Using Imagery to Enhance Three Types of Exercise Self-Efficacy among Sedentary Women

Lindsay R. Duncan*
*Yale University, USA

Wendy M. Rodgers
University of Alberta, Canada

Craig R. Hall
The University of Western Ontario, Canada

Philip M. Wilson
Brock University, Canada

The purpose of this study was to determine if task, coping, and scheduling self-efficacy (SE) for exercise could be influenced using guided imagery interventions in an experimental design controlling for overt exercise experiences. Healthy women (N = 205, M_age = 31.47) who did not exercise regularly were randomly assigned to guided imagery sessions targeting a specific type of SE or to a nutrition information control group. All participants attended a 12-week cardiovascular exercise program. The influence of the various imagery interventions on the three types of self-efficacy over time were assessed with two doubly multivariate ANOVAs: one from baseline to 6 weeks and the other from 6 to 12 weeks. The analyses were conducted for 61 participants who completed the exercise intervention. The first analysis demonstrated that task, coping, and scheduling SE were differentially influenced over time in response to the different imagery interventions. The results of the second analysis were non-significant, revealing that the main changes in SE were observed within the first half of the 12-week intervention. This study demonstrates that task, coping, and scheduling SE can be seen as independent from one another and that mental imagery interventions are an effective means for influencing exercise-related cognitions.

Keywords: exercise, imagery, intervention, self-efficacy
INTRODUCTION

Physical activity is associated with numerous physical and psychological health benefits including: lower rates of type II diabetes (Vimaleswaran et al., 2009), heart disease (Katzmarzyk, Church, & Blair, 2004; Katzmarzyk & Janssen, 2004), and some forms of cancer (McNeely et al., 2006) as well as lower rates of depression and anxiety, and increased positive mood (Scully, Kremer, Meade, Graham, & Dudgeon, 1998). Despite the extensive list of health benefits associated with physical activity, more than half of adults do not meet the minimum weekly recommendations for physical activity (e.g. Breuer, 2005; CFLRI, 2005; King et al., 2000). Physical inactivity poses considerable risk to the health of the population. In fact, the US Centers for Disease Control and Prevention have estimated that physical inactivity (in combination with poor diet) is responsible for approximately 365,000 deaths (16% of all deaths) annually (Mokdad, Marks, Stroup, & Gerberding, 2005). Physical activity, however, is considered a modifiable risk factor and has therefore received considerable attention from health practitioners and researchers as an avenue for intervention and a means to influence the health of the population.

Self-Efficacy and Exercise

One variable that has been found to be a robust predictor of health behavior, including physical activity, is self-efficacy (SE; Bandura, 1986, 1997). A substantial body of research has demonstrated a positive link between SE and exercise behavior, particularly when individuals are faced with challenges (Bandura, 1986, 2004; McAuley et al., 2005). SE refers to an individual’s confidence in his or her ability to perform the behaviors required to obtain a desired outcome (Bandura, 1986, 1997). Bandura (1997) argues that it is not only an individual’s perceived efficacy to engage in specific skills which is important, but also the efficacy to perform these skills under various dissuading circumstances (p. 43). That is, the mere ability to perform a specific behavior does not mean that one has the confidence to perform it under challenging situations. For example, an exerciser may judge herself as able to jog at a moderate pace for 30 minutes but have little confidence that she can complete this task when it is raining outside or she is feeling tired. SE reflects one’s confidence for managing the skills required to produce even relatively routine behaviors over and over again when specific circumstances of behavior are ever-changing. Furthermore, it has been demonstrated that SE is a predictor of long-term adherence to exercise among older adults and that SE can be manipulated in this population (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003; McAuley et al., 2007).
Luszczynska and Schwarzer and their colleagues have proposed a phase-specific conceptualisation of SE (e.g. Luszczynska & Schwarzer, 2003; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). In this conceptualisation, different skill sets are proposed to be more relevant at different phases of behavior adoption. Schwarzer and Renner (2000) have described “action SE” which is involved in a pre-intentional phase of behavior change and “maintenance SE” which is involved in post-intentional processes. The types of SE described in this conceptualisation are similar to task and coping SE, respectively. The conceptualisation of SE put forth by Schwarzer and colleagues is based on distinct phases of exercise adoption in which different types of SE are present during each phase.

In contrast to the phase-specific model, a three-factor model of SE for exercise has been proposed which includes task SE (i.e. SE to perform the elemental aspects of an activity), coping SE (i.e. related to overcoming barriers to exercise), and scheduling SE (i.e. related to coordinating one’s activities to include regular exercise) (Rodgers & Sullivan, 2001). This three-factor model stipulates that the different types of SE are present to some degree at all times and the relative importance of each type of SE is contingent on the phase of change. To date, the three-factor model of exercise SE has received considerable support (e.g. Rodgers & Sullivan, 2001; Rodgers, Murray, Courneya, Bell, & Harber, 2009). Rodgers and Sullivan (2001) found that when exercisers were categorised into four groups according to their exercise frequency, coping and scheduling SE better discriminated between the four groups than task SE, indicating that these types of SE have differential influences. Furthermore, Rodgers, Hall, Blanchard, McAuley, and Munroe (2002) examined the influence of task and scheduling SE in regular exercisers and found that task SE positively influenced intentions to exercise while scheduling SE had an effect on behavior. These findings demonstrated that task and scheduling SE are unique and represent different sets of skills. In a longitudinal study, Rodgers, Wilson, Hall, Fraser, and Murray (2008) examined changes in task, coping, and scheduling SE among female exercise initiates over the course of a 12-week strength training program. While no change was found for task SE over time, scheduling and coping SE increased from baseline to 6 weeks, and coping SE continued to increase from 6 weeks to 12 weeks. These results clearly demonstrated that the three types of SE change at different rates in response to overt experience with the task. Finally, Rodgers et al. (2009) examined task, coping, and scheduling SE for walking and for traditional (i.e. fitness center) exercise and demonstrated that SE is behaviour specific. Repeated measures MANOVAs indicated that the patterns of task, coping, and scheduling SE change were quadratic and specific to the exercise modality. It is important to note that this three-factor conceptualisation of SE maintains that all three factors are present at any given time; however, they become more or less important depending on the
situation. In addition, there is limited experimental evidence that the other sources of SE described by Bandura (e.g. vicarious experience) can influence the types of SE independently.

Mental Imagery and Exercise

Imagery, or mental practice, has been identified as an effective means for changing an individual’s behaviors, thoughts, and beliefs. In sport for example, athletes use imagery to learn and perfect new skills and strategies, stay motivated towards a goal, increase their self-confidence, and control arousal and anxiety levels (Hall, 2001; Martin, Moritz, & Hall, 1999). It is hypothesised that mental imagery is an important vehicle for information processing and that vivid mental images can closely represent an object, emotion, or psychological state and consequently link closely with perception (Farah, 1989). Research has demonstrated that visual images are most common, while images using other senses (i.e. kinaesthetic, auditory, and gustatory images) are less common (Kosslyn, 1994). Using multiple sensory modalities (as opposed to using only one of the senses) to create mental images has been found to be more effective in some situations (Hall, 2001).

Hall (1995) proposed that imagery may be an important determinant of exercise behavior and cognitions. Subsequent research has confirmed that regular exercisers frequently use imagery and by employing imagery exercisers can learn exercise tasks, become energised, set appearance-related goals, and cope with exercise barriers (Gammage, Hall, & Rodgers, 2000; Giacobbi, Hausenblas, Fallon, & Hall, 2003; Hausenblas, Hall, Rodgers, & Munroe, 1999). Additional research has demonstrated that exercise imagery is linked to greater exercise intentions (Rodgers et al., 2002), as well as increased task and scheduling SE (Wesch, Milne, Burke, & Hall, 2006). Moreover, Wilson, Rodgers, Hall, and Gammage (2003) examined exercise imagery in the context of self-determination theory and found that two functions of imagery, appearance and technique, were related to more self-determined exercise regulations.

While there is clear evidence supporting the relationships between imagery, behavior, and cognitions in an exercise context, most of the research to date has not had a strong theoretical basis. Furthermore, the limited research that has been driven by theory (e.g. Wilson et al., 2003) has been correlational and cross-sectional in nature.

One framework from which theoretically driven imagery interventions could be designed is Social Cognitive Theory (SCT; Bandura, 1986). SCT identifies (in order of their degree of influence) past performance success, vicarious experiences, social persuasion, and physiological or affective states as the four primary sources of self-efficacy. According to SCT, mental imagery would fall under the umbrella of vicarious experiences and could

have a relatively powerful influence on SE. Correlational evidence has identified a relationship between imagery and SE (e.g. Wesch et al., 2006); however, it is not known whether or not the different types of SE can be independently influenced and whether or not this can be done using an imagery intervention.

Study Aims and Hypotheses

The purpose of the present study was to determine if three types of SE (i.e. task, coping, scheduling) could be differentially influenced using guided imagery interventions in an experimental design controlling for overt mastery experiences. Since previous research has found that task, coping, and scheduling change at different rates (Rodgers et al., 2008), it was hypothesised that the three different types of SE could be differentially influenced and that guided imagery sessions oriented toward one specific type of SE would influence that type of SE and not the other two types. The effect of the imagery interventions on SE can be isolated from the effects of overt exercise experiences because these were controlled to be the same in all experimental groups (i.e. all groups did similar volumes of exercise).

Some research has demonstrated that while the three types of SE are important for both men and women, the relative importance of each type throughout behavior adoption and maintenance might be gender specific (e.g. Duncan, 2010). Furthermore, there is some empirical evidence to suggest that gender acts as a moderator on imagery use (Gammage et al., 2000; Hausenblas et al., 1999); therefore it was decided to focus our investigation on women only.

METHOD

Participants

The participants (N = 205) were healthy women between the ages of 18 and 45 (M = 31.47, SD = 9.25) recruited from on campus and in the community surrounding a large Canadian university. In order to be eligible for the study, individuals were required to be non-exercisers, or infrequent exercisers (i.e. exercised less than once per week for a period of at least 6 months prior to study recruitment) who intended to become more active. Among the 203 women who reported baseline activity, the mean frequency was 0.67 times per week (SD = .54), with 73 indicating that they never exercised, 123 exercising one time per week and seven indicating they exercised two times per week. The mean BMI of the participants was 27.71 (SD = 6.23), indicating that on average the individuals in this sample were slightly overweight. The majority of the participants in this study were highly educated with 90 per cent
indicating that they had completed or were currently enrolled in some form of post-secondary education. An additional 7.8 per cent of the participants indicated that they had obtained a high school diploma. The most common occupations reported by individuals in the sample were student (22%) and administrative or managerial occupations (22%). More than half (53%) of the participants identified themselves as White and 7 per cent identified themselves as Asian. Other racial identities included Hispanic (3.5%), Black (2%), Aboriginal (1.5%), and mixed (2.5%). Forty-six per cent of the women reported their marital status as single, while 44 per cent reported that they were married or common law. Most of the participants (56%) did not have any children and 41 per cent reported that they did have at least one child.

**Measures**

At baseline, participants were asked to complete a demographic questionnaire which assessed age, exercise frequency, race, income, education, occupation, marital status, and number of children. In addition, participant weight and height were measured by the researcher at the baseline and final assessments.

*Multi-Dimensional Self-Efficacy for Exercise Scale (MSES; Rodgers et al., 2008).* The MSES includes nine items that measure task SE (three items), coping SE (three items) and scheduling SE (three items). Following the stem “How confident are you that you can . . .”, each item is measured on a 100 per cent confidence scale ranging from 0 = “no confidence” to 100 = “completely confident”. The MSES has been found to possess adequate validity and reliability (Rodgers et al., 2008). The MSES was administered to the participants at baseline, 6 weeks (mid-point), and 12 weeks (post-intervention). Cronbach’s alpha coefficients for the MSES subscales at all three time points were good (> .78).

Exercise intensity and duration were assessed objectively using Polar RS400 Running Computer™ heart rate monitors (HRM). The HRM provided the researcher with minute-by-minute heart rate data as well as workout duration. Individual heart rate data were recorded throughout each workout and downloaded to a software program. Workout duration was also assessed by self-report at the end of each exercise session. Finally, workout frequency was assessed by attendance records kept by the research staff who monitored the exercise program.

**Procedures**

Prior to participant recruitment the research protocol was approved by the research ethics board at the host institution.
Recruitment. Participants were recruited on campus at a large Canadian university as well as from the local community through newspaper advertisements, posters, and word of mouth. The advertisements invited women aged 18 to 50 years who exercised less than once per week and who were interested in beginning a regular exercise program to contact the researcher. The advertisements also indicated that the participants’ fitness would be assessed, that they would be given a 12-week structured exercise program to follow, and that they would be asked to complete questionnaires assessing their motivation, self-efficacy, and imagery use. Interested potential volunteers who contacted the investigators were provided with more information via telephone or email. Participants were briefed on the study protocol then screened for eligibility.

Initial Assessment. Eligible and willing participants arranged an initial meeting with the researcher during which the study was explained in detail and informed consent was obtained. During the initial meeting, participants also completed baseline questionnaires measuring demographics and exercise SE.

During the initial meeting participants underwent a baseline sub-maximal aerobic fitness test on a cycle ergometer. The fitness test was conducted by a certified kinesiologist or a trained masters-level researcher in accordance with the guidelines outlined by the American College of Sports Medicine (ACSM; Franklin, Whaley, & Howley, 2000) and it took approximately 10–15 minutes to complete.

The initial assessment also involved an interactive lab tour in which the participants were familiarised with the exercise facility. The participants received a demonstration regarding the appropriate technique to be maintained on the various exercise machines (i.e. treadmills, rowing machines, stair climbers, and stationary bikes). The participants were then given the opportunity to try each of the machines to ensure that they were comfortable on the equipment.

Randomisation. Participants were randomly assigned to one of four treatment groups (i.e. task, scheduling, or coping imagery or control) following a simple randomisation procedure (computerised random numbers) on the date of the first intervention session (i.e. imagery or control session). Due to the nature of the intervention, in which the researcher read the imagery script (or control information) to the participant, it was not possible for the researcher in the lab to be blinded to the treatment condition.

Exercise Program. All participants were prescribed a 12-week individualised, cardiovascular program which was created based on the results of each individual’s sub-maximal fitness test and her resting heart rate value. The
participants were asked to exercise three times per week for 30–45 minutes and to maintain a heart rate within an assigned, predetermined range. The target heart rate range increased every 3 weeks beginning with a target heart rate between 50 and 60 per cent of heart rate reserve (age predicted maximum heart rate – resting heart rate) and climbing to a range of 60 to 70 per cent of heart rate reserve in the last 3 weeks of the program. The prescription also involved a progressive increase in workout duration which began at 30 minutes and increased to 45 minutes at the end of 12 weeks. The participants were asked to complete all of their exercise sessions in the study’s exercise facility. The participants were also informed that if they wished to do so, they could exercise more than three times per week; however, they were asked to complete these sessions at the study facility. Compliance with the program was monitored by attendance sheets located inside the exercise facility as well as minute-by-minute heart rate and exercise duration data collected by heart rate monitors worn during each exercise session.

Imagery Intervention. The participants were randomly assigned to one of three experimental groups: task SE, coping SE, or scheduling SE imagery groups or to the control group. Participants in the imagery groups received three guided imagery sessions over the course of one week, before they began the exercise program. The researcher administered the guided imagery to each participant on an individual basis in a quiet room by reading an imagery script that focused on enhancing the type of exercise SE designated by the group assignment. The participants were instructed to close their eyes, relax, and try to create the most vivid images possible, using as many of their senses as possible. Each imagery script reading took approximately 5 minutes. After each reading, the participants were given a copy of the script and instructed to practice their exercise imagery on their own, four times per week (once per day on the days that they did not exercise).

The task imagery scripts involved statements related to properly performing the exercise movements and accurately following the instructions given by the researchers (i.e. stay in the designated heart rate range for a minimum of 30 minutes). The task imagery scripts included statements such as; “Think about keeping the core of your body supported and upright”, and “Think about your heart beat. Imagine what it feels like to be exercising in a moderate heart rate range”. Because the exercise instructions were unique to each piece of equipment in the study facility and the participants were able to choose the equipment they would use, four separate task imagery scripts were drafted, one for each exercise machine. In the first week the participants listened to the script for the treadmill and the bike. At the third imagery script reading the participant was asked whether they thought they would use the stepper or the rower more frequently and the third imagery script was selected.
based on her response. When the participants returned for a “booster” imagery session (during the 6-week assessment) they selected the imagery script they would hear based on the machine they used most frequently.

The imagery scripts for the coping group reflected the ability to adhere to exercise in the face of challenges. The coping imagery script described statements that might challenge the participant to engage in exercise (e.g. feeling low in energy or experiencing muscle stiffness due to a previous workout). The participants were then led to imagine overcoming those challenges (e.g. beginning to feel invigorated and rejuvenated by the exercise or following the workout). Participants in the coping group listened to the same imagery script at each reading.

The imagery script for the scheduling group described the process of scheduling exercise into a day or week. This script also addressed the need to re-schedule a workout if a planned exercise session was missed. The scheduling script involved statements such as “Think about when, during your day you will exercise, and how you will coordinate this with your other daily activities”. One imagery script was written for the scheduling condition and the participants read the same script each time they met with the researcher.

Participants in the attention control condition met with the researcher three times before they began the exercise program and were given information regarding healthy nutrition. Each nutrition session lasted approximately 5 minutes. Following each session, the participants were given a handout detailing the nutrition information they had received during the session.

As indicated, participants in the imagery groups and the control group were all given a one-page handout summarising the details of their intervention session (either a copy of the imagery script or a nutrition information handout). The participants were aware that they had been randomly assigned to one of four treatment groups and upon receipt of each handout were reminded that sharing the information they received in their session with the other participants could bias the research. Therefore, the participants were encouraged to put their handout away immediately after their intervention session was complete and to refrain from discussing the details of the intervention with the other participants. In order to resolve their curiosities, the participants were informed that they would receive a summary of the study rationale, procedures, interventions, and results once the study had been completed.

Mid-Point Assessment and Intervention. At the mid-point of the exercise program (i.e. 6 weeks), the participants completed the MSES. At this meeting an imagery “booster” session was also provided. Participants in the imagery groups received one final guided imagery session targeting the designated type of SE and were reminded to continue practicing imagery on their own.
Participants in the control group met with the researcher for one additional nutrition information session.

**Final Assessment.** Upon completion of the 12-week exercise program, the participants were asked to attend a final assessment in which they completed the MSES. They also completed a debriefing questionnaire which served as a manipulation check for the imagery intervention and allowed them to provide personal feedback regarding their participation in the study. The final assessment also involved a sub-maximal fitness test using the same protocol employed at baseline.

**RESULTS**

Initially, 205 participants were enrolled in the study and randomised to the task imagery ($n=48$), scheduling imagery ($n=50$), coping ($n=54$) imagery groups or to the control group ($n=53$). It should be noted, however, that there was a large dropout rate among participants in this study. At the 6-week assessment, only 95 participants remained ($n=26, 18, 26$, and 25 participants in the task, coping, scheduling, and control groups, respectively). An additional 34 participants dropped out, leaving 61 participants to complete the study. At the final assessment point, 18 participants remained in the task imagery group, 13 in the coping group, 17 scheduling, and 13 control. Two chi-square analyses were conducted in order to determine differences in adherence across the four study groups and the results confirmed that there were no significant differences in dropout rates between the four groups by time 2 ($\chi^2(3) = 3.40, p = .33$) or time 3 ($\chi^2(3) = 2.61, p = .45$). It was important to include only participants who adhered to the exercise prescriptions, however, in order to ensure that they had equivalent overt experiences with the exercise. Therefore, the main analyses in this study were conducted with data from only those 61 participants who completed the study.

**Preliminary Analyses**

A series of one-way ANOVAs was conducted in order to determine if there were differences between the adherers and dropouts on age, BMI, predicted VO$_2$ max, or any of the SE variables at baseline. The analyses revealed that there were no differences between adherers and dropouts on any of these variables ($p < .05$), indicating that the sample used in the main analysis was representative of the initial study sample. The results of these analyses are not presented here; however, they are available from the first author upon request.

A second series of one-way ANOVAs was conducted to determine if there were any differences between the study groups on relevant baseline variables.
(age, BMI, predicted VO₂ max) and various indicators of adherence including: overall workout frequency, average duration (objectively measured), and average number of minutes spent in the prescribed heart rate zone. The mean scores on each of these variables for each of the four study groups are presented in Table 1. The analyses revealed that there were no differences between groups on any baseline variables. In addition, no differences were found between groups on the adherence indicators at any point in the 12-week exercise program (p > .05), supporting the assumption that mastery experience was equivalent for all groups (and therefore successfully controlled), allowing for the effect of the imagery interventions on SE to be isolated from the mastery experiences which can be assumed to be constant.

### Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>Task</th>
<th>Coping</th>
<th>Scheduling</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Age</td>
<td>32.48 (10.76)</td>
<td>33.00 (10.08)</td>
<td>30.74 (9.44)</td>
<td>31.88 (9.03)</td>
</tr>
<tr>
<td>Baseline BMI</td>
<td>27.55 (5.23)</td>
<td>26.12 (4.90)</td>
<td>25.31 (5.31)</td>
<td>28.86 (7.69)</td>
</tr>
<tr>
<td>Baseline predicted VO₂ max</td>
<td>35.68 (5.98)</td>
<td>34.72 (6.17)</td>
<td>36.62 (7.42)</td>
<td>34.12 (6.86)</td>
</tr>
<tr>
<td>Workout frequency</td>
<td>16.22 (12.83)</td>
<td>17.00 (14.88)</td>
<td>16.88 (14.38)</td>
<td>11.00 (12.10)</td>
</tr>
<tr>
<td>Average duration (HR monitor)</td>
<td>39.09 (5.85)</td>
<td>40.37 (7.66)</td>
<td>35.72 (3.97)</td>
<td>40.87 (8.12)</td>
</tr>
<tr>
<td>Minutes in prescribed HR zone</td>
<td>38.87 (12.03)</td>
<td>36.95 (6.08)</td>
<td>31.90 (2.11)</td>
<td>35.06 (6.48)</td>
</tr>
</tbody>
</table>

*Note: Units for predicted VO₂ max are ml/kg/min.*

Main Analysis

To test the influence of the various imagery interventions on the types of SE over time, two doubly multivariate ANOVAs were conducted, one for the first time period, from baseline to 6 weeks, and the other for the second time period, from 6 weeks to 12 weeks (end of intervention). The analysis specifically assessed the influence of four groups (task imagery, coping imagery, scheduling imagery, control) on the types [TYPE] of SE (task, coping, scheduling) over time (two times in each analysis) yielding a 4 (group) × 3 (type of SE) × 2 (time) with repeated measures on both type of SE and time. The scores on the MSES subscales served as the dependent variables. Treating the type of SE and time factors as repeated measures addresses the most important assumption of repeated measures analysis regarding the independence of the scores. Furthermore, including SE TYPE as a factor does not assume that all the SE types change similarly, and allows us to assess main effects...
associated with SE type as well as interactions. This analysis assumes that the types of SE and the time-based assessments are not independent of each other. The first analysis (baseline to 6 weeks) revealed the following significant multivariate effects (all for Pillai’s Trace): a main effect for time, $F(1, 57) = 12.91, p < .001$, $\eta^2 = .18$; a main effect for SE TYPE, $F(2, 56) = 63.87, p < .0001$, $\eta^2 = .69$; a time × SE TYPE interaction, $F(2, 56) = 8.72, p < .001$, $\eta^2 = .24$, and a time × SE TYPE × Group interaction, $F(6, 114) = 2.23, p < .04$, $\eta^2 = .11$. The means and standard deviations ($SD$s) for this analysis are in Table 2.

The three-way interaction is the analysis of principal interest because it shows that the TYPES of SE change differently over time in response to the different imagery interventions. This interaction can be understood by considering Figures 1, 2, and 3. Figure 1 shows that task SE increased significantly more for the group that received the task SE imagery intervention, although, as expected, we do see a generalised increase in task SE over the first 6 weeks of the intervention for all the groups. Follow-up univariate analyses revealed that task SE increased significantly only in the task imagery intervention group over the first 6 weeks, $F(1, 17) = 10.94, p < .005$, $\eta^2 = .392$. Similarly, we see that coping SE for exercise changed most among those people who received the coping SE imagery intervention, $F(1, 12) = 14.80, p < .005$, $\eta^2 = .55$, but also increased significantly in the task imagery intervention group, $F(1, 17) = 16.26, p < .001$, $\eta^2 = .49$ (Figure 2). Also, as expected, everyone’s coping SE for exercise increased over time with overt experience. Finally, we see that scheduling SE for exercise changed

<table>
<thead>
<tr>
<th>SE Type</th>
<th>Time</th>
<th>Task Mean (SD)</th>
<th>Coping Mean (SD)</th>
<th>Scheduling Mean (SD)</th>
<th>Control Mean (SD)</th>
<th>$\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task</td>
<td>1</td>
<td>74.26 (17.85)</td>
<td>73.72 (18.03)</td>
<td>74.71 (23.34)</td>
<td>81.59 (14.70)</td>
<td>.85</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>83.70 (12.87)</td>
<td>78.20 (17.31)</td>
<td>81.76 (14.15)</td>
<td>83.97 (13.08)</td>
<td>.86</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>83.70 (17.78)</td>
<td>83.59 (12.28)</td>
<td>85.10 (11.61)</td>
<td>83.46 (10.98)</td>
<td>.94</td>
</tr>
<tr>
<td>Coping</td>
<td>1</td>
<td>47.78 (24.57)</td>
<td>49.87 (12.66)</td>
<td>50.59 (23.49)</td>
<td>50.77 (20.55)</td>
<td>.78</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>65.00 (18.41)</td>
<td>70.26 (15.42)</td>
<td>56.96 (21.96)</td>
<td>57.69 (23.43)</td>
<td>.85</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>64.72 (25.02)</td>
<td>73.08 (18.38)</td>
<td>59.02 (26.33)</td>
<td>61.29 (23.04)</td>
<td>.93</td>
</tr>
<tr>
<td>Scheduling</td>
<td>1</td>
<td>71.01 (27.06)</td>
<td>73.20 (14.05)</td>
<td>70.20 (20.39)</td>
<td>77.82 (9.75)</td>
<td>.87</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>77.59 (15.20)</td>
<td>77.41 (18.21)</td>
<td>80.00 (14.43)</td>
<td>71.28 (17.61)</td>
<td>.86</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>80.19 (18.45)</td>
<td>81.10 (18.62)</td>
<td>79.31 (19.12)</td>
<td>76.28 (14.40)</td>
<td>.94</td>
</tr>
</tbody>
</table>

most rapidly among those people who received the scheduling SE imagery intervention, approaching significance, $F(1, 16) = 4.06, p = .06, \text{Eta}^2 = .20$ (Figure 3).

The second analysis (week 6 to week 12) revealed that only the main effect for SE type, $F(2, 56) = 41.39, p < .0001, \text{Eta}^2 = .60$, remained significant, reflecting a general flattening out of the curves for the types of SE in all groups; however, task SE tends to be higher (according to the marginal means) than the other types. These results suggest that the main changes observed within a 12-week intervention take place within the first 6 weeks. The means and standard deviations for this analysis are in Table 2.

**DISCUSSION**

Social Cognitive Theory suggests that overt mastery experience and vicarious experience are the two strongest sources of SE information. Previous research
has shown that SE for exercise increases as a result of overt exercise experience (e.g. Rodgers et al., 2008). As a result, in the current study we would expect an increase in all three types of SE for exercise by the study participants as a direct result of participation in the exercise program. In fact, the current results show us that overt mastery experiences have a strong influence on SE, as all types of SE increased from baseline to 6 weeks, regardless of their study group. However, the main purpose of the present study was to determine if task, coping, and scheduling SE could be differentially influenced using guided imagery interventions in an experimental design that controlled for mastery experiences (because all participants had similar mastery experiences). More specifically, it was hypothesised that the three different types of SE could be differentially influenced and that guided imagery sessions focused on one specific type of SE would influence that type of SE more than the other types. The results showed that each type of SE was augmented by the corresponding imagery to a greater extent than the other types of SE by the interventions as expected. Furthermore, these results suggest that the influence of multiple sources of SE information is not redundant. Future research is needed to replicate this effect, but clearly at least two sources of SE information (overt mastery and imagery) have a positive effect on task, coping, and scheduling SE.

FIGURE 2. Change in coping SE for exercise for four groups from baseline to 6 weeks.
Overall, the results of the current study show us that task, scheduling, and coping SE for exercise are independent of each other. Specifically, the results demonstrate that exercise participants report significantly different levels of each type of SE at all time points, suggesting that the SE types are both conceptually and practically distinguishable. Most importantly, the results also show that targeting each type of SE through intervention has separable effects that are primarily restricted to the targeted type. It should be noted, however, that task SE seems to be either (a) related to both the other types and/or (b) most quickly affected by overt experience. We would endorse both these arguments. First, it has been consistently argued and empirically demonstrated that the three types of SE are correlated to each other (e.g. Rodgers et al., 2008). This might be particularly true of task SE for exercise and the other two types, coping and scheduling, which both assume a certain degree of task confidence in addition to being able to perform the task in spite of varying obstacles. It is consistent with the original conceptualisation of the MSES that the types of SE should be correlated (Rodgers et al., 2008).
Second, Bandura (1997) has argued, and these data support, that the strongest source of SE is overt experience. Furthermore, the most overt experience gained in only 6 weeks of exercise is task experience; actually performing the exercises. We have argued previously (Rodgers et al., 2002, 2008) that it takes longer to accrue sufficient experience with overcoming scheduling barriers or other types of barriers to gain the same amount of confidence for performing exercise challenged by the barriers as for performing the exercise in the absence of barriers. This idea is consistent with the work of Schwarzer and Renner (2000) who contend that action (similar to task SE) and maintenance (similar to coping SE) self-efficacy have differential influences over time during behavior adoption. Nonetheless, in the present study some overt experience is being gained for all three types of SE for exercise over and above the imagery interventions designed to augment only one type of SE. Therefore, the three-way interactions observed here provide very strong evidence for some basic tenets of SE theory, as well as for the conceptual and operational independence of task, coping, and scheduling SE for exercise as assessed by the MSES. The power of the imagery interventions should not be overlooked. In addition to overt behavioral experience, the relatively small intervention (20 total minutes of guided imagery) produced a significant change in the type of SE targeted, suggesting that imagery is an important potential vehicle for changing exercise-related cognitions.

One limitation to the study involves the timing of the baseline assessment of SE. Baseline questionnaires were administered during the initial meeting with the participant, before the fitness test occurred, the exercise program was prescribed, and (most importantly) the imagery intervention was administered. The first post-imagery SE assessment took place at time 2, 6 weeks following the delivery of the imagery intervention. Between the administration of the first (baseline) and second (6 weeks) set of questionnaires, the participants engaged in the imagery intervention but also in a sub-maximal fitness test and a lab tour. Therefore, we cannot conclude that it was the imagery alone that had a differential impact on the SE of the participants. Having said that, our results reflected changes in SE that were specific to the intervention that was given and it is unlikely that the fitness test and lab tour caused differential increases in SE for the participants in the various study groups. Nonetheless, for the sake of prudence it would have been ideal to have a measure of self-efficacy taken after the fitness test and lab tour and before the imagery intervention was administered. Additionally, since the results of the current study indicate that the greatest changes in self-efficacy occurred within the first 6 weeks of exercise it would be ideal to have a post-imagery, pre-exercise assessment of self-efficacy. Based on the data, it is not possible to determine if the impact of the imagery intervention was the strongest directly after the intervention was delivered or whether the effects of the imagery were strengthened as the participants achieved overt experience.
in the exercise program. Future studies should include a more isolated assessment of the impact of an imagery intervention on the target variable.

The schedule on which the imagery intervention was delivered and the impact that it had on changes in SE should be noted. The study was designed to include three imagery sessions before the exercise portion of the study began because previous research has demonstrated that self-efficacy plays a more prominent role in the early stages of exercise adoption than it does later on (McAuley, 1992; Oman & King, 1998). However, Rodgers et al. (2008) noted that task, coping, and scheduling SE change at different rates. In retrospect, it would have been interesting to conduct additional imagery sessions throughout the exercise program in order to examine the impact that the imagery might have on the SE of the participants as they progress into later stages of behavior change.

As stated previously, a high rate of attrition occurred during the study. It is not known why so many participants did not complete the exercise program; however, some suppositions can be made. Since the majority of the imagery (or control) sessions were conducted within the first week and the booster session was not administered until 6 weeks later, it is possible that the imagery sessions were not strong enough to adequately motivate participation among many participants. Future research should seek to determine whether a more intense imagery intervention (with more sessions spread over a longer period of time) is able to promote greater adherence. It is also possible that upon signing up for the study the participants had false expectations regarding the amount of researcher contact and guidance they would receive (i.e., the women expected more of a one-on-one personal training-type situation throughout the exercise program). While the participants were monitored, the exercise was by no means delivered on a one-on-one basis. Future studies of this nature should attempt to manage the expectations of the participants in this regard and perhaps also assess the expectations of the participants throughout the program.

Despite the limitations, two main conclusions can be drawn from the current study. First, from both conceptual and operational perspectives, task, coping, and scheduling SE for exercise seem to be independent from one another. Second, the imagery intervention was successful and these results point to the utility of imagery interventions to influence exercise-related cognitions. More research is needed in order to determine whether imagery can be used to influence actual behavior and the imagery dose that would be required to do so.

ACKNOWLEDGEMENT

This research was supported by a grant from the Social Sciences and Humanities Research Council of Canada.
REFERENCES


