Routledge
Taylor & Francis Group

Investigating the effect of model type and practice format on performance expectations and actual physical performance

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Based on social cognitive theory, we tested the effects of model type (mastery vs. coping) and form of practice (physical, imagery, or none) on performance expectations (self-efficacy and perceived task difficulty) and balance on a stabilometer task. After obtaining baseline measures, 78 participants viewed either mastery or coping demonstrations of the task and practiced according to their allocated condition for 3 minutes. Following practice, all measures were assessed for a second time. Physical practice improved actual performance more than imagery and no practice. In support of social cognitive theory, physical and imagery practice raised self-efficacy beliefs, but only physical practice made the task seem easier to perform. Model type did not influence performance. We show that inflated estimates of physical ability following imagery, which are discordant with one's actual ability (*estimation inflation*), are not based on false perceptions of task difficulty. Our data concur with other studies that report no advantage of using a coping model over a mastery model when improving performance of a novel motor task.

Keywords: observational practice; imagery; stabilometer balancing; self-efficacy; performance

Introduction

Self-efficacy beliefs are constructed from different sources of information (Bandura, 1997). Of these, the two most influential types are performance accomplishments and vicarious experiences (Bandura, Adams, & Beyer, 1977; Wise & Trunnell, 2001). An individual's past performance accomplishments are considered the most dependable source, because they provide authentic information when formulating perceptions about one's capabilities (Bandura, 1997). Vicarious experiences are another means to promoting self-efficacy and are based on the performer observing others or oneself demonstrate the skill. Also known as observational learning, this form of social comparison allows performers to gain knowledge about how to carry out a skill and increase beliefs about their capability to be successful by appraising their skills in relation to the attainment of others (Bandura, 1997; McCullagh & Weiss, 2001, 2002). It is a particularly important source of self-efficacy for individuals who are inexperienced or uncertain with a task. Indeed, researchers have found that watching demonstrations raised efficacy beliefs and

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improved the learning and performance of novel skills (e.g., Feltz, Landers, & Raeder, 1979; McAuley, 1985).

The degree to which demonstrations are effective is dependent on several factors, including the type of modelled behaviour (Schunk, Hanson, & Cox, 1987). Two types of behaviour previously investigated have been coping and mastery models (Clark & Ste-Marie, 2002; Schunk et al., 1987; Weiss, McCullagh, Smith, & Berlant, 1998). According to Schunk et al., "coping models initially demonstrate the typical fears and deficiencies of observers but gradually improve their performance and help them gain confidence, whereas mastery models demonstrate faultless performance from the outset" (p. 54). Clark and Ste-Marie further explain that a coping model finds a task initially challenging and shows progressive improvement until their performance reaches a mastery level. This mastery attainment is conveyed through actual physical improvement of the performed skill and expressed verbally through statements suggesting increasing levels of confidence and perceived ease of performing the task. Conversely, a mastery model demonstrates a consistently perfect performance, and conveys feelings of high self-efficacy and low perceived task difficulty.

Bandura (1997) considers a coping model to be more favourable for skill acquisition because of the perceived similarity to observers. Testing this prediction, Weiss et al. (1998) found similar improvements after viewing either model type on fearful children's pre-test to post-test scores on swimming performance, fear levels, and self-efficacy. Encouragingly, however, the calculation of effect sizes revealed that viewing a coping model had a stronger effect on self-efficacy than a mastery model. Clark and Ste-Marie (2002) further investigated the effects of model type for learning how to dive and also found results contrary to expectation. Children viewing a coping model did not improve the most on self-efficacy, perceived task difficulty and diving performance. Instead, those who observed a mastery model had the best physical performance, and self-efficacy levels increased in all experimental groups. Clark and Ste-Marie suggested these findings were partially due to feedback having been presented on the videotape to both the coping and mastery groups (i.e., the diving instructor was heard giving feedback to the model), thereby providing the mastery group with both positive feedback as well as the opportunity to view a perfect dive. A next step in the literature would be to compare the effects of coping and mastery modelling without the provision of feedback from the experimenter to clarify the role played by model type in motor skill performance.

Imagery is another form of vicarious experience (Bandura, 1997) that has been shown to improve motor performance and raise self-efficacy beliefs (for reviews, see Hall, 2001; Murphy, Nordin, & Cumming, 2008). It usually involves the individual visually and kinaesthetically imaging themselves successfully carrying out the skill to be performed. In the current study, we refer to such imagery as imagery practice. Consistent with the modelling literature, imagery has also been classified into coping and mastery formats (Kazdin, 1973, 1974). Coping imagery involves individuals imaging themselves (or others) repeatedly confronting and mastering progressively more challenging situations. By comparison, mastery imagery depicts immediate successful performance of the task. Within a therapeutic setting, Kazdin demonstrated the superiority of coping imagery for reducing avoidance behaviours and the extinction of fears. Although this imagery type has not yet been applied to the acquisition of physical skills, the rationale drawn from Bandura's self-efficacy theory to support coping observational learning can also apply here. That is, individuals should feel more efficacious about their ability to learn and perform new skills when their imagery more accurately reflects actual development and progression. In other words, a greater similarity between imagery content and real-life occurrences will result from coping rather than mastery imagery.

Further rationale for these predictions is provided through the noted functional similarity between imagery practice and physical practice (Jeannerod, 1994). A shared network of brain

regions is activated during imagery and actual motor performance (Grèzes, & Decety, 2001). Consistent with this neural equivalence, imagined actions follow the same biomechanical constraints as real actions (Jeannerod, 1999; Johnson, 2000) and produce similar physiological responses (Gallego, Denot-Ledunois, Vardon, & Perruchet, 1996). Together, these data suggest that imagery practice and physical practice share functional equivalence (Decety, 1996; Decety & Grèzes, 1999; Jeannerod, 1994). Largely based on tenets of functional equivalence, the PETTLEP model of motor imagery was put forward by Holmes and Collins (2001, 2002). The PETTLEP model describes seven different elements (*P*hysical, *E*nvironment, *T*ask, *T*iming, *L*earning, *E*motion, and *P*erspective) to consider for developing more functionally equivalent imagery. Importantly, PETTLEP-based imagery interventions have been found to be more effective than less functionally equivalent imagery (i.e., little or no emphasis on the PETTLEP elements during imagery) for enhancing motor skill performance (e.g., Callow, Roberts, & Fawkes, 2006; Smith, Wright, Allsopp, & Westhead, 2007; Smith, Wright, & Cantell, 2008).

The PETTLEP model would predict that for new skills, coping imagery should be more functionally equivalent to physical practice than mastery imagery. As a consequence, coping imagery should be more effective for improving performance of novel motor skills. Three elements of the model are particularly relevant to supporting this prediction. First, *task* describes the importance of task-specificity and experience level. Holmes and Collins (2002) propose that imagery will be more functionally equivalent to actual performance if it reflects both the demands of the task and the individual's degree of task mastery. Similarly, *learning* describes imagery as most effective when it is congruent with the individual's current stage of learning. Mental representations of a task will change with learning and practice. Consequently, imagery should develop to accommodate these changes and maintain functional equivalence. The *emotion* element explains that appropriate thoughts and emotions should be included in imagery scripts to ensure that participants will experience them during the real-life situation. These elements suggest that coping imagery would provide a more realistic reflection of the changes that occur during physical practice than mastery imagery. Whether coping imagery is more effective for learning and improvements in motor skills, however, has not yet been investigated.

The literature reviewed thus far has shown that imagery practice shares functionally similar properties to physical practice (Jeannerod, 1994). Recently, however, Ramsey, Cumming, and Edwards (2009) demonstrated that imagery practice and physical practice produce dissociable effects on performance expectations (self-efficacy) and actual performance when learning a novel task (balancing on a stabilometer). Whereas physical practice increased both performance expectations and actual performance, imagery practice only increased performance expectations. This finding supports the view that for improving performance of novel tasks, brief bouts of imagery inflate estimates of performance but not actual physical performance, a phenomenon known as *estimation inflation* (Landau, Leynes, & Libkuman, 2001; Landau, Libkuman, & Wildman, 2002). In their study, Ramsey and colleagues only compared mastery forms of imagery practice to physical practice. It is not yet known if coping forms of imagery practice also show dissociable effects on performance estimates and actual performance. Furthermore, they did not measure participants' perceptions of task difficulty. Therefore, it is unknown whether the estimation inflation effect was produced because imagery practice resulted in false perceptions of (lower) task difficulty.

The main aim of the current study was to investigate the effects of model type (mastery vs. coping) and practice format (physical practice vs. imagery practice vs. no practice) on performance expectations and actual physical performance. To allow comparisons with similar research, balancing on a stabilometer was selected as a novel task to learn (Ram, Riggs, Skaling, Landers, & McCullagh, 2007; Ramsey et al., 2009) and the dependent variables measured were self-efficacy, perceptions of task difficulty and physical performance (Clark & Ste-Marie, 2002; Weiss et al., 1998).

The current design allowed the existing literature to be extended in three main ways. First, although proposals suggest that observational learning will be more effective when based on coping models than mastery models, the extant empirical evidence does not support this view (Clark & Ste-Marie, 2002; Weiss et al., 1998). We aimed to further delineate these mixed findings by addressing previous methodological limitations. To do so, we did not provide feedback to participants regarding their performance in order to remove the possible influence of positive feedback on our dependent measures. If observational learning using a coping model indeed provides additional benefits over a mastery model then we expect increased performance levels to be combined with increased self-efficacy and lower perceptions of task difficulty for coping compared to mastery observational learning.

Second, previous evidence has demonstrated benefits of coping over mastery imagery practice in therapeutic settings (Kazdin, 1973, 1974). However, no prior work has investigated a similar distinction in imagery format for improving performance of novel motor skills. We test whether coping imagery practice is more beneficial for enhancing motor skills than mastery imagery practice by comparing the effect of these two forms of imagery practice on our three dependent measures. If coping imagery practice provides additional benefits to skill learning compared to mastery imagery practice, then we would predict increased performance levels to be combined with increased self-efficacy and lower perceptions of task difficulty for coping compared to mastery imagery practice.

Third, physical practice and mastery forms of imagery practice produce dissociable effects on performance estimates (self-efficacy) and actual performance of novel tasks (Ramsey et al., 2009). Physical practice inflates performance estimates and improves actual performance, whereas mastery imagery practice only inflates performance estimates. This pattern of results is consistent with the estimation inflation effect, where imagery only serves to inflate estimates of physical abilities and not actual physical ability (Landau et al., 2001). It is not known if coping imagery practice, through greater functional equivalence to physical practice, removes the dissociation previously found between mastery imagery practice and physical practice. We test this prediction by comparing the influence of coping and mastery forms of imagery practice on self-efficacy and actual performance. If coping imagery practice removes the dissociation then we would expect both self-efficacy and actual performance to increase for the coping imagery practice group, but only self-efficacy to increase for the mastery imagery practice group. Further, we include an additional dependent measure: perceived task difficulty. By doing so, we can test if the estimation inflation effect occurs concurrently with perceptions of task difficulty that are incongruent with reality, which was not possible previously (Ramsey et al., 2009). If so, imagery practice should lower perceptions of task difficulty but not improve actual performance.

Method

Participants

The sample consisted of 78 undergraduate students (53 female, 25 male) of a Sport and Exercise Sciences degree who received course credit for their participation. They ranged in age from 19 to 25 years, with an average age of 20.32 ($SD = 1.15$) years. Participants were recruited via posted ads and word of mouth in the school where the research took place. They were randomly assigned to both a model type (coping versus mastery) and a practice condition (physical, imagery, or no practice control) resulting in six groups (all $n = 13$). Demographic information (gender and age) of the participants are reported in Table 1 according to experimental condition. As part of obtaining their background information, participants confirmed that they had no prior experience with the balancing task.

Table 1. Demographic variables of experimental groups.

Practice condition	Model type	Gender		Age (yr)	
		Females	Males	*M*	*SD*
Physical	Mastery	7	6	20.39	1.12
	Coping	10	3	20.00	.58
Imagery	Mastery	10	3	20.69	1.49
	Coping	9	4	20.31	1.38
Control	Mastery	8	5	20.23	1.01
	Coping	9	4	20.25	1.22

Measures

General balance ability. Participants were asked to rate their perceived balancing ability on a 5-point Likert-type scale, ranging from 1 (*very poor*) to 5 (*very good*). The average score was 3.22 (*SD* = .71), which indicated that the majority of participants perceived their general balancing ability as moderate to moderate-good.

General imagery ability. The Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997) was employed as a measure of general imagery ability to ensure that all participants were capable of imaging movement (i.e., an average score of 4 or higher on each subscale; Ramsey, Cumming, & Edwards, 2008). The MIQ-R is an eight-item questionnaire asking partici-pants to first physically perform, and then visually or kinaesthetically image four simple move-ments. The participants were then asked to rate their ability to image the movement on a seven-point Likert-type scale ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/ feel*). The items were then averaged to form visual (*M* = 5.47, *SD* = 1.05) and kinaesthetic (*M* = 5.09, *SD* = .89) subscales. Acceptable levels of internal reliability were found for both sub-scales with Cronbach alpha coefficients of .80 (kinaesthetic subscale) and .86 (visual subscale).

Self-efficacy. Based on previous work (Ramsey et al., 2009), a self-efficacy scale was designed to assess both the level and the strength of participants' beliefs about their ability to perform the balancing task (Bandura, 1997). Items were based on the question "How confident are you right now that you can keep the balance board perfectly stable?" The question was repeated a total of three times, with each question representing a progressively harder goal (i.e., on at least one of the three following attempts, on two of the following three attempts, and on all three of the following attempts). Participants indicated the strength of their belief in each statement in percentage ranging from 0% "*I am very sure I cannot do this*", to 50% "*I am unsure - it could go either way*", and 100% "*I am very sure I can do this*". Scores were averaged across the three questions to create a measure of self-efficacy. Acceptable levels of internal reliability were found for pre-test (α = .88) and post-test self-efficacy (α = .90).

Task difficulty. A single item was employed to tap into perceptions of task difficulty (see Clark & Ste-Marie, 2002). Participants were asked to rate on a seven-point Likert-type scale how easy or difficult they perceived the task, with scores ranging from 1 (*very hard*) to 7 (*very easy*).

Balance performance. The balancing apparatus was a custom-built stabilometer consisting of a 100 cm × 67 cm wooden platform mounted freely on a horizontal axis (centre of board) in the participants' frontal plane. From this horizontal axis, the maximum deviation possible was 14 degrees to either side. Data were collected using a potentiometer mounted on the horizontal

axis and sampled at 200 Hz by a PC-compatible computer with a C.E.D. 1401+ data acquisition board. Potentiometer data collected were transformed into degrees of variance from the horizontal equilibrium. Following the same procedure as Ramsey et al. (2009), participants' proficiency in performing the balancing task was then measured by the standard deviation away from horizontal axis, with a lower standard deviation score indicating a better balancing performance (i.e., less deviation from the horizontal axis).

Post-experimental manipulation check. Participants were asked a series of post-experimental questions in accordance with recommendations made by previous authors (e.g., Cumming & Ramsey, 2008; Murphy & Martin, 2002). First, they were asked to rate the degree of similarity between themselves and the model on a scale from 1 (*not at all*) to 7 (*very much so*). Only participants in the imagery group were then asked to rate how easy or difficult it was for them to visually and kinaesthetically image the balancing task. Their responses were rated on the same seven-point Likert scale used in the MIQ-R, with scores ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). Finally, all participants rated to what extent they tried to keep the balance board stable throughout the experiment on a scale from 1 (*not at all*) to 7 (*all of the time*).

Procedure

Ethical approval to conduct the study was first obtained from the university where the authors are based.

Introductory phase. Participants were given an information letter and completed a consent form. They were then asked to provide demographic information and rate their perceived balancing ability. A short definition of imagery was next provided (White & Hardy, 1998) and participants were asked to complete the MIQ-R. Baseline measures of performance were then obtained by asking participants to perform the balancing task for 30 seconds followed by 30 seconds of rest, repeated for a total of three trials. They were informed that no feedback or encouragement would be given throughout the experiment. Participants then completed their first measure of self-efficacy and perceptions of task difficulty.

Modelling phase. The participants were randomly allocated to view one of the two model types: mastery ($n = 39$) and coping ($n = 39$). The demonstration had been digitally recorded using a hand-held video camera, and the recording was played to the participants using a 17-inch PC monitor and Windows Media Player. The model for both conditions was a 22-year-old male who was unknown to the participants and was able to demonstrate mastery of the task. The participants viewed this model performing the balancing task for 30 seconds followed by a blank screen for 30 seconds. Participants assigned to the mastery model condition observed that the model was able to keep the balance board perfectly stable for the entire trial while verbalising high levels of self-efficacy and low perceptions of task difficulty (e.g., "This is quite easy"). The same video clip was repeated three times. Conversely, participants assigned to the coping model condition observed the model pretending to initially struggle with the task, and then show progressive improvements throughout the three video clips. The model also verbalised increasing levels of self-efficacy and lowering perceptions of task difficulty (e.g., "I am really struggling to keep this steady" to "It is getting a little bit easier" to "I am starting to get the hang of this now").

Practice phase. The participants were then randomly allocated to an observation plus physical practice group ($n = 26$), an observation plus imagery practice group ($n = 26$), and an

observation, no practice group ($n = 26$), with an equal number of each model type represented across the practice groups. Those assigned to the physical practice group practiced the balancing task by alternating between 1 minute of balancing with 1 minute of rest, and this was repeated three times for a total of six minutes. They were made aware that no measures of their performance would be obtained during this phase.

Participants in the imagery practice group followed almost the identical procedures, with the exception being that they were asked to practice the task by engaging in mental imagery. That is, participants engaged in one minute of imagery followed by one minute for rest, repeated three times for a total of six minutes. During the imagery, they were asked to mount the balance board and occupy the starting position. This instruction was based on the physical element of the PETTLEP model, and was included so that the imagery would more closely approximate the real-life experience (Holmes & Collins, 2001, 2002). To further support their images, the participants also heard pre-recorded imagery scripts describing either coping or mastery imagery depending on the model type previously viewed. Those participants who first observed a mastery model then imaged alongside to a mastery imagery script whereas those observing a coping model then heard the coping imagery script (see the Appendix). The same mastery imagery script was repeated three times and described the participant being successful at keeping the balance board stable, feeling confident, and finding the task easy to perform. By comparison, three different coping imagery scripts were employed and described progressive improvements in performance, greater feelings of confidence and ease of performing the task. Regardless of the imagery script heard, participants were instructed to image the scene as vividly as possible.

Finally, participants in the no practice group worked on a word search puzzle for 6 minutes, and this matched the length of practice time given to the other two groups.

Rest phase. Following their respective practice conditions, all participants were asked to work on a word search puzzle for 20 minutes before the subsequent retention and test phase. They were told that completion of the word search puzzle would not be assessed.

Retention and test phase. Immediately after the practice/rest phase, the participants were given a second measure of self-efficacy and task difficulty to complete. These measures were completed at this point in the protocol to examine the effects of the experimental manipulation on self-efficacy and perceptions of task difficulty without influencing participants' perceptions by further performance of the task. Thus, after these measures were completed, participants carried out the second measure of performance in the same sequences used in the pre-test. That is, participants were asked to balance for 30 seconds followed by 30 seconds of rest, repeated for a total of three times. Upon completion of the second measure of balancing performance, the participants were given a post-experimental manipulation check to complete.

Results

Preliminary analyses

Before proceeding with the main analyses, preliminary analyses were first conducted to establish that no variables other than those manipulated for the study purposes were influencing the results. Possible confounding variables considered were gender, perceived general balancing ability, and general imagery ability. A MANOVA was calculated with perceived balancing ability and the MIQ-R subscales as the dependent variables and model type and practice groups as the independent variables. No significant multivariate effect was found for model type or practice group, and

no significant model type by practice group interaction was found (all $ps > .05$). Further, three separate ANOVAS with a corrected alpha level ($p = .0167$) revealed no differences in baseline measures of performance, self-efficacy, or task difficulty according to gender. Given the lack of significant findings, the data were collapsed across these variables for the main analyses.

Post-manipulation checks

Perceived model similarity ($M = 4.12$, $SD = 1.65$) was fairly high across all participants. Two separate ANOVAs with a corrected alpha level ($p = .025$) determined whether differences existed in this dependent variable according to experimental groupings (i.e., model type and practice condition) or gender. In the first ANOVA, no significant differences were found according to practice group and there was no significant Model type by Practice group interaction. However, a significant effect was found for model type, $F(1, 71) = 17.10, p < .001, \eta^2 = .19$, indicating that participants who viewed the coping model ($M = 4.84$, $SD = 1.42$) rated themselves more similar to the model than those who viewed the mastery model ($M = 3.41$, $SD = 1.57$). No significant differences existed between the male and female participants.

The means for both specific visual and kinaesthetic imagery were above the mid-point of the scale suggesting that imagery group participants were able to image the balance task with relative ease. However, a paired t-test, $t(24) = 2.73$, $p = .01$, revealed that imagery group participants found it significantly easier to see ($M = 5.16$, $SD = 1.11$) than feel ($M = 4.40$, $SD = 1.23$). A MANOVA determined that no significant differences existed in ease of imaging according to model type.

Perceived adherence to the experimental instructions was fairly high among the participants ($M = 6.64$, $SD = .60$). An ANOVA revealed no significant differences in the degree to which participants attempted to keep the balance board stable throughout the experiment according to model type or practice condition, and there was no significant model type by practice condition interaction.

Main analyses

Means and SDs pertaining to the main analyses are reported in Table 2. Three separate ANOVAs with a corrected alpha level confirmed that no baseline differences existed in performance, self-efficacy, and perceived task difficulty according to model type and practice condition, and no significant model type by practice condition interaction existed. Separate 3 Practice condition (physical practice, imagery practice, or no practice) × 2 Model type (mastery or coping) × 2 Time (pre-test and post-test) ANOVAs with repeated measures on the last factor were then calculated with performance, self-efficacy, and perceived task difficulty as the dependent variables. The Greenhouse-Geisser adjustment was applied to all those analyses where violations to the assumption of sphericity were found. Significant interactions were explored using Tukey's HSD post hoc tests. Due to multiple comparisons undertaken on the dependent variables in the preliminary and main analyses, a corrected alpha level was used to determine significance of the tests ($\alpha = .0167$ or $.05/3$ comparisons per dependent variable).

Balancing performance. A main effect was found for time, $F(1,72) = 350.91$, $p < .001$, $\eta^2 = .83$, and a significant interaction was found between Practice condition and Time, $F(2,72) = 12.76$, $p < .001$, $\eta^2 = .26$, as shown in Figure 1. Post hoc tests on the significant interaction showed that participants in all three practice conditions significantly improved their balancing performance in the post-test compared to pre-test. The physical practice group improved significantly more than both the imagery practice and no practice groups with no

Table 2. Mean and standard deviations for performance (away from horizontal axis in degrees), self-efficacy (0–100% rating), and perceived task difficulty (1–7 rating).

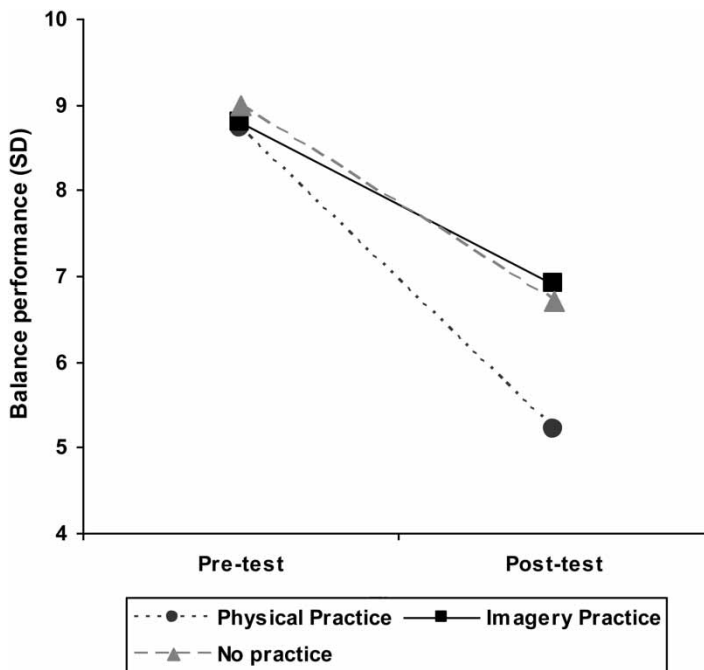| Practice condition | Model type | Performance | | | | Self-efficacy | | | | Task difficulty | | | |
| | | Pre-test | | Post-test | | Pre-test | | Post-test | | Pre-test | | Post-test | |
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Physical	Mastery	9.24	1.40	5.25	2.08	20.18	14.72	37.18	18.64	2.75	0.97	3.67	1.07
	Coping	8.20	1.63	5.15	1.65	17.95	19.17	33.08	19.98	2.75	1.22	4.08	1.08
Imagery	Mastery	8.79	1.67	7.19	2.02	19.62	21.24	29.74	20.70	2.33	1.30	2.83	1.27
	Coping	8.81	1.49	6.63	1.48	21.79	14.33	32.44	8.46	2.58	1.00	2.83	0.83
Control	Mastery	8.82	1.42	6.60	1.91	23.59	16.58	25.64	14.74	2.50	0.67	2.75	0.97
	Coping	9.17	1.17	6.80	1.29	22.64	13.88	23.21	12.29	4.54	7.68	4.92	7.58

Figure 1.   Balance performance (standard deviation away from horizontal axis in degrees) for the three experimental groups collapsed across model type.

differences found between these latter groups. No main effect was found for practice condition or model type (observed power = 56.8% and 8.4%, respectively). The remaining two-way (Model type × Time, Practice condition × Model type) and three-way (Practice condition × Model type × Time) interactions were not significant (observed power = 5.7% and 52.5%, respectively).

Self-efficacy. A main effect was found for time, $F(1,72) = 46.27, p < .001, \eta^2 = .29$, observed power = 100%, and a significant interaction was found between Practice condition and Time, $F(2,72) = 9.98, p < .001, \eta^2 = .22$, observed power = 98.1% as illustrated in Figure 2. Post hoc tests showed that the physical practice and imagery practice groups significantly increased their self-efficacy from pre-test to post-test, whereas the no practice group's self-efficacy did not change. Furthermore, the physical practice group's post-test self-efficacy was significantly higher than the no practice group. No main effect was found for practice condition or model type (observed power = 9.7% and 5.6%, respectively). The remaining two-way (Model type × Time, Practice condition × Model type) and three-way (Practice condition × Model type × Time) interactions were not significant (observed power = 6.4% and 6.1% respectively).

Task difficulty. As shown in Figure 3, a main effect was found for time, $F(1,72) = 44.65$, $p < .001$, $\eta^2 = .40$, observed power = 100%, and a significant interaction was found between Practice condition and Time, $F(2,72) = 8.20, p < .001, \eta^2 = .20$, observed power = 95.3%. Post hoc tests showed that the physical practice group found the task significantly easier after the practice phase. No changes in perception of task difficulty were found for the imagery practice and no practice groups. The imagery group reported greater perceptions of task difficulty at the post-test than the physical practice and no practice groups. No main effect was found for practice condition or model type (observed power = 14.5% and
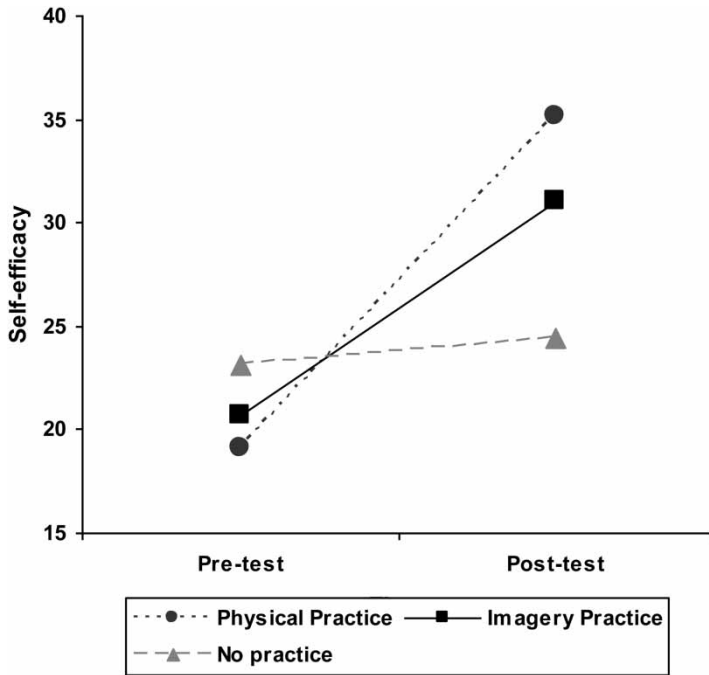
Figure 2.   Self-efficacy ratings (0 = "am very sure I cannot do this", 100% = "I am very sure I can do this") for the three experimental groups collapsed across model type.
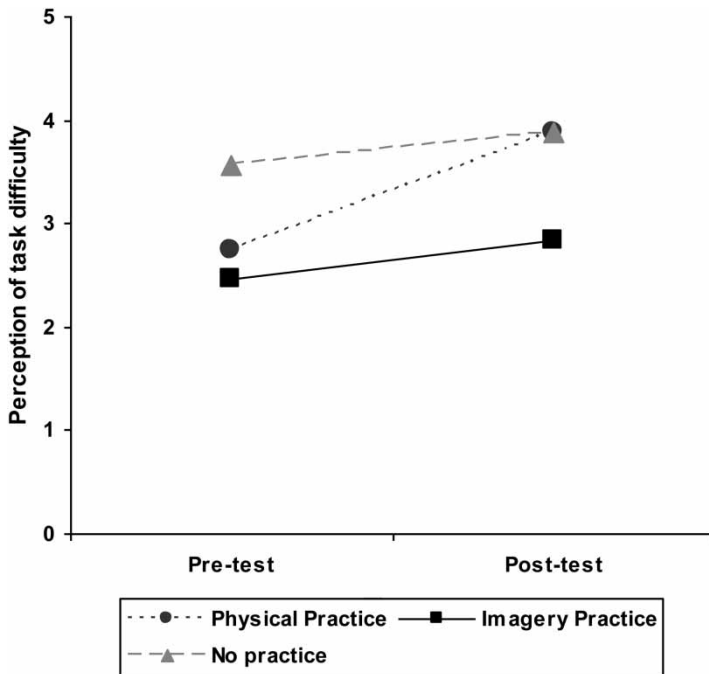

Figure 3.   Perceived task difficulty (1 = very hard, 7 = very easy) for the three experimental groups collapsed across model type.

17.6%, respectively). The remaining two-way (Model type × Time, Practice condition × Model type) and three-way (Practice condition × Model type × Time) interactions were not significant (observed power = 8.5% and 23.9%, respectively).

   Relationships between dependent variables at post-test. To explore whether perceptions of self-efficacy and task difficulty were associated with performance at post-test, bivariate correlations were performed by practice condition. Post-test performance was significantly and negatively related to self-efficacy, only for those in the physical practice condition ($r = -.49$, $p < .05$), and task difficulty, for those in both physical ($r = -.48$ $p < .05$) and imagery ($r = -.66$, $p < .01$) practice conditions. Because a lower performance score indicates better performance, these negative relationships indicate that participants who were more confident in their balancing ability (physical practice only) and perceived the task as easy (physical practice and imagery) performed more stably at post-test. No significant relationships were found between these variables for participants in the control group.

Discussion

We investigated the effects of model type and practice format on performance expectations and actual performance. In replication of the previous work, dissociable effects were observed for physical practice and imagery practice on performance expectations and actual performance of a novel task (Ramsey et al., 2009). Consistent with the estimation inflation effect, physical practice increased self-efficacy and actual performance, whereas imagery practice only raised self-efficacy (Landau et al., 2001). A novel dissociation between the effects of physical practice and imagery practice was also demonstrated. Although physical practice and imagery practice both inflated self-efficacy, only physical practice lowered perceptions of task difficulty. Hence, our data show that inflated estimates of physical ability following imagery practice are not based on artificially low perceptions of task difficulty. By contrast, no differences were observed between coping and mastery forms of observational learning or imagery practice. These data suggest that coping strategies provide no advantage compared to mastery strategies when improving performance of a balance task. Rather, both strategies provide equal benefits in simple skill improvement. The implications of these findings for modelling and mental practice theories will be discussed in turn.

Model type

Contrary to predictions, no benefits were found for viewing a coping model compared to a mastery model for any measure. Clark and Ste-Marie (2002) and Weiss et al. (1998) also failed to find differences between model types on similarly obtained measures. These previous findings were attributed to confounding variables such as the provision of feedback and inadvertent additional opportunities to view models. These issues were addressed in the present study by testing each participant individually and eliminating feedback from the experimenter. Despite greater experimental control, the results showed no differences between model types. Our data join a growing body of evidence that does not support the predictions made for coping and mastery model types of observational learning. Instead, learners appear to benefit equally from both model types when improving performance of simple skills. Supporting this view, Bandura (1997) has written that "some of the benefits commonly attributed to coping modelling may be overstated" (p. 99). He goes on to explain that a mastery model also conveys a great deal of functional information to the observer that could effectively raise self-efficacy beliefs.

The differences between model types might become clearer if the observer is faced with a particularly difficult skill where progress is frustrating and mastery requires considerable effort and investment. In such circumstances, Bandura (1997) posits that a coping model will instil a stronger sense of efficacy in individuals, particularly those who doubt their abilities to be successful. It does not appear that participants in the present study held these perceptions of task difficulty. When initially exposed to the task, they rated balancing on the stabilometer to be "somewhat hard" ($M = 2.89$, $SD = 3.32$) on a scale ranging from 1 (*very hard*) to 7 (*very easy*). Moreover, they believed their general balancing ability to be "moderately good" ($M = 3.22$; $SD = .71$) on a scale ranging from 1 (*very poor*) to 5 (*very good*). Plausibly, the task may not have been difficult enough to tease out meaningful differences between coping and mastery model types. This is further underscored by the improvements noted in stability following only 3 minutes of physical practice. In addition, the relatively short length of the modelling phase (1.5 minutes viewed in total/condition) may have been too short to distinguish between these model types.

Our manipulation check revealed greater ratings of perceived similarity for the coping versus mastery model type. Participants perceived themselves to be more similar to a model that displayed progressive improvements in the task rather than to the model that demonstrated immediate task mastery. This finding underlies one of the ways through which coping observational learning is proposed to raise self-efficacy beliefs (Bandura, 1997). That is, viewing a similar model improve with effort and perform the task successfully will communicate to the observer that they also possess the necessary capabilities. However, the greater perceived similarity between the observer and coping model did not impact the participant's beliefs about their performance of the balancing task in the present study. Schunk and Hanson (1989) explained that participants may overcome any initial perceptions of dissimilarity to a mastery model through the process of observing the model's skills. Another possible explanation is that participants' beliefs in their ability to improve on the task were sufficiently high enough to counteract perceptions of dissimilarity to the model.

Practice condition

In support of social cognitive theory (Bandura, 1997), greatest improvements in performance were achieved following physical practice as these participants received authentic experience with the task. In this condition, participants had an opportunity to view a model (a form of vicarious experiences) and gain mastery of the task (a form of performance accomplishments). Further and as predicted, physical practice and imagery practice produced dissociable effects on performance estimates and actual performance (Ramsey et al., 2009). Following physical practice, participants had higher performance estimates (greater self-efficacy and lower perceptions of task difficulty) and enhanced stability compared to imagery practice and no practice. By contrast, imagery practice resulted in increased self-efficacy but not improved stability compared to the no practice condition. Furthermore, higher self-efficacy beliefs were significantly associated with better balancing performance only for those who undertook physical practice. Together, these findings are consistent with the notion of estimation inflation, whereby imagery serves to increase beliefs about physical abilities (self-efficacy) without any corresponding improvements in actual physical ability (Landau et al., 2001).

Although imagery practice inflated self-efficacy, unlike physical practice it did not make the task seem any easier to perform. These data demonstrate a further dissociation in performance estimates and actual performance following physical practice and imagery practice, extending previous work by helping us to understand the estimation inflation effect. It was suggested that estimation inflation may, in part, be produced through imagery practice providing misleading information about the task (Ramsey et al., 2009). That is, participants may perceive the task to

be easier than it is in reality. The current dataset does not substantiate this prediction. Although participants' belief in their physical abilities increased to artificially high levels through imagery practice this was not due to misleading perceptions of task difficulty. If that were the case, perceptions of task difficulty would also be expected to be artificially lower following imagery practice. Instead, perceptions of task difficulty did not change following imagery practice. Moreover, perceptions of task difficulty were similarly associated with post-test performance for both the imagery and physical practice conditions.

Although these results refute one possible explanation of estimation inflation at least two other explanations remain open to direct testing: "memory" and "mental practice" accounts. The mental practice account suggests that imagery practice inflates self-efficacy by actually increasing one's ability to perform a task. By contrast, memory accounts predict that imagery practice inflates self-efficacy by making task-performance more readily available in memory, which is consistent with the autobiographical memory literature (Garry, Manning, Loftus, & Sherman, 1996; Heaps & Nash, 1999; Hyman & Pentland, 1996; Libby, 2003). Because the current dataset does not show support for a mental practice explanation, due to lack of performance improvements (see also Mulder, Zijlstra, Zijlstra, & Hochstenbach, 2004; Ramsey et al., 2009), a "memory" account of estimation inflation remains the most likely explanation. However, further investigation is warranted that tests the specific predictions made by both accounts before definitive conclusions are made.

Regardless of whether the participants imaged themselves progressively improving on the task (coping imagery) or immediate task mastery (mastery imagery), similar improvements in performance and self-efficacy were found. Past imagery research has mainly focused on the effect of mastery images when examining the effects of imagery practice on performance and self-efficacy (e.g., Nordin & Cumming, 2005). The present study, therefore, extends this literature by demonstrating that similar effects for self-efficacy also occur with coping imagery content.

The functional equivalence and PETTLEP model literatures would predict a different pattern of results when developing new skills (Decety, 1996; Holmes & Collins, 2001; Jeannerod, 1994). Coping imagery should develop with the imager's stage of learning and share greater functional equivalence with actual performance than mastery imagery. By consequence, coping imagery should be more beneficial to performance estimates and actual performance than mastery imagery. Support was not found for this assertion, and as stated, both mastery and coping imagery resulted in similar levels of performance improvement. Therefore, coping forms of imagery practice did not remove the dissociable effects previously found between mastery forms of imagery practice and physical practice on self-efficacy and actual performance (Landau et al., 2001; Ramsey et al., 2009). Moreover, participants reported imaging the task with relative ease regardless of whether they were assigned to the coping or mastery imagery type. Thus, it may have been fairly easy for participants to develop a mental representation of balancing on a stabilometer. It has been suggested that coping strategies may be more successful when individuals are faced with problems and deal with setbacks (Bandura, 1997). Therefore, differences as a function of imagery type might result for more complex skills examined over longer durations or with populations who find balance more challenging (e.g., older adults).

Similar to the previous work (Ramsey et al., 2009), there was a significant improvement in performance for the no practice group. It could be that viewing a model after completing three baseline trials of the task was sufficient enough "practice" for improvements to be found. Like imagery (Ehrsson, Geyer, & Naito, 2003; Fadiga et al., 1999), observing movements has also been found to activate similar neural regions in the brain and the specific musculature activated during the execution of those same movements (Buccino et al., 2001; Fadiga, Fogassi, Pavesi, & Rizzolatti, 1995). It is plausible that creating a mental representation of the task through viewing the model resulted in significantly enhanced performance. Similarly, viewing the model may have

led participants to spontaneously image the task (in both the control and physical practice groups), which in turn contributed to their improvement. This design choice enabled us to draw conclusions about the effect of assigned practice condition separately from model type; however, it remains unknown whether the combination of modelling plus practice led to the observed changes in dependent variables over other explanations (e.g., passage of time or imagery or physical practice alone). Future researchers may wish to clarify these issues by replicating the present study with the addition of another control group who do not view a model perform the task.

In conclusion, we report a novel dissociation between the effects of physical practice and imagery practice on performance estimates and actual physical performance. Whereas physical practice improved actual performance, inflated self-efficacy and lowered perceptions of task difficulty, imagery practice only served to inflate self-efficacy. Hence, our data show that overinflated estimates of physical ability following imagery practice are not based on false perceptions of task difficulty. By contrast, no differences were observed between coping and mastery forms of observational learning or imagery practice. From an applied point of view, these data suggest mastery and coping strategies provide equal benefits when enhancing performance of novel skills, at least when these skills can be improved in a relatively short period of time.

References

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman.

Bandura, A., Adams, N.E., & Beyer, J. (1977). Cognitive processes mediating behavioral change. *Journal of Personality and Social Psychology*, *35*, 125–139.

Buccino, G., Binkofski, F., Fink, G.R., Fadiga, L., Fogassi, L., Gallese, V., et al. (2001). Action observation activates premotor and parietal areas in a somatotopic manner: An fMRI study. *European Journal of Neuroscience*, *13*, 400–404.

Callow, N., Roberts, R., & Fawkes, J.Z. (2006). Effects of dynamic and static imagery on vividness of imagery, skiing performance, and confidence. *Journal of Imagery Research in Sport and Physical Activity*, 1. Retrieved April 12, 2007, from www.bepress.com/jirspa/vol1/iss1/art2.

Clark, S.E., & Ste-Marie, D.M. (2002). Peer mastery versus peer coping models: Model type has differential effect on psychological and physical performance measures. *Journal of Human Movement Studies*, *43*, 179–196.

Cumming, J., & Ramsey, R. (2008). Imagery interventions in sport. In S.D. Mellalieu & S. Hanton (Eds.), *Advances in applied sport psychology: A review* (pp. 5–36). London: Routledge.

Decety, J. (1996). Do imagined and executed actions share the same neural substrate? *Cognitive Brain Research*, *3*, 87–93.

Decety, J., & Grezes, J. (1999). Neural mechanisms subserving the perception of human actions. *Trends in Cognitive Science, 3*, 172–178.

Ehrsson, H.H., Geyer, S., & Naito, E. (2003). Imagery of voluntary movement of fingers, toes, and tongue activates corresponding body-part-specific motor representations. *Journal of Neurophysiology*, *90*, 3304–3316.

Fadiga, L., Buccino, G., Craighero, L., Fogassi, L., Gallese, V., & Pavesi, G. (1999). Corticospinal excitability is specifically modulated by motor imagery: A magnetic stimulation study. *Neuropsychologia*, *37*, 147–158.

Fadiga, L., Fogassi, L., Pavesi, G., & Rizzolatti, G. (1995). Motor facilitation during action observation - a magnetic stimulation study. *Journal of Neurophysiology, 73*, 2608–2611.

Feltz, D.L., Landers, D.M., & Raeder, U. (1979). Enhancing self-efficacy in high-avoidance motor tasks: A comparison of modeling techniques. *Journal of Sport Psychology, 1*, 112–122.

Gallego, J., Denot-Ledunois, S., Vardon, G., & Perruchet, P. (1996). Ventilatory responses to imagined exercise. *Psychophysiology, 33*, 711–719.

Garry, M., Manning, C.G., Loftus, E.F., & Sherman, S.J. (1996). Imagination inflation: Imagining a childhood even inflates confidence that it occurred. *Psychonomic Bulletin & Review, 3*, 208–214.

Grèzes, J., & Decety, J. (2001). Functional anatomy of execution, mental simulation, observation, and verb generation of actions: A meta-analysis. *Human Brain Mapping*, *12*, 1–19.

Hall, C. (2001). Imagery in sport and exercise. In R.N. Singer, H. Hausenblas, & C.M. Janelle (Eds.), *Handbook of sport psychology* (2nd ed., pp. 529–549). New York: John Wiley.

Hall, C., & Martin, K.A. (1997). Measuring movement imagery abilities: A revision of the Movement Imagery Questionnaire. *Journal of Mental Imagery*, *21,* 143–154.

Heaps, C., & Nash, M. (1999). Individual differences in imagination inflation. *Psychonomic Bulletin & Review*, *6,* 313–318.

Holmes, P.S., & Collins, D.J. (2001). The PETTLEP approach to motor imagery: A functional equivalence model for sport psychologists. *Journal of Applied Sport Psychology*, *13,* 60–83.

Holmes, P., & Collins, D. (2002). Functional equivalence solutions for problems with motor imagery. In I. Cockerill (Ed.), *Solutions in sport psychology* (pp. 120–140). London: Thomson.

Hyman, I.E., & Pentland, J. (1996). The role of mental imagery in the creation of false childhood memories. *Journal of Memory & Language*, *35,* 101–117.

Jeannerod, M. (1994). The representing brain - neural correlates of motor intention and imagery. *Behavioral and Brain Sciences*, *17,* 187–202.

Jeannerod, M. (1999). To act or not to act: Perspectives on the representation of actions. *The Quarterly Journal of Experimental Psychology*, *52A,* 1–29.

Johnson, S.H. (2000). Thinking ahead: The case for motor imagery in prospective judgements of prehension. *Cognition*, *74,* 33–70.

Kazdin, A.E. (1973). Covert modeling and the reduction of avoidance behavior. *Journal of Abnormal Psychology*, *81,* 87–95.

Kazdin, A.E. (1974). The effect of model identity and fear-relevant similarity on covert modeling. *Behavior Therapy*, *5,* 624–635.

Landau, J.D., Leynes, P.A., & Libkuman, T.M. (2001). Mental simulation increases physical performance estimates but not physical performance. *Journal of Mental Imagery*, *25,* 93–106.

Landau, J.D., Libkuman, T.M., & Wildman, J.C. (2002). Mental simulation inflates performance estimates for physical abilities. *Memory and Cognition*, *30,* 372–379.

Libby, L. (2003). Imagery perspective and source monitoring in imagination inflation. *Memory and Cognition*, *31,* 1072–1081.

McAuley, E. (1985). Modeling and self-efficacy: A test of Bandura's model. *Journal of Sport Psychology*, *7,* 283–295.

McCullagh, P., & Weiss, M.R. (2001). Modeling: Considerations for motor skill performance and psychological responses. In R.N. Singer, H. Hausenblas, & C.M. Janelle (Eds.), *Handbook of sport psychology* (2nd ed., pp. 205–238). New York: John Wiley.

McCullagh, P., & Weiss, M.R. (2002). Observational learning: The forgotten psychological method in sport psychology. In J. L. Van Raalte & B.W. Brewer (Eds.), *Exploring sport and exercise psychology* (2nd ed., pp. 131–149). Washington, DC: American Psychological Association.

Mulder, T., Zijlstra, S., Zijlstra, W., & Hochstenbach, J. (2004). The role of motor imagery in learning a totally novel movement. *Experimental Brain Research*, *154,* 211–217.

Murphy, S., & Martin, K.A. (2002). The use of imagery in sport. In T. Horn (Ed.), *Advances in sport psychology* (2nd ed., pp. 405–439). Champaign, IL: Human Kinetics.

Murphy, S., Nordin, S.M., & Cumming, J. (2008). Imagery in sport, exercise and dance. In T. Horn (Ed.), *Advances in sport and exercise psychology* (3rd ed., pp. 297–324). Champagne, IL: Human Kinetics.

Nordin, S.M., & Cumming, J. (2005). More than meets the eye: Investigating imagery type, direction, and outcome. *The Sport Psychologist*, *19,* 1–17.

Ram, N., Riggs, S.M., Skaling, S., Landers, D.M., & McCullagh, P. (2007). A comparison of modelling and imagery in the acquisition and retention of motor skills. *Journal of Sports Sciences*, *25,* 587–597.

Ramsey, R., Cumming, J., & Edwards, M.G. (2008). Exploring a modified conceptualisation of imagery direction and golf putting performance. *International Journal of Sport and Exercise Psychology*, *6,* 207–223.

Ramsey, R., Cumming, J., & Edwards, M.G. (2009). Mental imagery inflates performance expectations but not actual performance of a novel and challenging motor task. *Imagination, Cognition and Personality*, *28,* 331–347.

Schunk, D.H., & Hanson, A.R. (1989). Self-modeling and children's cognitive skill learning. *Journal of Educational Psychology*, *81,* 155–163.

Schunk, D.H., Hanson, A.R., & Cox, P.D. (1987). Peer-model attributes and children's achievement behaviours. *Journal of Educational Psychology*, *79,* 54–61.

Smith, D., Wright, C., Allsopp, A., & Westhead, H. (2007). It's all in the mind: PETTLEP-based imagery and sports performance. *Journal of Applied Sport Psychology*, *19,* 80–92.

Smith, D., Wright, C.J., & Cantwell, C. (2008). Beating the bunker: The effect of PETTLEP imagery on golf bunker shot performance. *Research Quarterly for Exercise and Sport*, *79*(3), 1–7.

Weiss, M.R., McCullagh, P., Smith, A.L., & Berlant, R. (1998). Observational learning and the fearful child: Influence of peer models on swimming skill performance and psychological responses. *Research Quarterly for Exercise and Sport*, *69*, 380–394.

White, A., & Hardy, L. (1998). An in-depth analysis of the uses of imagery by high-level slalom canoeists and artistic gymnasts. *The Sport Psychologist*, *12*, 387–403.

Wise, J.B., & Trunnell, E.P. (2001). The influence of sources of self-efficacy upon efficacy strength. *Journal of Sport & Exercise Psychology*, *23*, 268–280.

Appendix. Imagery scripts

Mastery imagery

From the starting position, apply your weight downward on the balance board. Your feet are spread apart and your weight is evenly distributed. It feels easy to keep the board level. Your eyes are fixed somewhere in the room and you are completely focused on the task. Your upper body feels absolutely in control and not moving. Your hands are out to the side and this makes you feel steady. You are confident that you can stay balanced like this for the entire time. The task feels easy and you are enjoying your performance.

Coping imagery

1. From the starting position, apply your weight downward on the balance board. You feel totally out of control and awkward as the board constantly hits the floor. You have trouble finding your balance and feel frustrated. Your feet are stretched wide apart and you feel an unequal pressure between them. Your upper body is swaying from side to side. Your knees sometimes give out under you. Your thighs are feeling the strain from having to work hard. Your confidence is low and you are finding the task very difficult.

2. From the starting position, apply your weight downward on the balance board. This time, you find it easier to move the board into a somewhat stable position. Your feet are closer together than before, and you are beginning to feel how your weight should be distributed underneath you. Your upper body is becoming more controlled and there is less movement side to side. Your arms are outstretched and you pick a point in the room to focus your eyes on. You find this helps to keep you balanced. The board sometimes hits the floor, but this happens much less frequently than before. You begin to feel more confident in your ability to keep the board level. The task is much less difficult than before and you notice real improvements in your performance.

3. From the starting position, apply your weight downward on the balance board. This time, you find it much easier to move the board right away into a stable position. Your feet are spread apart and your weight is evenly distributed. It feels easy to keep the board level. Your eyes are fixed somewhere in the room and you are completely focused on the task. Your upper body feels absolutely in control and not moving. Your hands are out to the side and this makes you feel steady. You are confident that you can stay balanced like this for the entire time. The task feels easy and you are enjoying the fact that your performance has improved so much in such a short period of time.