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Running head: IMAGERY AND ATTENTION IN SOFTBALL

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Effects of an Imagery Training Program on Selective Attention of National Softball Players

Claire Calmels and Christelle Berthoumieux

Institut National du Sport et de l'Éducation Physique, Paris, France

Fabienne d'Arripe-Longueville

Université de Nice Sophia-Antipolis & Institut National du Sport et de l'Éducation Physique,

Paris, France

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Abstract

Based on Neisser's (1976) perceptual anticipation hypothesis and related research (e.g., Farah, 1985; Michelon & Koenig, 2002), this study examined the effectiveness of an imagery training program in improving national softball players' selective attention. A multiple-baseline design across individuals was used. The participants were four national softball players. One remained at baseline, while the other three spent 10 min a day practising an audio-taped imagery program composed of 28 sessions. Measures of selective attention were collected via a base-ball/softball batting specific version stemming from Nideffer's (1976) Test of Attentional and Interpersonal Style (TAIS). The results demonstrated that the imagery training program generally enhanced the ability of softball players to integrate external stimuli without being overloaded with them and to narrow attention. Results were discussed in relation to the usefulness of multiple-baseline designs for investigating individual differences among elite athletes. Practical pedagogical considerations for coaching are proposed.

Key-words: selective attention, imagery, multiple-baseline design, softball

Effects of an Imagery Training Program on Selective Attention Among National Softball Players

The ability to control and direct attention effectively is seen as a determining factor in the success of athletes (Abernethy, 2001; Cox, 2002). Anecdotal testimonies of world-class performers, reported by Orlick (1990) and Weinberg (1988), and guidelines or recommendations provided in applied sport psychology manuals (e.g., Maynard, 1998) have outlined the importance of concentration in peak and consistent performance. Nevertheless, though the concept of attention is better known in the sports world as concentration, Nougier, Stein, and Bonnel (1991) have suggested that the concept of attention is used loosely to express different aspects of attention, such as alertness, limited capacity or resources, and selectivity (Posner & Boies, 1971). The aspect of selectivity, which refers to the process by which one selects certain stimuli over and above others, which are ignored, is recognized as being the single most important attribute of successful performance (Abernethy, Summers, & Ford, 1998).

To obtain a deeper understanding of selectivity, sport psychology researchers observed, described, and measured this phenomena through three kinds of measures. The first measure is behavioral and “involves measurement of directly observable behaviors, as manifestations of underlying cognitive and neurophysiological processes” (Abernethy et al., 1998, p.175). Researches used methods of selective occlusions of temporal or spatial features. A drawback with this kind of measure is the impossibility of accessing the thought processes of the athletes during performance (Abernethy et al., 1998). Researchers then used physiological measures (e.g., cardiac acceleration / deceleration, event-related potential measures from the electroencephalogram and eye movements) to examine the changes occuring within the process of attentional selectivity. This methodology has not been applied much mainly because of the cost of equipment and artificial experimental conditions (Abernethy et al., 1998).

Finally, cognitive measures were taken via self-report instruments. In the sport psychology area, the Test of Attentional and Interpersonal Style (TAIS; Nideffer, 1976), which is heavily derived from the work of Easterbrook (1959), was primarily used because it is the only tool that measures attentional selectivity or what Nideffer (1976) called “attentional styles.” Nideffer (1976) postulated that attentional skill varied according to two criteria: width and direction. The width refers to the amount of information an individual can take into account and its range varies between narrow and broad. The direction is related to the nature of the information a person is focused on, namely internal thoughts, feelings and/or environmental external stimuli. The combination of these two criteria generated four attentional styles: broad external, narrow external, broad internal, and narrow internal. The TAIS, developed in order to monitor these styles, looked at attentional and interpersonal characteristics. It is a 144-item self-report inventory with 17 scales. Six of these 17 scales describe selective attentional dimensions. The TAIS has been shown to display satisfactory psychometric properties (e.g., Nideffer, 1976; Salmela & Bale, 1980; Reis & Bird, 1982).

Sport-specific versions, such as a baseball / softball (Albrecht & Feltz, 1987), basketball (Summers, Miller, & Ford, 1991), or tennis (Van Schoyck & Grasha, 1981), were also developed to overcome criticisms concerning (a) the inability of the TAIS to predict the athletes’level of expertise (e.g., Landers, Boutcher, & Wang, 1986), and (b) the construct validity of its dimensions (Van Schyock & Grasha, 1981). More specifically, the use of these sport-specific versions made obtaining gains in psychometric properties. Test-retest reliability of the tennis and the baseball / softball TAIS was higher than the original TAIS on every dimension except for one baseball / softball scale (Albrecht & Feltz, 1987; Van Schyock & Grasha, 1981). Sport-specific forms also exhibited higher internal consistency than the parent measures (Albrecht & Feltz, 1987; Summers, Miller, & Ford, 1991; Van Schyock & Grasha, 1981). Moreover, scores obtained from the sport-specific versions predicted more accurately the athletes’ performance than did results of the original TAIS (Albrecht & Feltz, 1987; Van Schyock & Grasha, 1981). For instance, the baseball / softball TAIS version displayed a much more consistent relationship to batting ability than the general TAIS (Albrecht & Feltz, 1987). Though these specific forms provided improvements in the assessment of attentional selectivity, the use of the TAIS and its specific versions still remain controversial (e.g., Moran, 1996). In sum, each kind of measure to assess attentional selectivity displays strengths and weaknesses and choosing one method over and above others is directly related to the context of interest, namely the nature of the questions to be answered (Abernethy et al., 1998).

From an applied point of view, most elite competitors often master the process of selective attention as a result of trial and error through active sport experience involvement (Williams & David, 1995). Introducing potential training programs to speed up the development of this time-consuming learning process could therefore be an asset (Abernethy, 1993). Studies in sport psychology have shown that selective attention can be developed through different cognitive behavioral techniques. Firstly, labels defined as “attaching a name as an aid to memory” (Thomas, Lee, & Thomas, 1988) proved to be efficient in facilitating children’s selective attention during performance (e.g., Fronske, Blakemore, & Abendroth-Smith, 1997). Secondly, perceptual training programs, designed to improve one’s knowledge base in a specific sport via video-based simulation, produced favorable results (see Williams & Grant, 1999, for a review). These programs presumably improved the athlete’s “mental software”, such as the abilities to selectively attend to, recognize, analyze, and interpret game information quickly and accurately (e.g., Abernethy, Wood, & Parks, 1999; Singer, 1998). Most of the time, the techniques used involved a display of actual game films with (a) different amounts of instruction and feedback, or (b) selective temporal occlusion in which the participant had to make a judgment or a decision (for reviews, see Abernethy, Summers, & Ford, 1998, and Williams & Grant, 1999). Finally, a package including relaxation, imagery, and techniques of focusing and refocusing was effective in the ability of the participants to maintain performance in throwing tasks while ignoring visual and auditory distractors (Singer, Cauraugh, Murphey, Chen, & Lidor, 1991).

In addition, Jones and Hardy (1990) reported that some elite athletes perceived that imagining competitive situations led to a better transfer of their skills from practice to competitive contexts. More specifically, they felt that mentally rehearsing a variety of competitive situations gave them the opportunity to enhance their attentional control by maintaining an appropriate attentional focus. These anecdotal reports were consistent with Van Gyn, Wenger, and Gaul's (1990) findings which verified the role of imagery in allowing a transfer from training to performance. Moreover, assumptions and interpretations stemming from sport psychology meta-analyses and overviews (Feltz & Landers, 1983; Hale, 1994; Hecker & Kaczor, 1988; Janssen & Sheikh, 1994) suggested that imagery could serve an attentional purpose. Imagery can help top-level sports performers to focus their attention on the task-relevant stimuli needed to perform successfully, thereby ignoring irrelevant cues. This assumption, better known under the name of the attentional-arousal set theory in applied sports books (e.g., Cox, 2002) is interesting. However, the processes through which imagery regulates arousal and attention have not yet been clearly identified (Vealey & Greenleaf, 1998). To sum up, the relationship between imagery and selective attention or perception[1] are somewhat embryonic because insufficient scientific evidence has been provided to lend credibility to anecdotal reports and assumptions stemming from meta-analyses and overviews of Jones and Stuth (1997) and Martin, Moritz, & Hall (1999).

Studies conducted in the area of cognitive psychology could provide a useful theoretical framework for sport psychology researchers (Moran, 1996). More specifically, Neisser's (1976) perceptual anticipation hypothesis contributed to the investigation of the processes underlying the relationship between imagery and perception. This hypothesis presumes that imagining may facilitate perceptual processes "by priming mechanisms in the visual system, preparing them to receive information about a particular object or event" (Finke, 1989, p. 51). Evidence regarding this hypothesis was reported by Farah (1985). She showed that imaging letters of the alphabet facilitated their detection whenever the images formed by the participants matched the presented letters. More recently, Michelon and Koenig

(2002) found that imagery facilitated perceptual identification when the participants were instructed to focus on the detailed shapes of an object whilst generating an image of this object. Perception and identification of an object or a letter were thus improved by the imagery experience the individuals received. These results, which suggested that similar representations were activated in imagery and perception, were supported by studies in the neuroscience literature. For example, Kosslyn, Thompson, and Alpert (1997) have shown that about two-thirds of the same brain areas are involved during visual imagery and perception. This relationship between visual imagery and perception became even clearer when Mellet, Petit, Mazoyer, Denis, and Tzourio (1998) supported the existence of the "two cortical visual systems", namely the dorsal and ventral streams, (Milner & Goodale, 1992) during the process of mental simulation. More specifically, they demonstrated that: (a) the dorsal route, which is primarly concerned with perception for action (Milner & Goodale, 1992), was involved in spatial imagery tasks, even if no previous visual inputs were provided; and (b) the ventral route, which is mainly engaged in the recognition of objects (Milner & Goodale, 1992), and more generally in the encoding and retrieval of the figurative properties of visual representations (Martin, Wiggs, Ungerleider, & Haxby, 1996), was also concerned with the generation of mental images. This dichotomy between the dorsal and ventral streams that was found in visual imagery corresponds, to that observed in visual perception. This correspondence provides additional evidence to support the imagery-perception connection.

The little research which has been carried out by specialists in cognitive psychology has demonstrated the relationship between imagery and perception, but these findings are not necessarily applicable to sport psychology. Because these studies used laboratory tasks, the interpretation of these results for complex motor skills is questionable. How imagery facilitates the development of selective attention in sport settings is not only a question of theoretical importance, but it also has a strong applied focus. Indeed, this knowledge could help coaches or consultants to speed up the development of the athletes'attention to relevant cues by setting up individualized imagery programs.

The purpose of the present study was therefore to examine the effectiveness of imagery in improving national softball players' selective attention over time. Softball was chosen because as a "fast ball sport", rapid selective attention is a fundamental prerequisite for performing successfully (Abernethy, 2001). Indeed, the softball batter will bat productively by attending to relevant information (e.g., the field position of the players, characteristics of the pitcher, the relation of the ball to the batting area), and by ignoring irrelevant distractors (e.g., noise from spectators, weather conditions, opponent faking, thoughts about the score and the situation, past successes or failures). The intrinsic characteristics of softball and its competitive environment offer the adequate setting for the purpose of the present study.

Based on previous studies which showed that (a) common brain areas were involved during perception and imagery (e.g., Mellet et al., 1998), and (b) perception of an object was improved by the exposure to imagery experience (Farah, 1985; Michelon & Koenig, 2002), it was hypothesized that imagery would improve the batter' s selective attention, namely the ability to integrate many external (e.g., visual and auditory features from the environment) and internal (e.g., feelings, thoughts, bodily sensations) sources while being able at the same time to narrow down the number of these sources when necessary.

Method

Participants

The participants were four French national female softball players between 15 and 26 years of age. They were all drawn from the same team in which they had all been for the previous two or three years. They had regularly taken part in national competitions where the team was ranked in the top three in the country. All were right-handed batters and their batting average was between 0.40 and 0.75. According to the coach's judgment, the participants experienced concentration problems and could perhaps benefit from the intervention. Though none of the athletes had previous experience in mental skill training, they expressed interest in this kind of training and agreed to practise sport psychological techniques (i.e., imagery) four to five times a week.

Dependent Variables

To assess softball players' selective attention over time, the administration of behavioral or/and physiological measures is too time-consuming for, and obtrusive to the athletes to be replicated frequently. Thus, using these kinds of tools to collect data over time could lead the participants to refuse to participate, and the use of the most simple and unobtrusive recording system is therefore strongly recommended (Bloom, Fisher, & Orme, 2003). That is why cognitive measures and more specifically the French version of the baseball / softball batting-specific version of Nideffer's (1976) Test of Attentional and Interpersonal Style (B-TAIS; Albrecht & Feltz, 1987) was used in the present study to assess selective attention. The B-TAIS, elaborated by Albrecht and Feltz (1987) is a parallel version of the general Nideffer's (1976) TAIS in which Nideffer's original items were converted into a baseball/softball specific reference. Thus, items "are given a context pertinent to the specific sport being studied" (Summers et al., 1991), which allowed us to obtain a higher predictive validity than that of the original TAIS and allowed us to differentiate between athletes' levels in batting performance (Albrecht & Feltz, 1987).

The B-TAIS with its 5-point scale is a 59-item pencil-and-paper test. It is designed to measure six selective attentional dimensions: (a) Broad External Focus (BET), (b) Overloaded Externally (OET), (c) Broad Internal Focus (BIT), (d) Overloaded Internally (OIT), (e) Narrow Focus of Attention (NAR), and (f) Reduced Attentional Focus (RED) (see Table 1). Three dimensions are related to effective attentional dimensions, namely the ability to (a) integrate many external stimuli at once (BET), (b) integrate many ideas and information from several different areas (BIT), and (c) narrow the attention when needed (NAR). The other three dimensions mention ineffective attentional dimensions, namely the fact of (a) experiencing an overdose of external stimuli (OET), (b) thinking about too many things at once (OIT), and (c) restricting attention too much (RED). Because Nideffer (1981) and Zaichkowsky (1984) assumed that a narrow external focus was required for the batter to perform well, emphasis was put on the NAR scale without neglecting the other dimensions.

The method of back-translation (Brislin, Lonner, & Thorndike, 1973) was used and consisted in first translating the items and the scale from English to French by a bilingual researcher. This was followed by a second translation from French to English by an independent translator. The final English version thus obtained was then submitted to the first author of the BTAIS who acknowledged its conformity to the original. After the process of back-translation was confirmed, the BTAIS was administered to a sample of 44 national baseball/softball players to evaluate its internal consistency: Groups of players completed the questionnaire at the beginning of regularly scheduled training sessions. To assess the BTAIS test-retest reliability, the 44 participants were reassessed at a one-week interval under the same conditions as their first testing. Test-retest coefficients of each attentional dimension, except RED, were superior to .70 (see Table 2). The alpha coefficients, which were computed for the first administration of the BTAIS, were superior to .70 with the exception of the BIT, OIT, and RED scales (see Table 2). According to Nunnally and Bernstein (1994), the generally acceptable alpha level is above .70; because they displayed internal consistencies that were too low, the BIT, OIT, and RED dimension scales were therefore excluded from the analyses.

Imagery Program

The 5-step imagery program[2] was composed of 28 imagery sessions over seven weeks (see Table 3). Each session was audio-taped and lasted 10 min. Imagery sessions consisted of guiding and teaching the softball players at bat to integrate many external and internal stimuli at one time and to be able to restrict the number of the stimuli as the moment for batting approached by paying attention to stimuli that had been shown to be favored by the experts. Information about priority cues were based on the experience of the team coach, who was an ex-international female player, and on softball training manuals (e.g., Bost, 2000). These handbooks provided information about the (a) hitting fundamentals, mechanisms, (b) teaching of hitting skills, (c) common errors and the way to make changes, and (d) mental attitude, such as the observation of the pitcher, the defense, self-confidence, the way to handle the results, the match. Concretely, scripts of imagery described multifarious situations that could be encountered in competitive situations from the moment the batter executed warming-up exercises for the swing to the moment she batted and started to run to the first base (e.g., left- and right-handed pitchers, different characteristics of the pitches, place where the ball should be hit, runners at bases, noise, sun light, scores, unfair umpires).

The imagery scripts included stimulus propositions (e.g., physical details of the bat, of the softball area, presence of teammates, spectators, comments made by others) and response propositions (e.g., muscle tension/looseness, heart/respiratory changes) (Lang, 1977, 1979). Internal and external perspectives were also incorporated into the scripts to to encourage softball players to use both of them, knowing that sometimes athletes switch from one perspective to another one while performing specific gestures (Hall, 1997).

Specifically, the imagery program involved five steps in which a progression in the amount of external and internal details (e.g., flight of the ball, runners on base, scores, fame of a player, a team) was included in order to get the participant used to this amount of information. The first step was composed of 10 sessions where the batter mentally rehearsed various possibilities a player at bat might experience, (for example, with left and right-handed pitchers, balls delivered with curves and fastballs), from an internal and external perspective. The second step was composed of 4 sessions in which the batter carried on rehearsing mentally a successful performance in different situations to which she might be exposed. The third step included 4 sessions in which the batter imagined some of the same scenarios described in steps 1 or 2 but added mental rehearsal of the positions of potential runners on base while batting (e.g., runners on first, second or third base). The fourth step comprised of 5 sessions. The contents of the imagery were similar to those experienced in step 3 but the trajectory of the ball and its desired point of impact were imagined (e.g., a grounder which passes the infield players). The fifth step was composed of 5 sessions in which the batters rehearsed mentally various pitches with runners on base under different conditions with potential distractors, such as the weather, noise, the fame of the pitcher, score, inning, and an unfair umpire.

Procedure

We used a multiple-baseline design across individuals (Kazdin, 1982). A face-to-face meeting was organized between the experimenter and the three experimental participants. Information was provided about imagery and its perspectives and the progress of the study. The study lasted 14 weeks and involved two phases: a baseline and a treatment phase.

During the baseline phase (i.e., the initial period of observation), measures of softball players' selective attention were collected once a week through the completion of the BTAIS (see Table 3). These assessments were completed individually every Saturday at home and were given back to the coach every Monday in a sealed envelope in order to protect the participants' confidentiality, and thus to prevent them from responding in a socially desirable manner. Due to the practical dilemmas the experimenter faced (i.e., time constraints established by the length of the softball competitive season, weekly completion of a 59-item questionnaire, various dimensions that were assessed), it was not possible to wait for baseline measures to become stable. Thus, considering that a minimum of three points in a baseline was necessary (Barlow & Hersen, 1983), the treatment (i.e., imagery program) was administered at data collection point 5 for participant 1, 6 for participant 2, and 7 for participant 3. The introduction of a treatment staggered over time ensured that the changes in performance (B-TAIS scores) were due to the treatment rather than to uncontrolled variables (Kazdin, 1982). Thus, in the baseline phase, there were respectively five, six, and seven data points for participants 1, 2, and 3.

During the treatment phase, an imagery program was initiated. This program required the three participants to spend 10 min four to five times a week listening to the tape and practising the imagery just before sleeping (see Table 3). During the treatment phase, the completion of the BTAIS by the participants was realized under the same conditions as previously mentioned and corresponded to the end or the beginning of a treatment step (see Table 3). Thus, each participant had five data collection points. Participant 4 remained at baseline to control the training effect (Kazdin, 1982): She did not receive any treatment throughout the study. A randomization procedure was used to determine which players were assigned to the different baseline conditions and which participant was assigned to the control condition.

Data Analyses

To evaluate the psychometric properties of the French version of the BTAIS, the test-retest correlations and the alpha coefficients (Cronbach, 1951) were made up from a sample of 44 national baseball/softball players and this for each attentional dimension scale.

To assess the effects of the treatment in the present study, three types of criteria were used: (a) visual inspection, (b) statistical analyses, and (c) practical assessment questionnaire. For participant 4 (i.e., the participant who did not receive any treatment throughout the study), her first five weeks were compared to her following weeks. This decision was based on Wanlin, Hrycaiko, Martin, and Mahon's (1997) suggestion on how to examine intervention effects, and was made to facilitate the comparison of this control participant with her counterparts who received an imagery program.

Visual inspection. According to Kazdin's (1982) recommendations, characteristics related to the magnitude of changes (mean) and rate of changes (trend) are or were of obvious importance in visual inspection and were thus selected. A change in mean refers to a mean improvement or decrease from the baseline to the treatment phase. A change in trend refers to (a) the fact that the baseline trend is reversed by the treatment or (b) the emergence of a trend (decrease or increase) in the treatment phase after a horizontal baseline (Kazdin, 1982).

An additional means of establishing the effects of the imagery program was to compare the data of the participants who had received the treatment (participants 1, 2, and 3) with those of the participant who remained at baseline throughout the study (participant 4).

Statistical analyses. To reduce the shortcomings of visual inspection, such as a lack of explicit decision rules (Wolery & Harris, 1982), an inability to detect weak effects (Kazdin, 1982; Kromrey & Foster-Johnson, 1996), a difficult judgment due to complex patterns (Bloom, Fischer, & Orme, 2003), a biased judgment due to data autocorrelation (Bloom et al., 2003), and the difficulty inherent to an unstable baseline (Kazdin, 1982; Kromrey & Foster-Johnson, 1996), statistical analyses should be employed as a supplement to visual inspection: "Visual analysis is a tentative evaluation approach. It is useful for making quick and approximate judgments, but when the data relate to important content or when there is any doubt about the clarity of the data, non-visual (i.e., statistical) methods should be employed in the analysis" (Bloom et al., p. 567). The decision to use a parametric *t* test was made after the normality of the distribution of the variables, the homogeneity of the variance (homoscedasticity), and the independence of the data points were checked. The normality of the distributions was assessed with the Kolmogorov Smirnov Test (Tabachnick & Fidell, 2001), whereas the homoscedasticity was monitored with the *F* test. To check the independence of the data points, autocorrelations were calculated for the baseline and for the treatment phases (Kazdin, 1982). The independence of the data points signifies that adjacent data points are not correlated over-time or that the data do not exhibit serial dependency (Kazdin, 1982). In case the three assumptions for using a parametric test were not validated, the Mann-Whitney nonparametric test would have been applied to the data (Kazdin, 1982). Bonferroni's corrections were also used in order to minimize the likelihood of a type I error when computing multiple analyses, and thus the alpha level necessary to demonstrate significance was $p < .017$.

Practical assessment questionnaire. To determine the participants' reactions to treatment procedures and experimental outcomes, each of them completed a practical assessment questionnaire at the end of the treatment. Firstly, players were asked to rate on a 5-point scale their facility or difficulty in imaging. Secondly, to monitor the participants' point of view regarding treatment procedures and benefits drawn from the treatment, open-ended questions were asked, such as:

> Did you use imagery spontaneously? If so, specify when and for which reasons? Do you think the imagery program was helpful? If so, specify in what? Do you think the imagery program was easy to follow? Which imagery perspective did you prefer to use and why? What would you remove from or add to the imagery program to make it more efficient?

Results

Participant 1

Participant 1 received the treatment at data collection point 5.

Visual inspection. Participant 1's mean scores improved from the baseline to the treatment phase for the 3 selective attentional dimensions (BET, OET, and NAR) with respective increases of 12%, 15.95%, and 3.31% (see Table 4 and Figure 1). For the OET dimension, a reversed scale was used: The lower the scores, the more effective the participants were. An enhancement for the OET dimension was thus shown by a drop in scores.

Changes in trend were observed for OET and NAR dimensions: Initial OET and NAR baseline trends were reversed by the treatment (see Figure 1). The OET treatment trend line was heading downwards which corresponded to a progress for participant 1 because of the reversed scale of this dimension. The NAR treatment trend line displayed a decreasing trend with a slight improvement in the means from the baseline phase to the treatment phase.

Statistical analyses. The use of a *t* test was appropriate because for each dimension of (selective) attention, (a) the data in each phase was normally distributed, (b) the variance of the baseline data was equal to the variance of the post-intervention phase data, and (c) the data did not exhibit serial dependency. No statistical differences were observed for the BET, OET, and NAR dimensions.

Practical assessment questionnaire. Participant 1 felt that the imagery treatment had been useful, as it allowed her to become involved in a process of self-assessment of her performance after every match. She also enjoyed listening to the audio-taped sessions of imagery and found the mental simulation of unusual actual experiences or things which had not been lived through difficult. Finally, though she found the use of external and internal imagery easy, she preferred the latter.

Participant 2

Participant 2 received the treatment at data collection point 6.

Visual inspection. Participant 2's mean scores improved from the baseline to the treatment phase for 2 of the 3 selective attentional dimensions (OET and NAR) with respective increases of 28.08%, and 18.31% (see Table 4 and Figure 1).

Changes in trend were observed for the BET and NAR dimensions: Initial BET and NAR baseline trends were inverted as the treatment was administered (see Figure 1). BET treatment trend line showed an increasing trend, whereas the NAR treatment trend line showed a decrease with improvement of means from the baseline phase to the treatment phase.

Statistical analyses. The use of a *t* test was appropriate because the requirements of normality distribution, homoscedasticity and data independence were fulfilled for each attentional dimension except for the NAR dimension in which the treatment data displayed serial dependency ($p < .05$). Consequently, the Mann-Whitney nonparametric test was used for the analysis of this exclusive dimension. *t* tests indicated that change was significant for

OET, $t(9) = 5.911$, $p < .01$. The Mann-Whitney test showed a significant difference for the NAR dimension ($U = .000$, $p < .005$). No statistical differences were observed for the BET dimension. The measures of the OET and NAR dimensions increased from baseline phase to treatment phase.

Practical assessment questionnaire. Participant 2 reported that the imagery program was efficient in the way it allowed her to take a step back from the game. She did not, however, appreciate the rate at which the tape had been recorded because it led her to visualize slowly and not "in real time." She also preferred to use internal imagery rather than external imagery because, as she reported, the former involved memories stored in her brain, which meant that it was easier for her to form a mental image from an internal perspective.

Participant 3

Participant 3 benefited from the intervention at data collection point 7.

Visual inspection. Participant 3's mean scores improved from the baseline to the treatment phase for 2 of the 3 selective attentional dimensions (BET and NAR) with respective increases of 42.19% and 6.61% (see Table 4 and Figure 1).

A change in trend was observed for the NAR dimension: The initial NAR baseline trends was reversed by the treatment (see Figure 1). The NAR treatment trend line headed in a downwards direction with a slight means improvement from baseline to treatment.

Statistical analyses. The assumptions to use a parametric method were verified, and *t* tests indicated significant differences for BET, $t(10) = -6.615$, $p < .01$. No statistical differences were observed for the other dimensions. The measures of the BET dimension increased from baseline phase to treatment phase.

Practical assessment questionnaire. Participant 3 stated that the imagery program had altered the way she used to behave just before batting. After the completion of the program, she focused more on task-relevant stimuli. Within this experience, she also became aware of her behavior and playing habits. Finally, she gave the internal perspective preference over the external one and found it difficult to form mental images about an unusual experience. She said "not enough memories would allow me to form an image of the motion. It is also easier to imagine experiences after a game because we still have the right feelings."

Participant 4

Participant 4 did not receive the treatment. She merely filled in the BTAIS questionnaire once a week like her three counterparts who received the treatment.

Visual inspection. Participant 4' s first five weeks were compared to her following weeks (i.e., three following weeks). This procedure, based on Wanlin et al. (1997), revealed an improvement in means for the OET dimension with an increase of 12.74%. Decreases were observed for 2 of the 3 selective attentional dimensions (BET, NAR) with respective percentages of –3.44%, and -0.14% (see Table 4 and Figure 1). No changes in trend were observed.

Statistical analyses. The Mann-Whitney nonparametric test was used because the data displayed serial dependency ($p < .05$). No statistical differences were observed for the BET, OET, and NAR dimensions.

Practical assessment questionnaire. After 10 weeks, participant 4 withdrew from the study invoking boredom stemming from the repeated testing.

In sum, these results showed improvements in percentages for 7 out of 9 scores obtained on the three dimensions of the BTAIS for the three experimental participants (see Table 4). Two scores of 9 displayed drops of less than 5 % for participant 2 on her BET dimension, and for participant 3 on her OET dimension. However, these two changes were not significant. The seven remaining scores demonstrated (a) five increases superior or equal to 10 % with 4 significant changes among which two inverted changes in trend were observed, and (b) two increases inferior or equal to 6.61%.

Discussion

The aim of the present study was to examine the effectiveness of imagery in improving selective attention of national softball players over time. This was achieved by the use of a staggered single-subject design, which allowed the researchers to obtain, within 14 weeks, selective attentional measures in an ecologically valid competitive setting.

The results showed improvements in percentages for 7 out of 9 scores obtained on the three dimensions of the BTAIS for the three experimental participants (see Table 4). Three changes were significant. Though the other four increases were not statistically significant and for two of them slight (i.e., 12%, 3.31%, 6.61%), they should not be disregarded because they may be important for an elite athlete in a performance environment (Wanlin et al., 1997). For participant 2, the BET baseline inverted trend as the treatment was introduced; moreover a heading in an upwards direction could suggest a delayed effect of the treatment, as indicated by Kazdin (1982). This hypothesis of a postponement of intervention effects was supported by Shambrook and Bull (1996) and more recently by Callow, Hardy and Hall (2001). Both of them, in different contexts, have shown increases in performance data after a latency period. Thus, this study hints that imagery facilitated some aspects of selective attention among elite softball players (i.e., BET, OET, and NAR dimensions). Confidence in this suggestion is reinforced in that changes observed for the (a) BET and NAR dimensions were not shared by the control participant who displayed stable data over time, and (b) OET dimensions were superior for participants 1 and 2 to the control participant's change. Nevertheless, the 12.74% increase of the OET dimension for the control participant is ambiguous though it is not statistically significant. Such improvement in dependent variables sometimes occurs when the baseline phase is extended over a long period of time even if no treatment is administered (Kazdin, 1982). One main reason could be conjectured. The prolonged baseline assessment, requiring the "control participant" to fill out the B-TAIS regularly, provided the "control participant" with opportunities to consider the different aspects of attention. This might have led to the improvement in scores in the OET attentional dimensions of the B-TAIS. This analysis is supported by Rogerson and Hrycaiko's (2002) who accounted for enhancements in performance among ice hockey goaltenders through careful consideration of the performance, as determined by self-assessment questionnaires. Because of the withdrawal of the control participant from the study after a 10-week involvement, comparison between the data of the control participant (i.e., participant 4) and the experimental participants (i.e., participants 1, 2, and 3) should be considered with caution when interpreting the results.

The softball players' reports collected within the practical assessment questionnaire strengthen the internal validity of the study by showing how the treatment influenced the participants. The softball reported benefits from the imagery training program: Assessing the performance after its execution, taking a step back from the game or focusing more on task-relevant stimuli were reported by the players as being consequences of the treatment. A worthwhile consideration stemming from the practical assessment questionnaire suggests that the reactions to imagery are related to previous experiences. Indeed, athletes reported the difficulty to mentally simulate unusual experiences and the ease to image immediately after a game. One can hint that imagining an unfamiliar situation would involve a rough motor representation with superfluous cues, whereas the mental simulation of an usual situation would engage a more developed representation with only the essential cues.

In sum, these findings corroborate anecdotal reports and counseling experiences (e.g., Cox, 2002; Jones & Hardy, 1990). These results are also consistent with Farah (1985) and Michelon and Koenig (2002) who argued that imagining facilitates perceptual processes. Mental rehearsals of various scenarios, that purposely guided the athletes to focus in an effective way, may prime the visual system and help the player at bat to increase control of the stimuli to be taken into account. This suggestion is totally in line with Neisser's (1976) perceptual anticipation hypothesis and assertion (1976, p. 130): "Imagining is not perceiving, but images are indeed derivatives of perceptual activities. In particular, they are the anticipatory phases of that activity…" It also reinforces the contention that similar representations are activated during visual imagery and perception (Kosslyn et al., 1997).

It should be acknowledged that the results of the present study raise interesting methodological questions concerning single-research design. First, the withdrawal of the control participant from the study after a 10-week involvement suggests the question of including or not such a participant in this kind of design. Ethically, it is hardly acceptable for athletes to be the one who was excluded from a treatment, supposed to improve performance, and who was required to complete a task for evaluation purposes whilst his or her counterparts benefited from the treatment (Hrycaiko & Martin, 1996). That is probably why only two studies in sport psychology (Hanton & Jones, 1999; Wanlin et al., 1997) have used such a participant. In order to bypass this ethical consideration, one may consider using a wait-list-control participant, namely a participant who acts as a control participant but who receives the treatment when the study is completed. In the present case, the introduction of a control participant was a luxury we could have afforded, and her dropping out does not cast any doubts on the internal validity of this study, as in single-research design, there was no need for a control group because each participant acted as his/her own control (Kazdin, 1982).

It is difficult to determine with complete certainty whether measurable changes in BTAIS scores are due to the treatment, physical training, an interaction of these components, or unidentified variables because of the complexity of human lives. In the single-case research designs literature, it had been shown that extraneous factors, such as history or maturation of the participant, could have had an impact on the effects of the treatment (Bloom et al., 2003;

Kazdin, 1982). An event outside the intervention (e.g., family crises) or intrinsic processes (e.g., growing older) that happen simultaneously to the intervention could be responsible for the observed changes. In the present study, it was unlikely that maturation could have been a threat to internal validity because of the short period of time the study lasted (i.e., 14 weeks). The threats of history or other aforementioned variables may be more relevant but because the experiment was carefully conducted, the likelihood that the treatment was responsible for changes is high (Bloom et al., 2003). Some of the criteria mentioned by Bloom et al. (2003) to find out whether or not the treatment has a direct effect on changes (i.e., to infer causality) are noticeable in the present study: (a) the introduction of a treatment staggered over time; (b) the production of analogous changes when a similar treatment is applied to several people; (c) the congruence of the observed changes with the scientific knowledge and practical experience.

Finally, in the present study, the lack of reliability of three BTAIS scales out of six (i.e., BIT, OIT, and RED), because of their insufficient alphas, highlights the problem of the difficult choice of an appropriate questionnaire in single-research design. The appropriate questionnaire should display a good reliability and validity, be short, and should not require too much energy to be filled out in order to be completed frequently, namely daily (Bloom et al, 2003). Because the BTAIS was the only sport specific self-report instrument that measured selective attention and because it was recognized as a diagnostic tool in applied settings (e.g., Bond & Sargent, 1995), it was chosen and administered once a week. Nevertheless, to improve the methodology of the present study, future research could urge experimenters to develop their own scales, as it was suggested by Bloom et al. (2003). These scales, called individual rating scale (IRS), could be a means to overcome the BTAIS controversy about its psychometric properties, and could be the most appropriate tool when using a single-research design. Indeed, these scales are tailor-made for each individual and they display high validity equivalent to that provided by classical questionnaires with good psychometric properties (Nugent, 1992). They could also be used frequently because of their short length, allow a daily tracking of modifications, and might prevent control participants from dropping out.

Despite some limitations, the present study presents methodological strengths, such as the use of tape-recorded instructions in order to minimize experimenter effects (Christensen, 1988). The use of both visual inspection and statistical analyses, and the systematic checking of conditions required to use parametric tests also contributed to the robustness of the findings. Moreover, the care taken in the elaboration of the imagery scripts by taking account of the knowledge generated from research, training manuals, and from the experiential knowledge of the coach, who used to be an international player, allowed the scripts to be realistic and meaningful for the softball players. Finally, the use of a multiple-baseline design allows one to investigate individual differences among elite athletes, increases the understanding of the development of selective attention among this population, and offers practical pedagogical considerations for coaching. The use of imagery as an additional technique to more popular concentration techniques recommended by sport psychologists, such as concentration grids, routines, or use of “cue words”, is strongly suggested.

As suggested by Williams and Grant (1999), the way imagery may be integrated into attentional training programs, using video simulation techniques for instance, could be an interesting further subject for research. More specifically, how imagery can be associated with techniques, including a display of actual game film with variable quantities of instructions and feed back or with different kinds of occlusions in which the participant has to make a judgment or a decision, requires further investigation. Besides, as advised by Paull and Glencross (1997), the process of how mental rehearsal of various scenarios may allow the athletes to increase their repertoire experiences with the aim of “priming the motor system to perform” awaits further investigation. Finally, exploring the influence of imagery training on attentional focus and selectivity and in turn on performance is a question of primary interest, and one that needs to be addressed in future research.

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Author Notes

Claire Calmels and Christelle Berthoumieux, Institut National du Sport et de l'Éducation Physique, Paris, France

Fabienne d'Arripe-Longueville, Université de Nice Sophia-Antipolis & Institut National du Sport et de l'Éducation Physique, Paris, France

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Correspondence concerning this article should be addressed to Claire Calmels, Laboratoire de Psychologie du Sport, Département des Sciences du Sport, Institut National du Sport et de l'Education Physique, 11 Avenue du Tremblay, 75012 Paris. E.mail: ccalmels@hotmail.com

Telephone number: (33-1) 41 74 45 77

Fax number: (33-1) 41 74 45 35

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Footnotes

[1] In the sport literature, selective attention (Abernethy, Summers, & Ford, 1998; Ross, 1976) and selective perception (Kosslyn & Koenig, 1992; Moran, 1996; Zaichkowsky, 1984) are used synonymously and refer to the same process.

[2] A copy of the imagery scripts could be obtained from the first author.

Table 1

The BTAIS Selective Attentional Dimensions Adapted from the Nideffer's (1976) TAIS

Scale	Abbreviation	Description
Broad External Attentional Focus	BET	High scores on this scale are obtained by individuals who describe themselves as being able to effectively integrate many external stimuli at one time.
Overloaded by External Stimuli	OET	The higher the score, the more individuals make mistakes because they become confused and overloaded with external stimuli.
Broad Internal Attentional Focus	BIT	High scores indicate that individuals see themselves as able to effectively integrate ideas and information from several different areas.
Overloaded by Internal Stimuli	OIT	The higher the score, the more mistakes individuals make because they confuse themselves by thinking about too many things at once.
Narrow Attentional Focus	NAR	The higher the score, the more effective individuals see themselves with respect to being able to narrow their attention when they need to.
Reduced Attentional Focus	RED	A high score on this scale indicates that the individuals make mistakes because they narrow their attention too much.

Table 2

Test-Retest and Internal Consistency Reliability Coefficients for the BTAIS Selective Attentional Dimensions (n = 44)

Selective attentional dimensions	Test-retest coefficients	Internal consistency
Broad External Attentional Focus (BET)	0.82	0.71
Overloaded by External Stimuli (OET)	0.80	0.74
Broad Internal Attentional Focus (BIT)	0.71	0.64
Overloaded by Internal Stimuli (OIT)	0.74	0.65
Narrow Attentional Focus (NAR)	0.77	0.73
Reduced Attentional Focus (RED)	0.48	0.12

Table 3

Organization of the Procedure: The Week-by-Week Contact with the Participants

Weeks	Tasks for participant 1	Tasks for participant 2	Tasks for participant 3	Tasks for participant 4
Week 1	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS
Week 2	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS
Week 3	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS
Week 4	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS
Week 5	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS
Week 6	Thursday: Beginning of the treatment Thursday: Session 1 of step 1 Friday: Session 2 of step 1	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS
Week 7	Monday: Session 3 of step 1 Tuesday: Session 4 of step 1 Thursday: Session 5 of step 1 Friday: Session 6 of step 1	Thursday: Beginning of the treatment Thursday: Session 1 of step 1 Friday: Session 2 of step 1	Saturday: Completion of the TAIS	Saturday: Completion of the TAIS

Week 8	Monday: Session 6 of step 1 Tuesday: Session 7 of step 1 Thursday: Session 8 of step 1 Friday: Session 9 of step 1 Saturday: Session 10 of step 1+ Completion of the TAIS	Monday: Session 3 of step 1 Tuesday: Session 4 of step 1 Thursday: Session 5 of step 1 Friday: Session 6 of step 1	Thursday: Beginning of the treatment Thursday: Session 1 of step 1 Friday: Session 2 of step 1	Saturday: Completion of the TAIS
Week 9	Monday: Session 1 of step 2 Tuesday: Session 2 of step 2 Thursday: Session 3 of step 2 Friday: Session 4 of step 2 Saturday: Completion of the TAIS	Monday: Session 6 of step 1 Tuesday: Session 7 of step 1 Thursday: Session 8 of step 1 Friday: Session 9 of step 1 Saturday: Session 10 of step 1+ Completion of the TAIS	Monday: Session 3 of step 1 Tuesday: Session 4 of step 1 Thursday: Session 5 of step 1 Friday: Session 6 of step 1	Saturday: Completion of the TAIS
Week 10	Monday: Session 1 of step 3 Tuesday: Session 2 of step 3 Thursday: Session 3 of step 3 Friday: Session 4 of step 3 Saturday: Completion of the TAIS	Monday: Session 1 of step 2 Tuesday: Session 2 of step 2 Thursday: Session 3 of step 2 Friday: Session 4 of step 2 Saturday: Completion of the TAIS	Monday: Session 6 of step 1 Tuesday: Session 7 of step 1 Thursday: Session 8 of step 1 Friday: Session 9 of step 1 Saturday: Session 10 of step 1+ Completion of the TAIS	Saturday: Completion of the TAIS

Week 11	Monday: Session 1 of step 4 Tuesday: Session 2 of step 4 Thursday: Session 3 of step 4 Friday: Session 4 of step 4 Saturday: Session 5 of step 4 + Completion of the TAIS	Monday: Session 1 of step 3 Tuesday: Session 2 of step 3 Thursday: Session 3 of step 3 Friday: Session 4 of step 3 Saturday: Completion of the TAIS	Monday: Session 1 of step 2 Tuesday: Session 2 of step 2 Thursday: Session 3 of step 2 Friday: Session 4 of step 2 Saturday: Completion of the TAIS
Week 12	Monday: Session 1 of step 5 Tuesday: Session 2 of step 5 Thursday: Session 3 of step 5 Friday: Session 4 of step 5 Saturday: Session 5 of step 5 + Completion of the TAIS	Monday: Session 1 of step 4 Tuesday: Session 2 of step 4 Thursday: Session 3 of step 4 Friday: Session 4 of step 4 Saturday: Session 5 of step 4 + Completion of the TAIS	Monday: Session 1 of step 3 Tuesday: Session 2 of step 3 Thursday: Session 3 of step 3 Friday: Session 4 of step 3 Saturday: Completion of the TAIS
Week 13		Monday: Session 1 of step 5 Tuesday: Session 2 of step 5 Thursday: Session 3 of step 5 Friday: Session 4 of step 5 Saturday: Session 5 of step 5 + Completion of the TAIS	Monday: Session 1 of step 4 Tuesday: Session 2 of step 4 Thursday: Session 3 of step 4 Friday: Session 4 of step 4 Saturday: Session 5 of step 4 + Completion of the TAIS

Week 14	Monday: Session 1 of step 5 Tuesday: Session 2 of step 5 Thursday: Session 3 of step 5 Friday: Session 4 of step 5 Saturday: Session 5 of step 5 + Completion of the TAIS

Table 4

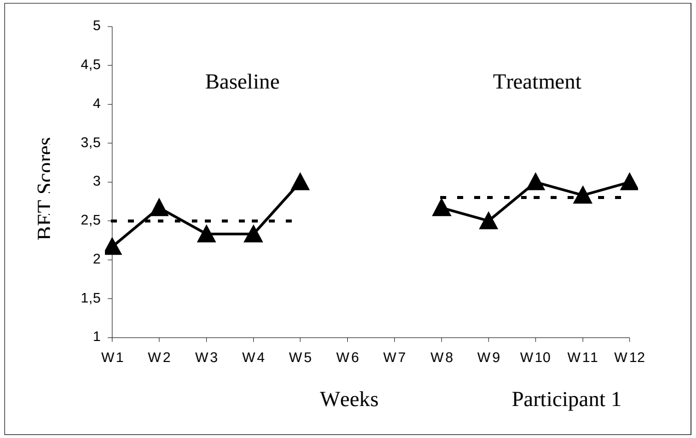
Means, Standard Deviations, and Percentage Changes for the BTAIS Scores for Each Participant

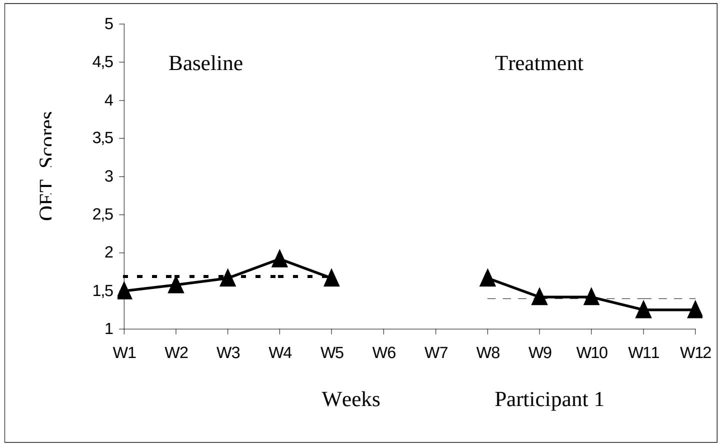
BTAIS scales		Participant 1		Participant 2		Participant 3		Participant 4	
								Extended baseline	
		Baseline	Treatment	Baseline	Treatment	Baseline	Treatment	First five weeks	Last three weeks
BET[a]	Mean	2.5000	2.8000	2.3900	2.3000	1.5950	2.2680	2.9340	2.8330
	SD	0.3338	0.2167	0.1391	0.3223	0.1307	0.2229	0.4015	0.1650
	% change	+12%		-3.77%		+42.19%		-3.44%	
OET[b]	Mean	1.6680	1.4020	2.6000	1.8700	2.5360	2.5660	1.7500	1.5270
	SD	0.1577	0.1722	0.2272	0.1710	0.2038	0.2150	0.1329	4.6E02
	% change	+15.95%		+28.08%		-1.18%		+12.74%	
NAR[a]	Mean	3.3260	3.4360	3.3200	3.9280	2.9490	3.1440	3.4920	3.4870
	SD	0.3466	0.1220	0.2555	0.1173	0.2693	0.1866	0.2124	0.1930
	% change	+3.31%		+18.31%		+6.61%		-0.14%	

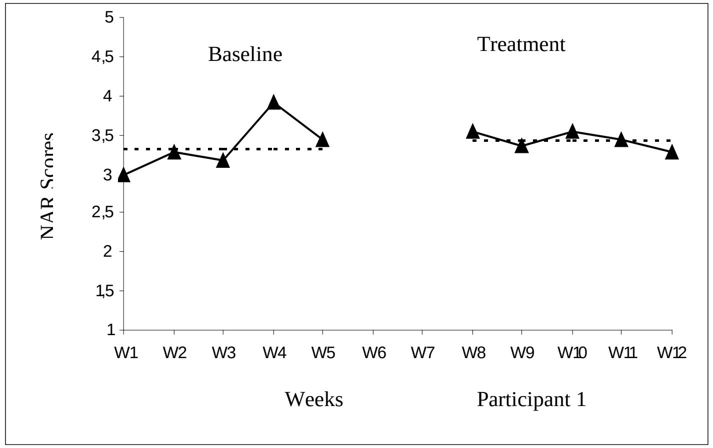
Notes. [a] The higher the scores, the more effective participants were. [b] Reversed scale: The lower the scores, the more effective participants were. The percentage of change for each BTAIS scale was calculated using the following formula: [(treatment score – baseline score)/baseline score] X 100. Means scores for each BTAIS scale range within a margin of 1 to 5 points.

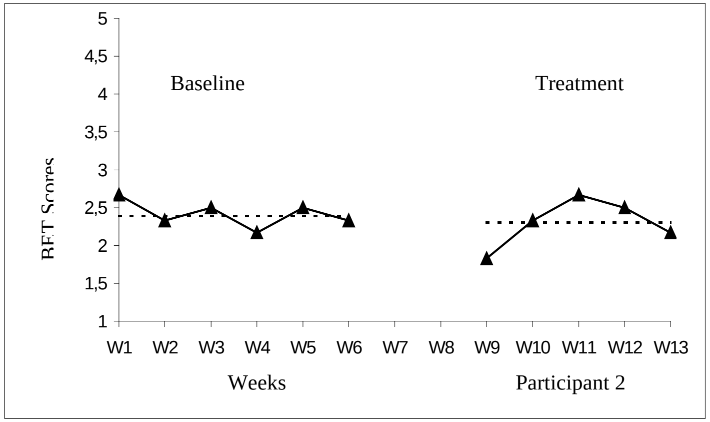
Figure Caption

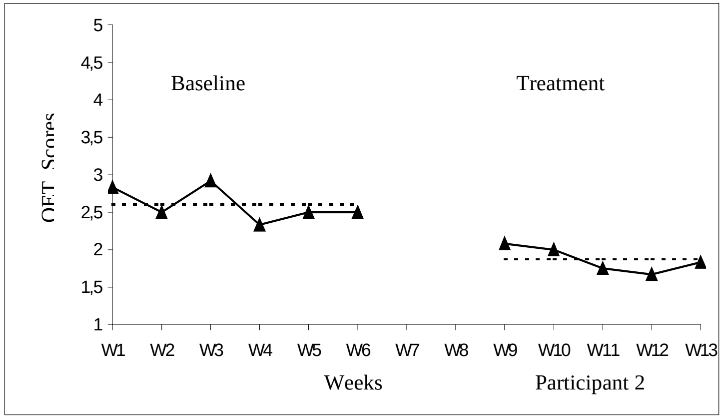
Figure 1. Selective attentional scores for each participant. Dotted lines represent means for each phase.

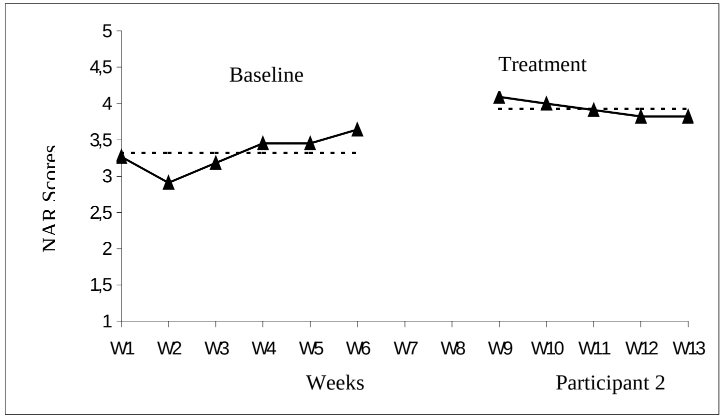

Baseline
Treatment
BFT Scores
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12
Weeks
Participant 1

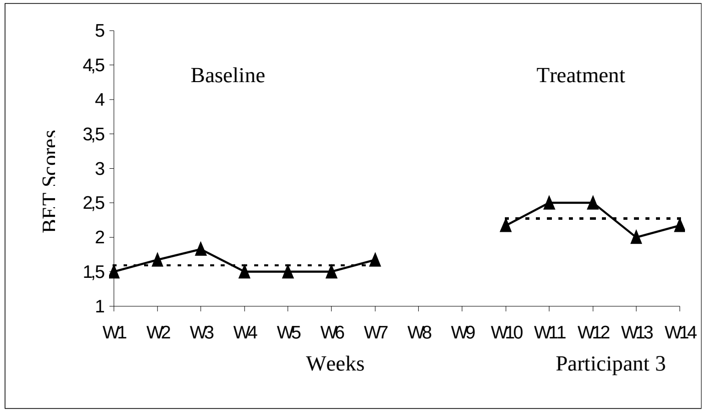

Baseline
Treatment
OFT Scores
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12
Weeks
Participant 1

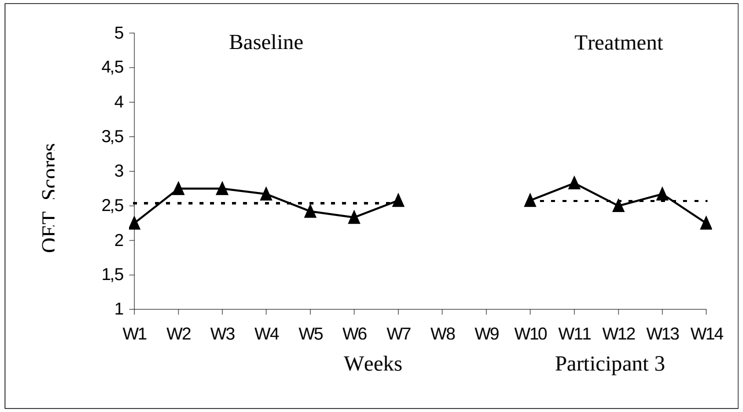

Baseline
Treatment
NAR Scores
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12
Weeks
Participant 1

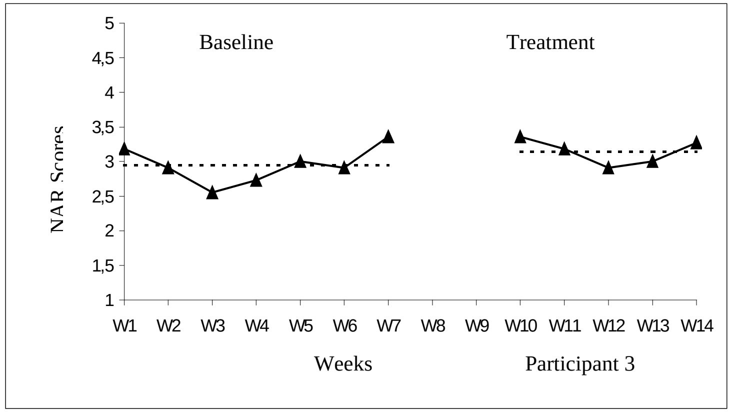

Baseline
Treatment
BFT Scores
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13
Weeks
Participant 2

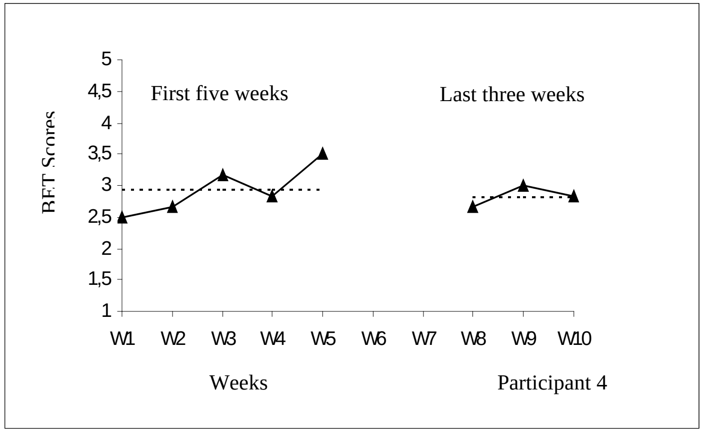

Baseline
Treatment
OFT Scores
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13
Weeks
Participant 2

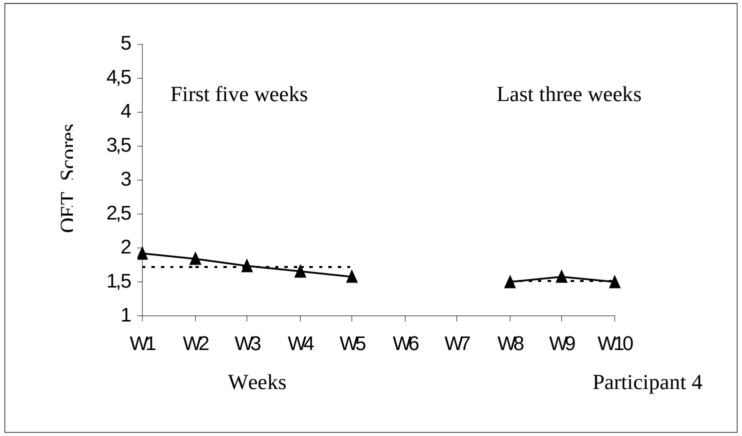

Baseline
Treatment
NAR Scores
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13
Weeks
Participant 2

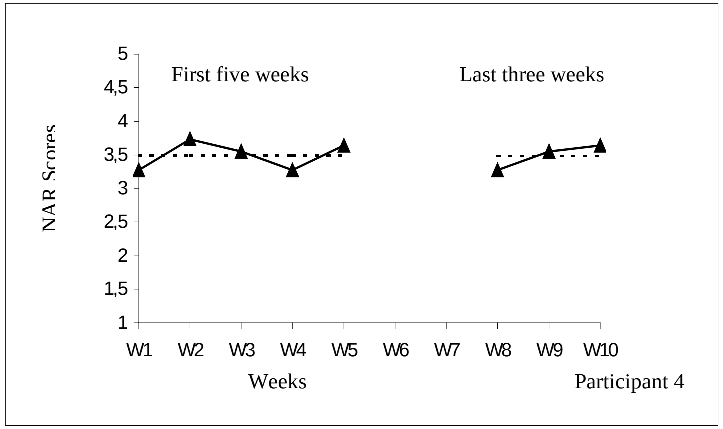

Baseline
Treatment
Weeks
Participant 3


Baseline
Treatment
Weeks
Participant 3


Baseline
Treatment
Weeks
Participant 3


First five weeks
Last three weeks
Weeks
Participant 4


First five weeks
Last three weeks
Weeks
Participant 4


First five weeks
Last three weeks
Weeks
Participant 4