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Mental imagery increases self-determined motivation to exercise with university enrolled women: A randomized controlled trial using a peer-based intervention

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ABSTRACT

Objectives: The purpose of this study was to examine the effects of a peer-based mental imagery intervention on the self-determined motivation and cardio-respiratory fitness of university enrolled women.
Design: Randomized controlled trial.
Method: 43 University enrolled women were randomized to peer-mentored or peer-mentored plus mental imagery conditions while 32 completed three meetings with peer-mentors and post-testing ($M^{age} = 19.91$; $SD = 1.70$).
Results: Significant improvements in cardio-respiratory endurance, ratings of perceived endurance, and self-determined motivation to exercise were observed across both study conditions. Participants assigned to the peer mentored plus mental imagery condition reported significantly greater increases in self-determined motivation to exercise at post-test compared to those in the peer-mentored condition.
Conclusions: Peer-based interventions are a viable way to improve fitness and health outcomes while mental imagery appears to be associated with increases in autonomous forms of exercise motivation.

Sedentary behavior, physical inactivity, and obesity are primary factors in global morbidity and mortality (World Health Organization, 2012). According to the World Health Organization (WHO), physical inactivity accounts for 6% of deaths worldwide primarily due to diabetes, breast and colon cancers, and ischemic heart disease. There is broad consensus that participation in regular physical activity reduces risk of coronary heart disease, diabetes, stroke, hypertension, and depression (Physical Activity Guidelines Advisory Committee, 2008). Physical activity is also a key determinant of energy balance and is therefore an important part of weight control strategies. Finding ways to promote the initiation and maintenance of physical activity behavior is an important global public health challenge.

Declines in physical activity (PA) begin in late childhood and show a significant drop during early adulthood. Population surveillance data in the United States (U.S.) shows that approximately 24.8% of 18–24 year old adults report engaging in no leisure-time physical activity, compared with 27.8% of adults aged 25–44, 32.5% of those aged 45–64, and 41.8% of older adults aged 65–74. Amongst 18–24 year olds, greater than 40% do not follow recommended guidelines of accruing 150 min of moderate intensity aerobic physical activity per week, or 75 min of vigorous intensity, or an equivalent combination (United States Department of Health and Human Services, Physical Activity Guidelines Advisory Committee, 2008). Likewise, Healthy Campus 2020 identified physical inactivity and fitness as 1 of 10 student health priority areas for university enrolled students (American College Health Association, 2012). In short, intervening with the university population may help individuals establish sustained patterns of physical activity which may impact long-term health (Keating, Guan, Pinero, & Bridges, 2005).

It is also important that a smaller proportion of adult women meet public health guidelines, and PA differences between men and women become increasingly exaggerated over the life course

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(USDHHS, 2010). Among ethnic minority women in the U.S., African American, Hispanic, and Native Indians are among the least active segments of the population for all age groups. This is unfortunate because women generally live longer than men but also suffer from a greater number of disabling physical and mental conditions and report lower health-related quality of life as compared to men (Boiche, Sarrazin, Grouzet, Pelletier, & Chanal, 2008; Guay, Mageau, & Vallerand, 2003). PA is one possible pathway that may explain some of the differences between men and women in self-rated health and quality of life. While some data suggests that university enrolled women are more active than those not enrolled, there have been calls in the literature for increased research attention to university students in order to help young adults establish and maintain habitual PA (Keating et al., 2005). For these reasons, interventions targeting women during early adult life transitions, such as university enrollment, represent an opportunistic time to promote physical activity. Such efforts could help women develop self-management skills important for the maintenance of life-long physical activity behavior.

The United States Task Force on Community Preventive Services recommends that programs attempting to help individuals incorporate PA into their daily routines should include self-management skills such goal setting, self-monitoring of progress towards goals, problem solving to maintain behavior change, behavioral reinforcement through self-reward, and positive self-talk (Guide to Community Preventive Services, 2012). Another self-management skill, mental imagery, is emerging as a viable tool that may help increase exercise behavior with adults. Mental imagery can be defined as "The creation or recreation of an experience generated from memorial information, involving quasi-sensorial, quasi-perceptual, and quasi-affective characteristics, that is under the volition control of the imager, and which may occur in the absence of the real stimulus" (Morris, Spittle, & Watt, 2005, p. 18). This definition acknowledges the role of memory, sensory experience, volition, and emotions. Finding effective ways to deliver mental imagery and other self-management skills is an important theoretical and practical public health challenge.

Peer-based intervention delivery models

A growing body of evidence has supported the use of peer-based interventions to increase PA with adults throughout the age span (Martin Ginis, Nigg, & Smith, 2013). One randomized controlled trial (RCT) with sedentary older adults tested the impact of an evidence-based PA telephone intervention comparing the effects of adult peer mentors versus professional staff (Castro, Pruitt, Buman, & King, 2011). Results revealed that participants assigned to the peer-mentored condition experienced significant and equivalent improvements in PA behavior compared to those assigned to professional staff or an attention-control condition at the end of 12-months. Another theoretically-based RCT with sedentary older adults also showed promising findings in the delivery of PA interventions by trained peers. Participants in this study were randomized to a PA support condition or an attention matched control group. The intervention was designed to foster the major constructs predicted by self-determination (SDT) and self-efficacy theories (Bandura, 1997; Deci & Ryan, 1985) and included goal setting, the development of support networks, overcoming barriers to exercise, and, of relevance for this study, the use of mental imagery. Attention matched control group participants completed group meetings with peer mentors focused on a range of relevant health topics (health promotion condition). Results revealed significantly greater gains in moderate to vigorous PA compared to those in the health promotion group after 18-months follow-up (Buman et al., 2011). A significant time-by-group interaction revealed that participants in the intervention condition showed significantly greater gains in self-determined motivation to exercise after 18 months as compared to control group participants. Importantly, the intervention used by Buman et al. (2011) included mental imagery homework assignments and the use of a guided imagery script.

Two reviews also support the use of peer-based interventions (Martin Ginis et al., 2013; Webel, Okonsky, Trompeta, & Holzemer, 2010). One meta-analytic review of randomized controlled trials across multiple health behaviors with adults across the age span supported the efficacy of peer-based interventions (Webel et al., 2010). The portion of the analysis focused on PA interventions showed a small to moderate standardized effect across the studies (Webel et al., 2010). In another systematic review researchers showed that all the studies reporting within-group analyses (5 out of 10) showed significant increases in PA behavior (Martin Ginis et al., 2013). When compared to alternative delivery methods, peer-based interventions were just as effective as professionally delivered approaches and more effective than attention control conditions. Overall, peer assisted interventions appear to be an effective way to nurture the basic needs predicted by SDT and increase PA behavior. What follows is theoretical and empirical justification for using a peer-based intervention model that involves the application of mental imagery to promote and increase exercise motivation and behavior with university women.

Self-determination theory

SDT has emerged as a viable framework to increase exercise behavior and appears well-suited for use within a peer-based intervention model. The basic need portion of SDT predicts that people have three basic psychological needs: autonomy, perceptions of competence, and relatedness (Deci & Ryan, 1985; Ryan & Deci, 2000; Ryan, Patrick, Deci, & Williams, 2008). Competence and autonomy are theorized to be necessary social conditions for people to be intrinsically motivated. When intrinsically motivated, individuals are autonomously engaged to exercise for the rewards, joy, and pleasure associated with chosen activities. SDT acknowledges that people have multiple intrinsic and extrinsic motives for exercise. Extrinsically motivated exercise behavior is performed for contingencies in the environment such as praise from others (Ryan & Deci, 2007). Although many people engage in exercise for both intrinsic and extrinsic reasons, adherence is more likely to occur if individuals find enjoyment, inherent satisfaction, and have internalized motives towards participation (Rodgers, Hall, Duncan, Pearson, & Milne, 2010; Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997). Importantly, SDT predicts that intrinsic motivation is most likely to flourish when the need for relatedness is also supported in addition to autonomy and perceptions of competence. Environments and relationships where people feel a sense of empathy, connectedness, and belonging are considered essential for intrinsic motivation while feelings of rejection, insecurity, or alienation undermine this motivational process (Ryan & Deci, 2007).

Recent studies and systematic reviews have supported the basic tenets of SDT as an intervention strategy with overweight and obese women. In a randomized controlled trial (RCT), researchers assigned 239 women aged 25–50 years old to a health education curriculum or an SDT based condition (Silva et al., 2010). Participants in the experimental condition met weekly or bi-weekly in groups of 25–30 over the course of 30 weeks with an interdisciplinary team of Ph.D. or M.S. level exercise physiologists, nutritionists, and psychologists. The intervention was designed to foster the three basic needs predicted by SDT. Results showed that participants assigned to the intervention condition showed significantly greater weight loss, exercise, and autonomous forms of motivation to exercise at one year follow-up as compared to controls. Finally, consistent support was observed for a positive relationship between autonomous forms of motivation and exercise behavior in a systematic review of 66 empirical studies that included experimental, cross-sectional, and prospective designs published up to June 2011 (Teixeira, Carraca, Markland, Silva, & Ryan, 2012). It was also determined that need satisfaction of perceptions of competence and intrinsic motivation positively predicted exercise behavior across a range of age groups and individuals with different health conditions.

For the reasons described, we theorized that age and gender matched peer mentors would be ideally suited to nurture the three basic needs predicted by SDT. Specifically, the lifestyle based model being employed here would emphasize autonomous choices of PA behavior rather than exercise prescription. The peers would be trained to nurture the need for relatedness by forming professional and empathetic relationships. Finally, peer mentors teaching mental imagery would likely nurture perceptions of competence by demonstrating and encouraging participants to practice this cognitive skill.

Mental imagery and exercise behavior

Recent interventions testing the impact of mental imagery on exercise behavior and psycho-social outcomes have shown encouraging results (Andersson & Moss, 2011; Duncan, Hall, Wilson, & Rodgers, 2012; Murru & Martin-Ginis, 2010; Stanley & Cumming, 2010). Andersson and Moss (2011) developed a 790 word imagery script that was administered on a CD given to participants. Participants were instructed to listen to the CD, which took approximately 5 min, every day for two weeks. Results showed that sedentary participants randomized to guided imagery significantly increased their PA behavior compared to relaxation and attention control groups. Stanley and Cumming (2010) tested the impact of an imagery script aligned with bio-informational theory (Lang, 1979) on the affective responses of university students before, during, and after a 20 min bout of cardiovascular exercise. Briefly, bio-informational theory suggests that mental imagery is a product of the brain's information processing capacity in long-term memory and involves the activation of physiological and behavioral prototypical responses when appropriate images are elicited. The results presented by Stanley and Cumming (2010) revealed that participants randomized to conditions that targeted enjoyment and energy imagery reported significantly higher affect valence compared to exercising without imagery. Duncan et al. (2012) also used a guided mental imagery script during an 8 week intervention with sedentary women who participated in supervised cardiovascular exercise 3 times a week. Participants randomized to the intervention group received guided imagery sessions, that were administered by an audio recording, prior to supervised cardiovascular exercise sessions, each week for 10 weeks. Results showed that participants in the imagery condition reported significantly greater increases in integrated regulation and intrinsic motivation after 8 weeks compared to a comparison group.

There are important shortcomings in the literature as none of the RCTs described above focused on the cognitive and motivational functions of imagery suggested by theorists (Hall, 1995; Munroe-Chandler & Gammage, 2005; Paivio, 1985) and supported by psychometric analyses (Giacobbi, Tuccitto, Buman, & Munroe-Chandler, 2010). Failure to adequately target both aspects of imagery in interventions may attenuate, or underestimate, relationships between imagery and important exercise outcomes. It is also important that the studies reviewed above relied on self-report measures of exercise behavior which are prone to biases (Corder et al., 2009). While other ways of measuring physical activity are available (e.g., accelerometers), we chose fitness assessments because this approach reflects the impact of cumulative bouts of exercise frequency and intensity conducted over time. For instance, cardio-respiratory fitness (CRF) is a health-related component of fitness and is defined as the ability of the respiratory, circulatory, and muscular systems to supply oxygen throughout the body during sustained physical activity behavior (Lee, Artero, Sui, & Blair, 2010). CRF is typically expressed as maximal oxygen update (VO_2 maximum) and can be reliably measured using field-based tests in community or fitness settings (American College of Sports Medicine, ACSM, 2000). CRF is a reliable and sensitive measure of habitual physical activity and is inversely related to coronary heart disease (Lee et al., 2010). Indeed, research has shown that individuals in the lowest quartile of cardiorespiratory fitness as measured by VO_2 maximum tests are at increased risk of death from all causes (Blair et al., 1989). Likewise, the use of ratings of perceived exertion (RPE) during fitness testing protocols have a long history (ACSM, 2000; Borg, 1998). For instance, Borg's RPE scale allows participants to subjectively rate her feelings of exertion and fatigue during a fitness testing protocol and this instrument has extensive evidence to support its use (Chen, Fan, & Moe, 2002). We are not aware of studies that have tested the impact of guided imagery on estimated cardio-respiratory endurance and RPE.

The purpose of this RCT was to examine the effects of a peer- and theory-based mental imagery intervention on the self-determined motivation to exercise of a demographically diverse sample of university enrolled women. A secondary purpose was to examine the impact of the intervention on CRF. Based on previous studies (Duncan et al., 2012), we hypothesized that participants exposed to guided imagery would exhibit increased self-determined motivation to exercise compared to those assigned to a comparison condition. No hypotheses were put forth for the CRF outcomes.

Method

Overview of study design

We conceptualized this study as a peer-mentored program intended to enhance exercise behavior with inactive, overweight, or obese university enrolled women. The study design was a 10-week RCT with pre- and post-test assessments that included field-based estimates of cardio-respiratory endurance, ratings of perceived exertion, and self-determined motivation to exercise. After pre-testing, participants were randomized to one of two study conditions: 1) peer-mentoring (PM); or 2) peer-mentoring plus mental imagery. (PMPMI) Participants met with peer mentors on three occasions between assessments in a university recreation facility with contemporary exercise equipment.

Recruitment, screening, and eligibility criteria

Recruitment occurred on a large university using flyers posted on campus after an institutional review board approved all study procedures. Potential participants telephoned study personnel for pre-screening assessments that included self-reported height, weight, and typical exercise behavior: this data was used to identify eligible participants only. The original recruitment criteria required participants to have a body mass index (BMI) greater than 25 [height (inches)/weight (pounds^2)]. However, these criteria resulted in too few participants eligible for participation. Revised inclusion criteria included one or both of the following: 1) A self-reported body mass index (BMI) over 25; and/or 2) Engaged in exercise one or fewer days per typical week. Individuals were excluded if they had uncontrolled high blood pressure, were advised by a physician not to exercise for any reason, or if they were pregnant or planning to become pregnant. Participants who met study criteria were assigned a date for pre-testing: randomization occurred after pre-testing.

Participants

Fig. 1 describes the flow of participants through the study and shows that 47 individuals were assessed for eligibility. Of those, 43 were randomized to one of the two study conditions. There were no significant differences in any of the variables between participants in either condition at baseline, those who completed the study versus dropouts, or in comparison to participants who worked with one mentor versus any of the others. There were minor differences between mentors in the number of participants who dropped out but these were not statistically significant. Overall, 68% of those randomized to experimental or control conditions completed 3 meetings with mentors and post-testing. Those who completed all meetings with mentors along with pre- and post-testing included 32 university enrolled women ($M^{age} = 19.91$; $SD = 1.70$). The majority of the sample was Caucasian (40%), 17% were Hispanic, 17% Asian, 9% African-American, 4% American Indian or Alaskan Native, 4% Hispanic plus Caucasian, and 4% other.

The intervention

Both study conditions

All participants were provided with a bound exercise journal and asked to track their PA behavior throughout the course of the study. They were also instructed to visit a password protected website to complete weekly monitoring of exercise behavior.

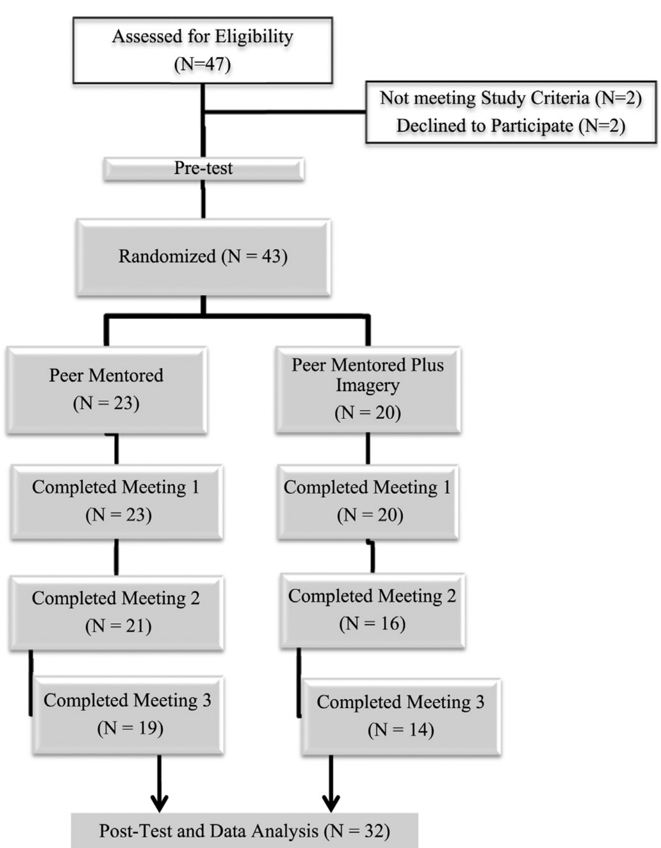

Fig. 1. Participant Flow. Participant flow from eligibility, randomization, completion of meetings with mentors, and post-tests.

During the first meeting, mentors described the exercise log in detail to participants which included guidelines about engaging in safe exercise (e.g., stretching, staying hydrated), self-monitoring during exercise that included ratings of perceived exertion (RPE), and where to find information about exercise on the internet (e.g., American College of Sports Medicine). Also included in the exercise journal was a goal setting activity, facilitated by mentors during meeting one, that encouraged participants to set specific, measurable, action-oriented (behavioral), realistic, and timed (SMART) exercise goals. Mentors encouraged participants to achieve a weekly goal of 150 min, or more, of moderate to vigorous PA in most instances. When participants stated their goals were to lose weight or increase their fitness then they were encouraged to adjust their goals for up to 300 min of PA which is consistent with public health recommendations (Physical Activity Guidelines Advisory Committee, 2008). Finally, all participants spent the last part of each meeting with mentors engaging in cardio-vascular and other exercises. Consistent with SDT, we allowed participants to choose the specific exercise activities they performed with mentors. These included the use of a treadmill, stationary bikes, stairmaster, circuit training, rock-climbing, and racquetball among others.

Peer-Mentoring Plus Mental Imagery (PMPMI)

In addition to the procedures described above, participants randomized to the PMP condition engaged in mental imagery during meetings with mentors and on the study website described above. During meeting one, mentors defined mental imagery, offered examples of how this skill can be used, and introduced a theoretically-based mental imagery script. The content of this script was based on previous exercise imagery research and self-efficacy theory (Bandura, 1997; Giacobbi et al., 2010; Munroe-Chandler & Gammage, 2005; Paivio, 1985) with additional emphasis on autonomy. The imagery script focused on performing a cardiovascular exercise and requested participants to create vivid and realistic images. This was followed by five specific scenarios: 1) imagining a place to exercise; 2) a slow paced warm-up exercise of the participants' choice; 3) images of a progressively more intense exercise; 4) imagining oneself coping with a vigorous activity; and 5) images encouraging participants to monitor exercise technique. During meetings 2 and 3, mentors read the mental imagery script out-loud while the participants were in a relaxed position. Participants in this condition were also provided with this guided imagery script on the study website previously described. The imagery script included ratings of vividness after each of the five sections on the script and were anchored on a scale of 1 (very little vividness) to 7 (a lot of vividness). The number of times participants completed the ratings between meetings with mentors were used as a manipulation check to verify adherence to the study protocol. Tracking this data also allowed us to measure how many times the participant practiced mental imagery during the intervention period.

Peer mentor training and quality control

Peer mentors were graduate and undergraduate female students who received training from the first author. Training involved assigned readings about mental imagery and the application of SDT principles in a mentoring relationship (Giacobbi, Hausenblas, Fallon, & Hall, 2003; Giacobbi et al., 2010; Ryan & Deci, 2007). During four training meetings that lasted from 60 to 90 min, the mentors were engaged in discussions and role-playing activities where peer-mentors were trained to (1) use neutral language (e.g., "may" and "could" as opposed to "must" or "should"); (2) provide exercise choices without the use of prescriptions, demands, extrinsic rewards, or other contingencies; (3) support behavior change with a clear rationale; (4) encourage participants to explore their values and make links between exercise and their underlying values; (5) give positive informational feedback to support participant efforts rather than exercise outcomes; and (6) offer opportunities to apply self-management skills linked to exercise behavior (e.g., mental imagery for those in the PMP condition only). Additional feedback was provided to mentors as needed throughout the intervention during regularly scheduled meetings. All 5 mentors exceeded 150 min of moderate to strenuous PA each week and they were viewed as ideal peer mentors for this project by the senior investigators.

Measures

Demographic and physiological measures

Demographic questions included date of birth, height, weight, and racial/ethnic data. During screening, participants self-reported height and weight data was used to compute body mass index (BMI) with the formula: BMI = weight (pounds)/[height(inches)]^2 × 703.

Cardio-respiratory fitness

The Queen's College Step Test (ST) was used to estimate maximal oxygen uptake (VO_2max) or cardio-respiratory fitness (McArdle, Klatch, & Pechar, 1972). While the ST provides less accurate estimates of cardio-respiratory fitness than a maximal graded exercise test, it is safe to perform and well-suited for inactive individuals or when laboratory procedures are not feasible (Chatterjee, Chatterjee, Mukkerjee, & Bandyopadhyay, 2004; D'Alonzo, Marbach, & Vincent, 2006). Equipment included a 16.25 inch step, computerized metronome, and a Polar heart rate monitor model FT4 with a T31 transmitter. The participants stepped up and down continuously at a pace of 22 steps per minute for 3 consecutive minutes. Recovery heart-rate was calculated after completion of the step-test using the heart rate monitor and this value was inserted into the following equation: VO_2 max = 65.81–0.1847 × recovery heart rate (beats per minute).

Ratings of Perceived Exertion (RPE)

Perceived exertion was assessed during the ST (Borg, 1998). The RPE scale was in view during the entire step test. After 2 min and 30 s, participants were asked to rate their perceived exertion from 6 (very, very light) to 20 (very, very intense). The RPE measures PA intensity levels or individuals perceptions of how hard they worked during exercise. Ratings between 12 and 14 generally indicate that one is performing at a moderate intensity level with values greater than 15 indicating intense activity and there is extensive validity evidence to support the use of this scale during fitness tests (ACSM, 2000; Chen et al., 2002).

Exercise Motivation Scale (EMS)

This 31-item self-reported survey was used to measure participants' motivation to exercise (Li, 1999). The EMS consists of eight subscales that measures the exercise motivation construct along the self-determination continuum: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, intrinsic motivation to learn, intrinsic motivation to accomplish tasks, and intrinsic motivation to experience sensations. The development of the EMS was based on SDT while scoring interpretations and factorial validity of the instrument has been supported with multiple samples of exercisers (Li, 1999; Wininger, 2007). While the EMS has shown factorial evidence to support its 8-factor structure, it can also be weighted across the 8 subscales to form a single indicator along the self-determination continuum which is how it was scored in this investigation: higher scores indicate more autonomous forms of motivation to exercise (Vallerand & Rousseau, 2001). The overall measure of internal consistency for this study was good ($\alpha = .90$).

Sample size and data analysis

Using G*Power 3.1.6, we determined that the sample size needed to detect an effect size of .25 or greater with alpha set at .05 and power of .80 was 34. Assuming a dropout rate of 20%–40% observed in similar studies (Duncan et al., 2012), we attempted to recruit 48 participants. Descriptive statistics (e.g., means, standard deviations) were calculated for all study variables. Repeated measures analysis-of-variance (R-MANOVA) were computed for estimates of cardio-respiratory fit ness, RPE, and EMS scores with alpha set at .05 using two-tailed tests. Tests of underlying assumptions for the R-MANOVA included Box's test in order to determine that the covariance matrices within groups and across time were equal and Levene's test to verify the assumption of equality in the error variances across time between the two groups. In all cases these assumptions were met. Effect size estimates of partial η^2 are reported for all outcome variables (Cohen, 1988): a small effect size is .20, a medium effect is .50, and a large effect size is .80. Finally, the manipulation check revealed that participants in the PMPMI arm of the study completed an average of 6.07 ($SD = 3.17$) imagery practice sessions throughout the intervention period.

Results

Fitness outcomes

Results of the ST showed that participants across both study conditions significantly increased their estimated cardio-respiratory endurance ($F(1,30) = 15.86$, $p = .000$, partial $\eta^2 = .35$) from pre- to post-test (Table 1). Overall, and compared to normative data, the participants began the study having poor cardio-respiratory endurance while the improvements represented a shift to fair (Heywood, 2006). A significant decrease over time across both study conditions was observed for RPE from pre- to post-test ($F(1,30) = 6.68$, $p = .002$, partial $\eta^2 = .18$) indicating participants experienced less fatigue during the post-test. The time-by-group interactions were not significant for either model.

Self-determined motivation to exercise

Results showed a significant time effect for scores on the EMS ($F(1,29) = 12.646$, $p = .001$, partial $\eta^2 = .304$) indicating that participants in both groups showed increases in self-determined motivation to exercise from pre- to post-test. Additionally, a time-by-group interaction was observed ($F(1,29) = 7.730$, $p = .009$, partial $\eta^2 = .210$) with PMPMI participants reporting significantly greater increases in self-determined motivation to exercise from pre- to post-test compared to controls (Fig. 2).

Table 1
Means and standard deviations for study outcomes ($N = 32$).

	Pre-test *M* (*SD*)	95% Confidence interval	Post-test (10-weeks)	95% Confidence interval
RPE	13.95 (2.36)	12.14–14.39	12.91 (1.97)[a]	11.41–13.30
Estimated VO_2 Maximum	34.14 (3.42)	32.89–35.42	39.29 (7.44)[a]	36.11–41.98
Exercise Motivation Scale	20.25 (3.74)	18.87–21.56	23.75 (5.07)[b]	22.04–25.58

Note: M = mean; SD = standard deviation; RPE = ratings of perceived exertion.
[a] Main effect for time.
[b] Time-by-group interaction.

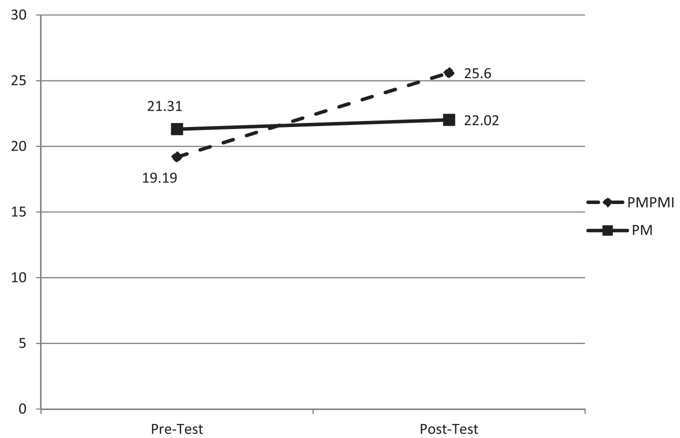

Fig. 2. Time-by-group interaction showing significantly greater increases for participants assigned to the peer-mentoring plus imagery condition from pre- to post-test compared to control group on the Exercise Motivation Scale.

Discussion

This study examined the impact of a theory- and peer-based mental imagery intervention on the self-determined motivation to exercise with women at-risk for physical inactivity and weight gain. A secondary purpose was to determine whether the intervention could impact participants' CRF. A significant time-by-group interaction for self-determined motivation to exercise revealed that those exposed to mental imagery reported significantly greater increases in self-determined motivation as a result of the intervention. While significant changes from pre- to post-test for cardio-respiratory fitness and RPE were observed across both study conditions, the between groups tests were not significant. These results are important given the potential for translation and dissemination of peer-based PA programs that include the use of mental imagery as a self-management skill linked to exercise behavior.

Consistent with previous studies (Buman et al., 2011; Duncan et al., 2012), exposure to mental imagery appears to be associated with more autonomous motives to exercise. Buman et al. (2011) observed a significant time-by-group interaction at an 18-month follow-up period with self-determined motivation to exercise. The common time-by-group interactions with our study and results reported by Buman et al. (2011) are interesting given the differences in study procedures. In their peer-based investigation with older adults, meetings between participants and mentors were conducted in small groups as opposed to the one-on-on encounters in this investigation. Another difference was that mentors in the Buman et al. (2011) study did not exercise with participants. Finally, mental imagery was one part of other self-management skills implemented with their intervention while our design manipulated mental imagery in order to isolate the impact of this cognitive self-management skill on motivation and cardio-respiratory fitness.

It is also interesting that Duncan et al. (2012) observed significant time-by-group interactions in integrated regulation and intrinsic motivation in their 8-week study with adult women. While their guided imagery scripts did not appear to be based on the cognitive and motivational aspects of imagery, their findings showed an impressive effect of mental imagery on self-determined aspects of motivation. The consistent findings of our results and those reported by others (Buman et al., 2011; Duncan et al., 2012), provide justification for additional theorizing about how mental imagery impacts self-determined motivation to exercise. One possible explanation for the effect of imagery on motivation is that the distinctly autonomous nature of mental imagery may nurture self-determined motives for exercise through increased mindfulness of one's autonomy. Indeed, mental imagery may be the most autonomous aspect of the human experience so it is possible that using this skill nurtures the need for autonomy. It is also possible that individuals' mental imagery skills improve with continued practice thereby impacting their perceptions of competence. With further qualifiers described below, the continued study of mental imagery as part of SDT based interventions appears strongly warranted given the consistencies in our study with those noted above.

The improvements in CRF across both study conditions are important for two reasons. First, improvements in CRF provide important protective benefits for CHD and other health and disease conditions for individuals across the age span (Physical Activity Guidelines Advisory Committee 2008). For women, PA behavior and improved CRF also reduces risk for breast cancer (Lee, 2003). Likewise, there is strong evidence that CRF is negatively associated with CHD risk factors such as high cholesterol, high blood pressure, and uncontrolled blood glucose levels common among type II diabetics (Jackson, Sui, Hebert, Church, & Blair, 2009; ACSM, 2000; Wang et al., 2010). Therefore, programs and self-management strategies that can improve CRF have potential to positively impact participants' long-term health. Second, peer-based interventions that promote PA have enormous potential for application in diverse settings (Martin-Ginis et al., 2013). Therefore, the dissemination of peer-based interventions could positively impact the health of large numbers of people. While further testing of peer-based interventions are warranted, the improvements in CRF for our sample over a relatively short period of time are encouraging.

The lack of significant between-group differences in cardio-respiratory fitness and RPE were not entirely unexpected. Studies have shown that sedentary individuals participating in supervised exercise training for 30 min, 3 times per week, over the course of 6 months can improve their cardio-respiratory endurance between 15 and 20% with large individual variations (Pollock, 1973). Given the improvements in CRF observed for both groups, an important question becomes whether participants were exposed to enough mental imagery in our investigation to significantly impact their CRF. Overall, our participants practiced mental imagery for 3 times during meetings with mentors and about 6 times between their meetings with mentors in the fitness facility. It is possible that this was not enough mental imagery practice to have an appreciable impact on participants PA behavior during this study. As discussed below, an important shortcoming in this study was not measuring PA behavior so it is impossible for us to determine exactly why there were no differences in CRF between participant conditions. Future investigators should build upon these shortcomings by increasing participants' exposure to mental imagery and measuring PA behavior.

While there were some differences in the number of participants who dropped out between mentors, our study likely benefitted from skilled mentors who, in addition to being highly active individuals, were empathetic and possessed good communication skills. These "people skills" included the ability to listen to participants' concerns in a non-judgmental manner while offering exercise choices and encouragement throughout the study. The mentors were trained to nurture a need supportive relationship with participants in the context of a psycho-educational intervention that relied on discussions about exercise behavior, fitness, and the use of mental imagery. The efficient mentor training model and likely cost advantages of peer-based models, versus professional staff, may be appealing for application in community settings. Finding ways to identify and measure the skills needed for successful mentoring would be prudent for investigators wishing to use this intervention model.

Study shortcomings and future directions

An important shortcoming of this study was the small sample size and dropout. Future interventions with larger samples, different demographic groups (e.g., community adults, men), and other measures of fitness, exercise behavior, and health are needed to further advance the intervention literature focused on peer-based interventions and the use of mental imagery. While the dropout rate in this study was comparable to other imagery interventions (Duncan et al., 2012; Murru & Martin-Ginis, 2010), an important future research question would be to better understand individual preferences for the use of mental imagery to help determine who is most likely to respond positively to this type of intervention. Finally, the relatively short duration of this study warrants future investigations conducted over longer time periods of time. The extent that mental imagery could impact PA adherence is an important research question that should be further investigated using more precise measures of PA behavior (e.g., accelerometers) and more sophisticated fitness tests (e.g., maximal oxygen capacity).

Conclusion

The continued study of mental imagery in PA settings is clearly warranted. Mental imagery, like peer-based PA interventions, can be readily applied in school, clinical, and community settings. Mental imagery can also serve as the primary intervention approach or it can be used as an adjunct to other aspects of an intervention (see e.g., Buman et al., 2011 for an example of the latter). It is also possible to implement mental imagery interventions using the internet (Murru & Martin-Ginis, 2010) creating the potential to intervene with large numbers of individuals. The findings observed here were consistent with previous investigations using peer-mentored approaches and mental imagery (Buman et al., 2011; Duncan et al., 2012; Martin Ginis et al., 2013). Generally, peer mentoring appears to be a viable way to increase exercise behavior and cardiorespiratory endurance while mental imagery is associated with increases in self-determined motivation to exercise. More sophisticated studies with larger samples that incorporate mental imagery into peer-based or other intervention approaches to increase exercise behavior are warranted.

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