Motiv Emot (2012) 36:452–464
DOI 10.1007/s11031-011-9271-4

ORIGINAL PAPER

The use of a mental imagery intervention to enhance integrated regulation for exercise among women commencing an exercise program

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Published online: 15 January 2012

Abstract The purpose of this study was to examine the effects of a mental imagery intervention designed to enhance integrated regulation for exercise among women commencing an exercise program. Healthy women who previously did not exercise regularly ($N = 102$; $M_{age} = 29.54$, $SD = 8.34$) participated in an 8-week cardiovascular exercise program in which they exercised 3 times each week at a moderate intensity. The intervention group ($n = 51$) received weekly guided imagery sessions which were administered in person via audio recording. A comparison group (i.e., attention control; $n = 51$) received health information delivered in the same manner. Despite substantial dropout of participants from both groups, the analysis revealed that participants in the imagery group experienced greater changes in integration than participants in the comparison group. These findings support the utility of imagery interventions for influencing exercise-related cognitions, and more specifically integrated regulation.

Keywords Integrated regulation · Exercise · Motivation · Imagery

Introduction

Motivation plays an important role in determining maintenance of long-term exercise behavior (Deci and Ryan 2008). Self-determination theory (SDT; Deci and Ryan 1985) is a general theory of motivation that provides a context for understanding motivation for exercise. One mini-theory within SDT, organismic integration theory, proposes that motivation can be intrinsic or extrinsic and that it can vary along an internalization continuum representing different levels of self-determination or internalization.

The most self-determined end of the continuum is anchored by intrinsic motivation. Behaviors that are intrinsically motivated are freely initiated by the individual. When an individual is intrinsically motivated he or she derives pleasure and satisfaction from the behavior itself, not from a consequence separable from that behavior (Ryan and Deci 2000). An exerciser would be intrinsically motivated, for example, if he went out for a bike ride just because he enjoys the feeling of being physically active in this way. Compared to intrinsic motives, extrinsic motives are less self-determined and are not freely initiated by the individual (Ryan and Deci). SDT describes four types of extrinsic motives of which two are considered to be autonomous (or, self-determined) and two are thought to be more controlling in nature.

The autonomous types of extrinsic motivation are integrated and identified regulations which represent motives related to a sense of personal importance and identity or to values and goals, respectively (Deci and Ryan 1985; Ryan and Deci 2000). They also represent successive steps

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toward the less self-determined end of the internalization continuum. Integrated regulation occurs when an individual has assimilated the reasons for exercising into his or her sense of self (Ryan and Deci 2000). In this case, the individual considers being "an exerciser" an important part of who he or she is. Identified regulation reflects engaging in a behavior such as exercise because it is consistent with one's health goals such as losing weight or improving cardiovascular fitness.

Further along the continuum are the controlled regulations; introjected and external. Introjection is characterized by an internal sense of pressure that can stem from a desire to avoid negative emotions or maintain contingent self-worth. For example, an individual may exercise because he or she knows they will feel guilty or ashamed if they do not. The least autonomous (and most controlled) type of extrinsic motive is external regulation, which reflects being motivated by a sense of external pressure or desire to obtain an external reward. For example, an individual may exercise without enjoying or valuing the activity, but will do so because a physician or spouse has recommended he or she do so. Finally, amotivation, which is actually neither intrinsic nor extrinsic, occupies the distal end of the internalization continuum. Amotivation reflects a loss or absence of motivation. Individuals who are amotivated may not identify any good reason for engaging in a behavior and may not undertake the behavior unless other types of motivation are also present (Ryan and Deci 2000).

Exercise motivation

According to SDT, when individuals are intrinsically motivated to engage in a behavior, the psychological outcomes of that behavior are more adaptive. In an exercise context, research consistently shows that intrinsic motivation is an important determinant of persistence (e.g., Grant 2008; Li 1999; Mullan and Markland 1997) and that autonomous motives are associated with stronger perceptions of physical self-worth (Wilson et al. 2006). Frederick and Ryan (1993) however, noted that individuals often engage in regular sports and exercise despite being extrinsically motivated. In fact, exercise motivation research supports this observation. For example, Wilson et al. (2004) examined the motivation of university-aged regular exercisers and found that identified regulation was the most important predictor of current exercise behavior, intentions to continue exercising in the next 4 months, and effort and importance associated with exercise.

Compared to regular exercisers, exercise initiates report less self-determined regulations for exercise involvement (Daley and Duda 2006; Li 1999; Mullan and Markland 1997). Recently, Hall et al. (2010) examined the motivation of regular exercisers, non-exercisers who intended to begin exercising (i.e., intenders), and non-exercisers who did not intend to begin exercising (i.e., non-intenders). As expected, regular exercisers reported significantly more intrinsic motivation and identified regulation than the other two groups although, they also reported significantly more introjected regulation than the non-intenders. While there were significant differences in the amount of intrinsic motivation and identified regulation reported between regular exercisers and intenders, there was no difference between these two groups in terms of introjected regulation. Finally, although external regulation did not differ significantly between the groups it was highest among the intenders. This suggests that the various behavioral regulations may develop independently and may also have independent influences on behavior. With respect to exercise behavior, these findings indicate that individuals who exercise regularly can be distinguished from those who do not based on their intrinsic motivation and integrated regulation; therefore, perhaps one way to influence the behavior of non-exercisers is to facilitate the internalization of their behavior.

Research has demonstrated that exercise initiates show an increase in autonomous regulations as they participate in and adhere to a structured exercise program (Rodgers et al. 2010). In a review and re-analysis of four longitudinal exercise studies, Rodgers et al. found that exercise initiates experienced an increase in identified regulation and intrinsic motivation within the first 8 weeks of participation. Interestingly, the values for these types of motivation did not reach levels reported by regular exercisers, even after 6 months of exercise participation. Rodgers et al. suggested that future interventions should aim to enhance the development of these types of motivation in an effort to increase the probability of long-term adherence among exercise initiates.

One major limitation to the SDT research in the exercise domain is the shortage of research including a measure of integrated regulation. One of the main reasons that integrated regulation has been left out of the exercise motivation literature is that it is difficult to develop valid and reliable items that tap an individual's sense of personal importance and identity, and that can be distinguished from identified regulation (e.g., Vallerand et al. 1989). The Behavioral Regulation in Exercise Questionnaire (BREQ; Mullan et al. 1997) and the subsequent adaptation (BREQ-2; Markland and Tobin 2004) are commonly employed to measure exercise motivation but do not include a measure of integration. Despite the exclusion of integrated regulation in a great deal of the exercise motivation literature, there is evidence that integration is an important type of motivation for athletes (Mallet and Hanrahan 2004) and is linked to health behaviors such as healthy nutrition (Pelletier et al. 2004). This evidence points to the need to consider integrated regulation in studies examining other health behaviors such as exercise and physical activity.

Wilson et al. (2006) developed a 4-item integration subscale for exercise and provided evidence supporting the construct validity of this scale. The addition of an integrated subscale has allowed researchers to begin examining the role of integrated regulation in exercise cognition and behavior and has yielded some promising data. For example, Duncan et al. (2010) used the BREQ-2 with the additional integrated subscale to assess the motivation of 1054 regular exercisers and found that integrated regulation was among the most strongly endorsed behavioral regulations (in addition to identified regulation and intrinsic motivation). Furthermore, integrated and identified regulations were significant predictors of exercise frequency and integrated regulation was a significant and positive predictor of exercise duration. These findings highlight that it is, in fact, important to consider integrated regulation when examining the motivation of exercisers.

Duncan et al. (2009) sought to examine the changes in all of the behavioral regulations in a sample of 57 previously inactive women over the course of a 6-week exercise program. As predicted, initiates experienced an increase in all types of autonomous motivation, including integrated regulation. However, even after 6 weeks of regular exercise the level of integration reported by the initiates did not reach levels reported previously for regular exercisers. This suggested that integrated regulation may be an effective target for interventions, to help facilitate the internalization of exercise behavior in initiate exercisers.

Exercise imagery

Hall (1995) proposed that mental imagery may be an important determinant of exercise behavior and cognition. Subsequent research has confirmed that regular exercisers frequently use imagery and that by employing imagery exercisers can learn exercise tasks (i.e., technique imagery), become energized (i.e., energy imagery), and set appearance-related goals (i.e., appearance imagery; Gammage et al. 2000; Giacobbi et al. 2003; Hausenblas et al. 1999). A number of cross-sectional studies have demonstrated a link between mental imagery and cognitions known to be related to regular exercise such as self-efficacy (e.g., Cumming 2008; Wesch et al. 2006) and intentions (Rodgers et al. 2001). In the context of SDT, researchers have demonstrated that two functions of imagery, appearance and technique, are related to self-determined exercise regulations and that appearance imagery is related to introjected regulation (Wilson et al. 2003).[1]

While primarily correlational and cross sectional in nature, the clear evidence supporting the relationships between imagery, behavior, and cognitions in an exercise context suggests that imagery could potentially be used as an intervention for enhancing exercise-related cognition and, ultimately, exercise behavior. Importantly, recent research has demonstrated that infrequent exercisers, and even non-exercisers, report using exercise imagery (Short et al. 2004), albeit to a lesser extent than regular exercisers (e.g., Gammage et al. 2000; Hausenblas et al. 1999), suggesting that employing an imagery intervention among exercise initiates is appropriate.

Recently, Duncan et al. (2011) demonstrated that targeted imagery interventions could be used to increase self-efficacy for exercise among female exercise initiates enrolled in a 12-week cardiovascular exercise program. In this study imagery intervention scripts were designed not to target any of the functions of imagery specifically, but rather to utilize all of the imagery functions to target self-efficacy for exercise. Specifically, imagery scripts were developed to target task, coping, and scheduling self-efficacy and women were randomized to one of these imagery conditions or to a control group. Within each condition the scripts were generic (i.e., they were not tailored to the individual participants). Women in the imagery groups received three guided imagery sessions over the course of 1 week, before the exercise program began, and one booster imagery session after 6 weeks. For each imagery session, the participant met individually with the researcher in a quiet room and was instructed to close her eyes, relax, and use as many senses as possible to create the most vivid images possible. Each imagery script was read to the participant and took approximately 5 min. After 6 weeks of exercise, the participants reported differential increases in self-efficacy for exercise according to the condition to which they were assigned. Overall, the authors determined that imagery scripts could be developed to target specific types of self-efficacy and that mental imagery was an effective means for enhancing exercise-related cognition among women initiating an exercise program. Based on the success of this intervention, it stands to reason that we may be able to experimentally manipulate other psychological variables related to exercise. Previously, researchers have suggested that exercise initiates may be more likely to achieve long-term adherence to an exercise program if they

[1] Although it is seemingly contradictory that appearance imagery is related to both autonomous and controlling motives, and that regular exercisers report using a great deal of appearance related- imagery, explanations for these findings can be forwarded. For example, individuals could exercise because they want to maintain some appearance related goals (e.g., a specific weight) and imagine these goals. They could also wish to maintain their physical self-worth and this might be partially accomplished through the use of appearance imagery.

undergo an intervention aimed at the development of integrated regulation (Duncan et al. 2009).

The purpose of this study was to examine the effects of a weekly guided imagery intervention designed to enhance integrated regulation among sedentary women who were beginning an exercise program. Throughout the study, participants' general use of imagery was assessed, using the functions of imagery identified in past reaserach (i.e., appearance, technique, and energy); however, in line with previous research, the current intervention was designed to target a social cognitive variable that is known to be an antecedent to regular exercise behavior (i.e., integrated regulation) rather than any of the imagery functions specifically. It was hypothesized that women who received the imagery intervention would experience greater increases in the target variable, integrated regulation, than participants in a comparison condition. Assessment of the imagery functions was simply to determine how an intervention targeting a specific construct may influence natural imagery use patterns.

Although previous research has demonstrated that men and women have similar exercise motivational profiles, particularly with respect to integrated regulation (Duncan et al. 2010), only women were recruited for the current study. At the time that this study was conducted, another exercise intervention was taking place in the study facility, which precluded the presence of men due to self-presentation concerns among the female participants in this other intervention. In order to accommodate both studies at one time, we were restricted to the inclusion of women only.

Method

Participants

The participants were women ($N = 102$) between the ages of 22 and 50 ($M_{age} = 29.54$, $SD = 8.34$). Participants were eligible to participate in the study if they exercised less than once per week for a period of at least 6 months prior to study enrolment, did not possess any contraindications to standard exercise recommendations (e.g., heart problems, high blood pressure, pregnancy), and were able to commit to the study protocol (i.e., regular visits to the study facility). The mean body mass index (BMI) of the participants was 26.54 ($SD = 5.10$) indicating that overall, the participants were slightly overweight. The majority of the participants were White (58%), 6% of the participants were Hispanic, and another 6% were Asian. The remaining 30% of the participants reported their ethnicity as "other" or "mixed" or did not report their ethnicity. Twenty-six percent of the participants reported that they had children and were responsible for childcare.

Measures

Participants completed a demographic questionnaire at baseline which assessed age, exercise frequency, ethnicity, income, education, occupation, marital status, and number of children. Weight and height were measured by the researcher at the baseline and final assessments.

The BREQ-2 (Markland and Tobin 2004) was used to assess exercise regulations according to the SDT framework. The BREQ-2 is a 19-item self-report measure which was adapted from the original BREQ (Mullan et al. 1997). The BREQ-2 is composed of five subscales including intrinsic motivation (e.g., "I enjoy my exercise sessions"; $n = 4$), identified (e.g., "It's important to me to exercise regularly"; $n = 4$), introjected (e.g., "I feel guilty when I don't exercise"; $n = 3$), and external (e.g., "I feel under pressure from my family/friends to exercise"; $n = 4$) regulations as well as amotivation (e.g., "I don't see why I should have to exercise"; $n = 4$). Each item is rated on a 5-point scale ranging from 0 (*not true for me*) to 4 (*very true for me*). Previous research has supported the BREQ-2's factor structure, invariance across gender, and the ability of scores on the BREQ-2 subscales to discriminate between physically active and non-active groups (Markland and Tobin 2004; Mullan and Markland 1997; Mullan et al. 1997; Wilson et al. 2002).

In the current study an additional subscale was used to assess integrated regulation (BREQ-2R; Wilson et al. 2006). The four items which comprise this subscale were constructed in the format of the BREQ-2 items (i.e., follow the question "why do you exercise" and use the same 5-point rating scale) and are easily administered along with this questionnaire. An example item reads "I participate in exercise because it has become a fundamental part of who I am". A reliability analysis revealed internal consistency values for each of the six BREQ-2R subscales (Table 3) that suggested minimal error variance in the observed scores.

The Exercise Imagery Questionnaire (EIQ; Gammage et al. 2000; Wilson et al. 2003) was used to assess the use of technique (i.e., "When I think about exercising, I imagine my form and body position"), energy (i.e., "To get me energized, I imagine exercising"), and appearance (i.e., "I imagine a leaner me from exercising") imagery. The EIQ includes nine items (three per subscale) measured on a 9-point Likert scale from 1 (*never*) to 9 (*always*). Cronbach's alphas calculated for all three subscales at baseline, 4, and 8 weeks indicated adequate internal consistency (Table 3).

Exercise intensity and duration were assessed objectively using Polar RS400 running Computer™ heart rate monitors (HRM) for all exercise sessions participants completed in the study facility. The HRM provided the researcher with minute-by-minute heart rate data as well as workout duration. Individual heart rate data was 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 program monitors. For the workouts that took place outside the lab, the participants self-reported the frequency and duration.

Procedure

Recruitment

The research protocol was approved by the research ethics board at the host institution prior to study recruitment. Participants were recruited on campus and in the community surrounding a large Canadian university using posters, newspaper advertisements, and word of mouth. The advertisements indicated that the researchers were seeking healthy, female volunteers, between the ages of 22 and 50, who exercised less than once per week but wanted to begin exercising more regularly. The advertisements also indicated that participation would involve exercising 3 times per week in the study facility, each participant's fitness would be assessed, each participant would be given a structured exercise program to follow, and that questionnaires would be distributed to assess thoughts related to exercise. Interested potential volunteers contacted the researchers via telephone or email at which point they were briefed on the study protocol then screened for eligibility.

Initial assessment

Participants who were interested and eligible arranged an initial meeting with the researcher. During the initial meeting the study protocol was explained in detail and informed consent was obtained. The participants were informed that they would meet individually with the researcher at the start of each week to listen to a brief (4–5 min) audio recording and that they would be randomly assigned to one of two groups (differing only with regards to the information that was presented in the recording). The participants were informed that the purpose of the project was to determine how the information in the recording influenced their thoughts about exercise. At the initial assessment the participants provided demographic information, as well as baseline measures of exercise motivation and imagery use.

A sub-maximal aerobic fitness test was completed at the initial meeting. The fitness test was conducted on a treadmill by a certified kinesiologist or a trained masters-level researcher in accordance with the guidelines outlined by the American College of Sports Medicine (ACSM 2000).

Each participant was given an interactive lab tour in which they were oriented to the study facility and the exercise equipment. It was ensured that the participants learned the appropriate technique to be maintained on the various exercise machines (i.e., treadmills, rowing machines, stair climbers, and stationary bikes).

Randomization

On the date of the first exercise session, each participant was randomly assigned to either the imagery or comparison group (using a computer-generated list of random numbers). Due to the nature of the intervention in which the researcher played the imagery (or comparison) script to the participant, it was not possible for the researcher in the lab to be blinded to the treatment condition.

Exercise program

Each participant was given an 8-week individualized, cardiovascular exercise program to follow. The program involved three workouts per week lasting 30–60 min.[2] Based on the results of each participant's sub-maximal fitness test and her resting heart rate value, she was provided with an individualized target heart rate range that she was encouraged to maintain throughout the workout. The target HR range increased every 2 weeks beginning with a target HR between 50 and 60% of heart rate reserve (HRR; age predicted maximum heart rate - resting heart rate) and climbing to a range of 60–70% of HRR in the last 3 weeks of the program. The participants were told that if they perceived the HR zone to be reflective of vigorous (rather than moderate intensity) exercise, they could lower their HR and proceed with the designated duration or, if they preferred, maintain that HR but shorten the workout to a more comfortable duration.

The exercise program also involved a progressive increase in workout duration from 30 min at the start of the program to 45–60 min at the end of 8 weeks. For each exercise session, the participants were instructed to begin with a self-paced warm up (lasting up to 5 min) followed by some light stretching, and finish with an active cooldown (i.e., self-paced exercise) until her HR approached

[2] The exercise program that participants in the current study were asked to complete was somewhat discrepant from typical exercise guidelines (e.g., Canadian Physical Activity Guidelines 2011). The decision to diverge from these guidelines was made for practical reasons. Asking the participants to visit the study facility more than three times per week could have represented a scheduling barrier (in our previous research even having participants visit the study facility three times per week proved challenging for many of them), and providing greater access to the study facility would have required considerably more resources (e.g., a larger number of research assistants) than were available.

pre-exercise levels. The warm-up and cool-down phases were included within the designated workout duration.

The participants were asked to complete the majority of their exercise sessions in the study's exercise facility. In weeks 1–4, all three exercise sessions took place in the study facility. In weeks 5 and 6 the participants were given the option to exercise in a preferred exercise location (i.e., home, local community centre or fitness facility) for one of the three exercise sessions. In weeks 7 and 8 the participants were given the option to exercise in their preferred location for two of their exercise sessions. Throughout the 8-week study the participants were given the option to conduct all three weekly exercise sessions at the study facility. The exercise schedule was arranged in this way to ensure that the participants were exercising in a safe environment with the availability of instrumental support early in the program. As the study progressed it was hoped that allowing the participants to exercise in their preferred setting would help them to establish an exercise related identity that was consistent with their natural environment and not isolated to our study facility.

Imagery intervention

Script creation

The goal of the script creation process was to create eight generic imagery scripts (i.e., scripts that could be administered to all women randomized to the imagery condition) that would enhance the participants' integrated regulation by leading her to imagine herself in a state where exercise is consistent with her identity. The first step in the script creation process involved compiling a list of words and phrases reflecting integrated regulation. These words and phrases were drawn from the SDT and identity literature, and from questionnaire items designed to tap integrated regulation in a number of domains (i.e., sports, exercise, education, etc.) as well as exercise identity. In the second step, eight women who exercised regularly were asked to describe the mental images they create when thinking of themselves as a regular exerciser. In the third step, the researchers discussed each of these words, phrases, and image descriptions and decided which statements would be appropriate to use throughout all eight imagery scripts, which would be more appropriate for early scripts (as the participants would be relatively new to exercise) and which would be better applied later in the series of scripts (once the participants had acquired some exercise experience). Based on this discussion, an outline for the imagery scripts was prepared.

Eight imagery scripts were created by the first author and reviewed by the research team. Each imagery script described a full workout (e.g., arriving at the exercise/study facility, preparing to exercise, warming up, doing the main part of the workout, cooling down, and finishing the session) and focused on integration-related thoughts and feelings. Additionally, some of the scripts involved looking ahead to the next exercise session and described thoughts and feelings reflecting integrated regulation. As indicated previously, the participants were allowed to do some of their workouts outside the study facility. To account for this, two of the imagery scripts (weeks 4 and 8) described exercising in a preferred environment. In these scripts, participants received generic instructions (e.g., "Imagine yourself preparing to exercise in your favorite exercise location outside the lab") and were therefore afforded some autonomy in terms of the images they could create. Overall, the scripts included statements such as "Imagine yourself in the lab, feeling like you belong", and "This is what it feels like to be an exerciser". The imagery scripts were not designed to target any specific imagery function; however, while appearance and technique-related statements can be observed throughout, statements reflecting energy imagery appeared most frequently (e.g., from week 4 "You may have felt a bit tired during your first few weeks of exercise. Now you notice that exercise is helping you to feel energized!").

Each of the imagery scripts were pilot tested on a regular exerciser as well as a non-exerciser. In each case the proposed script was read by the same reasearcher who would ultimately be recorded for the intervention recording. At the end of the reading the participants provided feedback regarding the wording or timing of statements within the script, as well as the images that they evoked from the script. Modifications were made to the scripts based on this feedback. After a series of practice readings, the scripts were audio recorded.

Script delivery

The imagery sessions were administered on a weekly basis, prior to the first exercise session of the week; therefore, there were eight imagery sessions in total. The general protocol for script administration was consistent with the protocol described by Duncan et al. (2011). Specifically, the participants met with the researchers individually in a quiet room, sat in a chair, and were encouraged to relax. The participants were reminded that the most effective imagery involves all of the senses and they were instructed to follow the script closely and to create the most realistic images possible. The audio recorded scripts were played through computer speakers for each participant on an individual basis. The door to the private room was closed to block out sounds from the outside that may have distracted the participant from the script. Each script lasted between 4 and 5 min.

Comparison condition

Participants in the attention control comparison condition met with the researcher for brief health information sessions. Each health information session focused on a different benefit of regular exercise (e.g., stress, depression, and anxiety reduction; osteoporosis, cancer, and diabetes prevention; and cardiovascular health). Each session provided information about how and why exercise is beneficial with respect to that particular health condition, as well as the type and dose of exercise that is most beneficial. The health information sessions were delivered on the same weekly schedule as the imagery intervention. Similar to the protocol for the imagery intervention, participants in the comparison group sat individually in a private room and listened to previously recorded health information played over computer speakers. Each health information session lasted approximately 5 min.

Mid-point and final assessments

At the mid-point of the exercise program (i.e., 4 weeks), the participants completed the BREQ-2R and the EIQ. This assessment was included because previous research demonstrated that three guided imagery sessions, all conducted within 1 week prior to participants begining an exercise program, led to changes in the target variable in the first half of the exercise program (6 weeks) and not in the second half (Duncan et al. 2011). In the current study we administered one imagery session per week over the course of the entire exercise program to account for the un-balanced schedule of imagery delivery employed in previous research (Duncan et al.). We included a mid-point assessment to allow us to help confirm our suspicion that an intervention spread over a longer period of time would continue to elicit changes in the target variable. Upon completion of the 8-week exercise program, the participants attended a final assessment in which they completed the BREQ-2R and EIQ, as well as a follow-up questionnaire which 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

At the outset of the study, 102 participants were randomized to either the intervention or comparison group. At the final assessment, only 58 participants remained (imagery, $n = 33$; comparison, $n = 25$), representing 57% of the original sample. A Chi-square analysis was conducted to detect differences in attrition across the two study groups and the results confirmed that there were no significant differences in dropout rates between groups ($p > .05$). Although the attrition that occurred in the current study is consistent with the dropout rate experienced during other behavioral interventions (e.g., Dishman 1982; Duncan et al. 2011) some interventions have had more success with participant retention (e.g., Daley et al. 2007). In order to achieve optimal explanatory ability it would have been ideal to retain a greater number of the initial sample. With that said, a series of t tests (with a Bonferroni correction to control for type I errors; i.e., $p < .004$) indicated that there were no differences in age, BMI, baseline fitness, imagery use, or motivation between those who completed the study and those who dropped out. An additional series of t tests examined the differences in motivation between individuals who adhered until the week 4 assessment (but dropped out before 8 weeks) and those who dropped out before week 4. No differences in motivation were observed for these two groups at baseline ($p = .01$). The results of these analyses are not presented here; however, they are available from the first author upon request.

To ensure that the participants had achieved equivalent experiences in the exercise program, and that changes in motivation could be attributed to the imagery intervention rather than to experience in the program, the remainder of the analyses were conducted for the 58 participants who completed all 8 weeks of exercise and all three psychological assessments.

To determine whether there were differential rates of adherence to the exercise program for participants in the imagery and the comparison groups one final series of t tests was conducted. Again, a Bonferroni correction was employed to control for type I errors ($p < .008$). No significant differences were found between the groups on any of the indicators of adherence including: total number of workouts, number of workouts done at the study facility, total number of workouts done at home, average duration of lab workouts, average duration of home workouts, and average number of minutes spent in the prescribed heart rate zone during lab workouts (Table 1).

Bivariate correlations were calculated to demonstrate the relationship between the motivation variables at 8 weeks and the adherence variables (Table 2). The analysis revealed that the total number of workouts was related to identified regulation only. Workout duration (both in the lab and at home) was significantly and positively related to the autonomous motives (identified, integrated, and intrinsic) with the relationship being strongest for integrated regulation. The average number of minutes that each participant spent in her prescribed heart rate zone was not significantly related to any type of motivation.

Table 1 Descriptive data for adherence variables for imagery and comparison groups

	Group	
	Imagery Mean (*SD*)	Comparison Mean (*SD*)
Total workouts	20.32 (3.13)	19.50 (4.99)
Workouts in study facility	13.94 (2.92)	14.17 (5.48)
Workouts at home	6.38 (3.29)	5.33 (2.30)
Average duration in study facility (minutes)	43.78 (6.85)	43.24 (9.37)
Average duration at home (minutes)	33.78 (13.26)	32.97 (19.32)
Average duration in target heart rate zone (minutes)	30.98 (11.83)	29.69 (5.36)

Imagery use

Individuals in both groups reported using all three functions of imagery before starting the exercise program or receiving an intervention (Table 3). In order to examine the changes in imagery use for the imagery and comparison groups across time, a 2 (group) × 3 (function: appearance, technique, energy) × 3 (time: baseline, week 4, week 8) MANOVA with repeated measures on function and time was conducted. The analysis revealed (for Pillai's Trace) a main effect for function, $F(2, 48) = 8.81$, $p < .001$, partial Eta^2 = .27; a main effect for time, $F(2, 48) = 6.85$, $p < .002$, partial Eta^2 = .22; a group × time interaction, $F(2, 48) = 8.47$, $p < .001$, partial Eta^2 = .26, and a group × function × time interaction, $F(4, 46) = 3.12$, $p = .02$, partial Eta^2 = .21. Further analysis of this latter interaction revealed that while both groups increased their use of imagery over time, there were no between-groups differences for any of the imagery functions at baseline or 4 weeks ($p > .05$) nor for appearance imagery at 8 weeks; however, at 8 weeks the imagery group reported using more technique and energy imagery ($p < .01$).

Table 3 Descriptive data for imagery use variables at baseline, 4, and 8 weeks

	Time	Group		α
		Imagery Mean (*SD*)	Comparison Mean (*SD*)	
Appearance	1	6.06 (2.25)	6.30 (2.10)	0.95
	2	6.97 (2.09)	5.96 (1.81)	0.96
	3	6.98 (2.08)	6.70 (2.05)	0.94
Technique	1	3.43 (2.14)	3.12 (2.10)	0.92
	2	4.60 (1.89)	3.77 (1.47)	0.92
	3	5.24 (2.38)[a]	4.30 (2.25)	0.96
Energy	1	2.72 (1.79)	3.00 (2.00)	0.88
	2	4.18 (1.71)	3.03 (1.57)	0.90
	3	4.71 (2.24)[a]	3.32 (2.17)	0.93

Imagery use variables were measured on a 9-point scale ranging from 1 (*never*) to 9 (*always*)

[a] Denotes a significant difference between imagery and comparison groups ($p < .01$)

Main analysis

Descriptive statistics for the motivation variables at baseline, 4, and 8 weeks for imagery and comparison participants are presented in Table 4. To examine the changes in integrated regulation for the imagery and comparison groups across time a 2 (group) × 3 (time: baseline, week 4, week 8) ANOVA with repeated measures on the second factor was conducted. The analysis revealed (for Pillai's Trace) a main effect for time $F(2, 54) = 50.45$, $p < .0001$, partial Eta^2 = .651, and a group × time interaction, $F(2, 54) = 7.51$, $p < .001$, partial Eta^2 = .218 (see Fig. 1). The main effect for time indicated, and paired-samples t tests

Table 2 Bivariate correlations between adherence variables and motivation at time 3

	1	2	3	4	5	6	7	8	9	10
1. Total workouts	–									
2. Average duration (study facility)	.27*	–								
3. Average duration (home)	.15	.16	–							
4. Average minutes in zone	.07	.18	.12	–						
5. Amotivation	−.08	−.13	−.30*	−.12	–					
6. External	−.06	−.29*	−.01	.00	.33*	–				
7. Introjected	.08	−.02	.22	.08	.03	.56**	–			
8. Identified	.29*	.30*	.35**	.09	−.30*	.09	.41*	–		
9. Integrated	.15	.41**	.34*	.12	−.31*	−.00	.39*	.72**	–	
10. Intrinsic	.19	.38**	.29*	.06	−.86**	−.06	.18	.60**	.70**	–

* $p < .05$

** $p < .01$

Table 4 Descriptive data for motivation variables at baseline, 4, and 8 weeks

	Time	Group		α
		Imagery Mean (*SD*)	Comparison Mean (*SD*)	
Intrinsic motivation	1	2.09 (.86)	2.16 (.99)	0.91
	2	2.61 (.79)[a, b]	2.05 (.71)	0.89
	3	2.85 (.71)[c]	2.41 (.95)[c]	0.94
Integrated regulation	1	1.48 (1.01)	1.40 (.92)	0.89
	2	2.33 (.88)[b]	1.95 (1.03)[b]	0.87
	3	3.08 (.61)[a, c]	2.23 (1.06)	0.93
Identified regulation	1	2.42 (.77)	2.55 (.68)	0.71
	2	3.03 (.72)[b]	2.84 (.75)[b]	0.76
	3	3.01 (.68)	3.05 (.61)	0.78
Introjected regulation	1	1.61 (.99)	1.87 (.95)	0.71
	2	2.08 (1.02)	2.25 (.84)	0.79
	3	1.52 (1.03)	1.98 (.88)	0.86
External regulation	1	.85 (.77)	.91 (1.01)	0.83
	2	1.00 (.80)	1.19 (1.04)	0.86
	3	.69 (.71)	.90 (1.00)	0.88
Amotivation	1	.20 (.44)	.20 (.43)	0.79
	2	.18 (.36)	.04 (.12)	0.81
	3	.12 (.28)	.20 (.44)	0.53

Motivation variables were measured on a 5-point scale ranging from 0 (*not true for me*) to 4 (*very true for me*)

[a] Denotes a significant difference between imagery and comparison groups ($p < .001$)

[b] Denotes a significant increase from baseline to 4 weeks

[c] Denotes a significant increase from 4 to 8 weeks

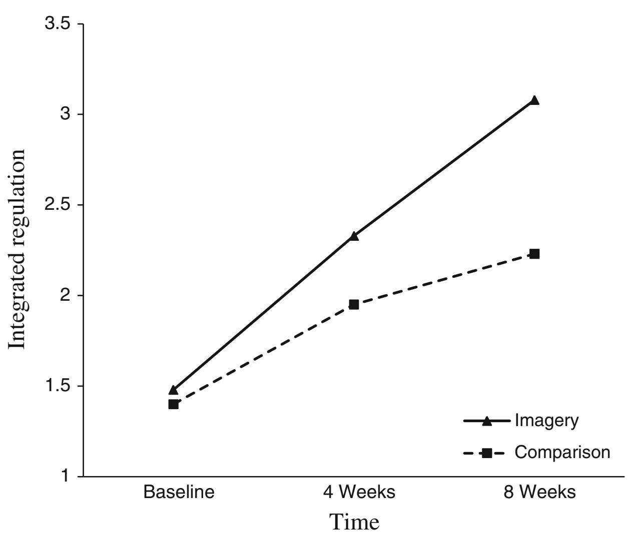

Fig. 1 Change in integrated regulation for imagery and comparison groups

conducted post hoc confirmed, that integrated regulation increased significantly for both groups from baseline to 4 weeks and for the imagery group only from 4 to 8 weeks.

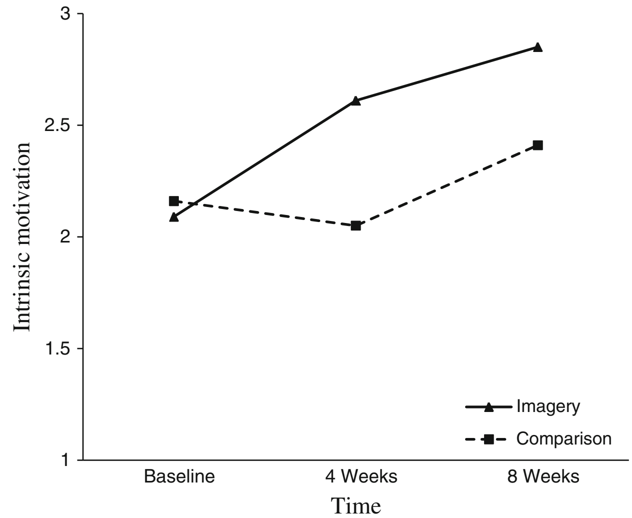

Fig. 2 Change in intrinsic motivation for imagery and comparison groups

The time × group interaction is of primary interest because it demonstrated that the imagery group experienced a greater increase in integrated regulation than the comparison group indicating that the imagery intervention was effective (Fig. 1). At 8 weeks, integrated regulation was significantly higher for the imagery group ($p < .05$).

A second 2 × 3 ANOVA examined the changes in intrinsic motivation for the imagery and comparison groups over time, and also revealed a main effect for time $F(2, 54) = 12.00$, $p < .001$, partial $\text{Eta}^2 = .324$, and a group × time interaction $F(2, 54) = 3.22$, $p < .05$, partial $\text{Eta}^2 = .114$ (see Fig. 2). The interaction depicted in Fig. 2 shows the changes in intrinsic motivation for the imagery and comparison groups across time. Paired-samples t tests conducted post hoc indicated that among imagery participants there were significant increases in intrinsic motivation from baseline to 4 weeks and from 4 to 8 weeks ($p < .05$). In contrast, for comparison participants intrinsic motivation significantly increased during the second half of the study only ($p < .05$). At 8 weeks, intrinsic motivation among imagery participants was significantly higher than intrinsic motivation among comparison participants ($p < .05$).

Finally, a third analysis examined the changes in identified regulation for the imagery and comparison groups over time. While there was no group × time interaction ($p > .05$), a main effect for time was observed $F(2, 54) = 25.37$, $p < .001$, partial $\text{Eta}^2 = .499$ (see Fig. 2). Paired samples t tests conducted post hoc indicated that for both groups, identified regulation increased significantly between baseline and 4 weeks, and although mean scores demonstrated an increase in identified regulation between 4 and 8 weeks for both groups this was not a significant change ($p > .5$). The lack of an interaction effect indicated that there was no difference in the change in identified regulation over time between imagery and comparison participants.

Discussion

Integrated regulation has been identified as a cognitive variable that is associated with regular exercise but is slow to change among exercise initiates (Duncan et al. 2010). Consequently, some of our previous work has led us to suggest that one way to increase exercise behavior among initiate exercisers might be to intervene in such a way that the reasons for exercising become internalized (Rodgers et al. 2010). Recent research has demonstrated that long-term imagery interventions may be one way to influence the exercise-related cognitions of exercise initiates (Duncan et al. 2011); therefore, the purpose of this study was to examine the effects of a guided imagery intervention designed to enhance integrated regulation among sedentary women as they began an exercise program. Overall, the findings demonstrated that integrated regulation is amenable to manipulation. Additionally, this study provides initial evidence that a mental imagery intervention may be used to facilitate the internalization of exercise behavior; however, replication of this study is needed in order to determine the generalizability of our findings.

At the outset of this study we identified the discrepancy in reported levels of integration between individuals who self-identified as regular exercisers and individuals who began a program of regular exercise relatively recently (Duncan et al. 2009). Given that a guided imagery intervention administered in conjunction with a regular exercise program had proven successful for helping exercise initiates achieve levels of task, coping, and scheduling self-efficacy reported by regular exercisers (Duncan et al. 2011), we theorized that an imagery intervention targeting integrated regulation would achieve a comparable result. Therefore, the differential increase in integrated regulation for the imagery group over that of the comparison group was expected.

Our initial intention was to create and test a series of imagery scripts that specifically targeted integrated regulation because previous research has demonstrated that the behavioral regulations differentially influence various motivational consequences (Wilson et al. 2004) and exercise behaviors (Duncan et al. 2010), and that integrated regulation is an important correlate of exercise behavior (Duncan et al.). Given the spill-over effect that was observed (i.e., the imagery intervention also had a positive effect on intrinsic motivation), it does not appear that the scripts were successful with regards to solely targeting integration. Upon examining the scripts, we do not believe that the spill-over reflected the inability for these two constructs to be theoretically distinguished, but rather a practical limitation in that the intervention was not as narrowly targeted as we had intended. Although the scripts primarily contained statements reflecting integrated regulation, some statements refered to feelings of pleasure and satisfaction associated with exercise. Although we were unable to isolate integrated regulation using the imagery scripts, the imagery had a wider effect on the internalization process for exercise behavior, by also enhancing intrinsic motivation.

Researchers have shown that integrated regulation and intrinsic motivation are closely linked and quite high among regular exercisers (Duncan et al. 2010; Wilson et al. 2006). Additionally, intrinsic motivation leads to interest and excitement which in turn influences performance and persistence (e.g., Sheldon et al. 1997). Therefore, even though we did not intend for our intervention to enhance intrinisic motivation, it was an unexpected benefit.

All study participants, regardless of experimental group, demonstrated a significant increase in identified regulation over time. This is consistent with previous research in which the identified regulation of exercise initiates increased as a result of exercise experience (Rodgers et al. 2010). Identified and integrated regulations are often highly correlated and some questionnaires assessing motivation have been unable to distinguish the two constructs (e.g., Vallerand et al. 1992; Pelletier et al. 1995). The current results support the distinction between these two regulations in the exercise domain and, more importantly, demonstrate that one can be experimentally manipulated without inducing changes in the other. From a theoretical perspective, it would be interesting to determine if separate imagery interventions could differentially influence integrated and identified regulations because this would provide further support for the theoretical distinctiveness of the two regulations.

An examination of imagery use by the imagery and comparison groups across time revealed four noteworthy findings. First, in line with previous research (i.e., Short et al. 2004) participants in both groups reported using imagery for all three functions (i.e., appearance, energy, and technique imagery) at baseline. This provided support for our contention that exercise initiates can create exercise images and, therefore, an imagery intervention is appropriate for use in this population. Second, no between-groups differences were observed at baseline. This helped to confirm that the randomization of participants to groups was successful. Third, over the course of the study period, both groups reported significant increases in the use of all three imagery functions. This demonstrated that imagery use changes as a function of increasing exercise participation. Although a substantial amount of cross-sectional evidence has demonstrated that frequent exercisers use more imagery than less frequent exercisers (e.g., Gammage et al. 2000; Hausenblas et al. 1999), this is the first longitudinal study to demonstrate that imagery use changed in concurrence with increasing exercise behavior. Finally, participants in the imagery group reported greater increases in the use of all technique and energy imagery compared to comparison participants. Although this study did not include a manipulation check to confirm that participants in the imagery group were using imagery reflecting integrated regulation, this indicates that at least the intervention participants were employing imagery to a greater extent than the comparison participants.

Given previous findings (Duncan et al. 2010), it was expected in the present study that the motivation variables would be related to some of the measures of adherence (e.g., total number of workouts, workout duration). While some of these expected relationships emerged, they did not completely correspond with previous findings (Duncan et al.) which demonstrated positive relationships between duration and intrinsic motivation, integrated, identified, and introjected regulations in a sample of regular exercisers The most likely explanation for the differences between the two studies is that Duncan et al. examined regular exercisers and employed a self-report measure of exercise duration, while the current study examined exercise initiates and objectively measured duration.

One important consideration in the development of guided imagery interventions is the intervention dose. Research has consistently shown that even a small dose of imagery can significantly influence cognition and performance (see Morris et al. 2005); however, work by Cumming and Hall (2002) would suggest more imagery is better. In a previous long-term imagery intervention, participants received three guided imagery sessions in 1 week prior to beginning a 12-week exercise program and one booster session at the mid-point of the program (Duncan et al. 2011). Significant increases in the target variables during the first half of the program were found with no further increases in the second half. Informed by these findings, in the current study we opted to deliver the imagery sessions throughout the entire exercise program. In doing so, the target variable increased not only in the first but also in the second half of the exercise program. Based on these findings it seems that either guided imagery should be included throughout the entire length of an exercise program, or perhaps some protocol should be developed for participants to do self-guided imagery once the guided imagery intervention is complete. Regardless, it appears that the impact of the imagery on the target variable is strongest while the imagery is being administered.

It is important to note that in the current study increases in integration were achieved at the same time that the participants were enrolled in a program of regular exercise, a situation in which perceptions of one's self were congruent with their current behavior. It would be interesting to examine the changes in integrated regulation once the prescribed exercise program was complete. Presumably, integration would remain high among those individuals who maintained a program of regular exercise and would decline for those participants who failed to maintain regular exercise. We cannot determine what happens to the target variable after both the guided imagery and structured exercise have ended because neither the Duncan et al. (2011) study nor the current study included a long-term follow-up. Because the benefits of regular exercise are only obtained when the behavior is maintained over the long term (Blair et al. 2004), it is important to understand motivation on a long-term basis. In the future it is recommended that researchers include such an assessment.

We were not able to extend our investigation beyond the psychological variables to also examine the impact of the imagery intervention on exercise behavior. The same exercise program was prescribed to the participants, regardless of group, and did not allow for variation in frequency, intensity, and duration. As a result, we were not able to investigate differences in exercise behavior between individuals in the intervention and comparison groups. Controlling exercise behavior permitted us to examine the effect of the imagery intervention on integrated regulation in isolation from the effects of overt exercise experiences because these were the same for individuals who completed the program, regardless of the group to which they were assigned. In order to examine changes in exercise behavior in the future, researchers should allow for greater individual variability in behavior by employing a less structured exercise program conducted in a more natural environment (rather than a research facility).

Outlining specific exercise guidelines for each of the study participants and creating generic scripts for all participants allowed us to have a certain degree of scientific control; however, it may have undermined the autonomy of the participants and is therefore an important limitation to the current study. In the exercise domain, SDT advocates strongly endorse the creation of autonomy-supportive contexts because they can facilitate self-determined behavioral regulation and foster feelings of eudaimonic well-being and health (Ryan and Deci 2000; Edmunds et al. 2008). In autonomy-supportive environments, authority figures listen with empathy, provide meaningful rationales for change, offer choice, do not pressure compliance, and acknowledge the challenges associated with behavior change (Ryan and Deci). In the current study, exercise frequency, intensity, and duration were assigned to each of the participants, restricting the degree of choice for those elements of the exercise program. Furthermore, the imagery scripts were generic, rather than individually tailored, and were designed by the researchers rather than informed by the thoughts of each individual participant. It is highly possible that the controlling nature of these two elements is responsible (at least in part) for the large dropout rate observed in this study. Previous research has demonstrated that autonomy-supportive exercise environments contribute to attendance at an exercise program (e.g., Edmunds et al. 2008) and perhaps adherence would have been improved had the exercise program and imagery intervention been more autonomy-supportive.

The above discussion is simply speculative because we did not assess the degree to which the participants felt their experience in the study was autonomy-supportive. In fact, although there were certainly controlled aspects of the exercise program, the participants were also afforded a considerable amount of choice. For example, within each of the in-lab sessions the participants were free to choose which pieces of exercise equipment they would use. Additionally, as the exercise program progressed, participants were encouraged to exercise outside the lab, allowing them to choose activities they enjoyed that could be easily incorporated into their weekly routine. In terms of the imagery intervention, the overall structure of the scripts was generic and could be interpreted as controlling; however, participants were encouraged to elaborate on the scripts in order to make them as realistic and personally relevant as possible. Because there was no differential dropout between participants in each condition, it is unlikely that the potentially controlling nature of the imagery scripts was the cause of the dropout. Participants in both groups underwent the same exercise program, however, which points to the nature of the exercise as a more likely contributor to the dropout rate. As further research is conducted using imagery interventions in conjunction with long-term exercise programs, researchers should consider how to support the autonomy of the participants through both the exercise and imagery components.

Another limitation of the present research was the failure to assess imagery ability, a factor known to moderate the relationship between imagery and exercise (Cumming 2008). An exercise-specific measure of imagery ability has not yet been validated; however, some researchers have recently reported successful attempts to measure exercise imagery ability. For example, Cumming (2008) created two scales to accompany the Exercise Imagery Inventory (Giacobbi et al. 2005), which is a measure of frequency of imagery use. For each EII item, participants were asked to rate how easy or difficult it was for them to see and feel the images. Similar companion scales have also been employed with the EIQ (Stanley and Cumming 2010). While it would have been prudent to measure imagery ability in the current study, the lack of such an assessment was not a critical limitation given that the imagery group reported greater imagery use and had higher integrated motives compared to the comparison group.

The primary strength of the present research is that it is one of the few studies to date to investigate the effectiveness of an imagery intervention in the exercise domain. Two main conclusions can be drawn from this study. First, from a theoretical perspective we have demonstrated that integrated regulation is, in fact, amenable to manipulation. Second, from a practical point of view the current findings indicate that imagery is an effective intervention strategy for enhancing integrated regulation among exercise initiates. Additional research is needed in order to determine whether imagery can be used to influence actual behavior.

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

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