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Asian Journal of Sport and Exercise Psychology 2 (2022) 106–113

Contents lists available at ScienceDirect

Asian Journal of Sport and Exercise Psychology

journal homepage: www.elsevier.com/locate/ajsep

A Real-world Examination of Progressive Imagery Delivery in Competitive Basketball

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ARTICLE INFO

Keywords:
Routine imagery
Progressive imagery
Retrogressive imagery
Self-efficacy
Basketball

ABSTRACT

Effective delivery of imagery training has been studied for some time. Recently, researchers have determined that, in some contexts, Progressive Imagery (PI), in which content is added to the imagery script in phases, can be more effective than Routine Imagery (RI), in which all the imagery content is presented in every session of an imagery program. However, most research to date consists of field studies, lacking ecological validity. We examined the efficacy of a PI program presented to highly-skilled basketball players in league competition across a whole season, using a Single-Case Design (SCD). Participants were five male players from Division 1 of the State Basketball League, who were pre-tested on the Sport Imagery Ability Measure (SIAM) to ensure they had at least moderate imagery ability. We monitored their Free-Throw Shooting (FTS) percentage in every league match of the whole season. The first 4 to 6 matches (Phase A) gave a stable baseline. Phase B, again lasting 4 to 6 matches, involved imagery that focused on static aspects of FTS movements. In Phase C (4 to 6 matches), more complex elements of FTS were added to imagery, including teammates and opponents on court. Phase D, lasting at least 4 matches, introduced imagery of a high-pressure context in which the FTS shot would decide the match. At the end of the season, each participant was interviewed about his experiences with imagery. We employed visual analysis and the split-middle technique to measure performance and self-efficacy. On these measures, all participants improved their FTS from baseline to Phase D, although two performed best in Phase C. Participants reported feeling comfortable with the changing phases, although one commented that he would have preferred the high-pressure imagery earlier, before he faced real high-pressure finals. We concluded that PI was an effective intervention among highly-skilled participants over a full competition season, while timing of high-pressure imagery should be tested prior to crucial season-ending matches.

Introduction

Researchers have proposed that imagery effectiveness is influenced by a number of factors, including the method used to deliver imagery (Cooley et al., 2013). However, the most effective imagery delivery method is yet to be determined, and researchers and practitioners remain uncertain about which method they should recommend to athletes. One type of imagery delivery, referred to as Routine Imagery (RI; Fazel et al., 2018), has been used in many studies and applied settings (for a review, see Cooley et al., 2013). In RI, participants imagine the same, usually complex, scene during every session, without any changes throughout the intervention period. While RI has been shown to be effective in many studies, researchers and practitioners have questioned whether it is always the most effective way to deliver imagery training (e.g., Cooley et al., 2013; Fazel et al., 2018).

Another method recently used in the literature, which is called Progressive Imagery (PI; Fazel et al., 2018, is to implement various elements of imagery in a progressive way. In other words, in PI, training programs start with simple images, few objects, and little action, then become more complex by adding information in steps. Similar to this approach, the term Layered Stimulus and Response Training (LSRT) has been used by other researchers (Quinton et al., 2014). This approach involves adding more content as the intervention progresses in layers. There are differences between PI and LSRT. Firstly, LSRT is participant-based, which means that participants choose what they want to add to the content, whereas in PI the researchers determine the content that is added. Secondly, the name layered does not indicate whether the content is taken away or added to the imagery script. For the above reasons, we chose PI, as it clearly suggests content is progressively added to the imagery script.

One of the first studies that generated the idea of using different imagery content was the study by Calmels et al. (2004a), Berthoumieux, and d'Arripe-Longueville (2004). In this 5-stage imagery intervention, researchers added more elements to the imagery script stage by stage to make the scenario more realistic. To be specific, the imagery that was

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https://doi.org/10.1016/j.ajsep.2022.09.002
Received 17 May 2022; Received in revised form 9 September 2022; Accepted 9 September 2022

presented to softball players became more complex with each stage by adding the position of potential runners on different bases and possible distractions (e.g., weather, noise, unfair umpire). After 28 days of imagery use, participants showed improvement on dimensions of selective attention. In a similar study, the imagery vividness of softball players increased after incorporating five phases of imagery training (Calmels et al., 2004b). Calmels et al. (2004b) added more details in each stage (e.g., the trajectory of the ball, desired contact with the bat, the weather, and the crowd noise), and also included imagery of dealing effectively with distraction information (e.g., the reputation of the pitcher, score, and a perceived unfair umpire). Calmels et al. (2004b) found this imagery delivery method, called PI in the current study, to positively affect participants' imagery vividness. Calmels and colleagues examined PI-style imagery interventions, but mainly focused on psychological variables, such as improvement in visual perception, imagery ability, and self-efficacy (Calmels et al., 2004a, b; Williams et al., 2011) and they did not examine the effect of such imagery on performance directly. However, their studies have been criticised because they involved small samples (N = 4) and for not employing a control condition (Williams et al., 2013).

Another study that examined LSRT was the study by Williams et al. (2013). In this study, participants were asked to add elements that they felt would make the imagery experience more realistic layer by layer. Williams et al. assigned participants into three different conditions, namely LSRT, movement imagery, and visual imagery conditions. Only participants in the LSRT condition showed improvement on their kinesthetic imagery ability, imagery ability of more complex skills, and actual golf-putting performance.

Quinton et al. (2014) examined the PI approach, using the LSRT approach. However, participants were children, and the imagery aimed to maintain their interest, avoid boredom, and also to prevent overloading them with too much new information at one time. Quinton et al. reported no significant impact on children's performance nor on their imagery ability. However, the effectiveness of LSRT was evident in other studies (e.g., Marshall & Wright, 2015; Williams et al., 2013). For example, Williams et al. compared LSRT effectiveness with imagery practice on performance and imagery ability. LSRT was found to be effective in performance improvement. Marshall and Wright also demonstrated effectiveness of the LSRT approach in enhancing performance.

A third training method, introduced by Fazel et al. (2018) for the first time, is Retrogressive Imagery (RETI), in which the process of PI is reversed, starting with the complex imagery scene, then removing elements to finish with imagery of the central task. The reason Fazel et al. named this imagery delivery method RETI is that the imagery starts with very detailed and complex scenarios, then elements are gradually removed to make the imagery script simpler. In Fazel et al., the three imagery delivery methods (RI, PI, and RETI) were compared, along with a no imagery training control condition to identify the most effective method in performance enhancement and self-efficacy improvement of athletes with limited skills. Results showed RETI to be superior to the other conditions for limited-skill players in basketball free throw shooting (FTS) performance, as well as self-efficacy. In another study, Fazel et al. (2022 submitted) repeated all aspects of the same study design, but with highly-skilled basketball players. They compared RETI, PI, and RI, with a no imagery control condition. Interestingly, they found that, with a sample of highly-skilled athletes, PI was the most effective imagery delivery method for enhancing performance and self-efficacy.

Most of the research that has been conducted on imagery delivery methods has used laboratory or field-study designs, which have been popular in other research examining imagery training in sport (Morris et al., 2005). However, sport psychology researchers and practitioners started to adopt more single case designs (SCD) because of concerns regarding the ecological validity of laboratory and field-studies (Hrycaiko & Martin, 1996). The number of studies using SCD has increased dramatically, leading Barker et al. (2013) to publish a special issue on SCD papers in sport psychology in the *Journal of Applied Sport Psychology*. The issue aimed to highlight the significance of SCD and raise awareness of such research methods as a credible approach in sport psychology. Experimental research designs do not always fit comfortably with the characteristics of an applied setting (Anderson et al., 2002), as laboratory-based, as well as field study, research creates an artificial environment, which often bears little resemblance to competition (Goldfried & Wolfe, 1996). Most studies, like those by Fazel et al. (2018, 2022under review) were field studies in which it was possible to control the scheduling and the number of FTS performed by each participant. Such field studies performed away from the real competition context examine performance in "sterile" situations lacking the stress of competition, as well as all the complications related to the presence of team-mates, opponents, referees, and spectators. Thus, the field studies by Fazel et al. provided only a partial test of how the different imagery delivery methods would function in high-level competition. In particular, they did not create a context to fully examine the impact of many key factors of high-level competition (the team-mates, opponents, referees, spectators, and the pressure of the competition context) as they were progressively added in the PI condition.

The primary aim of the current paper using SCD was to examine the impact of PI on FTS performance among high-level basketball players in league matches across a whole basketball season to confirm, challenge, or extend the findings of intervention field-studies (Fazel et al., 2018, 2022 submitted) in a real competition context. No study has examined the effects of any imagery delivery method (e.g., LSRT or PI) in real game situations at a high-level of skill. Performance could be affected differently during highly-competitive matches, where team-mates, opponents, officials, and spectators can all affect individual players, as well as the physical environment, particularly when it is not the home court (Maher et al., 2019, 2020). In addition, to understand what participants experienced over that period in terms of the PI training and its impact on their FTS performance in competition, we interviewed each player at the end of the season. In this way, we acquired more detailed information regarding what they liked and disliked about the intervention and its effect on their match performance to help elucidate the quantitative results.

Material and methods

Participants

Participants in this study were five male Victoria State Championship League players aged between 28 to 36 years (M = 31.8, SD = 3.4) with a minimum experience of 15 years playing basketball (M = 22.2, SD = 5.3). The state championship league is the highest level of men's basketball competition in Victoria, Australia and ranked third among Australian basketball leagues. Some players with national team experience, but near the end of their careers, and young talented players compete in the State Championships League.

Participants had no previous experience in systematic imagery training. They demonstrated the ability to imagine the content of the PI intervention. Players were required to have a minimum score of 150 out of 400 on the most relevant subscales for performing PI (vividness, control, visual, kinesthetic, tactile, and auditory) of the Sport Imagery Ability Measure (SIAM; Watt et al., 2004). All participants had a minimum of six FTS shots during each game in their previous playing season.

Study Design

A multiple treatment (ABCD SCD was employed to examine how adding new elements to the script phase by phase in the PI intervention affected participants' performance of FTS in matches throughout a competition season. Following the baseline (A) phase, which was a no imagery phase, the PI intervention was introduced to the participants progressively in three phases. During the three intervention phases (B, C, D), participants received more complex content in the imagery script in each phase. Thus, the intervention process extended the simple AB SCD to an ABCD design, so the separate impact of each intervention phase could be evaluated and compared with the baseline phase and with other imagery phases (Kazdin, 2011). Each phase lasted one month, which included between 4 and 8 home and away games, and each participant's FTS was measured individually in each game.

At the end of the study, we invited all participants to take part in an interview session. We conducted an individual face-to-face interview with each player in relation to social validation feedback about their experiences of using PI, and to obtain their estimate of the effectiveness of PI related to competition FTS performance. Players were also asked whether they had any suggestions to enhance the effectiveness of the PI program.

Measures

Demographic information form. We gathered specific details regarding participants' age, gender, years of basketball experience, and whether they had experienced imagery or other psychological techniques before, using a demographic information form.

Sport Imagery Ability Measure (SIAM; Watt et al., 2004**).** We administered the SIAM to ensure that participants had at least moderate imagery ability to perform the imagery tasks in the intervention. Athletes imagined each of four sport-related scenes, during a 60-second period for each scene. Following the imagery period for each scene, athletes responded to 12 items, representing five imagery dimensions (vividness, control, ease of generation, speed of generation, duration), six sense modalities (visual, auditory, kinaesthetic, olfactory, gustatory, tactile), and imagery of emotion, by placing a cross on 100mm visual analogue scales with verbal extremes at the end of each scale (e.g., "no image at all" to "perfectly clear image" for vividness). Scores for each dimension or modality were summed across the four scenes, so each subscale score varied between 0 and 400 points. In the original validation process, the SIAM revealed alpha values between .66 and .87 (Watt et al., 2004). The scores of the key dimension subscales (vividness, control) and sense modality subscales (visual, kinesthetic, tactile, and auditory) that are considered to be most relevant to basketball free-throw shooting performance were evaluated to ensure that athletes' imagery ability was adequate (>150 out of 400) to benefit from the imagery training in this study.

Free throw shooting percentage. We used the basketball league's statistics regarding participants' FTS attempts and successful FTS for each game. Data was also obtained from the official score sheets of the games. In case of any discrepancy between these two sources, we used the official score sheets due to the high level of accuracy of this data recording system. Game free-throw percentages, number of successful shots, divided by total number of attempts, multiplied by 100, were calculated for all home and away games.

Imagery manipulation check. To verify the imagery experience, participants filled out a manipulation check form after each imagery session. This check followed recommendations previously made in the literature (e.g., Cumming & Ste-Marie, 2001; Nordin & Cumming, 2005; Smith & Holmes, 2004). We asked participants to rate how well they saw, heard, felt, and how well they performed the imagery they were instructed to do. They made ratings on a 4-point Likert scale ranging from 0 (*not at all*) to 4 (*very much*).

Social validation interview. Social validation has been commonly used in SCD studies within sport and exercise psychology research. As recommended in the literature (Page & Thelwell, 2013) we used semi-structured interviews for data collection, using content analysis to analyze these data, reporting qualitative social validation results in a thorough manner. At the end of the intervention phase, we interviewed all participants in one-on-one sessions to explore their personal experiences and acquire more detailed information regarding the PI intervention and its effectiveness. The main research questions focused on participants' imagery experience, perceived effects of the intervention, aspects of the imagery content that were easy-hard-useful, how they felt during the imagery process and during real FTS performance during the game, and if their preparation to execute FTS had changed during the course of the season. The interviews were conducted for each participant a week after their final game of the season, recorded and transcribed verbatim.

Intervention

Phase A was the baseline no intervention phase, during which we monitored FT performance of athletes for four to six games. After baseline was completed, we introduced the first intervention phase (Phase B) by instructing athletes to imagine simple static aspects of the basketball FT context during a game. Players imagined court lines, the rim, and themselves standing at the foul line sensing the muscles in their legs and arms, and performing FTS. They performed the imagery three times a week for four weeks. In Phase C, we instructed the players to include more details in their imagery scene by adding team-mates and opponents standing around the basketball key, as well as the voice of the referee, and the noise of the crowd. This was followed by the final intervention phase, Phase D, during which we increased the complexity further. We instructed participants to imagine a high-pressure situation in which there was one second left on the clock, their team was behind by one point, and the outcome of the game depended on their FTS.

Procedure

The study was approved by the University's Human Research Ethics Committee. Participants read a statement about the purpose of the study, asked any questions about what was expected of them, and signed an informed consent form, if they were willing to volunteer. We selected State Championship basketball players who were likely to have substantial numbers of FTSs during most games by looking at their FT statistics from the previous season and the first three games of the current season, because that is the best indicator of their standard when they entered the study. We invited them to participate in the study by sending an email to them. In the first individual meeting, following the consent process, as an introduction to the concept of imagery, each participant was given a definition of imagery, and was informed about the effective use of imagery by elite performers in many sports, with examples. Participants were then given the opportunity to ask questions to ensure they understood why imagery is widely used by high-level performers. Participants then completed the SIAM, which reflects the use of imagery in six sense modalities, five dimensions, and the experience of emotion during imagery.

We implemented a SCD procedure to assess each player's FTS percentage performance in all games during the playing season. To attain a stable baseline, Phase A varied between 4 and 6 games. This phase generated pre-intervention data for competitive FTS. The intervention phases (B, C, and D) lasted for 4 to 6 games each. In each intervention phase, players listened to the designated PI content presented in mp3 format and saved on each player's mobile phone, in three sessions a week for four weeks. In a study of netball shooting, and in a strength task, Wakefield and Smith (2009, 2011) reported that imagery training is more effective, when it is conducted three times per week, compared with once or twice per week. As participants in this study had three sessions of basketball training each week, we decided to assign participants three imagery sessions per week, after their training sessions. These and other researchers, including Fazel et al. (2018, 2022 submitted for review) have chosen four weeks of imagery training, along with three imagery sessions per week, and found this to be effective. In some weeks during the intervention phase, players had two games over the same weekend (Saturday night and Sunday morning), so there was no imagery practice between those games. This also explains why the imagery phases lasted four weeks, but the number of games in that period varied between 4 and 6. Players who made the finals had two extra games in the last intervention phase. This means that once they reached the full imagery content in Phase D, they continued to listen to the final imagery script for the rest of the season. At the end of the intervention (a week after the final game of the season), we invited all five participants to attend an individual interview to capture their personal experiences. Finally, we gave each participant the opportunity to ask any questions or make any comments. After this debriefing, we thanked them for their participation.

Table 1
imagery ability scores of participants.

	Auditory	Visual	Kinaesthetic	Tactile	Control	Vividness
Scott	293	232	257	259	286	299
Tom	299	316	244	270	316	306
Jason	250	259	208	206	313	281
Sam	290	382	244	173	256	362
Manny	254	318	232	257	326	287

Table 2
Participants' Imagery check means and standard deviations for the four phases.

Participant		Phase A	Phase B	Phase C	Phase D
Scott	*M*	3.48	3.54	3.50	3.57
	SD	.34	.37	.36	.28
Tom	*M*	3.32	3.36	3.46	3.82
	SD	.56	.40	.37	.10
Jason	*M*	2.82	3.23	3.39	3.35
	SD	.32	.64	.30	.26
Sam	*M*	2.63	2.80	2.96	2.95
	SD	.66	.54	.32	.42
Manny	*M*	3.33	3.56	3.87	3.92
	SD	.48	.32	.06	.04

Analyses

We employed visual analysis to determined changes in each participant's FT percentage trend from one phase to another throughout the study. The visual inspection method has been widely used to analyse the data from SCD studies by looking for changes in trend, level, slope, and variability (Ximenes et al., 2009). The main criteria used in this study to visually analyse the graphs of each participant were change in the mean, change in level, and slope or direction of the celeration line from phase to phase. We calculated the mean of each phase by summing the values of all the data points of each phase and dividing the total by the number of data points in that phase to check whether FT shooting performance either increased or decreased from the previous phase. We calculated trend lines to provide a descriptive aid for visual inspection and allow for level and slope measurements to be calculated. To create a trend, or celeration, line for the purpose of examining the results in SCD studies, a technique called the Split-middle Technique has been developed (White, 1972, 1974). We applied the split-middle technique to determine trend lines for each phase and to calculate the level and slope of the lines for visual inspection of the data as proposed by White (1974). Steps for creating a trend line are, a) draw a vertical line in the middle of the data points, so there will be the same number of data points in each half. If there is an odd number of data points, the line will be drawn through the middle point. b) Find the median of the data points in the left half, as well as the median of the points in the right half. c) Draw a vertical line in the middle of each half, so you divide the data points into 4 quarters with an equal number of data points in each quarter. d) Find the intersection between the vertical line in the middle of each half and the median of the same half. e) The trend line will be the line connecting the two intersection points.

Level refers to the value of the dependent variable where the celeration line passes through the end of one phase (last game in the baseline phase, Phase A, for instance) with the beginning of the next phase (first game in Phase B). To calculate the change in level, the larger of the two values is divided by the smaller. The trend or slope refers to the direction of successive data points within each phase, compared to the next phase. The slope of the line for each phase is calculated by arbitrarily identifying a point on the line along with the point on the ordinate through which the line passes (Kazdin, 2011). The larger value of these two phases is then divided by the smaller to derive the slope of the line. A multiplication sign (x) is given to the line, if an increment (shift up) occurs in level as well as in slope, and a division sign (÷) is used, if a decrement (shift down) occurs.

We employed inductive content analysis to analyze the social validation interview. In the interviews, we aimed to explore participants' experience of imagery, PI in particular, and their attitude towards it, and not to drive a new theory (Patton, 2002). To do so, we transcribed the recorded interviews verbatim and checked content accuracy by reading the transcribed interviews and listening to the interview records several times. Raw data interview statements were grouped to derive themes related to participants' experience by reading, rereading, and coding (known as open coding; Patton, 2002) and to ensure that all the raw statements were categorized into the most suitable theme. To ensure reliability and trustworthiness, the method of triangulation was used (Patton, 1990), in which two or more researchers independently review and interpret the same set of transcripts of qualitative data and then compare their interpretations, discussing differences until consensus is reached. To do this triangulation analysis, we asked a sport psychology researcher familiar with the social validation interview analysis process to independently examine the transcripts of the interviews. Then, the first author met with this researcher to discuss issues raised and resolve disagreements about coding. For detailed discussion of the triangulation process see Smith and McGannon (2018) (Table 2).

Results

In this study, we examined the effect of PI training on competition FTS performance of highly-skilled basketball players. In this results section, we present participants' profiles followed by their imagery screening scores, game-by-game FTS percentage, and interview responses. Game FTS percentage for all five participants is illustrated in Fig. 1, followed by their interview responses. In particular, we include in the interview responses section participants' explanations of their feelings during the imagery training and during their FTS performance in a real-time situation. We also explored whether participants' experience changed during the season. The names used in this section are pseudonyms.

Participants' profile. Participants' average age was 30.8 years, with an average of 20 years' experience of playing basketball. They all played at a high level of basketball from state championship to national representation. All five participants played an important role in their team. With respect to scoring, they had an average of 22.8 points per game during the previous playing season. This means they were key team members in terms of the core criterion of points scored in league competition. None of the participants had previous experience in any kind of psychological training program, including imagery.

Screening for Imagery Ability. To ensure that participants had sufficient imagery ability to benefit from the PI intervention program, we measured their imagery ability using SIAM. A minimum score of 150 out of 400 on all six most relevant SIAM subscales was required for participants to be eligible for this study. Imagery ability of all participants on the six key subscales is presented in Table 1. In general, all participants' imagery ability scores were high and well above the cut off for acceptance in the study.

Free throw performance. Successful FTS percentage for each game for all participants was measured throughout the season. Fig. 1a-e shows performance across the four phases in the study, including the mean for each phase, the level of the celeration line, and the slope of the celeration line into the next phase, for all five participants. This figure was compiled to facilitate comparison between participants.

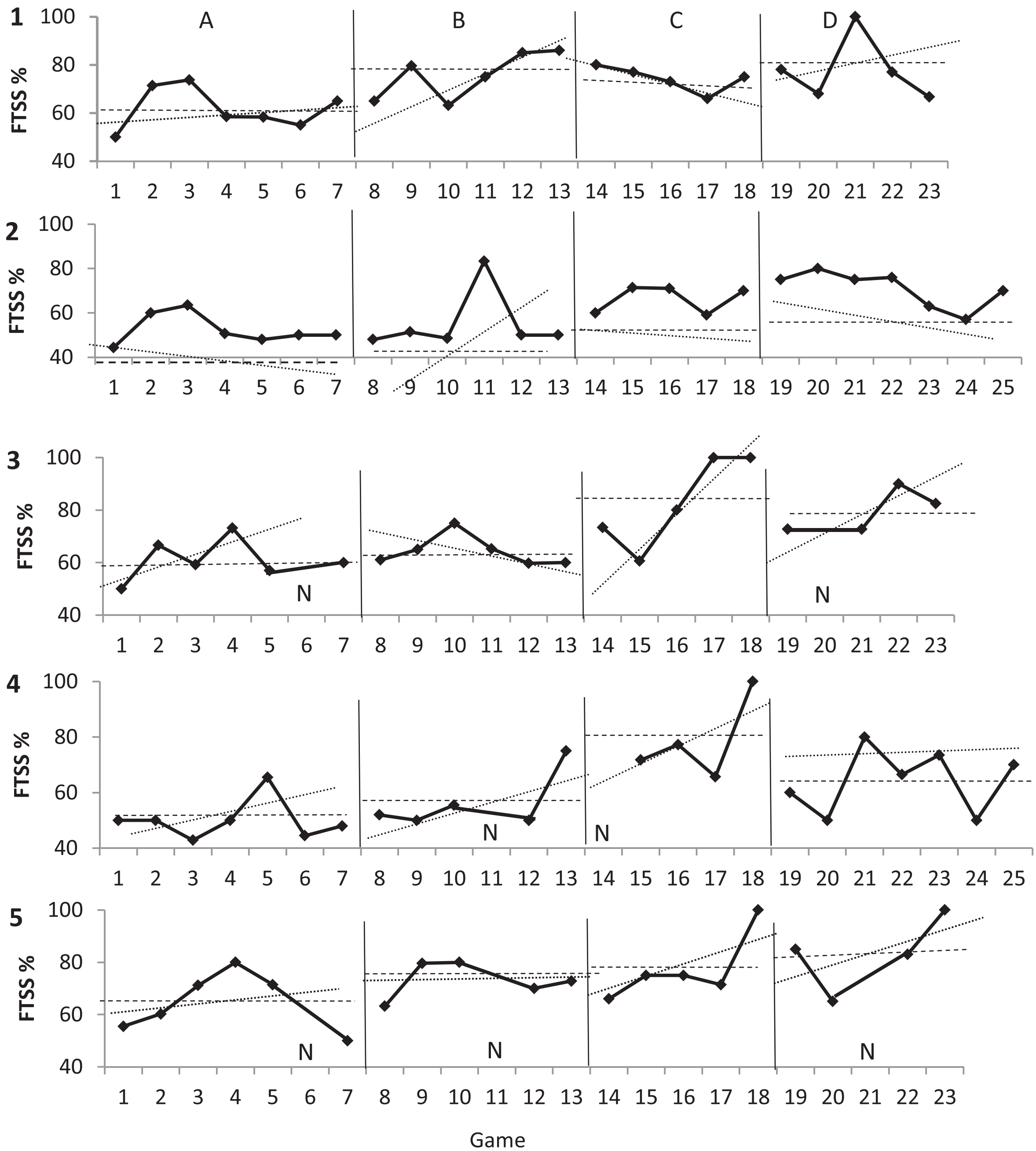

Fig. 1. Split-middle analysis of participants' fts percentage throughout the season.
Notes: 1. In Figure 1, graph (1) is Scott; (2) is Tom; (3) is Jason; (4) is Sam; and (5) is Manny.

Scott's mean FTS shooting percentage (Fig. 1a) increased by 16.06 %, the level shifted down 6%, and the trend line increased (x 1.06), during Phase B compared to the baseline phase (A). In comparison with Phase C (2nd intervention phase), Scott's FTS% mean decreased 3.56%, the level shifted down 4.9%, and the trend line decreased (÷1.38). During Phase D, Scott's FTS% mean recovered by 3.74%, approximately to the same mean level as Phase B, the level shifted up by 6%, and the trend line decreased (÷ 1.09) compared to Phase C. Overall, Scott showed an improved FTS percentage mean in the second phase and maintained the improvement in Phase D, at the end of the season.

2. The solid, bolded, vertical lines indicate the point of phase change, horizontal dashed lines represent mean performance for each phase, and dotted lines in each phase signify celeration lines.

3. The symbol N in this figure indicates that no free throw was awarded to the player during that game.

Tom's FTS percentage mean (Fig. 1b) increased by 2.84%, the level shifted down 8.3%, and the trend line increased (x 1.51) during Phase B compared to the baseline phase. Tom's FTS percentage mean increased further by 11.07%, however, the level shifted down by 10.4%, and the trend line decreased (÷1.39) during Phase C compared to the Phase B. During Phase D, performance improved by 4.57%, the level shifted up 14.5%, and the trend line decreased (÷1.10) compared to Phase C. In summary, Tom's FTS shooting improved in gradual steps through the phases. His FTS percentage mean during the baseline phase was 52.37, and, after the imagery intervention, he improved his FTS percentage to 70.85.

In relation to Jason's performance, his FTS percentage mean (Fig. 1c) showed 4% improvement, the level shifted down 5.5%, and the trend line decreased (÷ 1.32) during Phase B compared the baseline phase. During Phase C, Jason's FTS percentage dramatically increased by

20.15%, the level shifted down marginally 2%, and the trend line increased (×1.60) compared to Phase B. In Phase D, Jason's mean performance decreased by 5.67%, the level shifted down 45%, and the trend line decreased (÷ 1.26) compared to Phase C. Overall, Jason's mean performance increased in Phases B and C. Even though performance dropped a little in Phase D, there was still a big improvement compared to the baseline. Jason started with 61% FTS shooting, during the baseline phase, and his FTS performance increased to 85.15% in Phase C, and Jason finished the intervention in Phase D, with FTS performance of 79.48%, a large increase from the baseline phase.

From the visual inspection analysis of Sam's performance (Fig. 1d), specifically during Phase B, the FTS percentage mean improved slightly by 7.50%, the level shifted down 14.4%, and the trend line increased (x 1.00) compared to the baseline phase. During Phase C, the second intervention phase, Sam's performance mean increased substantially by 21.05%, the level shifted up marginally 0.6%, and the trend line increased (x 1.09). In Phase D, his FTS percentage deteriorated by 14.39%, the level shifted down by 16%, and the trend line decreased (÷ 1.08) compared to Phase C. Overall, Sam's improvement showed a similar pattern to that demonstrated by Jason. He showed improvement in FTS percentage mean in Phases B and C, with a very large improvement in Phase C, but FTS performance declined in Phase D compared to Phase C. However, Sam's performance in Phase D was greatly improved compared to Phase A, the baseline, with a 14.16% increase.

Based on the split middle analysis, Manny's mean FTS percentage performance (Fig. 1e) improved by 8.4%, the level shifted up 3.9%, and the trend line decreased (÷ 1.02) in Phase B compared to the baseline phase. Manny's mean performance in Phase C increased around 4.36%, the level shifted down 6.2%, and the trend line increased (x 1.21) compared to Phase B. In Phase D, Manny's mean FTS percentage performance improved by 5.77% the level shifted down 21.1%, and the trend line decreased (÷ 1.00) compared to Phase C. Overall, like Tom, Manny improved in his FTS percentage mean and continued to improve phase by phase. Before the intervention phase, he was shooting 64.72%, and after taking part in the imagery intervention his FTS percentage improved to 83.25%.

Imagery Manipulation Check. To verify the imagery experience, participants filled out a manipulation check form after each imagery session. Participants were asked to rate how well they saw, heard, felt, and how well they performed the imagery they were instructed to do on a 4-point Likert scale ranging from 0 (*not at all*) to 4 (*very much*). All five participants reported strong to very strong imagery that typically increased from Phase A to Phase D.

Social validation interview analysis. All participants reported that they found the PI intervention to be very clear and well structured. PI helped them to experience vivid and detailed imagery of the FTS performance situation, although it was challenging for some of them initially, as they had never performed imagery before. For example, one of the participants mentioned "I have never done imagery before and it felt awkward". They all mentioned using all their senses when practising imagery to make the experience more realistic. All participants claimed that, towards the end of the intervention, they experienced some of the feelings that they would get when actually performing FTS, but to a lesser extent.

Imagery helped each participant differently. For example, Scott reported that the imagery helped him with the way he approached the FTS during the game, particularly to "sort out his routine". He noticed that during imagery practice he concentrated more on shooting, rather than talking to the players and the referee as opposed to the real game situation. Tom, on the other hand, stated that imagery helped him not to think too much. For Tom, imagery helped him to remove "all emotions and everything else that was going on". He mentioned that thinking about physical aspects of FTS during PI helped him to pay less attention to his normal emotional reactions during FTS performance. He stated, "It slowed the FT preparation down and removed the emotions and it made it more instinctive, which is good". He suggested that the more he focused on thinking about what he needed to do physically to perform FTS successfully, the less emotion would interfere with his performance. PI training also gave him the time to slow things down in his mind, which he explained was what he needed. With support from the PI, Jason felt very calm, relaxed, and more confident on the free-throw line than he was before the intervention. "This is in direct contrast to the situation in the past where I have felt rather nervous at the FT line, especially if I am in a period of bad form where I haven't hit a few in a while, and I get extremely nervous in those situations", he said. He stated that "in one game, even after I missed my first FT, I could stay focused and calm and hit my second shot with confidence", which he claimed he normally could not do prior to the intervention. For Sam, creating the pressure situation in the fourth phase was the highlight of his imagery experience. In his opinion, by imagining that he could make shots when a crowd was watching in those high-pressure situations, he felt he could hit those shots when the pressure was not as intense. So, imagery helped him to manage pressure when he really was in those situations. He pointed out that he always failed to ignore people who were watching him, and imagery training taught him that he should deal with the audience pressure instead of trying to ignore the pressure. Manny found imagery training really useful because it helped him to focus on key aspects of FTS that he needed to perform at the FT line, and to block out a lot of distractions. Manny reported that he was able to concentrate on his shots more, rather than just getting to the line and rushing his shots, or letting distracting thoughts come into his mind. Specifically, PI helped Manny to manage his mind, which meant rejecting unnecessary thoughts that create stress, such as "what ifs". Instead, he could think about some other useful hints, like focusing on the rim and making the basket. He added, "It is a familiar scene when you go through your routine. It is like you have been in those situations a hundred times and you feel more relaxed". He found imagery very helpful by saying, "The picture is painted clearly in your mind, and it is good because if you have been in a situation like that even in your mind, you can get those points in real games as well". Overall, all five participants felt PI was effective in promoting their improvement. While two participants reported that they found the changes in delivery at the start of new phases to be challenging initially, this appeared to be because they had no prior experience of imagery within the context presented here, and they soon adjusted to the new imagery content. Although the imagery training helped each participant in a different way, they all thought it played a crucial role in increasing their FTS percentage.

Discussion

The present study cannot be directly compared to previous research because we are not aware of any studies that have examined the efficacy of PI among highly-skilled sports performers, conducting tasks that are well-learned, in real competition, over a whole league competition season. Williams et al. (2013) conducted an imagery intervention study, using what they called layered (LSRT) imagery. The difference between the current study and Williams et al. (2013) is that they compared two conditions (layered stimulus and response training with motor imagery training) among novices who had low imagery ability. In the current study, the participants were highly-skilled athletes with moderate to high levels of imagery ability. Also, in the Williams et al. study, participants were the ones who decided what propositions to add to the content that they felt would make the image a more realistic representation of the actual situation, whereas in the present study participants were directed to generate specific propositions by the researchers. Although meaningful imagery chosen by participants has been reported to result in more effective outcomes in some studies (Lang, 1979; Cumming & Williams, 2013) it could be debated. For example, whether self-selected imagery will be more meaningful would depend on individuals' prior experience with imagery, as well as their skill level. In a previous study that compared self-selected and researcher-selected imagery content, we found that researcher-selected content produced slightly superior outcomes with participants who had limited prior experience of imagery (Kuan et al., 2017). Another study conducted by Quinton et al. (2014) examined LSRT among children performing soccer skills. In this study, performance did not improve significantly with layering. However, Marshall and Wright (2015) found LSRT to be effective in putting performance, while no improvement was shown in a non-LSRT imagery condition and a control condition.

Fazel et al. (2022 under review) conducted a field study, comparing a PI intervention to RI, RETI, and a control condition. Participants were skilled basketball players. The task was FTS performance, with four phases, imagery of the FTS task alone in the first phase, imagery of the task with teammates and opponents round the key in the second phase, inclusion of an audience in the third phase, and addition of pressure, with a shot to win the match, in the fourth phase. Performance improved most for PI, followed by RI, while RETI was little different to the Control condition. The present study was designed to examine whether the success of PI in a field study, with highly-skilled performers, would transfer to real competition over an extended period, with similar, highly-skilled basketball players. Results of this study support our prediction that PI can be effective in the real-world context of season-long competition, focussed on performance of the key skill of FTS. Basketball players, teams, and their coaches are likely to be most impressed by FTS performance. On average, the five players in this study improved their FTS from a solid 58.4% in Phase A to a strong FTS percentage of 77.4% in Phase D.

The present study does have a number of limitations, some of which are inherent in SCD. The sample of five basketball players was relatively small, but it is challenging to ask highly-skilled players, performing in one of the most competitive leagues in the country, to commit to a study in which they must undertake imagery training for the whole season. Also, published SCD studies in sport often have very small samples (Barker et al., 2013), including a single participant (Filgueiras, 2016).

Certain limitations are more specific to the design of this study. We had no control over the number of free shots that each player had in each match. Most players had one or two matches in which they were “shut out” by strong opposition, having no free shots in that match (indicated by N in Fig. 1). A related limitation is that we had no control over variations in the strength of the opposition in different matches. This impacted on the number of FTS that players had in different games. However, the outcome measure we used was percentage of successful shots, which takes some account of those variations. A larger number of shots produces more opportunities to miss, but one miss, if a player has only three shots in a match, results in a lower percentage (67% success) than missing two shots out of 10 opportunities (80% success). On one hand, playing in a strong team would give a player more FTS opportunities across the season. On the other hand, the players competed against all the other teams in the competition, which averages out the level of challenge across the season.

In addition, we had no control over the way in which several extraneous variables might have affected performance of FTS in different matches. These variables include whether the match was played at home or away, the player’s perception of the opposition in each match, when (on the clock) the FTS performance occurred in the match, what the match score was when each FTS was performed, size and orientation of the audience (pro or con the player’s team), and pressure experienced by the player at the time of each shot. In future, more extensive SCD studies could monitor some or all these variables. At the same time, their effect could be examined more precisely in controlled field studies, although this would probably affect the ecological validity of studies. There is always going to be a trade-off between degree of control and ecological validity. A combination of controlled field studies and ecologically valid real-world studies might help to clarify the role of variables that are systematically manipulated in field studies and monitored as they vary naturally in SCD research.

Conducting research projects that involve interventions over a whole season, in league basketball that involves 16 to 18 weeks of competition, presents problems. The participants in the present study were all volunteers, but under the varying pressures of high-level competition, as the season progresses, even volunteers might start to question their commitment. Players did not present any major disruptions, while their responses to the social validation questionnaire did not suggest any problems with motivation, but participants might not have wanted to raise any concerns about their effort once the study was completed. Conducting short interviews periodically during a long study like this one might be an effective way of monitoring fluctuations in participants’ motivation, mood, and other relevant psychological variables. Reflection on FTS performance, perhaps, tells an interesting story. All five players were highly skilled. They had successful FTS records in the previous season. Thus, improving might have been a challenge during the season we studied. Nonetheless, they all increased their FTS performance by around 20% from Phase A to Phase D, which speaks for itself.

For two players, Tom and Sam, the season lasted longer than it did for the other three. They were involved in finals, which prolonged the season by two matches. Further, these matches involved more pressure because they were finals. These matches occurred at the end of the season, when players had just been involved in Phase D, the high-pressure imagery phase. We decided to continue Phase D into the finals. It is possible that actually experiencing high-pressure matches, immediately after experiencing, and while still continuing to experience, high-pressure imagery might have disrupted performance for those two participants. In the social validation interviews, one player, who participated in finals, reported that it would have been helpful to experience the high-pressure phase of imagery training earlier, so that its positive effects were more established by the time the finals arrived.

Although researchers have examined the effect of layered and progressive imagery on performance (Fazel et al., 2018; Quinton et al., 2014; Williams et al., 2013), as well as on psychological variables (Calmels et al., 2004a, b, Fazel et al., 2018; Williams et al., 2011), the number of studies that have been published is limited, while none have employed SCDs. Thus, there is great potential for programs of research examining these promising methods of delivering imagery training. Basic questions that should be straightforward to examine relate to whether PI effects can be generalized. For example, the present study only included male basketball players. PI should be examined in skilled female basketballers. The study only examined one skill, raising the question of whether similar results would occur with other discrete sports skills, such as golf putting, soccer penalty taking, and pistol shooting. The present sample comprised mature players with a great deal of experience. Studies should examine whether PI benefits are also evident in younger athletes. One study of layered imagery conducted with children found no significant performance effect in soccer skills (Quinton et al., 2014). A problem that frequently arises in research examining age differences is that variations in age can be confounded with differences in skill level, as well as inevitable variations in experience of the task. However, to date, there have not been any studies that have examined age differences of imagery training in the same task. This raises another basic issue, namely whether PI is effective across a wide variety of discrete sports skills and beyond to serial tasks, such as gymnastics floor routines and figure skating, as well as open skills, that is, skills performed in an unpredictable environment, such as team ball games and individual racquet sports. Different studies have examined a wide variety of sports skills, many studies have been laboratory-based, others have been field studies, and there have been a smaller number of SCDs. Studies have varied age, gender, skill level, and experience. These variations make it difficult to identify patterns. The study of PI is in its early stages, offering the opportunity for researchers to develop programs that control as many of these variables as possible, while examining the effects of one variable. For example, while examining the effect of PI on skill level, researchers should control for age and experience. Then, it would be possible to control skill level, while examining another key variable, such as experience of the task.

A problem that has impacted on the study of imagery in sport is the great diversity of contextual and participant variables that have been examined in research on imagery. Contextual variables, such as the nature of the task, can be examined systematically in field studies, but there is no substitute for research in real matches to study the effect on PI of contextual variables. These include size and commitment of audience, which relates to whether the match is played at home or away, objective quality and perceived quality of the opposition, perceived pressure, and state of the match when the skill is performed. Such variables can be studied in SCD studies, some by recording matches on video, which can be analysed for occurrence of a range of contextual variables, and others by conducting in-depth interviews. A combination of analysis of videos and interviews could be most revealing. For example, video analysis could show that taking FTS in high-pressure situations in basketball leads to some players producing a lower percentage of success (choke), whereas others increase their percentage (clutch), compared with FTS in general play. Interviews might suggest that those who choke tend to avoid high pressure, whereas those who clutch welcome and approach the same high-pressure situations (Gröpel & Mesagno, 2019; Hill et al., 2019; Maher et al., 2019, 2020; Marchant et al., 2014). Importantly, these contextual variables are also factors that should be examined for effectiveness as part of PI training programs, both individually and then in combination. In the study of contextual variables as factors that influence behaviour during the implementation of PI programs to enhance sports performance, and the examination of PI training programs that aim to help athletes cope with the pressure presented by contextual variables, a more fine-grained analysis of athletes' experiences could be gleaned by conducting interviews at the end of each phase, not just at the end of the whole program.

Conclusion

Because the present study is one of the first to apply the PI delivery method in a real-world, high-level competition context, more evidence is required, examining PI under such conditions. Nevertheless, some insights can be taken from the outcomes of this research. Following up on its effectiveness, compared to RI, RETI, and a control condition in a 4-phase field study, the present study supports the effectiveness of PI with highly-skilled, male sports performers in competition over a whole basketball season. Reflecting on the differences between the patterns of performance across phases of participants in this study, it appears to be important to understand the context of performance, as well as characteristics of individual players. Conclusions should be drawn with caution, but based on performance variations, as well as comments made in the social validation questionnaire, introduction of a high-pressure PI phase close to the stressful end of the season did have different effects on various players. One or two players felt their performance was disrupted in Phase D, whereas others continued to improve. This was also influenced by the continuation of Phase D during finals for two players. Although improvements for all five players from the baseline Phase A to Phase D, the final phase, support the use of PI with highly-skilled players, whose performance might not otherwise show systematic performance increases across a season, care should be taken in the design of PI studies, both in terms of the specific content of imagery, and in its timing. Practitioners will be able to design individualised PI training programs, once further evidence emerges from studies that control or monitor key contextual and personal characteristics. There is no doubt that there is much to be learned from well-designed studies of factors influencing the impact of PI, particularly SCD studies in real, competitive sport.

Conflict of interest

None.

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