MENTAL IMAGERY has a special relationship with emotion (Holmes & Mathews, 2005; Kosslyn, 1994). In sport, this relationship is apparent when we recall pleasant emotions with images of success and unpleasant emotions with images of failure (Paivio, 1985). Intuitively, success and failure invoke positive and negative images and researchers have established that positive images lead to performance improvement whereas negative images lead to performance deterioration (Taylor & Shaw, 2002; Beilock et al., 2001). The emotional content of these images and the influence of these images on emotions, however, has received limited examination in a sport context. For instance, MacIntyre and Moran (2007) observed that the taxonomy of imagery functions developed by Hall et al. (1998) lacked an adequate explanation for negative imagery and associated emotions in athletes. In addition, the recently developed Motor Imagery Integrative Model in Sport (Guillot & Collet, 2008) includes anxiety but no other specific emotions are discussed; however, emotion is included in Holmes and Collins’ (2001) PETTLEP approach to motor imagery emphasising its role in strengthening the memory trace (Lang 1985). In short, emotion is acknowledged in imagery research, but the link is not well understood (Holmes & Mathews, 2005; Jones et al., 2002).

Emotions are ubiquitous in sport. And positive emotions such as sport enjoyment serve many functions. For example, it is a characteristic of peak experiences (Cohn, 1991), flow states (Csikszentmihalyi, 1990) and is a powerful determinant of long-term commitment to sport (Carpenter et al., 1993). In other words, when people enjoy themselves, they tend to perform favourably and continue participating (McCarthy & Jones, 2007; McCarthy et al., 2008). Youth athletes, in particular, crave enjoyment – which they get by mastering sport skills. A tennis player who feels she can master her tennis skills feels competent, enjoys tennis and shows a functional pattern of behaviours including persistence, effort, and long-term involvement. Promoting positive feelings may be possible using mental imagery. To explain, Paivio’s (1985) framework for the functional analysis of imagery proposed mental imagery serving cognitive and motivational functions operating on general and specific levels. Motivational functions include goal-oriented responses and arousal management while cognitive functions involve skill rehearsal and strategies of play – functions that could enhance one’s competence and positive feelings. Despite this conceptual proposal, limited experimental research supports imagery having a motivational and emotional function (Callow et al., 2001). In addition, contemporary research among elite athletes suggests that the motivational function of imagery is usually overstated (McIntyre & Moran, 2007); however, the function of mental imagery for youths may differ compared with elite athletes because of youths’ basic need to demonstrate competence and enjoy sport (McCarthy & Jones, 2007).

Hall et al. (1998) used Paivio’s (1985) original taxonomy of imagery function to develop the Sport Imagery Questionnaire (SIQ). The SIQ measures athletes’ use of five types of imagery: Cognitive-General (CG; e.g. executing sport skills); Cognitive-Specific (CS; e.g. imaging successful strategies in sport); Motivational General-Mastery (MG-M; e.g. being confident and mastering chal-
lenging situations); Motivational General-Arousal (MG-A; e.g. imagining feelings associated with competition); and Motivational-Specific (MS; e.g. imagining achieving a specific goal). Research among youth athletes indicated that although they use different types of imagery, MG-M imagery is used most often (Cumming et al., 2002; Harwood et al., 2003) perhaps fulfilling a need for competence. Jones et al. (2002) used MG-M and MG-A imagery to modify cognitions and helped novice climbers to respond with a more positive emotional state in a stressful situation. This study offers a foundation for future intervention research among children and adolescents; however, the effectiveness of mental imagery interventions among this age group remains limited (Strachan & Munroe-Chandler, 2007).

Youths pass through different stages of cognitive development as they mature (Piaget, 1952), affecting their ability to understand and use psychological skills such as mental imagery without adequate social support. For instance, children aged 7 to 11 (concrete operational phase) reason logically, yet their ability to solve problems and think in abstract terms is underdeveloped compared with children aged 12 and older (formal operational phase). Research among children indicated that visual and kinaesthetic imagery ability improves from the concrete operational phase to the formal operational phase (Wolmer et al., 1999) suggesting mental imagery is an appropriate skill to study among children and adolescents (Strachan & Munroe-Chandler, 2007). Piaget’s work, however, did not recognise the influence of social processes in cognitive development (Vygotsky, 1981) where peers and adults, more able than the child, can contribute to the child’s learning. In this instance, a sport psychologist may facilitate a child learning to use mental imagery by shaping the child’s lower mental functions to integrate higher mental functions during these formative years (Foster & Weigand, 2008).

In summary, research on the relationship between mental imagery and emotion and the role of cognitive development in imagery interventions remains limited in the sport psychology literature. To redress this imbalance, this case study introduced three competitive youth swimmers to MG-M imagery to enhance their affective experiences in swimming. MG-M imagery represents coping and mastering challenges such as being confident and focused during competition and these experiences foster positive affective responses (Jones et al., 2002). Positive affective responses are indicative of sport enjoyment, which positively influences sport commitment among youth athletes (Carpenter et al., 1993).

**Method**

**Participants**

Three competitive youth swimmers participated in this eight-week intervention comprising two 15-year-old females and one 13-year-old male. All swimmers possessed a minimum of three years’ competitive swimming experience and competed at county and regional level in central England. Pre-screening established no participant had previously received training in mental imagery or used the imagery technique before or during performance. Parents of each child provided informed written consent before participating.

**Experimental design**

A multiple-baseline design examined the effects of a MG-M imagery intervention on the affective responses of competitive youth swimmers. This design allowed an evaluation of the imagery influence upon affective responses at the point when each participant received the intervention (Kazdin, 1982).

**Dependent Variables**

**Motivational General-Mastery Imagery**

Motivational general-mastery imagery was assessed using the SIQ (Hall et al., 1998). The SIQ consists of 30 items comprising five subscales, on which athletes rate how frequently they image the suggested item. Each subscale contains six items and athletes...
rate how often they use each type of imagery on a seven-point Likert scale (1=rarely and 7=often). Exploratory and confirmatory factor analyses have verified the five-factor structure of the SIQ and demonstrated acceptable internal reliabilities (Hall et al., 1997, 1998).

Movement imagery ability
Movement imagery ability was measured using the revised Movement Imagery Ability Questionnaire (MIQ-R). Visual and kinaesthetic imagery were measured using the MIQ-R (Hall & Martin, 1997). The MIQ-R is a shortened version of the Movement Imagery Questionnaire (MIQ; Hall & Pongrac, 1983). This eight-item inventory asks participants to image actions either visually or kinaesthetically and then assign a value to the vividness of their image on a seven-point Likert scale (1=very hard to see/feel and 7=very easy to see/feel).

Swimming affective responses
Participants responded to two subscales that measured positive and negative affect (Watson et al., 1988) after swimming training. The positive affect subscale consists of 10 items (interested, alert, excited, inspired, strong, determined, attentive, enthusiastic, active, proud), and the negative affect subscale consists of 10 items (irritable, distressed, ashamed, upset, nervous, guilty, scared, hostile, jittery, afraid). Positive affect reflects the extent to which a person feels enthusiastic, active and alert. High positive affect signals high energy, high concentration and full engagement. Negative affect, on the other hand, is a general dimension of subjective distress and unpleasant engagement. Participants rated the extent to which they felt each of the 20 emotions on a five-point scale from ‘not all’ to ‘extremely’ after swimming training.

Social validation questionnaire
After finishing the intervention, participants completed a post-intervention questionnaire to provide information on the perceived importance of the study and effectiveness of the intervention. Each participant answered whether he or she thought the intervention was acceptable and useful for swimming.

Procedure
The university ethics committee and chairperson of a swimming club in central England gave permission to conduct this study. After obtaining parental consent and child assent, data collection begun. All participants scored at least a mean of 16 for the visual and kinaesthetic subscales of the
MIQ-R as recommend by Callow et al. (2001). Participants reported their affective responses to swimming during the baseline and intervention phase. Each participant received the intervention at different points, with a minimum of seven points in a baseline (Barlow & Hersen, 1984). Participant 1 received the intervention after seven training sessions, Participant 2 after 10 training sessions, Participant 3 after 13 training sessions. Each participant had equal numbers of data points across the intervention phase.

**Treatment: The Motivational General-Mastery Imagery Intervention**

Psychologists have recommended short intervention sessions in line with children’s cognitive development and attention span (Stallard, 2002, 2005). Therefore, the imagery training intervention was a 30-minute session to maintain each child’s attention. In addition, a psycho-educational booklet on mental imagery explained and illustrated the abstract concept of mental imagery (Stallard, 2002; 2005). The author attended at least one training session during each week of the intervention to refresh and reinforce the material presented in the initial education session and answer any questions that the athletes had regarding the process (Driskell et al., 1994). Participants imaged for a few minutes at a time when they practiced imagery and practiced before bedtime to maintain adherence. Although Hinshaw’s (1991) meta-analysis suggested that imagery sessions of less than one minute and those between 10 and 15 minutes were most effective in enhancing performance, limited information on the effects of imagery duration on performance or emotions among children exists.

**Data Analysis**

*Positive and negative affect data.* Data were analysed using visual inspection and statistical analyses. To establish a significant experimental effect using visual inspection, five criteria were established (Hrycaiko & Martin, 1996): (a) a stable baseline; (b) consistency of effect across participants; (c) fewer number of overlapping data points between baseline and intervention phases; (d) immediacy of effect after the intervention; and (e) the magnitude of the effect during the intervention compared to baseline. Although visual inspection is the traditional method to analyse single-subject data (Parsonson & Baer, 1978), other researchers have identified some shortcomings in this method (Crobie, 1993, Fisch, 2001; Kazdin, 1982). For example, visual inspection decision rules are subject to bias (Wolery & Harris, 1982), an inability to detect weak effects (Kazdin, 1982), a biased judgment due to autocorrelation (Bloom et al., 2003) and difficulties associated with an unstable baseline (Kazdin, 1982). Statistical methods could reduce these weaknesses. Parametric (e.g. ANOVA, t-test) and non-parametric tests (e.g. Mann-Whitney) can examine differences between baseline and intervention groups of scores. Parametric tests, however, assume independence of error terms. Adjacent data points, correlated over time in single-subject designs violate this assumption, known as serial dependency. Calculating autocorrelations separately for baseline and intervention data points resolves this difficulty. If parametric assumptions (i.e. homogeneity of variance, normal distribution of variables, independence of data points) are violated, a non-parametric test should be applied. In addition, unstable baselines disguise whether a change occurred because of the intervention, but statistical analyses account for this occurrence and provide information that may be difficult to obtain using visual inspection.

**Results**

**Participant 1**

*Visual inspection*

Participant 1’s mean positive affect improved from baseline (M=2.20) to treatment (M=2.86) by 30 per cent (Figure 1) and achieved a relatively stable baseline with only one overlapping point. The intervention
Figure 1: Graphic representation of positive affect data for all participants. The vertical line, on each graph, indicates the point at which the participant received the intervention.
revealed an immediate effect upon introduction followed by a general increase in trend in positive affect. Although negative affect decreased from a mean of 1.29 in the baseline to 1.01 during post-intervention (a 22 per cent decrease), this effect was not immediate and negative affect remained stable into the intervention with no difference between pre- and post-intervention (Figure 2).

Statistical analyses
A t-test examined the change from baseline to treatment phase in positive and negative affect. The requirements of normality of distribution, homoscedasticity, and data independence were fulfilled for the positive and negative affect scores. As indicated by the t-test, change was significant for positive affect (t=4.00, p<.001) but not negative affect (t=1.43, p>.05).

Social validation
Participant 1 reported using imagery before bedtime to prepare for the county swimming championships. She explained that the imagery programme helped enhance her confidence: ‘It made me more confident in my swimming and in my ability to swim well.’ She favoured an external imagery perspective because this perspective allowed her to examine her ‘stroke’ in the pool. She expressed an interest in integrating images of ‘winning trophies and medals’ to the imagery script to make the imagery more meaningful.

Participant 2
Visual inspection
Participant 2’s mean positive affect increased from baseline (3.84) to treatment (4.43) by 15 per cent but a stable baseline did not emerge. An immediate increase in positive affect occurred after the introduction of the intervention though data points overlapped from baseline to intervention phase (Figure 1). Negative affect remained relatively stable from baseline through intervention (Figure 2).

Statistical analyses
The requirements of normality of distribution, homoscedasticity, and data independence were fulfilled for the positive and negative affect scores. Similar to Participant 1, change was significant for positive affect (t=5.51, p=.001) but not negative affect (t=1.17, p>.05).

Social validation
Similar to Participant 1, Participant 2 also reported using imagery to prepare for the county swimming championships. As well as improving confidence, Participant 2 also explained he ‘…could visualise races and plan them out beforehand.’ He also used an external imagery perspective to assess his stroke ‘from the side and above the pool’. In an effort to enhance the imagery programme, Participant 2 suggested having imagery scripts for training and competitions.

Participant 3
Visual inspection
Participant 3’s mean positive affect increased from baseline (1.73) to treatment (2.13) by 23 per cent; however, neither a stable baseline nor an immediate effect of the intervention emerged. Many data points overlapped between baseline and intervention; however, a general increase in the trend of positive affect emerged (Figure 1). Negative affect remained relatively stable with a mean of 1.58 in the baseline to 1.59 during post-intervention. Negative affect fluctuated during the intervention period. Four overlapping data points appeared between baseline and intervention phases (Figure 2). Overall, PA and NA were not stable and so it is difficult to reach a firm conclusion about the intervention.

Statistical analyses
The requirements of normality of distribution, homoscedasticity, and data independence were not fulfilled for the positive and negative affect scores. Therefore, a Mann-Whitney test was used. As indicated by the
Figure 2: Graphic representation of negative affect data for all participants. The vertical line, on each graph, indicates the point at which the participant received the intervention.
Mann-Whitney test, change was significant for positive affect (U=53.5, \( p = .041 \)) but not negative affect (U=95.0, \( p = .907 \)).

Social validation
Participant 3 also used imagery before bedtime but focused on improving specific weaknesses relating to her swimming stroke. By doing imagery at night, she explained that it helped her to ‘sleep well’ and ‘wake up determined to swim quickly’ in the morning. She also used an external imagery perspective to assess ‘strengths and weaknesses of the arm movement’. In addition to the weekly follow-ups relating to the imagery intervention, Participant 3 also emphasised a need for more detailed discussions to ensure the imagery is ‘done to the best of my ability’.

Discussion
This study explored the effect of MG-M imagery on affective responses among three competitive youth swimmers. Statistical analysis showed significant increases in positive affect for all participants supporting the hypothesis that MG-M imagery could enhance the positive affect experienced by competitive youth swimmers. No statistically significant reduction in negative affect emerged for these participants. Under visual inspection, however, Participant 3 did not show a significant increase in positive affect after the intervention. Although a mean increase in positive affect from baseline to treatment is evident, many overlapping data points appear and the immediacy of an effect observed after the intervention is minimal. Toward the end of the treatment period, however, the data trend ascends suggesting a delayed effect of the treatment (Kazdin, 1982). Researchers in different sport contexts have shown increases in performance data after a latency period (Callow et al., 2001; Shambrook & Bull, 1996). In short, these results show some promise for MG-M imagery to enhance positive affect among youth sport performers. Small but reliable changes in affective responses are noteworthy for psychological well-being and these small changes, when accrued over an extended period are valuable (Fredrickson, 1998).

All participants reported increases in visual and kinaesthetic imagery suggesting an effect of the intervention (see Table 1). Participant 2 and Participant 3 reported increases in MS imagery, and participant three reported an increase in CS imagery. Although this intervention focused on MG-M imagery, no changes in MG-M imagery emerged after the intervention; nevertheless, the pre-intervention scores for MG-M imagery were the highest of all five categories in the SIQ for all participants. Participants received an imagery script reflecting MG-M imagery, however, they used imagery for other functions (e.g. assessing arm movement and race plans). That these participants used imagery for functions other than that suggested by the sport psychologist indicates that manipulation of the independent variable may not be reliable and that imagery interventions may serve more than one function. These findings emphasise Murphy et al.’s (2008) caution that the efficacy of Hall et al.’s (1998) taxonomic framework is uncertain and further manipulation checks during the intervention may provide greater understanding of the focus and content of athletes’ imagery. Interestingly, participants did not explicitly report affective changes (e.g. feeling happier) after the intervention in the social validation questionnaire. With an MG-M imagery intervention, however, a description of changes in confidence rather than affect was expected and that is what emerged.

All participants adopted an external imagery perspective to provide feedback on swimming performance factors such as arm movements. Hardy and Callow (1999) indicated that external visual imagery was superior to internal visual imagery for the acquisition and performance of tasks that depend on form for successful performance. Furthermore, Collins et al. (1998) argued that external imagery followed by kinaesthetic imagery is the perspective sequence
Table 1: SIQ\(^a\) and MIQ-R\(^b\) Scores for Pre- and Post-Imagery Training Programme.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Participant 1</th>
<th>Participant 2</th>
<th>Participant 3</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Cognitive-Specific</td>
<td>14</td>
<td>14</td>
<td>33</td>
</tr>
<tr>
<td>Cognitive-General</td>
<td>12</td>
<td>12</td>
<td>35</td>
</tr>
<tr>
<td>Motivation-Specific</td>
<td>16</td>
<td>17</td>
<td>34</td>
</tr>
<tr>
<td>Motivational General-Arousal</td>
<td>13</td>
<td>13</td>
<td>34</td>
</tr>
<tr>
<td>Motivational General-Mastery</td>
<td>21</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>MIQ-R – Visual</td>
<td>23</td>
<td>29</td>
<td>44</td>
</tr>
<tr>
<td>MIQ-R – Kinaesthetic</td>
<td>25</td>
<td>32</td>
<td>38</td>
</tr>
</tbody>
</table>

Note: \(\text{SIQ scores are reported as means for the six items on each sub-scale. A higher score indicates greater imagery use; MIQ-R scores are reported as mean for each sub-scale. A higher score indicates higher imagery ability.}\)

used by learners. Because these swimmers are in specialising years of sport participation (Côté, 1999), and are still learning swimming strokes, it makes sense that these participants would use external imagery. That these swimmers reported using external rather than internal imagery may also reflect an instinctive tendency to use an imagery perspective that provides the greatest information to improve performance.

At least three lines of research are worthy of further investigation. First, longitudinal research could uncover long-term changes in affective states and motivational variables due to imagery. In addition, determining imagery quantity to change performance and psychological variables such as emotion and motivation among youths remains an important question (Morris et al., 2005). Second, sport psychologists in professional practice advocate mental imagery to stimulate change in emotion, motivation and confidence. Future research could provide additional focus to these imagery functions rather than using performance as the only dependent variable. Finally, an in-depth understanding of how young athletes acquire and develop imagery skills is lacking (Murphy & Martin, 2002).

The present study had at least three limitations with implications for future research. First, no specific focus on visual or kinaesthetic imagery was emphasised; however, post-intervention assessments of visual and kinaesthetic imagery indicated that visual and kinaesthetic imagery improved for each participant. Second, one could address the temporal lag due to learning the skill for Participant 3 with an extended post-intervention phase (Shambrook & Bull, 1996). Third, the imagery treatment consisted of a single practice session followed by weekly manipulation checks to assess what the participants actually imaged. Although the participants were instructed to use MG-M imagery, it transpired that the participants also used imagery for other functions (e.g., cognitive-general). Finally, the swimming coach considered further data collection a disruption to training, therefore, no post-intervention follow-up data was available to assess the long-term effect of MG-M imagery on affect or determine whether the participants continued to practice imagery.

Despite these limitations, this study presents methodological strengths and guidance for the sport psychologist. For example, using visual inspection, statistical analyses and the systematic checking of conditions...
required to use appropriate parametric or non-parametric tests contributed to the robustness of these findings. Furthermore, a multiple-baseline design allows one to investigate individual differences among competitive youth athletes, increases our understanding of the effects of MG-M imagery on affective responses among this population, and offers practical guidance for using mental imagery among youth athletes. Thus far, only a few imagery studies in sport (e.g. Callow & Waters, 2005; Casby & Moran, 1998) have used single-case research designs. Working with youth athletes is challenging and rewarding. Challenging when one has to integrate each child’s cognitive, emotional and physical development into an intervention whilst recognising the socioenvironmental (e.g. coach, parents and peers) and task constraints (e.g. readiness for competition) imposed on them; nevertheless, these considerations are necessary to enhance a child’s psychological and emotional development through sport. The psychologist’s reward is a happy child who perceives greater control in sport from the social, emotional and educational support provided.

In summary, three competitive youth swimmers received an MG-M imagery intervention to enhance affective responses in swimming. Visual inspection and statistical analyses established that imagery used in practice settings could enhance positive affect in sport. Tailoring interventions to meet the cognitive developmental needs of youth athletes and manipulation checks to determine what athletes are imaging during interventions is imperative. This study provides initial support for the use of imagery among youth athletes for enhancing positive affective responses.

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