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1 Running head: IMAGERY VIVIDNESS DEVELOPMENT IN SOFTBALL

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3 The Development of Movement Imagery Vividness Through a Structured Intervention in Softball

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Running head: IMAGERY VIVIDNESS DEVELOPMENT IN SOFTBALL

The Development of Movement Imagery Vividness Through a Structured Intervention in Softball

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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.

1 scenarios and are provided with a rating scale for each image they generate along a Likert-type
2 scale of vividness. Research has shown that the ability to image vividly varies among individuals
3 (e.g., Isaac & Marks, 1994), and also that individual differences in vividness ability can influence
4 the learning and the performance of motor and cognitive skills. Walczyk (1995) showed that
5 good imagers performed better than poor imagers in memory task activities. Similarly, McKelvie
6 (1995) found the same differentiation for perceptual and motor control tasks. Clarkson (1985)
7 also found the same results with an encoding information task. Good imagers also displayed
8 shorter latencies in retrieving information from long-term memory (Hishitani, 1991) or in
9 generating an image (Denis, 1995).

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

23 Studies in a therapeutic context have shown that imagery vividness can be developed
24 through a number of different techniques. Firstly, verbal report training of imagined behavioral

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

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

1 version of the VMIQ were both assessed at a three-week interval. They displayed correlation
2 coefficients of $r = .67$ respectively for the French version and $r = .76$ for the original version.

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

9

10 *Procedure*

11 A multiple-baseline design across individuals was employed. A face-to-face meeting was
12 organized between the experimenter and the four participants. Information was provided about
13 imagery and perspective differences. In addition, participants were informed as to the expected
14 progress of the study. Participants were alerted to the distinction between generating a mental
15 image, control of an image and the vividness of imagery. The study was divided in two phases: a
16 baseline phase and a treatment phase. The baseline phase was four weeks in length for participant
17 1, five weeks for participant 2, six for participant 3, and seven for participant 4. During the
18 baseline phase, measures of softball players' vividness of movement imagery were collected once
19 a week through the administration of the French version of the VMIQ (see Figure 1).

20 Consequently, participant 1 completed the VMIQ four times during baseline, participant 2 five
21 times, participant 3 six times, and participant 4 seven times. The questionnaire was filled in
22 individually weekly and returned to the coach within 48 hours.

23 The imagery treatment was administrated at data collection point 4 for participant 1, 5 for
24 participant 2, 6 for participant 3, and 7 for participant 4. The staggering of treatments across time

1 ensured that the changes in the VMIQ scores were due to the treatment rather than to
2 uncontrolled variables (Kazdin, 1982). The five-step treatment lasted 28 days and consisted of 28
3 audio-taped sessions of imagery that required the participants to spend 10 minutes, four or five
4 sessions per week listening to the tape.

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

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

14 *Treatment and Imagery Script*

15 The imagery sessions were audio-taped and lasted 10 minutes each. Imagery sessions
16 described the varied situations that a batting softball player could encounter in competitive
17 situations. These situations were reviewed, described, and written with the help of a female coach
18 who had also been an international player. However, critical to the theoretical validity of the
19 study, the imagery scripts also contained athlete-generated stimulus and response propositions
20 (Smith, Holmes, Whitemore, Collins, & Devenport, 2001). Smith et al. (2001) have shown that
21 imagery scripts containing a high proportion of response propositions, such as reference to heart
22 rate, breathing, or muscle tension, produced more vivid images than imagery scripts including
23 only stimulus propositions. Some of the stimulus propositions employed in the present study
24 were non-visual, for example auditory cues, such as hearing the ‘crack’ of the bat making contact

1 with the ball. These individually meaningful cues, it has been suggested, may enhance imagery
2 vividness through their inclusion in scripts (Gould & Damarjian, 1996; Smith et al., 2001;
3 Weinberg & Gould, 1999).

4 The treatment involved five steps and comprised 28 imagery sessions over seven weeks.
5 The first comprised ten sessions where the batter imaged multi-environment conditions (for
6 example, with left and right-handed pitchers, balls delivered with curves and fastballs) from an
7 internal and external perspective. The second step comprised 4 sessions in which the batter
8 imaged performing successfully in all the possible situations in which she might be exposed. The
9 third involved 4 sessions in which the batter imaged some of the same scenarios described in step
10 1 or 2 but adding the positions of potential runners on base while batting. The fourth step
11 comprised 5 sessions. The content of the imagery was similar to that experienced in step 3 but the
12 trajectory of the ball and its desired point of impact were imaged. Finally, the fifth step
13 comprised 5 sessions in which the batters imaged various known pitches with teammates on base
14 under different conditions with individually identified potential distracters. These included: the
15 weather; noise; the reputation of the pitcher; score; and a perceived unfair umpire.

16 *Data Analysis*

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

19 *Visual inspection.* According to Kazdin's (1982) recommendations, characteristics related
20 to the magnitude of changes (mean) and rate of changes (trend) were of importance in the visual
21 inspection. A change in mean refers to a mean shift across phases (Kazdin, 1982). A change in
22 trend refers to (a) the fact that the baseline trend is reversed by the treatment or (b) the emergence
23 of a trend (decrease or increase) in the treatment phase after an horizontal baseline (Kazdin,

1 1982). Thus, mean percentage from baseline to treatment phase was calculated for each
2 participant and observation of the direction of trends in each phase was undertaken.

3 *Statistical analyses.* To reduce the shortcomings of the visual inspection, such as its
4 inability to detect weak effects and its difficulty to be applied with an unstable baseline (Kazdin,
5 1982; Kromrey & Foster-Johnson, 1996), statistical analyses were employed as a supplement to
6 visual inspection. Because the data from participants 1 and 3 were the only ones to fulfill normal
7 homoscedasticity, and the data point's independence assumptions allowing the use of a
8 parametric test, the Mann-Whitney U test was used in order to treat the data in the same way for
9 all the participants.

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

19 Results

20 *Visual Inspection*

21 Participant 1's mean scores, measuring the vividness of movement imagery, improved
22 11.8% and 15.8% from the baseline to the treatment phase for external and internal perspectives
23 respectively (see Table 1 and Figure 1). Participant 2's scores improved for external and internal
24 perspectives with increases of 31.1% and 21.2% respectively. Participant 3's mean scores also

1 improved from the baseline to the treatment phase for the two perspectives with increases of 7%
2 and 5.6% respectively. Participant 4's mean scores also improved with increases of 32.3% and
3 32.2% for the external and internal perspectives respectively.

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

9 *Statistical Analyses*

10 Mann-Whitney U tests revealed significant differences for the internal perspective for
11 participant 1 ($U = 1.5, p < .05$) and participants 2 and 4 ($U = .000, p < .005$). Significant
12 differences were also found for the external perspective for participants 2 ($U = .000, p < .01$) and
13 4 ($U = .000, p < .005$). No statistical differences were observed for either the external or internal
14 perspective for participant 3.

15 *Practical Assessment Questionnaire*

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

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

1 Finally, she felt that the imagery treatment had been useful, as it allowed her to become involved
2 in a process of self-assessment of her performance after every match.

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

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

15

16 Discussion

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

21 The results from a visual inspection of the magnitude of the changes of the data showed
22 general improvement in vividness scores on both external and internal imagery perspectives, with
23 increases of 5.6% to 32.3% between baseline and treatment phase for all the participants.

24 Statistical analyses supported the results of the visual inspection data. Self-rated measures of

1 vividness from external and internal perspectives significantly increased from baseline to
2 treatment phases, with the exception of participant 3 on both perspectives, and participant 1 on
3 her external imagery perspective.

4 These results, which suggest that imagery training can improve vividness of movement
5 imagery for softball players are in line with Lang's (1977, 1979, 1985) bio-informational theory.
6 According to this theory imagery vividness is suggested to improve as multiple sensory cues or
7 modalities are emphasized. Moreover, the results of the present study fully support those of Lang
8 (1978), which showed that vividness can be enhanced through an effective, response proposition-
9 laden imagery training program.

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

18 Lang, Levin, Miller, and Kozak (1983) have shown that imagery scripts that include
19 response propositions are significantly related to previous experiences. An individual who has
20 already experienced a particular situation displays stronger somatic feelings accompanying her or
21 his images of this situation than an individual whose experience in the situation is non-existent.
22 This finding should not be surprising since the mechanisms of activity-dependent synaptic
23 plasticity and long-term potentiation are well known with regard to learning and memory (e.g.,
24 Bliss & Collingridge, 1993) and support Lang's (1979) argument for a central brain mechanism

1 for imagery. The findings from our study also support the concept of providing meaningful,
2 previously experienced images for the softball players. Simulations of unusual or never
3 previously experienced images were perceived as difficult tasks. Imagery immediately after a
4 game was reported as highly beneficial and such findings are supported by the neuroscience
5 literature.

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

21 Future research should attempt to determine how best to measure vividness of imagery.
22 Specifically, when an image is generated and an assessment of its vividness is the objective, what
23 are the processes individuals use to realize this operation and to what kind of model or frame is
24 imagery vividness compared? These concerns are supported by Belleza (1995), who has reported

1 that the process of rating the vividness of imagery is not known. In addition, future research
2 should consider the correlation between of image similarity and actual experience (which, we
3 would argue, is a different issue to Lang's (1985) concept of a meaning proposition) and its
4 luminosity-clarity aspect in the process of vividness assessment (Cornoldi et al., 1991). Context
5 or well-defined shape and contour, have also been reported to influence vividness ratings and
6 should be considered (Cornoldi et al., 1991). Further study will be necessary in order to develop
7 an instrument able to reflect these considerations. Such an instrument could play a vital role in
8 the measurement of imagery skill.

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References

Ahsen, A. (1984). ISM: The triple code model for imagery and psychophysiology. *Journal of Mental Imagery*, 8, 15-42.

Belleza, F.S. (1995). The characteristics of imagery cues. In S.J. McKelvie (Ed.), *Vividness of visual imagery. Measurement, nature, function and dynamics* (pp. 123-129). New York: Brandon House, Inc.

Bliss, T.V.P., & Collingridge, G.L. (1993). A synaptic model of memory long-term potentiation in the hippocampus. *Nature*, 361, 31-39.

Bull, S.J. (1991). Personal and situational influences on adherence to mental skills training. *Journal of Sport & Exercise Psychology*, 13, 121-132.

Clarkson, J.K. (1985). Imagery and peripheral vision. In D.F. Marks & D.G. Russell (Eds.), *Imagery I* (pp.24-25). Dunedin, New Zealand: Human Performance Associates.

Cornoldi, C., De Beni, R., Giusberti, F., Marucci, F., Massironi, M., & Mazzoni, G. (1991). The study of vividness of imagery. In R.H. Logie & M. Denis (Eds.), *Mental images in cognition* (pp. 305-313). North Holland: Elsevier Science Publishers B.V.

Denis, M. (1995). Vividness of visual imagery and the evaluation of its effects on cognitive performance. In S.J. McKelvie (Ed.), *Vividness of visual imagery. Measurement, nature, function and dynamics* (pp. 136-138). New York: Brandon House, Inc.

Driskell, J.E., Copper, C., & Moran, A. (1994). Does mental practice enhance performance? *Journal of Applied Psychology*, 79, 481-491.

Feltz, D.L., & Landers, D.M. (1983). The effects of mental practice on motor skill learning and performance: A meta-analysis. *Journal of Sport Psychology*, 5, 25-57.

Finke, R.A. (1989). *Principles of mental imagery*. London: MIT Press.

- 1 Fournier, J., Le Cren, F., & Monnier, E. (1994, September). *Validation et adaptation en langue*
2 *française du questionnaire de clarté de l'image du mouvement* [Validation and adaptation in
3 French of the Vividness of Movement Imagery Questionnaire]. Paper presented at the
4 International Conference of the French Sport Psychology Society (SFPS), Poitiers, France.
- 5 Goginsky, A. M. (1992). *Imagery/physical practice schedules in the enhancement of dart*
6 *throwing performance*. Unpublished doctoral thesis, University of Pennsylvania, USA.
- 7 Goss, S., Hall, C.R., Buckolz, E., & Fishburne, G. (1986). Imagery ability and the acquisition and
8 retention of movements. *Memory and Cognition*, 14, 469-477.
- 9 Gould, D., & Damarjian, N. (1996). Imagery training for peak performance. In J.L. Van Raalte &
10 B.W. Brewer (Eds.), *Exploring sport and exercise psychology* (pp. 25-50). Washington, DC:
11 American Psychological Association.
- 12 Hall, C.R., & Pongrac, (1983). *Movement Imagery Questionnaire*. London, Canada: University
13 of Western Ontario.
- 14 Hall, C.R., Rodgers, W.M., & Barr, K.A. (1990). The use of imagery by athletes in selected
15 sports. *The Sport Psychologist*, 4, 1-10.
- 16 Hishitani, S. (1991). Vividness of image and retrieval time. *Perceptual and Motor Skills*, 73, 115-
17 123.
- 18 Holmes, P.S., & Collins, D.J. (2001). The PETTLEP approach to motor imagery: A functional
19 equivalence model for sport psychologists. *Journal of Applied Sport Psychology*, 13, 60-83.
- 20 Howe, E.S. (1985). High community among judgment of imagined and perceived novel visual
21 characteristics of the fantasy-prone personality. *Journal of Mental Imagery*, 9, 45-56.
- 22 Hrycaiko, D., & Martin, G.L. (1996). Applied research studies with single-subject designs: Why
23 so few? *Journal of Applied Sport Psychology*, 8, 183-199.

- 1 Isaac, A., Marks, D.F., & Russell, D.G. (1986). An instrument for assessing imagery of
2 movement: The vividness of movement imagery questionnaire (VMIQ). *Journal of Mental*
3 *Imagery, 10*, 23-30.
- 4 Isaac, A.R., & Marks, D.F. (1994). Individual differences in mental imagery experience:
5 Developmental changes and specialization. *British Journal of Psychology, 85*, 479-500.
- 6 Kazdin, A.E. (1982). *Single-case research designs. Methods for clinical and applied settings*.
7 Oxford: Oxford University Press.
- 8 Kromrey, J.D., & Foster-Johnson, L. (1996). Determining the efficacy of intervention: The use of
9 effect sizes for data analysis in single-subject research. *The Journal of Experimental*
10 *Education, 65*, 73-93.
- 11 Lang, P.J. (1977). Imagery in therapy: An information processing analysis of fear. *Behavior*
12 *Therapy, 8*, 862-886.
- 13 Lang, P.J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology, 16*, 495-
14 512.
- 15 Lang, P.J. (1985). The cognitive psychophysiology of emotion: Fear and anxiety. In A.H. Tuma
16 & J.D. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 131-170). Hillsdale, N.J.:
17 Lawrence Erlbaum Associates.
- 18 Lang, P.J., Kozak, M.J., Miller, G.A., Levin, D.N., & McLean, A., Jr. (1980). Emotional
19 imagery: Conceptual structure and pattern of somato-visceral response. *Psychophysiology,*
20 *17*, 179-192.
- 21 Lang, P.J., Levin, D.N., Miller, G.A., & Kozak, M.J. (1983). Fear behavior, fear imagery, and the
22 psychophysiology of emotion: The problem of affective response integration. *Journal of*
23 *Abnormal Psychology, 92*, 276-306.

- 1 Lang, P.J., Melamed, B.G., & Hart, J. (1970). A psychophysiological analysis of fear
2 modification using an automated desensitization procedure. *Journal of Abnormal Psychology*,
3 76, 229-234.
- 4 Marks, D.F. (1973). Visual imagery differences in the recall of pictures. *British Journal of*
5 *Psychology*, 64, 17-24.
- 6 McKelvie, S.K. (1995). The VVIQ as a psychometric test of individual differences in visual
7 imagery vividness: A critical quantitative review and plea for direction. In S.J. McKelvie
8 (Ed.), *Vividness of visual imagery. Measurement, nature, function and dynamics* (pp. 1-106).
9 New York: Brandon House, Inc.
- 10 McKenzie, A.D., & Howe, B.L. (1997). The effect of imagery on self-efficacy for a motor skill.
11 *International Journal of Sport Psychology*, 28, 196-210.
- 12 Sheehan, P.W. (1967). A shortened form of Betts questionnaire upon mental imagery. *Journal of*
13 *Clinical Psychology*, 23, 386-389.
- 14 Sheehan P.W., Ashton, R., & White, K. (1983). Assessment of mental imagery. In A.A. Sheikh
15 (Ed.), *Imagery. Current theory, research, and application* (pp. 189-221). Chichester: John
16 Wiley and Sons.
- 17 Smith, D. (1987). Conditions that facilitate the development of sport imagery training. *The Sport*
18 *Psychologist*, 1, 237-242.
- 19 Smith, D. K., Holmes, P. S., Whitemore, L., Collins, D., and Devenport, T. (2001). The effect of
20 theoretically-based imagery scripts on field hockey performance. *Journal of Sport Behavior*,
21 24, 408-419.
- 22 Vallerand, R.J., & Halliwell, W.R. (1983). Vers une méthodologie de validation trans-culturelle
23 de questionnaires psychologiques: implications pour la psychologie du sport [Towards a

- 1 cross-cultural validation of psychological inventories: Implication for sport psychology].
2 *Canadian Journal of Applied Sport Science*, 8, 9-18.
- 3 Walczyk, J.J. (1995). Between- versus within-subjects assessment of image vividness. In S.J.
4 McKelvie (Ed.), *Vividness of visual imagery. Measurement, nature, function and dynamics*
5 (pp. 161-175). New York: Brandon House, Inc.
- 6 Weinberg, R.S. & Gould, D. (1999). *Foundations of sport and exercise psychology*. Leeds, UK:
7 Human Kinetics.
- 8 Wilson, S.L. (1995). Single case experimental designs. In G.M. Breakwell, S. Hammond, & C.
9 Fife-Schaw (Eds.), *Research methods in psychology* (pp.69-84). London: Sage Publications.
- 10 Wolf, M.M. (1978). Social validity: The case for subjective measurement or how applied
11 behavior analysis is finding its heart. *Journal of Applied Behavior Analysis*, 11, 203-214.

1 Table 1

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

4

VMIQ		Participant 1		Participant 2		Participant 3		Participant 4	
conditions		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%	

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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.

Imagery Vividness Development in Softball 24

