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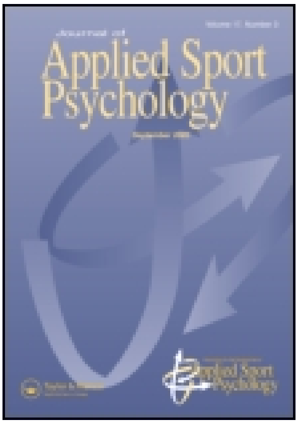
Phillip G Post
New Mexico State University

Duncan Simpson
IMG Academy



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Phillip Post [a], Sean Muncie [b] & Duncan Simpson [c]
[a] New Mexico State University
[b] Las Cruces
[c] Barry University

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The Effects of Imagery Training on Swimming Performance: An Applied Investigation

PHILLIP POST

New Mexico State University

SEAN MUNCIE

Las Cruces

DUNCAN SIMPSON

Barry University

A multiple-baseline design was used to examine the influence of an imagery intervention on the performance of swimmers' times on a thousand-yard practice set. Performance times for four swimmers were collected over a 15-week period during preseason training. The intervention took place over a 3-week period and was introduced after the fourth week of the study. The results revealed that three out of four participants significantly improved their times on the one thousand-yard practice set after being introduced to the imagery intervention. The results are discussed in terms of the implications of using imagery to improve athlete's performance on continuous tasks.

> I continue to visualize all my races days and weeks before they happen . . . I have never been to a competition, including the Olympic Games, where I didn't see myself win in my mental images before I got there. It is just part of the whole training package. Janet Evans (Ungerleider, 2005, p. 165)

Imagery was an integral part of training and preparation for Olympic swimmer Janet Evans. Her use of imagery is perhaps not surprising given that numerous Olympic and elite athletes report using imagery (MacIntyre & Moran, 2007; Orlick & Partington, 1988). Defined as the creation or re-creation of an experience in the mind (Weinberg & Gould, 2011), imagery is a mental skill used by an increasing number of athletes to facilitate sport performance (Munroe, Giacobbi, Hall, & Weinberg, 2000). Sport psychology literature suggests that athletes engage in imagery to enhance skill acquisition (Hall, Mack, Paivio, & Hausenblas, 1998), performance (MacIntyre & Moran, 2007), motivation (Munroe et al., 2000), and self-confidence (Hall, Rodgers, & Barr, 1990), as well as to regulate arousal (Weinberg, Butt, Knight, Burke, & Jackson, 2003).

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Address correspondence to Phillip Post, New Mexico State University, Human Performance, Dance, & Recreation, 1600 Stewart St., HPDR 215, Las Cruces, NM 88003. E-mail: ppost@nmsu.edu

Although imagery is used for variety of purposes, a major focus of prior research has been examining the effects of imagery on athletes' sport performance (Weinberg, 2008).

As a whole, previous research suggests that imagery facilitates performance on a variety of tasks. For example, imagery interventions have improved athletes' performance of basketball free-throw shooting (Post, Wrisberg, & Mullins, 2010), trampoline routines (Isaac, 1992), field hockey penalty flicks (Smith, Wright, Allsopp, & Westhead, 2007; Study 1), gymnastics routines (Smith et al., 2007; Study 2) and bunker shots in golf (Smith, Wright, & Cantwell, 2008). Generally research indicates that imagery alone is not as beneficial as physical practice, but that imagery improves learning and performance to a greater extent than no practice at all (Weinberg, 2008). As a result of these findings, authors have suggested that imagery is most effective when used in combination with physical practice (Morris, Spittle, & Watt, 2005; Weinberg & Gould, 2011).

Several theories have been proposed to explain the benefits of imagery (for a review, see Murphy, Nordin, & Cumming, 2008). Notably, Lang's (1977, 1979) bio-informational theory has received a considerable amount of attention because interventions based on this theory have contributed to improved sport performance (Callow, Roberts, & Fawkes, 2006; Post et al., 2010). Lang posited that imagery accesses information from memory that is similar to actual behavior. Specifically, Lang suggested that during imagery individuals access stimulus, response, and meaning propositions stored in long-term memory. Stimulus propositions describe the context of an event (i.e., the situation and physical environment), response propositions comprise the various responses to that event (i.e., the emotional, psychological, and physiological responses), and meaning propositions represent the perceived importance of the image. According to Lang, learning and performance involves linking appropriate stimulus and response propositions, and that individuals can strengthen these links through imagery. Therefore, with repeated imagery rehearsal performers can become more adept at matching the most effective response propositions to particular sets of stimulus propositions. Thus, when the performer is faced with an actual situation he/she will be more likely to respond appropriately.

Despite the documented benefits of imagery, Weinberg (2008) has called for further applied imagery investigations. Since this call, a few studies have been published (Bell, Skinner, & Fisher, 2009; Post et al., 2010), but additional research is needed to clarify the effects of imagery on different task demands in applied settings. Previous field research (e.g., Post et al., 2010; Smith et al., 2007; Smith et al., 2008) has largely shown benefits of imagery on an athlete's performance of discrete tasks (i.e., tasks that have a clear identifiable beginning and end; e.g., free throw shooting, golf pitching) and/or serial tasks (i.e., tasks involving a series of discrete skills; e.g., gymnastics and trampoline routines). However, there has been little field research examining the effects of imagery on continuous tasks (i.e., tasks that do not have a recognizable start and end; e.g., swimming and running). It is possible the imagery only benefits discrete/serial tasks in which the performer can rehearse rapid movements in advance. It would be important for sport psychologists working with athletes performing continuous tasks to know if the benefits of imagery also extend to movements unfolding slowly over a longer period of time. To date, slalom skiing is the only continuous task in which the effects of an imagery intervention have been examined (Callow et al., 2006). The results of this research indicated that a dynamic imagery group (i.e., the group actively imaged slalom skiing movements while wearing their equipment) had significantly higher confidence and vividness scores than the static imagery group (i.e., the group imaged their run sitting in a hanger), but no differences were observed in performance between these two groups. However, the dynamic imagery group did significantly outperform a control group. These findings suggest that imagery may be effective in enhancing an athlete's performance of continuous tasks; however, further research is needed.

Despite the limited field research examining the impact of imagery on the performance of continuous tasks, survey and qualitative research suggests that athletes performing such tasks (e.g., swimmers and runners) often use imagery to facilitate motor performance (MacIntyre & Moran, 2007; Weinberg et al., 2003). Such reports provide additional evidence that imagery may be an effective skill for improving motor performance of continuous tasks. One sport that is a good candidate for imagery rehearsal is swimming. Similar to skiing, swimming is a sport in which performers execute a skill continuously over a period of time. Survey research and anecdotal reports of Olympic swimmers suggests that these athletes use imagery to enhance motor performance (Ungerleider, 2005; Weinberg et al., 2003). However, despite such reports, there is little documented evidence that imagery benefits swimming performance.

Previous research has established that imagery is an effective mental skill for improving athletes' motor performance of discrete/serial tasks, but it is still uncertain what effects imagery has on continuous tasks. Thus, additional research is needed to examine the influences of imagery on the performance of continuous types of tasks. Therefore, the purpose of the present study was to investigate the effectiveness of imagery on swimmers' performance of a distance swim. The investigation examined the effects of an imagery intervention on youth swimmers' performance (i.e., time) on a 1000-yard practice set. Based on previous research it was hypothesized that the imagery training would benefit participants' performance times.

METHOD

Participants and Experimental Design

The participants were four (1 male and 3 female) youth swimmers from a competitive swimming club in the Southwest region of the United States. The club had approximately 110 members and consists of four competitive levels. However, all participants ($N = 4$; M age = 15.5 years; $SD = 1.29$) in the present study were selected from the senior age group and had been swimming with the club for up to 10 years ($M = 6.5$ years; $SD = 2.65$). Prior to data collection, each participant (P1, P2, P3, P4) was informed about the purpose of the study and completed assent documents. Written consent was also obtained from each participant's parent.

In collaboration with the coach, the authors decided to evaluate the influence of imagery training during practice sessions because the swim club only competed in eight meets during the short course season. Therefore, using competition times as a performance variable would not yield enough data points to sufficiently evaluate the impact of the imagery intervention. Due to these constraints, the coach and authors evaluated the impact of imagery training on performance of a weekly 1000-yard practice set. The performance measure (i.e., time) was collected once a week on the same day each week during the baseline and post-intervention phases. The study spanned 15 weeks and took place during the club's normal training sessions. To avoid any training effects, participant's baseline times were not recorded until a month into the swimmers' preseason training.

Due to the applied nature of the study, a single-subject-multiple baseline design was used to evaluate the effects of the imagery intervention on each participant's performance times. Single-subject designs offer the benefit of allowing all participants to receive the treatment and to also serve as their own control. These designs are especially effective when examining the impact of psychological interventions in field settings (Hrycaiko & Martin, 1996). Multiple baseline designs are also effective in controlling for extraneous variables, such as, training effects, because participants receive the intervention in a staggered fashion throughout the study (Satake, Jagaroo, & Maxwell, 2008). Furthermore, prior research has demonstrated that single-subject designs are effective in examining the influence of imagery interventions on sport performance (see Bell et al., 2009; Jordet, 2005; Post et al., 2010).

Measures

Previous research has established that imagery ability is a factor that influences the effectiveness of the intervention (Hall 1985; Isaac, 1992). Therefore each participant's imagery ability was measured using the Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997), before the imagery training commenced.

Imagery ability

The MIQ-R was used to assess each participant's imagery ability. The MIQ-R is a shortened version of the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983), which has demonstrated adequate reliability coefficients for both the visual .89 and kinesthetic .88 subscales (Hall & Martin, 1997). The MIQ-R measures visual and kinesthetic imagery ability and is composed of eight questions that require participants to first perform a specific action (e.g., arm, leg movements, etc.), and then image the just performed movement (Hall & Martin, 1997). After imaging the movement, participants are asked to rate their ability to see or feel the action on a 7 point Likert scale, from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). The MIQ-R has shown correlations with the MIQ for both visual ($r = -.77$) and kinesthetic ($r = -.77$) scales (Hall & Martin, 1997). The present study used recommendations from Callow et al. (2001) that participants should score at least a mean of 16 on both the visual and kinesthetic subscales of the MIQ-R for the imagery intervention to be effective.

Performance measure

As part of the team's normal training, participants swam a 1000-yard set once a week after an initial 20-min warm-up period. The warm-up consisted of 10-min of stretching followed by a 10-min self-paced swim. During the baseline and post-intervention periods, participants' performance was recorded once a week. Participants swam the 1000-yard timed set using their dominant stroke. Three participants (P1, P2, P4), swam using a freestyle stroke and one participant (P3) swam five 200-yard individual medleys. The individual medley consists of four strokes in the following order: butterfly, backstroke, breaststroke, and freestyle. The total time for participants to complete their 1000-yard set was recorded in seconds using a stopwatch. The head coach collected all performance times to avoid any possible biasing due to the first author being present (Rosenthal, 1976).

Post-experimental interview

Obtaining social validity is an integral part of multiple baseline designs (Hrycaiko & Martin, 1996). It allows researchers to understand the extent to which the target skill is important to the participant, if the procedures were followed, and whether or not the intervention was perceived to be beneficial. Social validity in the current study was obtained through post-experimental interviews conducted two weeks after the completion of the study by the primary investigator. The interview questions were adapted from Callow et al. (2001); specifically, participants were asked to respond to three questions using a Likert scale from one to five. The three questions were: (a) "How much did improving your 1000 yard-practice times matter to you?" with responses ranging from 1 (*doesn't matter at all*) to 5 (*matters very much*); (b) "Did you enjoy using the imagery intervention?" with responses ranging from 1 (*not at all*) to 5 (*very much*); and (c) "Do you think the imagery intervention benefited your 1000-yard practice times?" with responses ranging from 1 (*not at all beneficial*) to 5 (*very beneficial*). In an effort to gain additional insight into participants' perception of the imagery intervention, they were asked three open-ended questions: (a) "How much time did you spend practicing the imagery intervention each week?"; (b) "Will you continue to use imagery for competitions and practices?"; (c) "If you think the use of imagery helped improved your performance, could you give a few reasons why you think it helped you? (Or if you did not think it helped your performance, could you give a few reasons why?)"

Procedure

Before the club's short course season, the first author contacted the head coach (the second author) about the possible study. The head coach was receptive to the idea, and after an initial meeting he agreed to the study. Upon institutional review board approval participants were recruited based on their current level of training and practice attendance. All swimmers competing in the club's senior group (i.e., the highest level) were initially eligible to take part in the study. This group consisted of 16 swimmers who were at least 13 years old ($N = 16$; M age = 15.9 years; $SD = 1.89$), swam year round, and practiced approximately 20 hr a week. To ensure there were no differences in training, the recruitment pool was narrowed to swimmers in the senior group who regularly attended full practice sessions the entire week. Eight out of the 16 swimmers periodically missed practices or did not train for full practice sessions throughout the week because of other activities (e.g., church group, participation in other sports, etc.). Out of the eight remaining swimmers two had injuries that prevented them from participating. After a team meeting the principal investigator invited the remaining six eligible swimmers to participate in the study. Potential participants were informed that the purpose of the study was to examine how imagery impacted performance. However, to avoid any experimenter expectancy effects, the participants were simply given a description of the mental skill and told that it was uncertain what impact (if any) it would have on their performance. Out of the six potential participants five agreed to take part in the study; however, due to a shoulder injury one participant was unable to finish.

The study consisted of baseline, intervention, and post-intervention phases. A minimum of at least three consecutive observations should be used for the purposes of plotting data points during each phase of the experiment (Satake et al., 2008); therefore, during the baseline phase, performance was measured once a week until each participant achieved a stable baseline after the third practice session. Tawney and Gast (1984), suggested that stability is achieved if 80% to 90% of the data points of the baseline phase fall within a 15% range of the mean level of all data points. Participant 1 demonstrated a stable baseline after the fourth practice session; at that point the imagery intervention was introduced. The intervention was next introduced to the participant demonstrating the most stable baseline after the fifth practice session and so forth until each participant received the intervention in a sequential and staggered fashion. During the intervention phase performance data was not collected. After the intervention phase was completed, data collection resumed until the end of the study.

Imagery Intervention

The principal investigator, who has experience implementing imagery interventions as a practitioner, carried out the intervention. The intervention instructions were written down to ensure that each participant received the same set of instructions. Altogether the imagery intervention phase lasted three weeks for a total of nine sessions. The training program was consistent with the imagery-training program (ITP) suggested by Morris et al. (2005). The first three imagery sessions consisted of three parts: (a) participants were introduced to imagery, (b) imagery ability was assessed using the MIQ-R, and (c) individualized imagery training commenced. Only one of the participants (P3) had previous experience with imagery, but she had no formal training. Individualized training consisted of having participants practice basic images in a quiet and comfortable room. Participants then identified the content and aspects of their personal imagery script. Participant feedback along with the coach's input was used to develop imagery scripts specific to each swimmer.

After the first three sessions, participants listened to a rough draft of their imagery script and continued to practice basic images associated with their performance (e.g., stroke and flip turns). Participants were then given an opportunity to make changes and modify their script to their individual preference. During the next five sessions the imagery training was reinforced and the script was continually customized to ensure that it met each participant's needs as well as the coach's recommendations. Specifically, this involved the swimmer listening to an audio file of his/her script and providing feedback (i.e., technical, timing, and emotional aspects of the script) to the first author immediately afterwards. This information was then presented to the head coach for additional feedback (e.g., wording of technique). The audio file was then subsequently updated for the participant's next imagery session. After the ninth session the participants were provided with a final MP3 file on a CD containing their individualized script. Participants were instructed to listen to their imagery script twice a week (i.e., once during the week and once on the weekend) and once before their practice of the timed 1000-yard practice set.

Adherence is an important factor to consider when examining the effectiveness of an imagery intervention (Callow & Waters, 2005). Thus, to ensure adherence participants were required to fill out a log each time they listened to their imagery script. Participants recorded the date they listened to the script and rated their ability to see/feel the imagery session on a 7-point Likert scale, from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*).

Imagery Scripts

Although each participant's intervention was individualized, all scripts were theoretically based using Lang's (1977, 1979), bio-informational theory (see Appendix). Thus, each script contained stimulus and response propositions. Stimulus propositions described the situations being imagined (e.g., environment and distractions) and response propositions described the swimmer's desired response to the particular situation (e.g., perfect stroke, flip turns, and pushing past fatigue). Consistent with ITP model recommended by Morris et al. (2005), the scripts included multiple senses (e.g., vision, audition, and kinesthetic), environmental (i.e., practice setting), and timing (i.e., correct timing of stroke/flip turns) elements. These aspects were incorporated to increase the vividness of each swimmers imagery experience.

Data Analysis

To date there is no standard method for analyzing single subject data. Some authors have suggested using parametric (Gentile, Roden, & Klein, 1972) or non-parametric (White, 1974), statistics to compare baseline and post-intervention observations. However, the independence of error terms assumption for parametric tests (e.g., ANOVA and *t* test) are violated in single subject data when adjacent points are correlated over time; this is known as serial dependency (Crosbie, 1993). For non-parametric tests (e.g., binomial test), Type I error rates are inflated when serial dependency exists in the data set (Crosbie, 1993). Therefore, before considering these procedures, autocorrelations were calculated separately for both the baseline and post-intervention phases to check for serial dependency. The results revealed that P4's baseline performance times were significant $p < .05$, indicating serial dependency. Additionally P3's post-intervention phase approached significance $p = .07$. Therefore, parametric and non-parametric statistics were deemed not appropriate for analyzing the data set. Other authors have suggested using interrupted time series analysis to evaluate the results of single subject data (Crosbie, 1993; Gottman, 1981). However, Huitema (2004) argued that such procedures are not appropriate for single subject data containing fewer than 50 observations because the procedures provide estimates that are misleading and inconsistent with the logic of interrupted time-series designs.

Given the small number of observations in the current study, statistical procedures were deemed inappropriate and traditional visual inspection was used to analyze the data set. This included graphing participants' times on the 1000-yard practice set and then visually analyzing the graphs to evaluate their level of change, amount of overlapping data points, and changes in slopes across phases (Hrycaiko & Martin, 1996; Satake et al., 2008). The two-standard-deviation method was used to determine if there was a significant level of change between the baseline and post-intervention observations (Satake et al., 2008). This procedure involves computing the mean and standard deviation for each participant's baseline data. Then, two standard deviation confidence intervals are drawn around the mean of the baseline and extended through the post-intervention phase. The level of change is considered significant if at least two successive data points in the intervention phase fall outside one of the two standard deviation confidence intervals (Satake et al., 2008). To examine changes in slope, celeration lines were drawn for each participant's baseline and post-intervention phases. The celeration line is a straight line that most approximates the majority of the data points in a given series (see Satake et al., 2008 for specific procedures). Lines are considered to have three slopes; accelerating (i.e., line increasing with respect to the ordinate value), zero (i.e., level), and decelerating (i.e., line decreasing with respect to the ordinate value). Changes in the celeration line are significant if the slope changes in direction from baseline to post-intervention phase in the direction of the intended treatment effect.

RESULTS

Imagery Ability and Adherence

All participants' MIQ-R mean scores were above 16 for both the visual and kinesthetic scales (see Table 1). Imagery logs and post-experiment interviews revealed that three out of the four participants (P2, P3, P4) adhered to the studies protocol. These participants listened to their imagery scripts twice outside of practice and once before the timed 1000-yard practice set. Participant 1 did not turn in all of his imagery logs. In the post-experimental interview, P1 revealed that he forgot to record several imagery sessions. Logs that were turned in suggest that P1 listened to the scripts once to twice a week, but he had difficulty listening to the imagery script before the 1000-yard timed practice set. The ability ratings on the imagery logs (where

Table 1
Participants mean MIQ-R scores for both Kinesthetic and Visual subscales.

	Participant			
Scale	**1**	**2**	**3**	**4**
Kinesthetic	26	23	26	27
Visual	27	23	25	25

1 = *hard* and 7 = *easy*) indicated that all of the participants had no difficulty feeling ($M = 6.29$; $SD = .79$) or seeing ($M = 6.35$; $SD = .79$) their respective imagery scripts.

Performance

All participants' performance times can be seen in Figure 1. Participant 1's mean performance time during baseline was 631.5 s and 630.9 s during the post-intervention phase for difference of .6 s. Analysis of the two standard deviation confidence intervals shows two consecutive data points below the lower confidence interval in the post-intervention phase. However, P1 had several overlapping data points between the two phases and his post-intervention phase was much more variable ($SD = 11.56$) than his baseline phase ($SD = 2.38$), suggesting no real

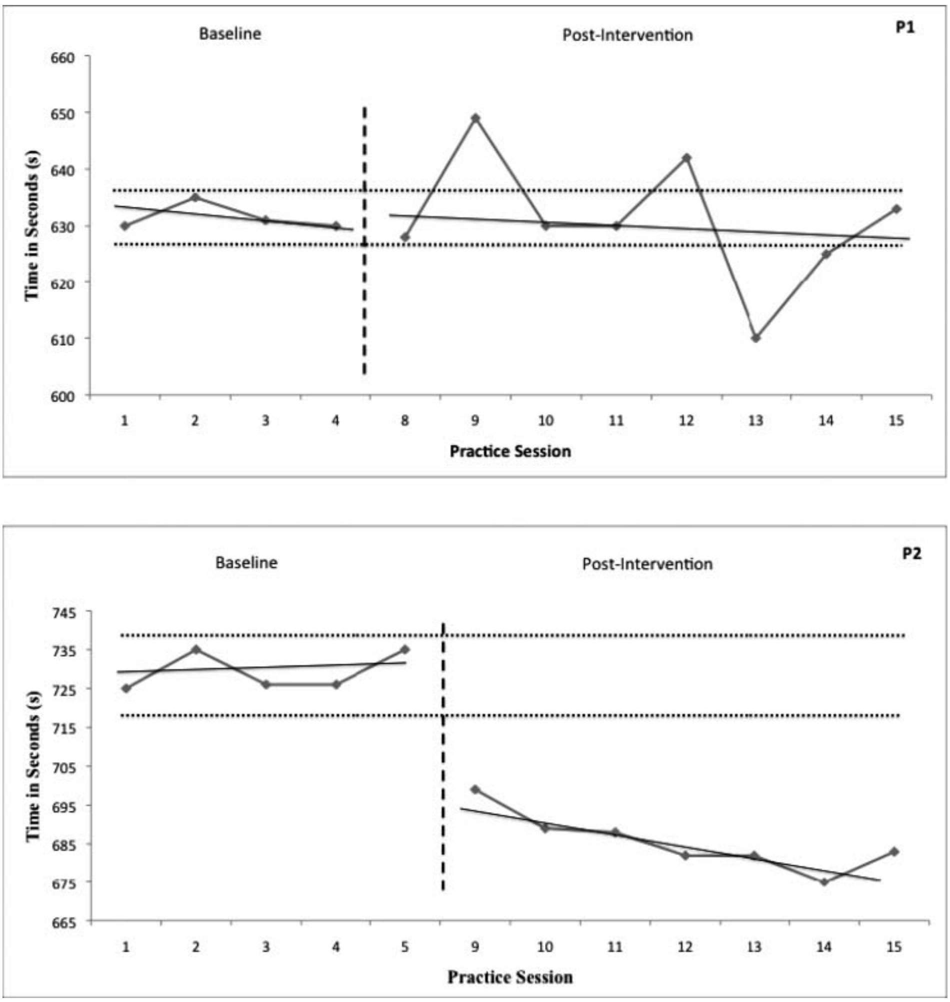
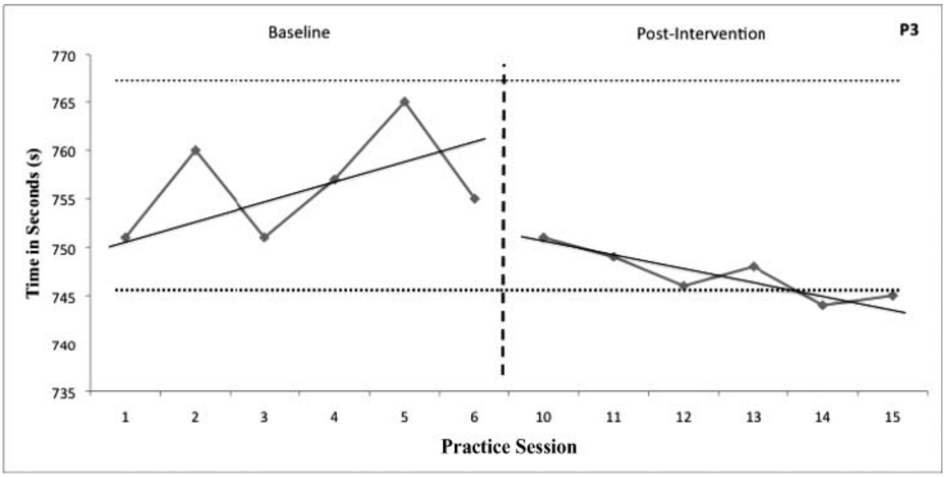


Figure 1. Participants'1000 yard practice set times in seconds during baseline and post-intervention phases and the two standard deviation confidence intervals.



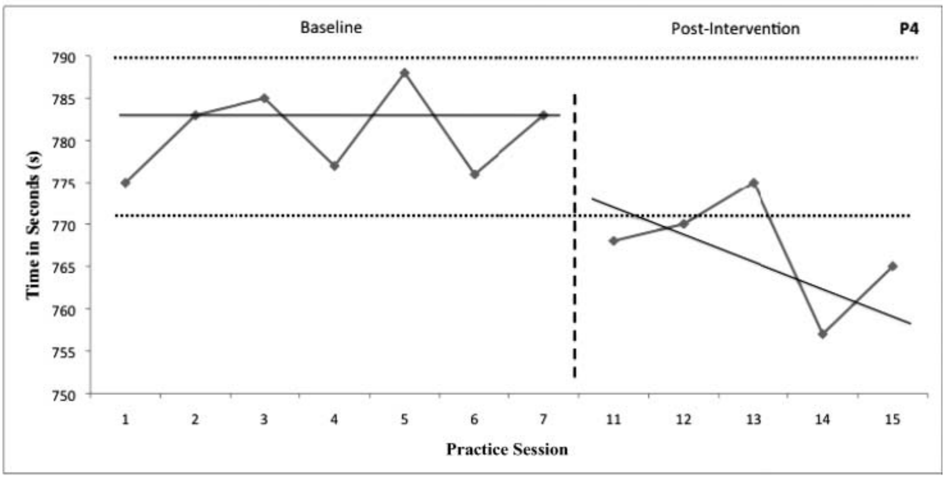


Figure 1. (Continued)

change between the two phases. Examination of the celeration lines also revealed no change in slope between the two phases. Taken together the results of the visual inspection suggest no change in times between P1's baseline and post-intervention phases.

Participant 2's mean performance time during baseline was 729.4 s and 685.8 s for the post-intervention phase. Participant 2 dropped an average of 43.6 s during the post-intervention phase compared to her baseline performance. Analysis of the two standard deviation confidence intervals demonstrates that all observations during the post-intervention phase were outside the lower confidence interval, suggesting a significant change in level from her baseline times. Furthermore, there were no overlapping data points, but the variability was slightly lower during P2's baseline times ($SD = 5.13$) than her post-intervention times ($SD = 7.55$). Examination of the celeration lines suggests a significant change in slope between the two phases. The trend line during the baseline phase was accelerating, whereas the slope was decelerating in the post-intervention phase. Collectively, the results of the visual inspection suggest that P2's times significantly improved from the baseline to the post-intervention phase.

Participant 3's mean performance time during the baseline phase was 756.5 s and 747.2 s during the post-intervention phase. Participant 3 dropped an average of 9.3 s from her baseline performance during the post-intervention phase. Analysis of the two standard deviation confidence intervals reveals that the final two data points fell outside of the lower confidence interval, suggesting a significant change in level between the two phases. There was only one overlapping data point between the baseline and intervention phase, but, the variability during the baseline phase ($SD = 5.43$) was slightly higher than the post-intervention phase ($SD = 2.64$). Inspection of the celeration lines suggests a significant change in slope between the two phases. During the baseline phase the trend was accelerating, but during the post-intervention phase the trend reversed and was decelerating. Taken together the results of the visual inspection suggest that P3's times significantly improved from the baseline to the post-intervention phase.

Participant 4's mean performance time during the baseline phase was 781 s and 767 s during the post-intervention phase. During the post-intervention period P4 dropped an average of 14 s from her baseline times. Inspection of the two standard deviation confidence intervals shows that P4 had two consecutive data points outside the lower confidence interval at the beginning and end of the post-intervention phase. There was only one overlapping data point between the phases and P4's variability was similar during the baseline ($SD = 5$) and post-intervention ($SD = 6.7$) phases. Analysis of the celeration lines suggests a significant change in slope between the two phases. During the baseline phase the slope was zero but during the post-intervention phase the slope was decelerating. Taken together the results suggest that P4's times significantly improved from the baseline to the post-intervention phase.

Post-Experimental Interviews

The post-experimental interviews revealed that it was important for all of the participants to improve their times on the 1000-yard practice set. Participants 2, 3, and 4 reported that they very much enjoyed using the imagery intervention and the same participants believed that the intervention was very beneficial in improving their times. However, P1 indicated that he somewhat enjoyed using the intervention and only thought the imagery intervention was somewhat beneficial to his performance. Nonetheless, all participants reported that they would continue to use imagery for competitions and practices. When asked to explain why they thought the imagery intervention benefited their performance, participants generally indicated that it helped them focus on what they needed to do. Participant 1 revealed "It helped me to relax and focus on the 1000-yard practice set, on . . . the things I needed to do to swim well" and P4 shared:

> It helped me narrow down my focus on the practice set . . . on what I was supposed to be doing instead of freaking out because that is what I would normally do when swimming the one thousand. I wasn't freaking out as much when I starting doing the imagery because I would just focus on what I was doing in my imagery, you know not getting tired, my stroke and I think that helped me out a lot.

Participant 2 indicated, "The focusing part for one, it allowed me to focus on the 1000, focus on my stroke and it helped me be able to get rid of distractions before getting to practice." Participant 3 revealed that the imagery intervention allowed her to focus on each IM stroke "It allowed me to really break down my strokes, so I can focus on them exactly how I wanted to perform them." Participant 3 also mentioned that she was more motivated to swim the practice set after receiving the intervention "It also got me more motivated, I had a better attitude because I would think of the thousand and think about okay this is what I have to do." Interestingly P2 shared that she used imagery during the 1000-yard practice set "During the 1000 I played the track in my head. . .pictured my stroke or pictured my flip turns and then I would try to act it out while I swam, this helped me avoid getting distracted by pain." It appears that this in performance imagery provided P2 with a reminder of the correct technique and focus. Coupled together these comments suggest that Participants 2, 3, and 4 found the intervention extremely effective.

DISCUSSION

Sport psychology research has demonstrated that imagery benefits athletic performance of several types of tasks (Post et al., 2010; Smith et al., 2007). However, with the exception of one study (Callow et al., 2006) the majority of this research has examined the influence of imagery on discrete/serial tasks. Therefore, the purpose of the present study was to examine the effects of imagery on the continuous task of swimming. The results are consistent with the one previous imagery study using a continuous task (Callow et al., 2006). However, the results extend prior research by demonstrating the benefits of imagery with swimmers.

The imagery intervention appeared to improve times on the 1000-yard practice set for three out of the four swimmers. Participant 2's data showed an immediate and pervasive benefit of the imagery intervention, there were no overlapping data points, and a clear change in level and slope. Participant 2 had a dramatic improvement in performance compared to the other swimmers; it's possible her use of imagery during performance allowed her to experience benefits above and beyond that of other participants. Despite each having one overlapping data point, P3's and P4's data demonstrated positive changes in level and slope. These changes suggest a significant improvement in performance after they received the imagery training. These interpretations were further supported by the participants' post-experiment interviews. All three swimmers rated the imagery intervention as very beneficial in improving their performance.

Although the imagery intervention appeared to positively impact three participants' times, the results suggest that the intervention had little effect on P1's performance. Participant 1 did have two consecutive data points outside the lower two standard deviation confidence interval during the post-intervention phase; however, there were several overlapping data points, increase in variability, and no change in slope, collectively suggesting no change in performance. This interpretation was supported by P1's response that the intervention only somewhat benefited his performance. However, as noted previously, P1 also struggled to adhere to the imagery protocol and therefore significant changes in performance above those normally attributed from continued practice should not be realistically expected. It appears imperative that researchers further investigate the concept of adherence relating to such imagery interventions. Secondly, P1 demonstrated the lowest times prior to beginning the intervention phase. It is possible that P1 only had marginal room for improvement and, thus, no differences could be observed. Previous research suggests that imagery may produce larger gains in performance for skilled athletes who have greater room for improvement (Jordet, 2005).

Despite the lack of improvement for P1, the performance results and exit interviews suggest that imagery may be an effective skill for improving swimmers' performance of a distance set. The results are in line with prior imagery research using a continuous task. Callow et al. (2006), demonstrated that active imagery benefits skiers' performance on a slalom course compared to a control condition. Taken together these results imply that the benefits of imagery seen with discrete/serial tasks may also extend to tasks that unfold slowly over a period of time.

The benefits observed in the present study may be because the intervention was based on Lang's (1977; 1979) bio-informational theory. By continually repeating stimulus propositions (e.g., the environment, emotions, and feelings) and matching them with desired response propositions (e.g., executing their stroke ideally, having ideal rhythm, and dealing with fatigue) the swimmers may have become more adept at matching their ideal performance with their 1000-yard practice set. Post-experiment interviews appear to support this notion. When giving reasons for why the intervention benefited their performance, participants reported that it allowed them to focus on what they needed to do to swim the 1000-yard practice set well. Instead of focusing on distractions (e.g., fatigue and worry) participants concentrated on their ideal stroke, focus, and feel. Another unique finding from the post-experiment interviews was P2's comments about the use of imagery during her swim. It appeared that this imagery provided her with reminders about her ideal stroke and focus. Participant 2's comments are consistent with recent qualitative research suggesting that gymnasts use in performance imagery to assist with a shift in focus or as a technical reminder for an upcoming skill (Post & Wrisberg, 2012).

The present study has implications for applied sport psychologist consultants (SPC's) working with swimmers. First, SPC's should consider implementing imagery interventions systematically, which includes introducing the swimmer to imagery, assessment, and individualized training. This systematic approach will allow SPC's to customize imagery scripts to meet the athlete's personal needs rather than imposing a rigid intervention. Second, SPC's would benefit from consulting coaches about their swimmer's imagery script. Feedback from coaches can ensure practitioners design imagery interventions that focus on the specific skills that the athlete needs to improve upon. Third, SPC's should consider including stimulus and response propositions into their athlete's imagery scripts. Although the present study did not directly compare the effects of an imagery intervention without these propositions, previous research has demonstrated that the combination of these propositions are effective in improving athletic performance (see Callow et al., 2006; Post et al., 2010). Finally, SPC's must work with athletes and coaches to improve adherence to such interventions.

The results of this study offer several possibilities for future imagery research. First, more applied and experimental research is needed to examine the influence of imagery interventions on continuous types of tasks. If a robust benefit of imagery were found, it would allow practitioners to implement effective imagery scripts with athletes performing such tasks. Second, future research should critically analyze the effects of imagery interventions on different task demands, such as, the performance environment (open vs. closed), mode of control (open vs. closed loop), the organization of the task (discrete, serial, vs. continuous) and the relative importance of motor and cognitive elements. Such a task analysis would shed some light on how imagery impacts different task demands that sport performers have to deal with. Third, applied imagery research using a multiple baseline designs should include psychological measures (e.g., confidence and motivation) in addition to performance measures. The inclusion of these measures would provide additional information about how imagery impacts psychological factors associated with successful performance. Fourth, qualitative research is needed to examine athletes' use of in performance imagery, specifically with athletes who perform continuous tasks over long durations. It is possible that these athletes use imagery during performance to assist with a shift of focus or to avoid distractions related to their performance (e.g., pain). Finally, future research should compare imagery interventions containing stimulus and response propositions to those not containing these propositions. Such research will allow practitioners to identify the necessary components of effective imagery rehearsal.

Although the imagery intervention appeared to benefit three out of the four swimmers' performance, the results should be viewed with some caution. First, the individual implementing the intervention was the primary investigator of the study. It is possible that experimenter expectancies may have influenced participants' outcomes (Rosenthal, 1976). Experimenter expectancies relates to the notion that the investigator unintentionally influenced the results in the preferred direction. Although steps were taken to avoid biases, it is possible that the primary investigator unintentionally influenced the results. Second, motivation was not assessed in the current study. Previous research has demonstrated that imagery can enhance participants' motivation (Martin & Hall, 1995). Participant 4 mentioned that she was more motivated to swim the 1000-yard practice set after beginning the intervention. It is possible that the performance improvements observed could be due to enhanced motivation rather than the use of the imagery. Third, it is also possible that a placebo effect may have influenced the results. Simply being introduced to the mental skill may have unintentionally made participants believe their performance times would improve. Fourth, although steps were taken to avoid possible training effects (i.e., timing of baseline collection and multiple baseline design) it is possible that improvements observed in the present study were a result of regular training and not the imagery intervention. Finally, the study was conducted during the team's practice sessions because of limited number of competitions. It would be important to determine if the benefits of imagery observed in this study extend to competition performance as well.

Despite these limitations, the results of the current study suggest that the imagery may be an effective skill for improving swimming performance. The finding that three out of four swimmers improved their times is an important extension to our current understanding of how imagery influences different types of task demands and sports. It appears that the benefits of imagery observed with discrete/serial tasks may also extend to continuous types of tasks. Furthermore, to these authors' knowledge this is the first applied study showing that imagery as a stand-alone intervention can positively influence swimming performance.

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APPENDIX

Excerpt from one imagery script:

Hear (coach) yell out that you will be swimming the 1000 for time. Experience yourself in your lane getting read . . . and begin to narrow your focus on your practice set. Again release any possible distraction . . . cold water . . . the school day . . . and remind yourself of what you need to do in order to swim your ideal practice set . . . whether that be going out faster . . . keeping your stroke long . . . executing your flip turns flawlessly . . . or maintaining a tighter dolphin kick off the wall. As you wait to start, experience yourself being confident, positive, having high energy, and a competition focus for the upcoming set. Now adjust yourself in the water as you wait to start your practice set . . . just a few seconds to go. As (coach) yells go . . . image yourself starting your ideal 1000-yard practice set. See and feel yourself going out fast . . . swimming strong . . . keeping your stroke long . . . maintaining your tempo . . . having a hard kick . . . executing a perfect s-shaped catch . . . timing your breathing just right with your stroke . . . As you get to the first wall experience yourself executing your ideal flip turn without breathing into the turn . . . cleanly coming over the top having your hips and legs come straight over . . . staying low to the surface . . . hitting the wall shoulder-width apart and pushing off the wall . . . using a tight and fast dolphin kick as you get good distance from the wall. As you surface see and feel yourself swimming ideally. Now for the next few minutes experience yourself going through the first half of your timed practice set . . . try to image this with as clear and vivid an image as possible . . .