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Abstract

The purpose of the present study was to examine the effect of a structured imagery intervention on self-reported vividness of movement imagery in four female national softball players. A multiple-baseline design across individuals was employed. Participants spent 10 minutes, four or five times per week, practising an audio-taped imagery program, which was consisted of 28 sessions. Measures of imagery vividness were obtained from the Vividness of Movement Imagery Questionnaire during the baseline and treatment phases. Results showed significant improvements in vividness scores on both the external and internal imagery perspective scales, with increases in the range of 15.8 % to 32.3 % from the baseline to the treatment phase. The findings are discussed with regard to individual cases and Lang's (1979) Bio-informational Theory.

Keywords: imagery, vividness, softball.

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While the generally positive role of imagery in improving sport performance is well recognized by the scientific community (Driskell, Copper, & Moran, 1994; Feltz & Landers, 1983), the reported benefits from imagery training programs vary. One reason for the conflicting results may be the impact of many individual differences. For example: the degree of adherence to the program (Bull, 1991); belief in the effectiveness of the intervention strategy (Smith, 1987); previous task experience (McKenzie & Howe, 1997); and imagery ability (Goss, Hall, Buckolz, & Fishburne, 1986; McKenzie & Howe, 1997). Goss et al. (1986) indicated that participants classified as “good imagers” according to their self-rated imagery ability benefited more from an imagery program than “poorer imagers.” Good imagers and poor imagers were labels identified by higher and lower imagery scores obtained on imagery questionnaires, such as the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983), the shortened version of Betts’s (1909) original Questionnaire of Mental Imagery (Betts QMI; Sheehan, 1967), and the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973). However, the extent to which the imagery skill measured by such questionnaires can be developed remains relatively untested.

In psychology literature, questionnaires measuring vividness of imagery have frequently been used as indicators of the similarity between imagery and perception (e.g., Finke, 1989). Vividness of imagery has usually been referred to as either the extent to which the image matches, or is similar to, actual experience, or the luminosity or clarity of the image, according to different degrees of image brightness (Cornoldi et al., 1991). From an applied perspective, the assessment of imagery ability has mainly been made through questionnaires or other self-report inventories (Sheehan, Ashton, & White, 1983). Individuals are asked to imagine different scenarios and are provided with a rating scale for each image they generate along a Likert-type scale of vividness. Research has shown that the ability to image vividly varies among individuals (e.g., Isaac & Marks, 1994), and also that individual differences in vividness ability can influence the learning and the performance of motor and cognitive skills. Walczyk (1995) showed that good imagers performed better than poor imagers in memory task activities. Similarly, McKelvie (1995) found the same differentiation for perceptual and motor control tasks. Clarkson (1985) also found the same results with an encoding information task. Good imagers also displayed shorter latencies in retrieving information from long-term memory (Hishitani, 1991) or in generating an image (Denis, 1995).

Holmes and Collins (2001) have offered a neuroscientific explanation for the improvement of motor imagery vividness. They have suggested that vividness of a motor image can be enhanced through the inclusion of perceptual information from different modalities involved in the actual performance of the skill. This perceptual information stimulates those parts of neural network associated with the task, thereby increasing the excitation of the neurons involved and allowing a more developed motor representation to be accessed in imagery and overt performance. Lang (1977, 1979, 1985) has theorized that appropriate ‘response proposition’ laden scripts will contain the perceptual information that could allow strengthening of the motor representation. In one of their early studies, Lang, Melamed, and Hart (1970) showed, in a therapeutic context, that the more the physiological responses generated during imagery were prominent, the more changes in subsequent overt behavior were influenced. Consequently, the development of imagery vividness through structured, response-proposition laden interventions could be viewed as an important sports-performance-related skill.

Studies in a therapeutic context have shown that imagery vividness can be developed through a number of different techniques. Firstly, verbal report training of imagined behavioral experiences modified the structure of the image by increasing its vividness (Lang, 1979; Lang, Kozak, Miller, Levin, & McLean, 1980). Participants were asked to imagine scenes presented through scripts that included response propositions. After each mental simulation, the experimenter asked the participants to explain what they had imagined. Systematically, the experimenter reacted to these verbal reports by reinforcing all the response propositions the participants had experienced while imagining. The vividness of mentally simulated event was significantly improved. Ahsen (1984), using a form of heart rate biofeedback, also demonstrated how images could be developed to become more vivid. Poor imagers were exposed to a colorful heartbeat picture and then told to imagine the picture with it physically present. The training technique significantly improved the imagery vividness of the participants. While these clinically-based studies have shown that vividness can be improved, the findings may not be wholly applicable to sport psychology since the structured imagery programs were implemented to treat various phobic and anxiety disorders. As such, the techniques require consideration within sporting populations given that the development of imagery vividness is clearly of theoretical and practical importance to sports performance.

The purpose of this study, therefore, was to consider movement imagery vividness in elite sports performers. Research has shown that elite performers use imagery more frequently in practice, in competition, and before an event than their less skilled counterparts (e.g., Hall, Rodgers, & Bars, 1990) and rarely have imagery studies employed as participants the individuals for whom the findings are intended. Few studies have employed truly elite performers since they rarely provide the participant numbers for traditional group-based analysis and they are difficult to include in research studies. Consequently, while low population numbers can create statistical difficulties, data from these individuals offer high ecological validity but require a more individual-based approach to the data interpretation.

Based on the reviewed literature, it was predicted that a structured imagery program containing response proposition laden scripts would improve imagery vividness ability. No predictions were made for physical performance.

Method

Participants and Experimental Design

The participants were four female French national softball players aged between 17 and 26 years, two aged 17, one 18 and one 26 years. None of the athletes had previous experience of imagery or mental skills training. The study lasted 14 weeks and all the participants were involved in twice monthly softball matches. A multiple-baseline design across individuals (Kazdin, 1982) was used to address the shortage of elite participants and to provide important information in the changes that occurred during the treatment (Wilson, 1995). Written consent was obtained from the participants and, in the case of the minors, parental consent was also obtained.

Dependent Variables

Movement imagery vividness was evaluated via the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986) that was both translated to, and validated in, French by Fournier, Le Cren, and Monnier (1994). Fournier et al. (1994) employed a method inspired by the cross-cultural validation of psychological inventories (Vallerand & Halliwell, 1983) and found psychometric properties that were very similar to those of the VMIQ. Firstly, no significant difference was found between four different versions of the VMIQ questionnaire (i.e., English and French versions of the VMIQ, a first half English and second half French and a first half French and second half English version of the VMIQ), thus attesting the concurrent validity of the French version of the VMIQ. Secondly, test-retest reliability of the French and original version of the VMIQ were both assessed at a three-week interval. They displayed correlation coefficients of r = .67 respectively for the French version and r = .76 for the original version.

The French version of the 24-item VMIQ uses a 5-point Likert-type scale to measure the imagery vividness of a movement in two conditions. Firstly, when the movement is imaged from an external perspective, as if viewing oneself on video, and secondly, when it is imaged from an internal or first person perspective. Scores range between a low of 24 and a high of 120 for each perspective. A low rating (24-48) indicates low imagery vividness, whereas a high rating (96-120) indicates high imagery vividness (Goginsky, 1992).

Procedure

A multiple-baseline design across individuals was employed. A face-to-face meeting was organized between the experimenter and the four participants. Information was provided about imagery and perspective differences. In addition, participants were informed as to the expected progress of the study. Participants were alerted to the distinction between generating a mental image, control of an image and the vividness of imagery. The study was divided in two phases: a baseline phase and a treatment phase. The baseline phase was four weeks in length for participant 1, five weeks for participant 2, six for participant 3, and seven for participant 4. During the baseline phase, measures of softball players' vividness of movement imagery were collected once a week through the administration of the French version of the VMIQ (see Figure 1). Consequently, participant 1 completed the VMIQ four times during baseline, participant 2 five times, participant 3 six times, and participant 4 seven times. The questionnaire was filled in individually weekly and returned to the coach within 48 hours.

The imagery treatment was administrated at data collection point 4 for participant 1, 5 for participant 2, 6 for participant 3, and 7 for participant 4. The staggering of treatments across time ensured that the changes in the VMIQ scores were due to the treatment rather than to uncontrolled variables (Kazdin, 1982). The five-step treatment lasted 28 days and consisted of 28 audio-taped sessions of imagery that required the participants to spend 10 minutes, four or five sessions per week listening to the tape.

The first step of the treatment comprised 10 days of imagery training, whereas the second step was made up of four days of imagery training, the third step of four days, the fourth step of five days, and the fifth step of five days. During the treatment phase, the VMIQ was completed under the conditions previously mentioned and corresponded to the end or the beginning of a treatment step (see Figure 1). Therefore, 5 data collection points were taken for each participant during the treatment phase. All together, participant 1 completed the VMIQ nine times, participant 2 ten times, participant 3 eleven times, and participant 4 twelve times (see Figure 1).

A randomization procedure was used to determine which players were assigned to the different baseline conditions**.**

Treatment and Imagery Script

The imagery sessions were audio-taped and lasted 10 minutes each. Imagery sessions described the varied situations that a batting softball player could encounter in competitive situations. These situations were reviewed, described, and written with the help of a female coach who had also been an international player. However, critical to the theoretical validity of the study, the imagery scripts also contained athlete-generated stimulus and response propositions (Smith, Holmes, Whitemore, Collins, & Devenport, 2001). Smith et al. (2001) have shown that imagery scripts containing a high proportion of response propositions, such as reference to heart rate, breathing, or muscle tension, produced more vivid images than imagery scripts including only stimulus propositions. Some of the stimulus propositions employed in the present study were non-visual, for example auditory cues, such as hearing the ‘crack’ of the bat making contact with the ball. These individually meaningful cues, it has been suggested, may enhance imagery vividness through their inclusion in scripts (Gould & Damarjian, 1996; Smith et al., 2001; Weinberg & Gould, 1999).

The treatment involved five steps and comprised 28 imagery sessions over seven weeks. The first comprised ten sessions where the batter imaged multi-environment conditions (for example, with left and right-handed pitchers, balls delivered with curves and fastballs) from an internal and external perspective. The second step comprised 4 sessions in which the batter imaged performing successfully in all the possible situations in which she might be exposed. The third involved 4 sessions in which the batter imaged some of the same scenarios described in step 1 or 2 but adding the positions of potential runners on base while batting. The fourth step comprised 5 sessions. The content of the imagery was similar to that experienced in step 3 but the trajectory of the ball and its desired point of impact were imaged. Finally, the fifth step comprised 5 sessions in which the batters imaged various known pitches with teammates on base under different conditions with individually identified potential distracters. These included: the weather; noise; the reputation of the pitcher; score; and a perceived unfair umpire.

Data Analysis

Three types of criteria were used to assess the effects of the treatment in the present study: visual inspection; statistical analyses; and practical assessment questionnaire**.**

Visual inspection. According to Kazdin's (1982) recommendations, characteristics related to the magnitude of changes (mean) and rate of changes (trend) were of importance in the visual inspection. A change in mean refers to a mean shift across phases (Kazdin, 1982). 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 an horizontal baseline (Kazdin, 1982). Thus, mean percentage from baseline to treatment phase was calculated for each participant and observation of the direction of trends in each phase was undertaken.

Statistical analyses. To reduce the shortcomings of the visual inspection, such as its inability to detect weak effects and its difficulty to be applied with an unstable baseline (Kazdin, 1982; Kromrey & Foster-Johnson, 1996), statistical analyses were employed as a supplement to visual inspection. Because the data from participants 1 and 3 were the only ones to fulfill normal homoscedasticity, and the data point's independence assumptions allowing the use of a parametric test, the Mann-Whitney U test was used in order to treat the data in the same way for all the participants.

Practical assessment questionnaire. Practical assessment questionnaire was considered to determine the participants' reactions to treatment procedures and experimental outcomes (Kazdin, 1982; Wolf, 1978). The procedure comprised two parts. First, after the first, third, and fifth steps of the treatment, assessments related to the ease of imaging from an external and internal perspectives were determined using a 5-point Likert-type scale. The scale was structured accordingly: "1" (*being very difficult to image*) and "5" (*being very easy to image*). Participants were also encouraged to write remarks on the imagery process. Secondly, at the end of the treatment, participants completed a questionnaire relating to their impression of the effectiveness of the treatment.

Results

Visual Inspection

Participant 1's mean scores, measuring the vividness of movement imagery, improved 11.8% and 15.8% from the baseline to the treatment phase for external and internal perspectives respectively (see Table 1 and Figure 1). Participant 2's scores improved for external and internal perspectives with increases of 31.1% and 21.2% respectively. Participant 3's mean scores also improved from the baseline to the treatment phase for the two perspectives with increases of 7% and 5.6% respectively. Participant 4's mean scores also improved with increases of 32.3% and 32.2% for the external and internal perspectives respectively.

For participants 1, 2 and 3 there were no observed changes in trend for the external and internal perspectives. For participant 4 no change in trend was observed for the external perspective (see Figure 2). With regard to the internal perspective however, the initial baseline trend was reversed by the treatment (see Figure 2); there was a slight decreasing trend with improvement of 32.2% from the baseline phase to the treatment phase.

Statistical Analyses

Mann-Whitney U tests revealed significant differences for the internal perspective for participant 1 ($U = 1.5$, $p < .05$) and participants 2 and 4 ($U = .000$, $p < .005$). Significant differences were also found for the external perspective for participants 2 ($U = .000$, $p < .01$) and 4 ($U = .000$, $p < .005$). No statistical differences were observed for either the external or internal perspective for participant 3.

Practical Assessment Questionnaire

Participant 1 found the imagery training treatment difficult to follow, especially the external imagery perspective. She found it difficult to have an holistic view of the game and to see herself batting well from a third-person perspective. Indeed, until the fifth session she saw herself batting as an anonymous right-handed batter even though she is left-handed. However, her skill in external imagery improved across the treatment. The use of the internal perspective was preferred over the external and the imagery treatment was perceived as very useful. She reported that it allowed her to relax prior batting and improve her ability to image her own performance.

Participant 2 found the mental simulation of situations, which she had not previously experienced, difficult to produce. She preferred using an internal perspective while imaging.

Finally, she 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.

Participant 3 said that the imagery treatment was useful, as it was perceived as a good aid for imaging herself batting and for increasing her self-confidence. She preferred using an external perspective while imaging.

Participant 4 found it difficult to form mental images that were not frequent in her performances, such as imaging facing a left-handed pitcher. She reported, “I do not have sufficient memories to allow me to form an image of the action.” She preferred the internal perspective to the external and confessed to finding it easier to imagine experiences after a game because she still could better recall her feelings. She explained that, following the treatment, kinesthetic sensations stored in her memory were easier to retrieve and experience during imagery rehearsals. Finally, participant 4 stated that the program allowed her to focus more on task-relevant stimuli, such as identifying the nature of the pitch earlier, and that she was now more able to ignore crowd noise.

Discussion

The aim of the study was to examine whether imagery vividness could be enhanced via an imagery-training program provided to national softball players. This was determine via the use of a staggered single-subject design, which allowed the researchers to obtain, within 14 weeks, self-reported measures of movement imagery vividness.

The results from a visual inspection of the magnitude of the changes of the data showed general improvement in vividness scores on both external and internal imagery perspectives, with increases of 5.6% to 32.3% between baseline and treatment phase for all the participants. Statistical analyses supported the results of the visual inspection data. Self-rated measures of vividness from external and internal perspectives significantly increased from baseline to treatment phases, with the exception of participant 3 on both perspectives, and participant 1 on her external imagery perspective.

These results, which suggest that imagery training can improve vividness of movement imagery for softball players are in line with Lang's (1977, 1979, 1985) bio-informational theory. According to this theory imagery vividness is suggested to improve as multiple sensory cues or modalities are emphasized. Moreover, the results of the present study fully support those of Lang (1978), which showed that vividness can be enhanced through an effective, response proposition-laden imagery training program.

A closer look at the findings in the present study indicates that the treatment seemed to be least effective for participant 3. Indeed, the results for this participant showed a non-significant increases of 7.0% for the external imagery perspective and 5.6% for the internal, whereas participants 1, 2, and 4 displayed statistically significant increases between 15.8% and 32.3% for both perspectives. Her high baseline level of vividness ratings may explain participant 3's scores in that she had little room for improvement. However, while statistically insignificant, the percentage changes seen may be important for an elite player in a performance environment (Hrycaiko & Martin, 1996).

Lang, Levin, Miller, and Kozak (1983) have shown that imagery scripts that include response propositions are significantly related to previous experiences. An individual who has already experienced a particular situation displays stronger somatic feelings accompanying her or his images of this situation than an individual whose experience in the situation is non-existent. This finding should not be surprising since the mechanisms of activity-dependent synaptic plasticity and long-term potentiation are well known with regard to learning and memory (e.g., Bliss & Collingridge, 1993) and support Lang's (1979) argument for a central brain mechanism for imagery. The findings from our study also support the concept of providing meaningful, previously experienced images for the softball players. Simulations of unusual or never previously experienced images were perceived as difficult tasks. Imagery immediately after a game was reported as highly beneficial and such findings are supported by the neuroscience literature.

The ease with which participants were able to generate images seemed to be related to imagery preference. Higher scores were reported on the players' preferred perspective (i.e., external or internal), as they were asked, within the treatment phase, to assess their ease or difficulty in forming images. This observation cannot be discussed in the context of any previous research because, to our knowledge, no research has addressed this relationship. However, it does imply that practitioners should consider preferred perspective as an important factor in imagery program design. In summary, the present study indicates that movement imagery vividness of national softball players can be enhanced through a structured imagery intervention. In addition, the use of visual inspection, statistical analyses and practical assessment questionnaire provided a robust method for increasing the validity of the data interpretation. We made a conscious attempt to differentiate image generation from its vividness, throughout the study, by implementing personal assessments after the first, third, and fifth steps of the treatment, and through the French translation of the VVIQ. This differentiation was made because the participants may naïvely assess vividness on the basis of the ease to generate an image, especially if they were not alerted to distinguish them (Howe, 1985).

Future research should attempt to determine how best to measure vividness of imagery. Specifically, when an image is generated and an assessment of its vividness is the objective, what are the processes individuals use to realize this operation and to what kind of model or frame is imagery vividness compared? These concerns are supported by Belleza (1995), who has reported that the process of rating the vividness of imagery is not known. In addition, future research should consider the correlation between of image similarity and actual experience (which, we would argue, is a different issue to Lang's (1985) concept of a meaning proposition) and its luminosity-clarity aspect in the process of vividness assessment (Cornoldi et al., 1991). Context or well-defined shape and contour, have also been reported to influence vividness ratings and should be considered (Cornoldi et al., 1991). Further study will be necessary in order to develop an instrument able to reflect these considerations. Such an instrument could play a vital role in the measurement of imagery skill.

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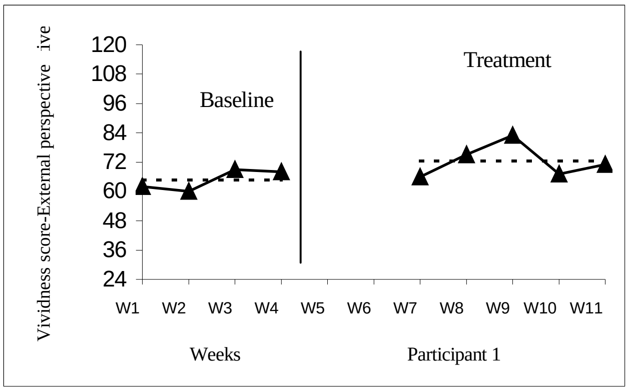
Table 1

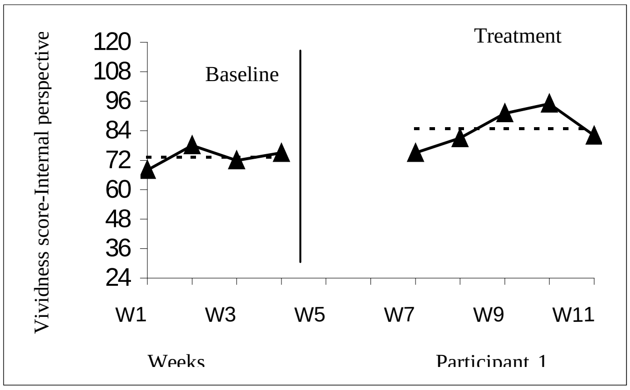
Means, Standard Deviations, and Percentage Changes for the Scores Measuring the Vividness of Movement Imagery from an External and Internal Perspective.

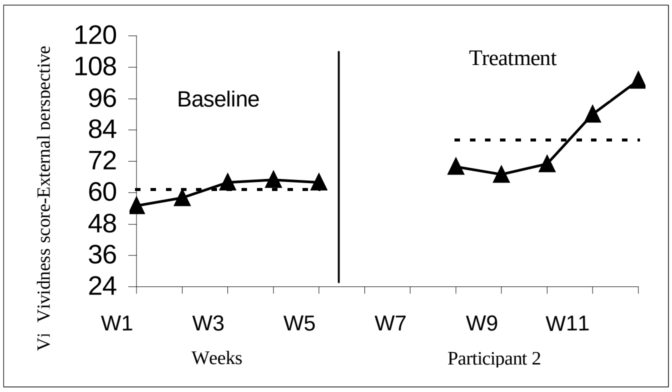
VMIQ conditions		Participant 1		Participant 2		Participant 3		Participant 4	
		Baseline	Treatment	Baseline	Treatment	Baseline	Treatment	Baseline	Treatment
External perspective	Mean	64.7	72.4	61.2	80.2	107.8	115.4	85.4	113
	SD	4.4	6.9	4.4	15.6	7.1	3.3	13.9	3.7
	% change	+11.8%		+31.0%		+7.0%		+32.3%	
Internal perspective	Mean	73.2	84.8	77.4	93.8	108.5	114.6	87.4	115.6
	SD	4.3	8.0	5.8	11.9	7.8	3.6	12.8	3.8
	% change	+15.8%		+21.2%		+5.6%		+32.2%	

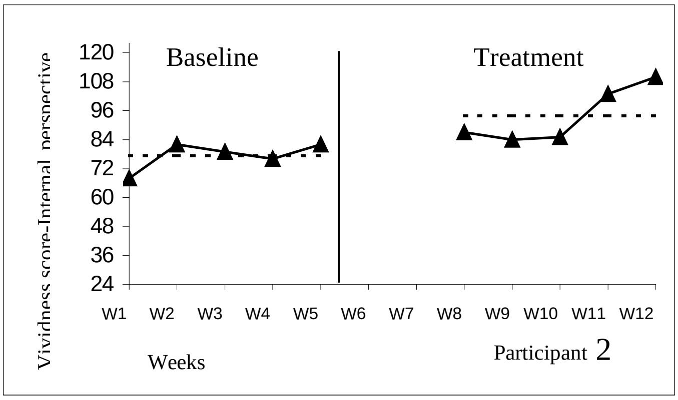
Figure Caption

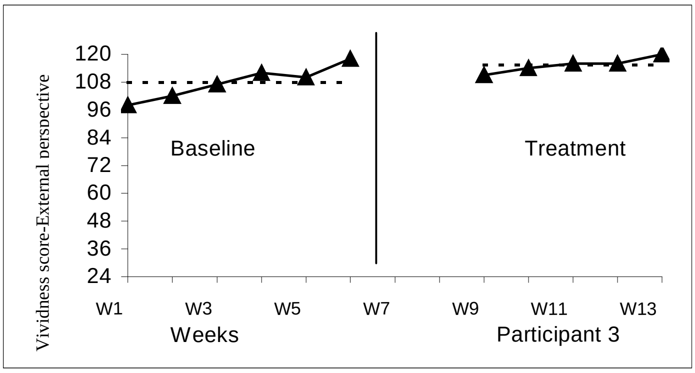
Figure 1. Vividness scores from an external and internal perspectives for participants 1, 2, 3, and 4. Scores range between a low of 24 and a high of 120 for each perspective. A low rating indicates low vividness, whereas a high rating indicates high vividness. Dotted lines represent means for each phase and complete vertical lines show when treatment began.

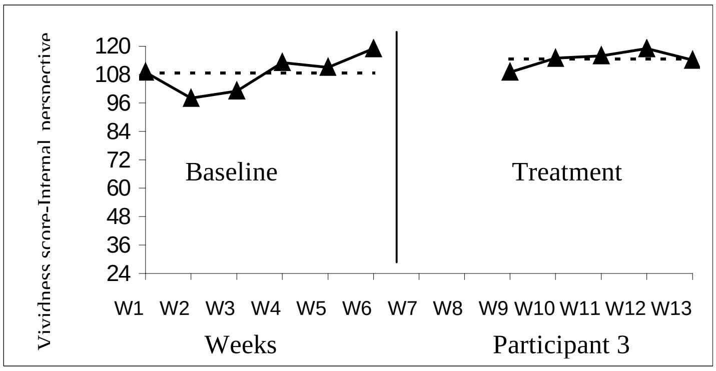

Vividness score-External perspective
120
108
96
84
72
60
48
36
24
Baseline
Treatment
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11
Weeks
Participant 1

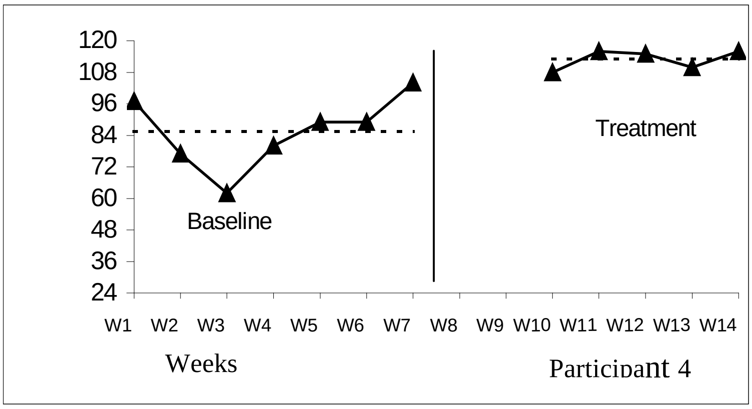

Vividness score-Internal perspective
120
108
96
84
72
60
48
36
24
Baseline
Treatment
W1 W3 W5 W7 W9 W11
Weeks
Participant 1

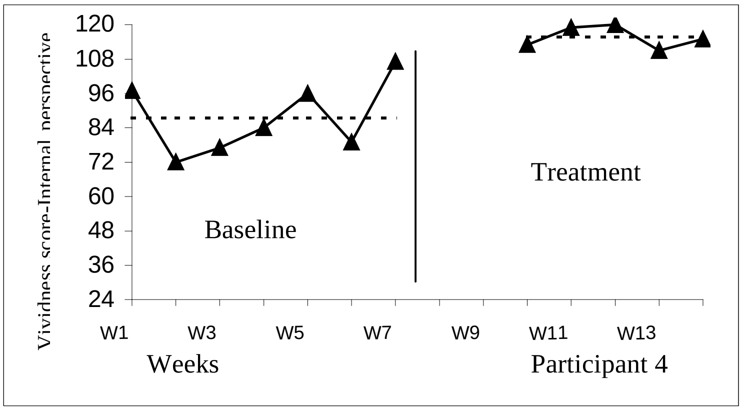

Vi Vividness score-External perspective
120
108
96
84
72
60
48
36
24
Baseline
Treatment
W1 W3 W5 W7 W9 W11
Weeks
Participant 2


120
108
96
84
72
60
48
36
24
Baseline
Treatment
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12
Weeks
Participant 2


Vividness score-External perspective
120
108
96
84
72
60
48
36
24
Baseline
Treatment
W1 W3 W5 W7 W9 W11 W13
Weeks
Participant 3


120
108
96
84
72
60
48
36
24
Baseline
Treatment
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13
Weeks
Participant 3


120
108
96
84
72
60
48
36
24
Treatment
Baseline
W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14
Weeks
Participant 4


120
108
96
84
72
60
48
36
24
Treatment
Baseline
W1 W3 W5 W7 W9 W11 W13
Weeks
Participant 4