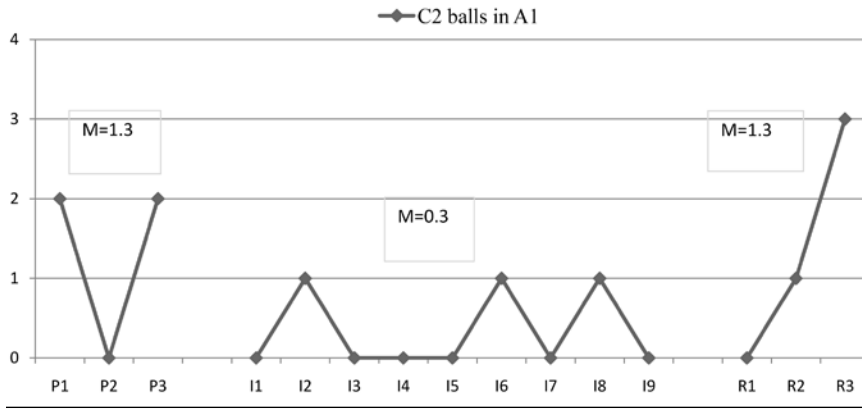

Figure 6 — Participant C2 balls hit in A1

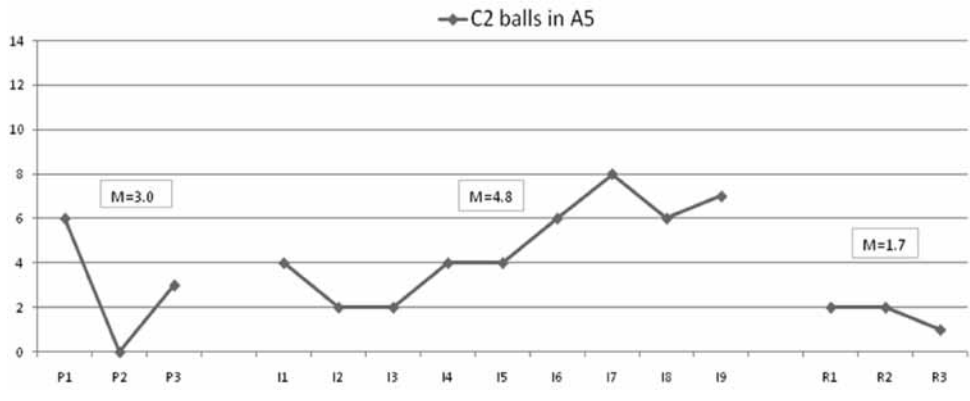

Figure 7 — Participant C2 balls hit in A5

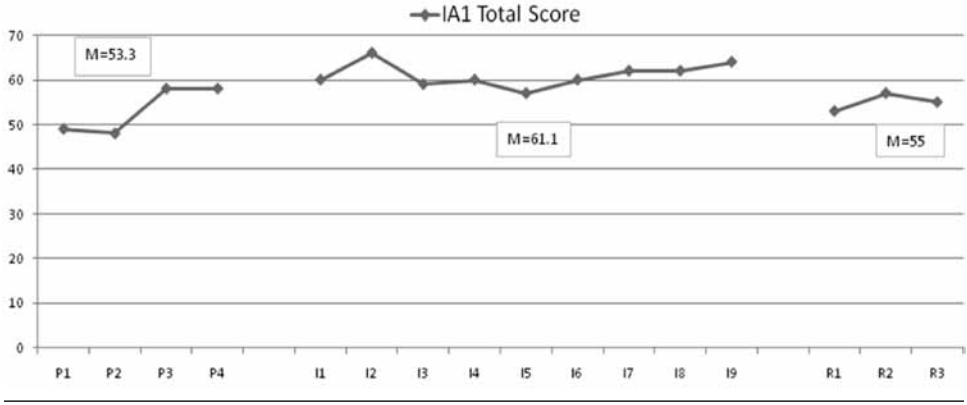

Figure 8 — Participant IA1 total score

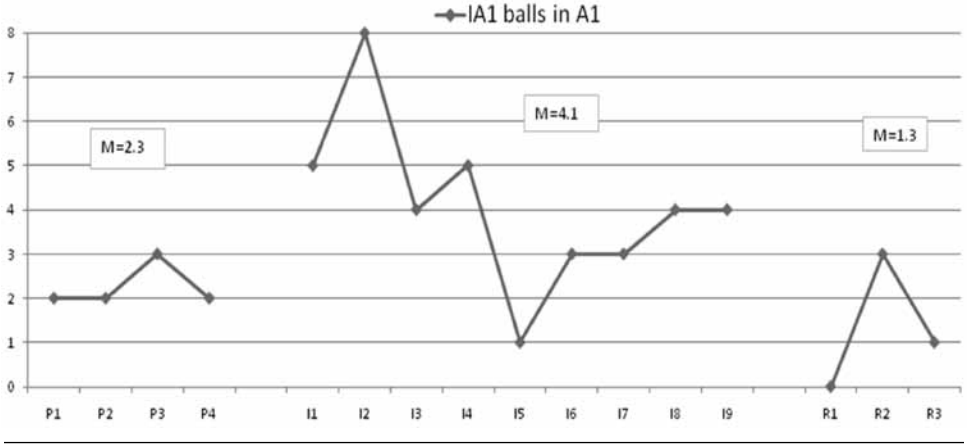

Figure 9 — Participant IA1 balls hit in A1

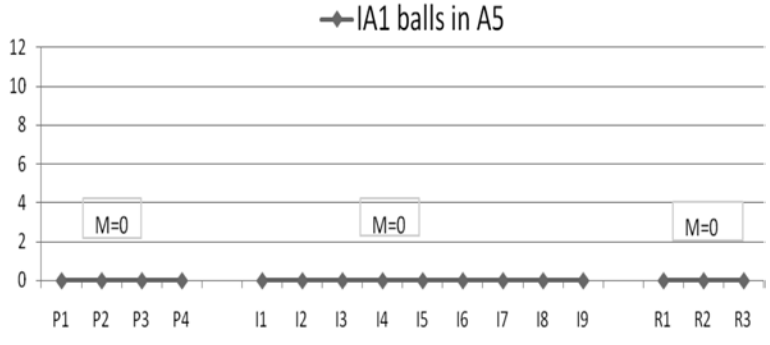

Figure 10 — Participant IA1 balls hit in A5

Participant IA2. Participant IA2 showed improvement from baseline to intervention (See Figure 11). All data points during the intervention were higher than those in the baseline phase. Mean comparison showed a large increase between baseline (M = 24.7) and intervention (M = 35.4). IA2's performance declined during the withdrawal test (M = 30), however his performance remained higher than baseline levels (M = 24.7). Participant IA2 scored consistently scores throughout testing for balls hit into A1 (See Figure 12). Participant IA2 decreased balls hit into A5 from baseline (M = 9.7) to intervention (M = 4.1) (See Figure 13). The mean decreased by five balls hit into A5 out of 15 recorded shots.

Participant IA3. Participant IA3 showed an increase in total score from baseline (M = 40.7) to intervention (M = 45) (See Figure 14). Overall, the withdrawal average (M = 51.7) was higher than both intervention and baseline. For balls hit

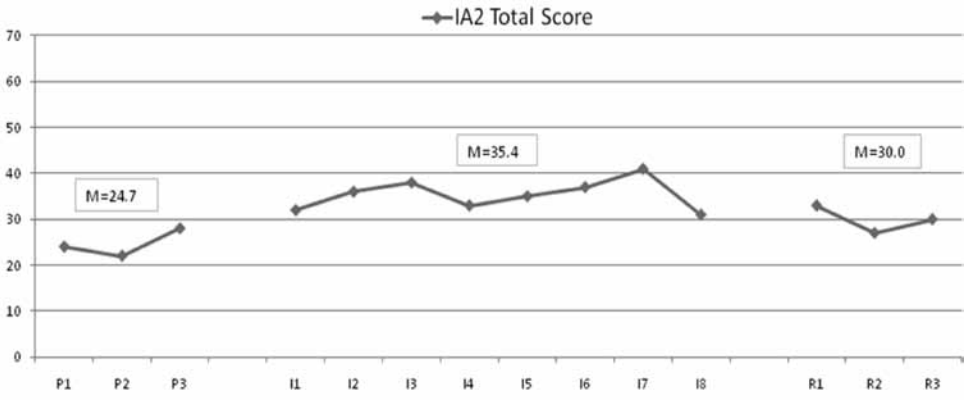

Figure 11 — Participant IA2 total score

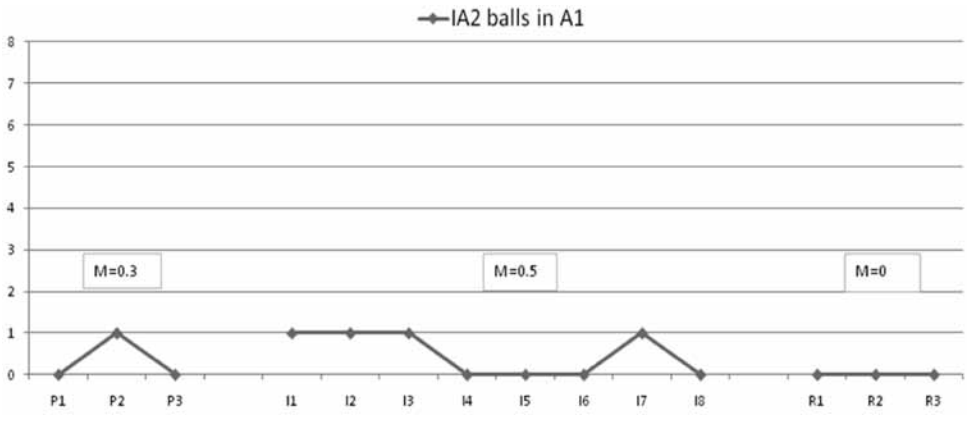

Figure 12 — Participant IA2 balls hit in A1

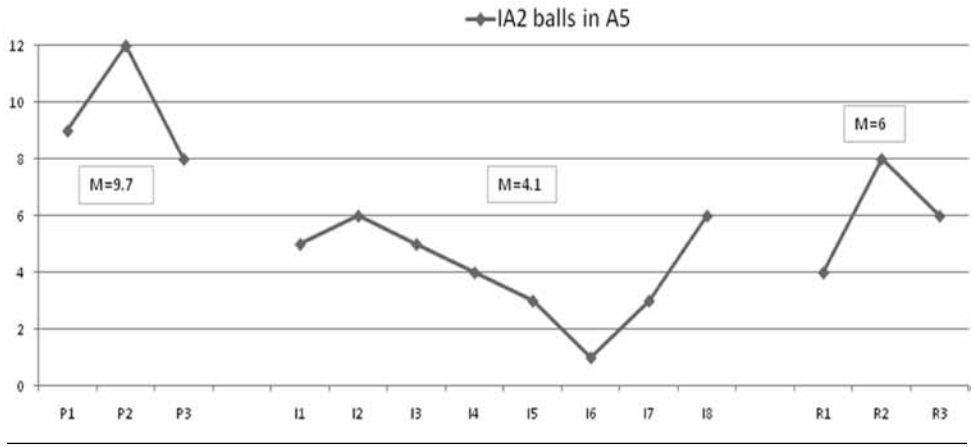

Figure 13 — Participant IA2 balls hit in A5

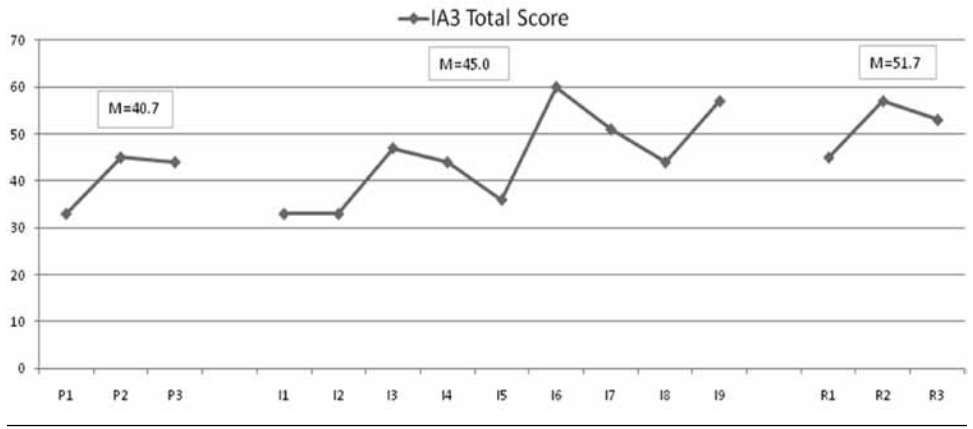

Figure 14 — Participant IA3 total score

into A1, scores improved in the intervention (M = 2) and withdrawal (M = 3.3) phases, pointing to a treatment effect (See Figure 15). Participant IA3 showed a small decrease in balls in A5 when comparing the means of baseline (M = 2.7) and intervention (M = 1.8) (See Figure 16).

Imagery Before Group

Participant IB1. Participant IB1 showed a small increase in total score from baseline (M = 49) to intervention (M = 54.7) (See Figure 17). Withdrawal scores were slightly higher than those of the intervention (M = 56.3). Within the intervention phase, session I2 seems to be the only session that increased over baseline scores. Overall, this participant showed small increases in total score throughout

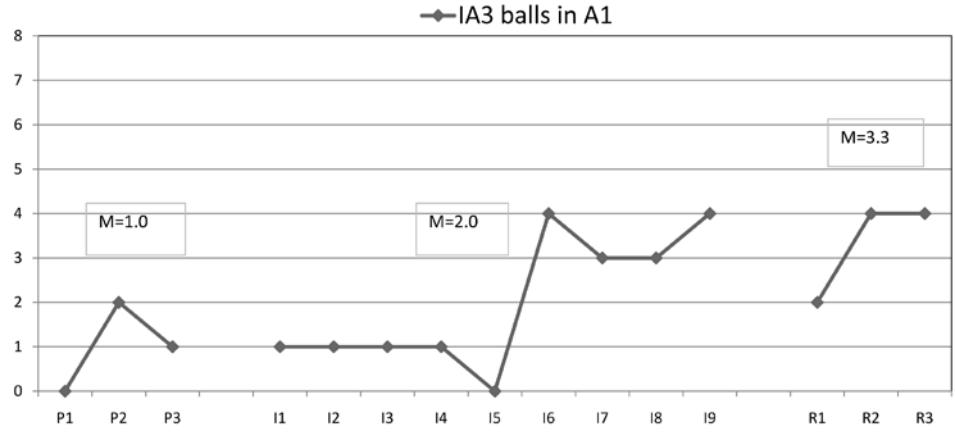

Figure 15 — Participant IA3 balls hit in A1

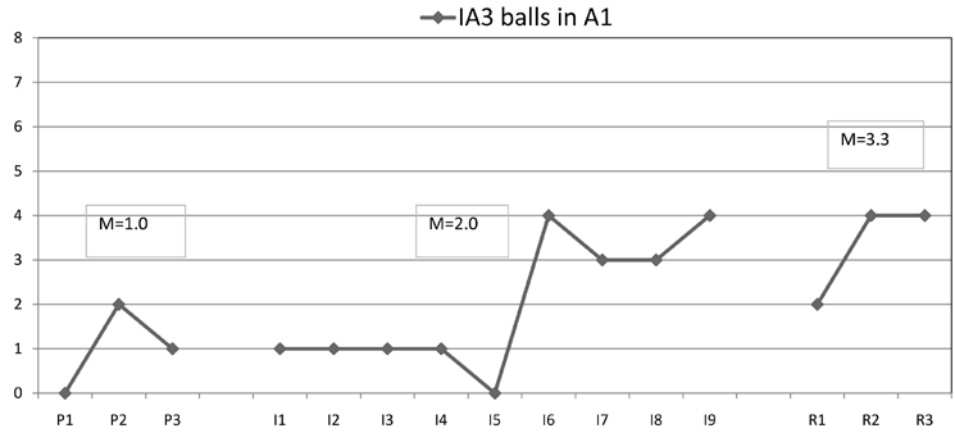

Figure 16 — Participant IA3 balls hit in A5

the study. Participant IB1 had large fluctuations in balls hit into A1 (See Figure 18). During the baseline phase, participant IB1 showed fluctuations ranging from zero balls to four with a mean of 1.5 for balls hit into A5 (See Figure 19). During the intervention and withdrawal tests, participant IB1 hit zero balls into A5.

Participant IB2. Participant IB2 showed a small increase from baseline (M = 52) to intervention (M = 55) when comparing means (See Figure 20). Mean comparison shows that the withdrawal scores (M = 50) decreased slightly from the intervention and baseline phases. Participant IB2 also showed fluctuation in balls hit in A1, although his scores did increase from baseline (M = 1.7) to

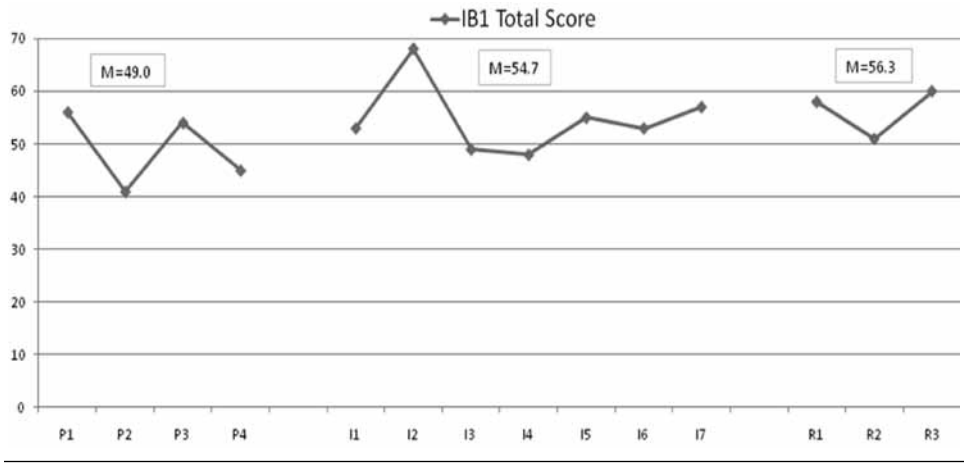

Figure 17 — Participant IB1 total score

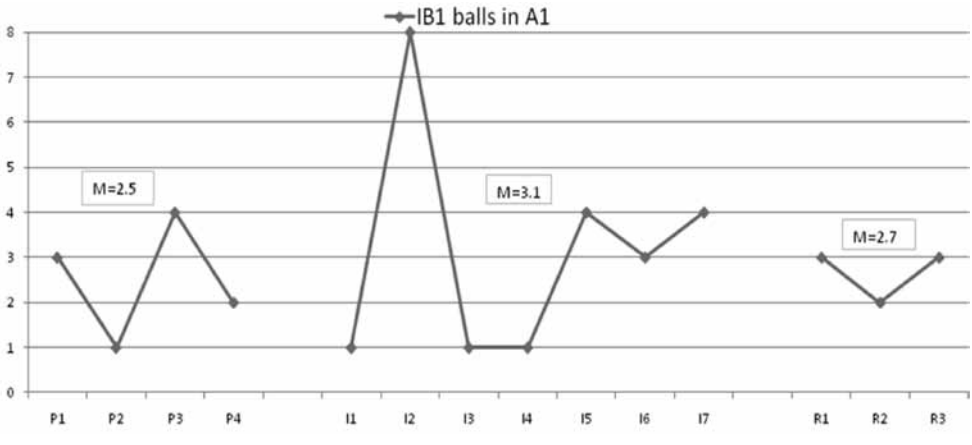

Figure 18 — Participant IB1 balls hit in A1

intervention (M = 3) (See Figure 21). The withdrawal test saw a decrease in balls into A1 drop below baseline (M = 1.3) levels. Participant IB2 did not hit any balls into A5 throughout the course of the testing (See Figure 22).

Participant IB3. Participant IB3 showed a small increase in means from baseline (M = 45.7) to intervention (M = 49.5) (See Figure 23). Scores peaked early in the intervention and then decreased to levels similar to baseline. This continued through the withdrawal phase with a mean of 46.7. Participant IB3 had some variation in balls hit into A1 (See Figure 24). His mean scores indicated an increase

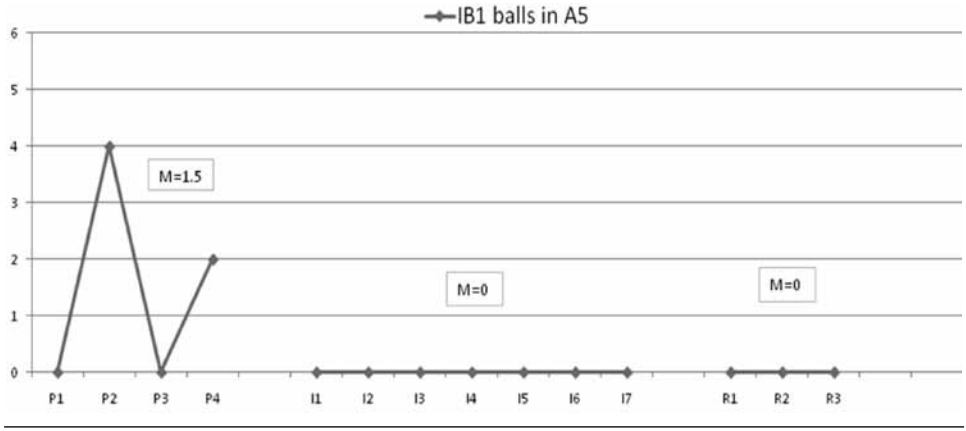

Figure 19 — Participant IB1 balls hit in A5

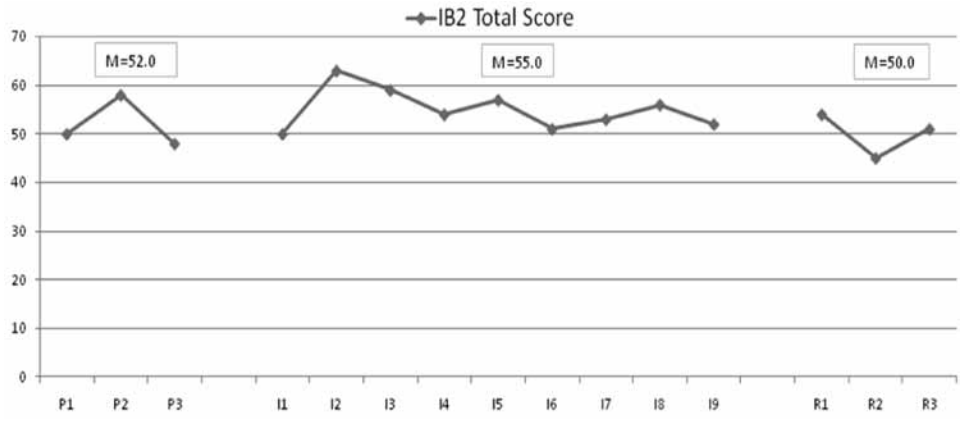

Figure 20 — Participant IB2 total score

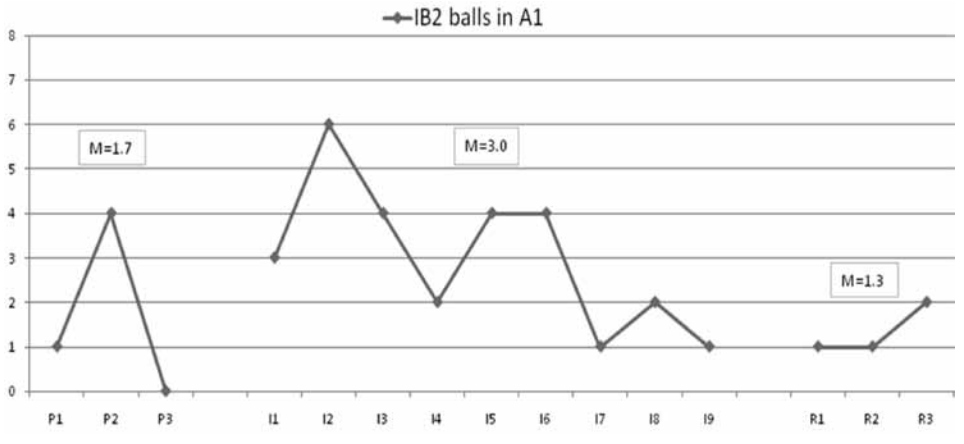

Figure 21 — Participant IB2 balls hit in A1

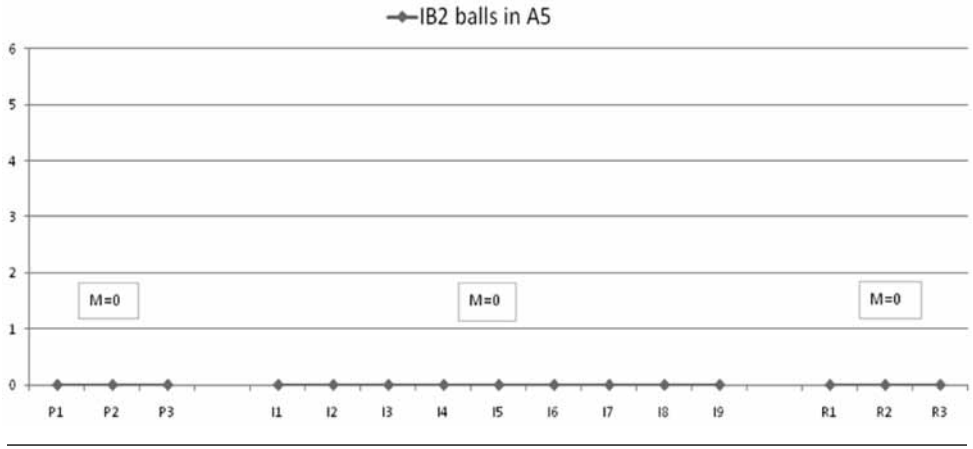

Figure 22 — Participant IB2 balls hit in A5

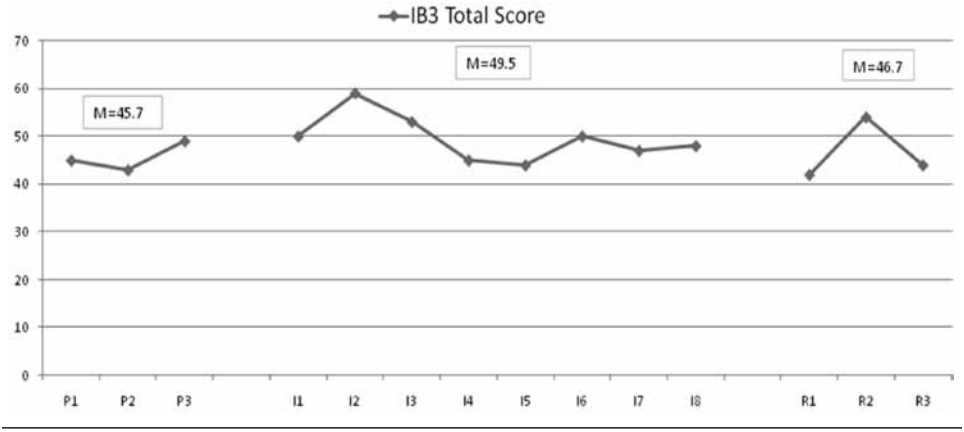

Figure 23 — Participant IB3 total score

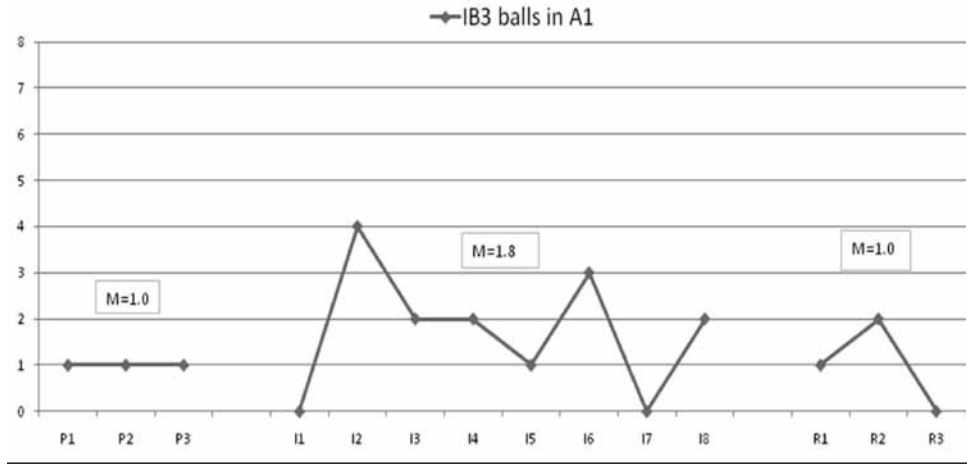

Figure 24 — Participant IB3 balls hit in A1

in performance during the intervention phase. For balls hit into A5, Participant IB3 had a mean score of 2.0 during baseline testing with some variation; hit zero balls into A5 during both intervention testing and withdrawal (See Figure 25).

Participant IB4. Participant IB4 showed the largest increase in scores from baseline (M = 32.7) to intervention (M = 40.3) (See Figure 26). The withdrawal scores (M = 46.7) were higher than both baseline and intervention and continued to increase from the intervention phase. While the mean increases appear small, zero balls were hit into A1 during baseline and only one or two balls were hit into A1 in seven out of 11 intervention and withdrawal trials (See Figure 27). Total scores for participant IB4 were consistent throughout the testing. When

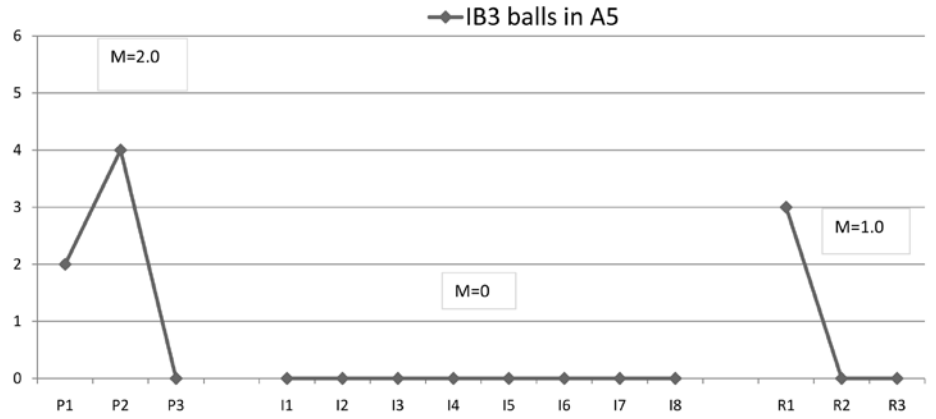

Figure 25 — Participant IB3 balls hit in A5

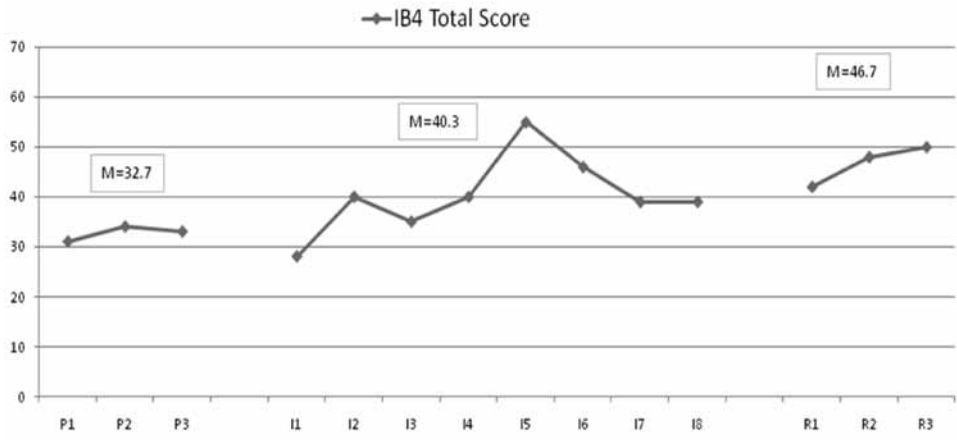

Figure 26 — Participant IB4 total score

comparing the means for balls hit into A5, the intervention (M = 1.8) decreased from baseline and continued to decrease in the withdrawal testing (M = 0.3) with only one ball being hit into A5 (See Figure 28).

Combined Results

When comparing control means: the intervention phase (M = 29.15) decreased in total score from baseline (M = 33.85), and withdrawal (M = 33.8). The combined average for the imagery-after group was baseline (M = 39.6), intervention (M = 47.2), and withdrawal (M = 45.6). Lastly, the combined average means for the

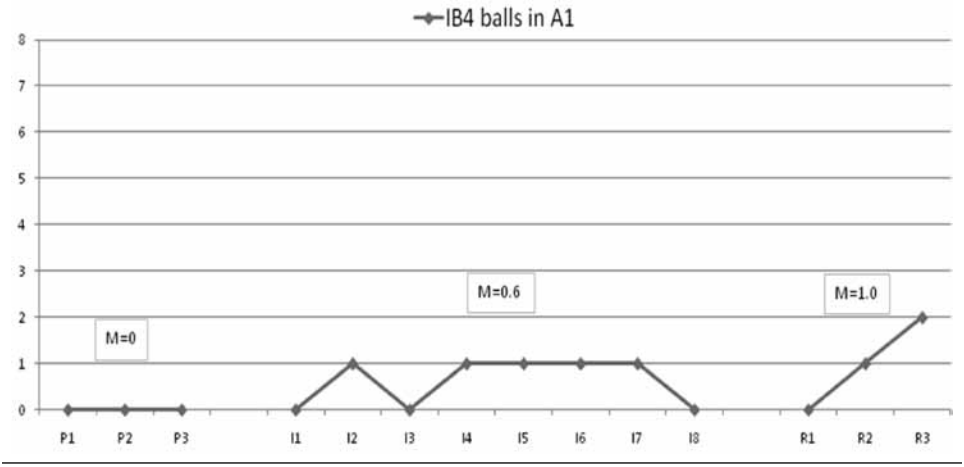

Figure 27 — Participant IB4 balls hit in A1

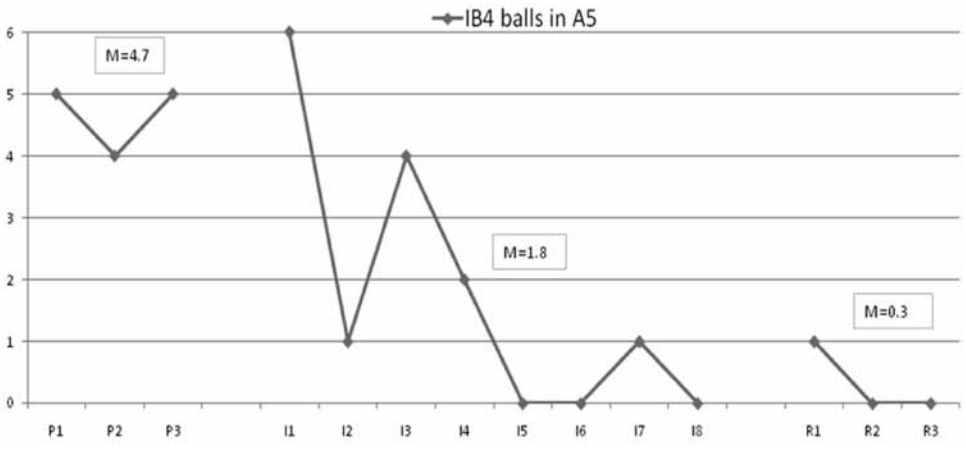

Figure 28 — Participant IB4 balls hit in A5

imagery-before group included baseline (M = 44.9), intervention (M = 49.), and withdrawal (M = 49.9). All imagery participants improved from baseline (M = 42.25) to intervention (M= 48.1) and remained higher at withdrawal (M= 47.75).

Discussion

The purpose of this study was to investigate the impact of using PETTLEP imagery as a part of a pre-shot routine on full swing golf shots. An additional purpose was to determine if imagery is more effective when used before or after a pre-shot routine. Through visual analysis and mean comparisons, evidence supports the hypothesis that imagery has a positive effect on performance. An intervention can be considered effective based on achievement of certain criteria (Bar-low & Hersen, 1984; Hrycaiko & Martin, 1996). For the current study based on visual analysis, there seemed to be a larger effect on golf score with the intervention than in baseline. Imagery appeared to affect the golfers' total score, balls hit into A1, and balls hit into A5. There was little evidence to support the hypothesis that the imagery after group would improve more than the imagery before group. Both groups experienced increases in total score from baseline to intervention, but neither group improved more than the other. This also holds true for balls hit into A1 and balls hit into A5.

Overall, total score for the control group did not increase from baseline to intervention; mean scores decreased. In terms of balls hit into A1, participants in the control group either scored consistently or decreased from baseline to intervention. For balls hit into A5, individuals in the control group either stayed consistent or increased from baseline to intervention.

Meanwhile, across all imagery participants, total score means were higher during the intervention phase compared with baseline. Mean scores increased from baseline to intervention in terms of balls hit into A1. Mean scores decreased from baseline to intervention for balls hit into A5 for imagery participants. These results suggest that imagery had a positive effect on golf performance.

When looking at balls hit into A1, the degree of increase varied between participants. Participant IA1 had one data point in the intervention portion lower than the highest baseline point. Participant IA3's last four data points during intervention were all higher than the highest baseline point. This suggests a later effect in the intervention for IA3. The majority of the data points in the intervention for participants IB3 and IB4 were higher than the highest baseline point. Only two of the seven imagery participants increased from baseline to intervention. Although there seems to be an effect from the imagery for balls hit into A1, it does not appear to be the case for all participants.

An additional finding suggests that participants with lower average golf scores saw improvement in balls hit into A1, while participants with higher average golf scores saw no increase in balls into A1. Three of the four participants with average golf scores in the 70s saw their average balls into A1 double from baseline to intervention. Participants with average scores near 90 did not experience the same level of improvement in balls hit into A1. It makes sense that golfers with less ability might not improve as much as higher ability players for balls hit into A1. Golfers with average scores around 90 are less likely to hit balls within 10 feet of the hole. When looking at the golfers with average scores in the 70s, they improved

in terms of balls hit into the closest area (A1). This suggests that for higher level players, imagery can increase the amount of shots hit closer to the hole. This finding expands upon previous research that imagery can improve performance or shot accuracy. Several studies found that imagery could improve putting (Woolfolk, Parish, & Murphy, 1985; Ploszay et al., 2004; Thomas & Fogarty, 1997), bunker play (Smith, Wright, & Cantwell, 2008), and pitch shots (Brouziyne and Molinaro 2005). The current study as well as previous research suggests that imagery can be an effective tool for several types of golf shots.

PETTLEP imagery was developed to create the most realistic imagery possible. It is likely that high ability golfers are able to create a realistic image visualizing the ball landing close to the hole. On the other hand, lower ability golfers may not be used to hitting the ball close to the hole, thus unable to create such a realistic image. This inability to successfully image a shot could inhibit image quality for less-skilled participants compared with highly-skilled golfers. If this is the case, it would be expected that the intervention would not have a significant effect on lower ability golfers when hitting in A1.The imagery intervention seemed to increase balls in A1 for the majority of the high ability golfers, but not for the lower ability golfers. However, imagery participants across all skill levels decreased balls hit into A5 from baseline to intervention.

There was a large effect for balls hit into A5 across all participants with viable data. During intervention, participants IA2, IA3, IB1, IB3, and IB4 decreased the number of balls hit into A5. This is compelling evidence that participants' imagery affected the number of balls hit into A5. This appears to be meaningful across all participants with viable data. The increase in total score for all imagery participants seems to be accounted for by the decrease in balls into A5. Although imagery might not increase balls hit close to the hole for all skill levels, it may decrease the amount of poor shots hit far away from the hole. Limiting the number of shots hit off line can lead to better play for golfers of all skill levels. Similar results were found by Ploszay et al. (2004) with putting.

Overall, an increase in total score was observed across all imagery participants, while control participants saw a decrease in total score. Specifically for high ability golfers, balls in A1 increased across both imagery groups. Balls in A5 drastically decreased across all imagery participants, while control participants stayed consistent or increased during the intervention phase. This suggests that PETTLEP imagery can have a positive effect on full swing golf shot accuracy. Although there is no previous research with PETTLEP imagery and full swing golf shot accuracy, Smith, Wright, and Cantwell (2008) suggested that PETTLEP imagery can enhance bunker shot accuracy. The improvements in full golf swing accuracy experienced by those using PETTLEP imagery in the current study contribute to this previous research.

As stated, no differences were found between the imagery before and imagery after groups. This does not support the original hypothesis that, based on the recency effect, the imagery after group would improve more than the imagery before group. The last thing the imagery after group did was image the shot, and it was hypothesized that this would increase the power of the image in comparison with that of the imagery before group. The time between the imagery and the actual shot was greater for the imagery before group, which was hypothesized to inhibit the power of the imagery. It is possible that, regardless of when the imagery was

done, insufficient time elapsed between the imaging and the shot to significantly differentiate the image quality between the imagery after and imagery before groups. Additional research could be conducted to replicate these results regarding timing of imagery.

There are many practical implications from this study. The results suggest that imagery can be an effective tool in increasing full shot accuracy for golfers of all abilities. Imagery can be particularly helpful for beginning or lower ability golfers. Lower ability golfers may not increase the number of shots hit close to the hole, but imagery could help them achieve lower total scores by reducing the number of poor shots hit in a round. For those working with higher ability golfers, this imagery intervention suggests that accuracy can be improved by increasing balls hit closer to the hole and reducing shots hit off line. It is also possible that the changes in scores may have been due to something other than imagery. No matter when used, the overall scores with imagery were better than the baseline and remained high during withdrawal. This is the same pattern observed by the control group scores remained the same for imagery and withdrawal.

There are several limitations of this study that could have contributed to the results. First, the results obtained could also be the consequence of experimenter bias or Pygmalion effect (Rosenthal & Jacobson, 1968). Participants may have performed better after learning that imagery was implemented to determine whether it would improve their performance. In addition, the outdoor conditions of the test produced changes throughout the course of the study. Fluctuations in temperature may have impacted results as the ball tends to travel farther on warm days and shorter on cold days. The wind direction also varied from downwind, into the wind, and some cross winds. Occasionally the wind influenced the club selection of the participants. Weather also caused a few cancellations of testing sessions for participants.

Another limitation of the study was the scheduling of participants. Participants were given a schedule at the beginning of the study; however, the three groups were all on different schedules. Two of the groups met Monday, Wednesday, and Friday, while the other group met Monday, Tuesday, and Friday. Some groups met in the morning, some in the afternoon, and some in the evening throughout the course of the week. These different times and days could have offered one group better conditions during testing. A more ideal format would have been to have all the groups meet at similar times and schedules during the week. In addition, it was not determined whether participants were receiving golf lessons before or during the study. However, with each participant having similar skill level and handicap, lessons regarding physical play may or may not influence imaging ability.

One limitation is that there is no way to determine whether the imagery groups ceased using imagery during the withdrawal period. The Imagery Before group actually experienced increases in scores during the withdrawal period. The Control group and the Imagery After group did not see such increases during withdrawal. Although there is no data to support this claim, it is quite possible that the Imagery Before group continued using imagery throughout the withdrawal period. The only way to validate this claim is to replicate the current study with this limitation in mind.

Finally, two participants' data were affected by "the shanks". This can be detrimental to the confidence of the golfer, potentially resulting in poor performance. Participant C2 saw a larger decrease in total score from baseline to intervention.

C2 also saw a dramatic increase in balls in A5 during this time. However, when he came back for withdrawal testing, no shanks were present and his total scores increased slightly above baseline levels. Participant IA3 saw a smaller increase in total score in comparison with the other participants. "The shanks" could have contributed to these results. As stated in the results, it appears the effect of the imagery had a later effect, but it could also be explained by the "shanks" seen between I1 and I5. The remainder of the intervention saw scores that were much higher, as no shanks were present in the withdrawal phase. Overall, the results and research design seem to have strong ecological validity. The participants implemented imagery, practice swings, and actual hitting on a real golf course. The imagery scripts were based on journaling and key words supplied by the participants. The experimental design mirrored actual golf play as closely as possible. However, the results can only be generalized to golfers who already use a pre-shot routine within the specified handicap.

Future studies could take these limitations into account and potentially explore how imagery ability might affect the results. High or low ability imagers might have produced different results when using imagery with a full swing shot. In addition, imagery interventions could explore different types of shots and distances; for example, how imagery could impact driving accuracy.

Despite the limitations outlined above, the results of this study suggest that PETTLEP imagery increases full swing shot accuracy. Specifically, this type of imagery decreases the amount of poor shots hit 40 feet or further from the hole. In addition, for higher ability golfers the intervention increased balls hit within 10 feet of the hole. With these results, future studies could continue to look at how a more complex task, like a full swing golf shot, can be impacted by psychological skills training.

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Appendix

Imagery Script

Start by standing on the range where you would hit from with the proper club in hand. Close your eyes and take several deep breaths. The ball is 120 yards from the hole. Feel the club in your hands. Notice the texture of the grip and the weight of the club. Image setting up to the ball, take into account your natural stance, posture, weight distribution, and feel your arms hanging down holding onto the club. Sense the feeling of confidence of a solid golf shot about to be stuck. Now image the start to the backswing, feel the weight of the club, the sensation of your arms moving and your body starting to turn. (Individualize the rest of the golf swing, backswing, position at the top, downswing, feeling of impact, and follow through). Visualize the ball leaving the ground and flying in the air, notice the trajectory of the ball, the curvature of the ball flight (all this will be individualized based on the participants' ball flight and natural curvature). Visualize the ball landing and rolling toward the flag. The ball comes to rest close to the pin. Notice the feeling or emotions that come with hitting a great golf shot (those specific emotions and feelings with be individualized). During the imaging process participants will be encouraged to use whichever perspective they feel comfortable with (internal or external). They will also be allowed throughout the intervention to make minor changes to the script as they learn and become more comfortable with the imaging process. Also changes might be made because the participants become more aware of movements or emotions felt during the golf swing and when good shots are hit.