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Let's Walk Outdoors! Self-Paced Walking Outdoors Improves Future Intention to Exercise in Women With Obesity

Kleverton Krinski,[1] Daniel G. S. Machado,[2,3] Luciana S. Lirani,[1] Sergio G. DaSilva,[4] Eduardo C. Costa,[3] Sarah J. Hardcastle,[5] and Hassan M. Elsangedy[3]

[1]Federal University of Vale do São Francisco; [2]Londrina State University; [3]Federal University of Rio Grande do Norte; [4]Federal University of Paraná; [5]Curtin University

In order to examine whether environmental settings influence psychological and physiological responses of women with obesity during self-paced walking, 38 women performed two exercise sessions (treadmill and outdoors) for 30 min, where oxygen uptake, heart rate, ratings of perceived exertion, affect, attentional focus, enjoyment, and future intentions to walk were analyzed. Physiological responses were similar during both sessions. However, during outdoor exercise, participants displayed higher externally focused attention, positive affect, and lower ratings of perceived exertion, followed by greater enjoyment and future intention to participate in outdoor walking. The more externally focused attention predicted greater future intentions to participate in walking. Therefore, women with obesity self-selected an appropriate exercise intensity to improve fitness and health in both environmental settings. Also, self-paced outdoor walking presented improved psychological responses. Health care professionals should consider promoting outdoor forms of exercise to maximize psychological benefits and promote long-term adherence to a physically active lifestyle.

Keywords: adherence, affect, attentional focus, enjoyment, perceived exertion, self-selected exercise intensity

Physical activity is important for preventing and treating obesity (Street, Wells, & Hills, 2015). Although physical activity is recommended as an integral component of most weight-loss interventions, the participation and adherence rates of individuals with obesity, and especially women, are dismal (Ekkekakis, Vazou, Bixby, & Georgiadis, 2016). Less than 1.5% of U.S. women with obesity perform 30 min/day of moderate-to-vigorous-intensity physical activity (Tudor-Locke, Brashear, Johnson, & Katzmarzyk, 2010). On average, they perform only 13.8 min of moderate-to-vigorous-intensity physical activity per day (Archer, Hand, & Blair, 2013).

The most common physical activity barriers among women with obesity include perceptions of effort (such as exercise is tiring, hard work, and/or fatiguing), lack of motivation, lack of time, and exercising alone (Sharifi, Mahdavi, & Ebrahimi-Mameghani, 2013; Thomson, Buckley, & Brinkworth, 2016). Obese individuals also tend to perceive exercise as more difficult and less pleasurable than their normal-weight counterparts (DaSilva et al., 2011; Ekkekakis, Lind, & Vazou, 2009). Therefore, it is important to examine which types of exercise promote more pleasure, higher exercise tolerance, and lower ratings of perceived exertion (RPE) among obese individuals. Additionally, research has highlighted the importance of considering both subjective experiences (i.e., attentional focus, enjoyment, RPE, affective responses) and exercise for enhancing exercise adherence in individuals with obesity (Dalle Grave, Calugi, Centis, El Ghoch, & Marchesini, 2011; DaSilva et al., 2011; Focht, 2013; Hardcastle et al., 2015). Therefore, in order to increase the physical activity participation and adherence in women with obesity, the psychological responses during exercise should be explored (Dalle Grave et al., 2011; DaSilva et al., 2009; Ekkekakis & Lind, 2006; Mattsson, Larsson, & Rössner, 1997).

In this regard, several studies have highlighted the potential benefits of self-paced walking for individuals with obesity due to lower physical discomfort and a more

Kleverton Krinski and Luciana S. Lirani are with the Department of Physical Education, Federal University of Vale do São Francisco, Petrolina, Pernambuco, Brazil. Daniel G. S. Machado, Eduardo C. Costa, and Hassan M. Elsangedy are with the Department of Physical Education, Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil. Daniel G. S. Machado is also a PhD student at the Center of Physical Education and Sport, Londrina State University, Londrina, Paraná, Brazil. Sergio G. DaSilva is with the Department of Physical Education, Federal University of Paraná, Curitiba, Paraná, Brazil. Sarah J. Hardcastle is with the Health Psychology and Behavioral Medicine Research Group, School of Psychology and Speech Pathology, Faculty of Health Sciences, Curtin University, Perth, Western Australia, Australia. Address author correspondence to Hassan Mohamed Elsangedy at hassan.elsangedy@gmail.com.

pleasant experience (DaSilva et al., 2009; Focht, 2013; Mattsson et al., 1997). For example, self-paced walking promoted lower RPE and higher feelings of pleasure in overweight women compared with an imposed exercise intensity (Ekkekakis & Lind, 2006), even when the imposed intensity was matched with a self-selected intensity (Lind, Ekkekakis, & Vazou, 2008). However, these studies have either been conducted indoors or in a laboratory environment. There is a current gap in knowledge on the effects of self-paced outdoor walking on physiological and psychological responses in sedentary obese women.

Exercise may feel easier when performed in the outdoor environment (Gladwell, Brown, Wood, Sandercock, & Barton, 2013). For example, Focht (2009) found that physically active normal-weight women self-selected a faster walking speed outdoors and reported a lower RPE compared with indoors. This may result from higher externally focused attention (Harte & Eifert, 1995), which may help to divert attention away from uncomfortable and/or unpleasant bodily sensations (Gladwell et al., 2013; Lacharité-Lemieux, Brunelle, & Dionne, 2015). Furthermore, review-level evidence has also found that outdoor activity in the natural environment promotes greater feelings of revitalization, positive engagement, enjoyment, satisfaction, and greater intent to engage in future exercise behavior compared with indoor activity (Thompson-Coon et al., 2011). This may be particularly beneficial for individuals unaccustomed to exercise. Moreover, outdoor settings may provide greater opportunities for physical activity participation due to the lower financial costs (Dunton, Berrigan, Ballard-Barbash, Graubard, & Atienza, 2009; Yeh et al., 2016).

Given that outdoor exercise is associated with improved positive affective response, lower RPE, greater enjoyment, and satisfaction compared with indoor exercise (Thompson-Coon et al., 2011), it is quite likely that these aspects would foster increased intentions to participate in physical activity in obese individuals. This presupposition is consistent with the key tenets of the theory of planned behavior, in that attitudes (instrumental and affective) directly influence intentions for behavior change (Ajzen, 1985). It is likely that preferences for outdoor exercise, in addition to greater enjoyment, satisfaction, and lower RPE, foster more favorable attitudes toward participation in outdoor exercise, which in turn is likely to directly influence future exercise intentions. However, there is a gap in research investigating the effectiveness of self-paced walking in different environments for sedentary obese women on future exercise intentions.

Therefore, the primary aim of this study was to compare the influence of a single session of self-paced walking in an indoor and outdoor environment on physiological (i.e., heart rate, oxygen uptake) and psychological (i.e., affective response, RPE, attentional focus, and enjoyment) responses of women with obesity. Moreover, this study aimed to explore the influence of environmental setting and psychological predictors of future intentions to walk. We hypothesized that walking outdoors would result in higher positive affective response, higher enjoyment, lower RPE, more externally focused attention, and similar physiological demand during exercise. We also hypothesized that walking outdoors would result in stronger future intentions to walk compared with walking indoors. Finally, we hypothesized that the in-task affective responses would be the main predictor of future intentions to exercise.

To the best of our knowledge, our study is the first to compare the psychological and physiological responses to self-paced exercise in different environments (outdoor vs. indoor) among sedentary obese individuals and contributes to an important gap in the literature concerning the effectiveness of self-paced exercise in different environments for this population. It is also the first study to explore the impact of environmental setting and in-task psychological responses on future intentions to walk.

Methods

Participants

Participants were recruited from church groups, university settings, and community centers via oral invitations, fliers, and social media. They were told that the purpose of the study was to assess their physiological and psychological responses to exercise and that they would be required to perform two exercise sessions in which these variables would be assessed. At the end of the experiment, participants were informed that the real purpose was to compare physiological and psychological responses to exercise on a treadmill and outdoors.

Volunteers ($n = 110$) were assessed for eligibility, where 38 women met the inclusion criteria and participated in the study (Table 1). Inclusion criteria were (a) body mass index ≥ 30 and < 40 kg/m^2, (b) stable body mass (< 2.5 kg

Table 1 Participant Characteristics and Physiological Responses to the Graded Treadmill Test ($n = 38$)

Variables	*M*	*SD*
Age (years)	45.64	8.63
Body mass (kg)	88.75	9.12
Height (cm)	159.12	.11
BMI (kg/m^2)	35.12	3.42
Body fat (%)	43.05	4.32
Fat free mass (kg)	50.54	6.42
VO_{2max} (mL·kg^{-1}·min^{-1})	20.12	3.82
VO_{2VT} (mL·kg^{-1}·min^{-1})	14.58	3.51
%VO_{2max} at VT	72.50	6.12
HR_{max} (beats/min)	175	12.08
HR_{VT} (beats/min)	143	16.42
%HR at VT	82	8.15

Note. BMI = body mass index; VO_{2max} = maximal oxygen uptake; VO_{2VT} = oxygen uptake at the ventilatory threshold; VT = ventilatory threshold; HR_{max} = maxima1 heart rate; HR_{VT} = heart rate at the ventilatory threshold.

net change during the previous 3 months), and (c) having exercised for less than 1 hr/week in the last 6 months. Women who smoked, used β-blockers, or had cardiovascular and/or metabolic disease or orthopedic limitations to exercise were excluded. Participants were informed about the benefits and risks involved in the study prior to providing written consent. The university's ethics committee previously approved all procedures.

Experimental Design

The experimental design included five visits: (a) initial screening and body composition assessment; (b) instruction session; (c) graded exercise test on a treadmill; and (d) two 30-min self-paced walking trials, with one on a treadmill and one on a standard outdoor track. In the instruction session, participants were familiarized with the treadmill in addition to the various scales (i.e., attentional focus, RPE, affective response) and the procedures for self-paced walking. The graded exercise test was performed to determine the physiological variables such as maximal oxygen uptake (VO_{2max}), maximal heart rate (HR_{max}), and oxygen uptake at ventilatory threshold (VT or VO_{2VT}) and to define low and high perceptual anchors of RPE. Finally, the trials were performed in a randomized and counterbalanced order in the morning between 8 and 12 a.m. under similar environmental conditions. There was a 24–48-hr interval between the trials.

Body Composition Assessment

Body weight (kg) was measured with an electronic scale (Toledo, São Paulo, Brazil) to the nearest 0.1 kg. Height (cm) was measured with a stadiometer (Sanny, São Paulo, Brazil) to the nearest 0.1 cm. Body mass index was calculated as body weight divided by height squared (kg/m^2). Body composition was determined using a whole-body DEXA scanner (DPX-IQ; Lunar Corp., Madison, WI).

Instruction Protocol

The participants were familiarized with the Borg RPE Scale, the Feeling Scale (FS), the Felt Arousal Scale (FAS), the Attention Scale, as well as with a motor-driven treadmill (model Super ATL, Inbramed™, Porto Alegre, Brazil) in a laboratory setting and the process related to their choice of self-paced walking. Standard instructions of the scales were read to the participants. Afterward, the participants performed a standardized familiarization procedure for self-paced walking using the following instructions: "Please select an exercise intensity to walk for 30 min." This instruction was given to verify the participants' regular walking activity without any interference from the researcher.

Maximal Graded Treadmill Test

The graded exercise test was performed using the Bruce protocol (Bruce, Kusumi, & Hosmer, 1973). In order to obtain the VO_{2max}, participants had to achieve at least two of the following criteria: (a) a plateau in oxygen uptake (change of < 150 mL/min between the last three consecutive 20-s mean values); (b) a respiratory exchange ratio of ≥ 1.10 (*M* = 1.14, *SD* = .15); and (c) heart rate within ± 10 beats/min of the age-predicted HR_{max} (220 − age). Participants received verbal encouragement at every stage during the last 10 s approaching the transition for the next stage. The VT was determined for each participant using the ventilatory equivalent method (Caiozzo et al., 1982). Gas exchange was analyzed on a breath-by-breath portable metabolic analyzer (Cosmed $K4b^2$, Rome, Italy), with which VO_2, ventilation, and produced carbon dioxide (VCO_2) were assessed. Heart rate was measured continuously using Polar Heart Rate technology (Polar Electro™, Oy, Finland).

Self-Paced Walking Trials

The self-paced walking trials consisted of 30 min of continuous walking at a self-selected pace in a laboratory setting on a treadmill and on a standard outdoor track. Standard instructions about the use of the RPE, FS, FAS, Attention Scale, and pace selection were read for the participants before each trial. The participants were then fitted with a heart-rate monitor and wore a harness to carry the portable metabolic analyzer. The volunteers were allowed to make pace adjustments (increase, decrease, or maintain) every 5 min in both self-paced walking trials. The treadmill grade was fixed at 1%, and the speedometer was covered so that participants could not see the speed. In the outdoor trial, the walking speed was determined by a global positioning system integrated to the Cosmed $K4b^2$ system. All outdoor trials were performed during the autumn (August 2015), and the weather was typically mostly sunny with an average temperature of 21 °C and 55% humidity. Two outdoor trials were rescheduled due to inappropriate weather conditions. The participants performed the trials individually to avoid any possible group dynamics or social interaction effects on psychophysiological responses to exercise. For the outdoor condition, participants walked on a standard outdoor 400-m tartan track (Lane 1) that loops around a well-maintained football field. The environment surrounding the outdoor track contains trees and vegetation, complemented by birds chirping and flying. In the outdoor condition, four researchers were positioned at every 100 m and two more were moving along the track but not accompanying the participant. At the assessment time, the researcher who was closest to the participant walked in their direction and administered the scales/questionnaires.

Psychological Assessments

Whole-body perceived exertion during exercise was assessed using the Borg RPE 6–20 Scale (Borg, 1982). The affective valence (pleasure–displeasure) was measured using the FS, which is a single-item 11-point scale that ranges from +5 (*very good*) to −5 (*very bad*; Hardy &

Rejeski, 1989). Perceived activation was assessed using the FAS, composed of a single-item 6-point scale that ranges from 1 (*low arousal*) to 6 (*high arousal*; Svebak & Murgatroyd, 1985). Attentional focus was assessed by an amended version of Tammen's Attention Scale (Tammen, 1996) according to recent studies (Jones, Karageorghis, & Ekkekakis, 2014; Karageorghis et al., 2013). The bipolar scale consisted of a single-item 20-cm bipolar line that required participants to state a number between 0 (*internal focus/associative*) and 100 (*external focus/dissociative*) to represent their predominant focus. Affective (FS and FAS), RPE, and attentional focus values were measured every 5 min during the experimental trials, and the presentation order of the scales was counterbalanced. Enjoyment was assessed using the Physical Activity Enjoyment Scale (PACES), which includes 18 items rated on a 7-point bipolar scale based on the instruction of "how do you feel at the moment about the physical activity you have just been doing?" (Kendzierski & DeCarlo, 1991). Higher PACES scores reflect greater levels of enjoyment. Cronbach's alpha for the PACES items measured after the treadmill session was .89 and was .74 after the outdoor session.

Intention to participate in walking was assessed using a single-item percentage scale ranging from 0% to 100%, with verbal anchors at 0% (*not at all interested*), 50% (*moderately interested*), and 100% (*very interested*), over four time intervals: (a) tomorrow; (b) on most or all (5–7) days for the next week; (c) on most or all (5–7) days for the next 2 weeks; and (d) on most or all (5–7) days for the next month, following procedures described by Focht (2013). The intention score was calculated by taking the average score of the four items. The scale was internally consistent with α coefficient of .78 following the outdoor session and .87 following the treadmill session. Participants responded to the PACES and intention scales immediately postexercise.

Statistical Analysis

Descriptive data are expressed as means and standard deviations, and the outcome measures as means and 95% confidence intervals (95% CI). The data were tested for normality using the Shapiro–Wilk test. Repeated-measures analysis of variance (ANOVA) was used to compare speed, $\%VO_{2max}$, $\%VO_{2VT}$, $\%HR_{max}$, RPE, FS, FAS, and attentional focus, two trials (treadmill and outdoor) × six times (5, 10, 15, 20, 25, and 30 min). A repeated-measures ANOVA was also employed to compare FS and FAS responses pre- to postexercise, two trials (treadmill and outdoor) × three times (preexercise, 5- and 15-min postexercise). Whenever the sphericity assumption was violated, the degrees of freedom were adjusted and reported using the Greenhouse–Geisser epsilon correction. Partial eta squared ($\eta^2_{partial}$) was used as a measure of effect size (ES). ANOVA was followed by Bonferroni post hoc to determine where the significant differences occurred. The differences in ratings of enjoyment, intention to walk for exercise in the future, mean speed, and distance covered between the two trials (indoor vs. outdoor) were examined with a paired-samples *t* test. Cohen's *d* was used to determine the ES, where a significant difference was found. Cohen's *d* was considered small = 0.20–0.49, medium = 0.50–0.79, or large ≥ 0.80.

Additionally, Pearson's product-moment correlation was used to test a possible correlation among psychological variables. A linear regression analysis was performed including variables that demonstrated statistical significance in bivariate Pearson's correlation with future intention to walk for exercise. All data were analyzed using Statistica 8.0 for Windows (StatSoft™, Tulsa, OK). The statistical power of the ANOVA with repeated measures within–between groups interaction was calculated a priori using Gpower software version 3.1.9.2 (Universität Kiel, Kiel, Germany), using the option "as in SPSS," including the following criteria: (a) power = 0.8; (b) medium ES ($\eta^2 = .07$; Focht, 2009); and (c) α = .05, number of groups = 2, number of measurements = 6, and nonsphericity correction = 1. Accordingly, the sample size required to achieve 80% power was 38. Participants were recruited and screened until the required sample size was reached. Moreover, the achieved power by a posteriori analysis confirmed that all analysis had a power > 85%, except for Felt Arousal Scale pre-/postexercise (76%), RPE (78%), correlation between enjoyment and future intentions in the indoor session (76%), and correlation between affective responses in-task and activation outdoor (67%).

Results

Speed and Distance Covered

There was a main effect of the environmental setting, $F(1, 37) = 25.38$, $p < .001$, $\eta^2_{partial} = .407$, time, $F(2.57, 95.21) = 7.41$, $p < .001$, $\eta^2_{partial} = .167$, and an environmental setting by time interaction, $F(1.84, 68.19) = 8.49$, $p < .001$, $\eta^2_{partial} = .187$. Participants walked steadily and faster during the outdoor trial than indoors, despite the increase in speed over time in the latter (Table 2). Additionally, participants displayed a higher average speed and distance covered in the outdoor trial than indoors ($M = 2.52$, $SD = .16$ km vs. $M = 2.41$, $SD = .20$ km), $t(74) = 5.04$, $p < .001$, $d = 0.60$ (Table 2).

Oxygen Uptake

There was a main effect of time, $F(2.2, 82.2) = 13.20$, $p < .001$, $\eta^2_{partial} = .263$, and environmental setting by time interaction, $F(1.92, 70.9) = 4.81$, $p = .01$, $\eta^2_{partial} = .115$, with no effect of environmental setting, $F(1, 37) = .005$, $p = .94$, $\eta^2_{partial} = .001$, on the $\%VO_{2max}$. Participants displayed a constant $\%VO_{2max}$ during the outdoor trial, which increased over time in the indoor trial (Table 2).

Similarly, there was a main effect of time, $F(2.4, 89.29) = 15.24$, $p < .001$, $\eta^2_{partial} = .292$, and environmental setting by time interaction, $F(2.5, 92.59) = 4.39$, $p < .01$, $\eta^2_{partial} = .106$, with no effect of the environmental

Table 2 Physiological Responses to Indoor and Outdoor Self-Paced Walking Conditions in Women With Obesity ($n = 38$)

	5 min	10 min	15 min	20 min	25 min	30 min	Average
Speed (m/s)							
Indoor	1.31 [1.27, 1.35]	1.32 [1.29, 1.36]	1.34 [1.30, 1.38][a]	1.35 [1.31, 1.39][a,c]	1.36 [1.32, 1.40][a,c]	1.36 [1.31, 1.41][a,c]	1.34 [1.30, 1.38]
Outdoor	1.38 [1.35, 1.41]*	1.41 [1.38, 1.43]*	1.42 [1.39, 1.44]*	1.41 [1.37, 1.44]*	1.39 [1.35, 1.42]*	1.38 [1.34, 1.42]	1.40 [1.37, 1.43]*
$\%VO_{2max}$							
Indoor	61.9 [60.1, 63.8]	62.9 [61.0, 64.8]	65.2 [62.9, 67.4][a]	66.1 [63.6, 68.6][a,c]	66.8 [64.4, 69.2][a,c]	67.7 [65.0, 70.3][a,c]	65.1 [63.1, 67.1]
Outdoor	64.6 [62.7, 66.4]	64.8 [62.8, 66.8]	64.6 [62.7, 66.5]	65.2 [63.0, 67.5]	65.6 [63.2, 68.1]	66.2 [63.6, 68.7]	65.2 [63.2, 67.1]
$\%VO_{2VT}$							
Indoor	87.5 [85.1, 89.9]	90.0 [87.5, 92.5]	93.0 [90.0, 95.9][a,b]	94.5 [90.7, 98.2][a,c]	95.1 [91.0, 99.1][a,c]	96.2 [92.2, 100.2][a,c]	92.7 [89.7, 95.7]
Outdoor	91.6 [88.9, 94.3]	91.9 [89.0, 94.8]	91.7 [88.7, 94.6]	92.7 [89.4, 95.9]	93.1 [89.2, 97.0]	94.6 [90.3, 98.8]	91.6 [89.6, 95.6]
$\%HR_{max}$							
Indoor	67.1 [65.1, 69.1]	70.8 [68.6, 73.0][a]	72.1 [69.7, 74.6][a]	74.2 [71.8, 76.5][b,c]	75.7 [72.6, 78.7][b,c]	76.7 [73.8, 79.6][b,c]	72.8 [70.5, 75.0]
Outdoor	69.9 [67.9, 71.8]	71.9 [69.9, 74.0]	73.4 [71.1, 75.7]	73.2 [70.8, 75.7]	73.7 [70.9, 76.5]	74.5 [71.6, 77.4]	72.8 [70.6, 75.0]

Note. Data are displayed as mean and 95% confidence interval [lower limit, upper limit]. $\%VO_{2max}$ = percentage of maximal oxygen consumption; $\%VO_{2VT}$ = percentage of oxygen consumption at the ventilatory threshold; $\%HR_{max}$ = percentage of maximal heart rate.

[a]Different from 5 min in the indoor setting. [b]Different from 10 min in the indoor setting. [c]Different from 15 min in the indoor setting (all $ps < .05$).

*Difference between environmental settings at the same time point (all $ps < .05$).

setting, $F(1, 37) = .01$, $p = .92$, $\eta^2_{partial} = .001$, on the $\%VO_{2VT}$. Participants displayed a constant $\%VO_{2VT}$ during the outdoor trial with an increase over time in the indoor trial (Table 2).

Heart Rate

In relation to the $\%HR_{max}$, there was a main effect of time, $F(2.18, 80.80) = 36.33$, $p < .001$, $\eta^2_{partial} = .495$, and time by environmental setting interaction, $F(1.88, 69.44) = 6.11$, $p = .004$, $\eta^2_{partial} = .142$, with no main effect of the environmental setting, $F(1, 37) = .001$, $p < .99$, $\eta^2_{partial} = .001$. Similar to $\%VO_{2max}$ and $\%VO_{2VT}$, $\%HR_{max}$ was kept steady during the outdoor trial and increased over time in the indoor trial (Table 2).

Affective Response

For affective responses during exercise, there was a main effect of the environmental setting, $F(1, 37) = 7.01$, $p = .01$, $\eta^2_{partial} = .159$, time, $F(2.76, 101.99) = 30.68$, $p < .001$, $\eta^2_{partial} = .453$, and environmental setting by time interaction, $F(3.45, 127.80) = 3.80$, $p = .009$, $\eta^2_{partial} = .093$. Positive affect was higher during the outdoor trial at 15 ($d = 1.41$), 20 ($d = 1.00$), 25 ($d = 1.00$), and 30 min ($d = 1.00$), despite the trend for positive affect to decrease over time in both environmental settings (see Figure 1).

Regarding the affective responses pre- and posttask, there was a main effect of time, $F(1.72, 63.61) = 16.11$, $p < .001$, $\eta^2_{partial} = .303$, and an environmental setting by time interaction, $F(1.93, 71.42) = 8.27$, $p < .001$, $\eta^2_{partial} = .183$, with no effect of the environmental setting, $F(1, 37) = .27$, $p = .60$, $\eta^2_{partial} = .007$. Affect was more positive at 15-min postexercise only in the outdoor trial ($d = 1.01$; see Figure 1).

Ratings of Perceived Exertion

Regarding RPE, there was a main effect of the environmental setting, $F(1, 37) = 26.1$, $p < .001$, $\eta^2_{partial} = .414$,

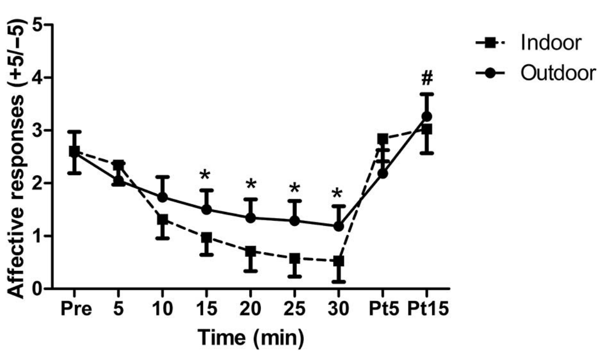

Figure 1 — Feeling Scale pre, during, and 5- and 15-min post an indoor (treadmill) and outdoor (lap track) walking at a self-selected pace. Data are shown as mean and 95% confidence interval. Pt = post. *Difference between environmental settings ($p < .05$). #Different from preexercise in the outdoor session ($p < .001$).

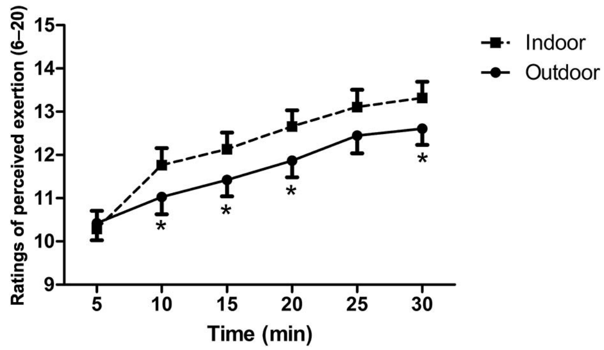

Figure 2 — Ratings of perceived exertion during an indoor (treadmill) and outdoor (lap track) walking at a self-selected pace. Data are shown as mean and 95% confidence interval. *Difference between environmental settings ($p < .05$).

time, $F(3.74, 138.39) = 82.87$, $p < .001$, $\eta^2_{partial} = .691$, and an environmental setting by time interaction, $F(4.356, 161.16) = 2.605$, $p = .034$, $\eta^2_{partial} = .066$. Exercise was perceived as less intense during the outdoor trial at 10 ($d = –0.61$), 15 ($d = –0.61$), 20 ($d = –0.68$), and 30 min ($d = –0.63$), despite RPE increasing as time elapsed in both environmental settings (see Figure 2).

Felt Arousal Scale

On the perceived activation during exercise, there was an effect of time, $F(2.01, 74.32) = 8.38$, $p < .001$, $\eta^2_{partial} = .185$, environmental setting, $F(1, 37) = 7.65$, $p < .009$, $\eta^2_{partial} = .171$, and an environmental setting by time interaction, $F(3.38, 125.23) = 3.11$, $p = .02$, $\eta^2_{partial} = .077$. Perceived activation was lower during the outdoor trial at 25 ($d = –0.55$) and 30 min ($d = –0.58$), despite it only increasing over time in the indoor trial (see Figure 3).

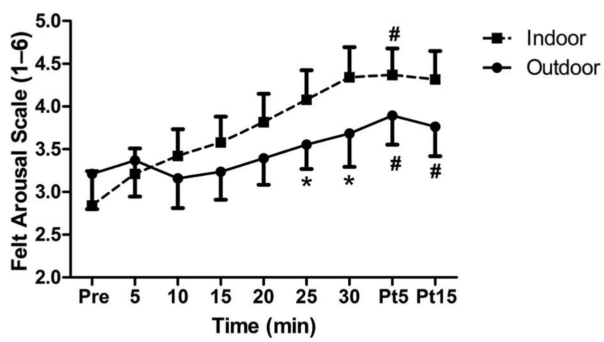

Figure 3 — Perceived activation assessed by the Felt Arousal Scale pre, during, and 5- and 15-min post an indoor (treadmill) and outdoor (lap track) walking at a self-selected pace. Data are shown as mean and 95% confidence interval. Pt = post. *Difference between environmental settings ($p < .05$). #Different from preexercise in the same session ($p < .05$).

Regarding perceived activation postexercise, there was a main effect of time, $F(1.746, 64.611) = 30.145$, $p = .001$, $\eta^2_{partial} = .449$, and environmental setting by time interaction, $F(1.448, 53.570) = 4.774$, $p = .021$, $\eta^2_{partial} = .114$, with no effect of the environmental setting, $F(1, 37) = 2.025$, $p = .163$, $\eta^2_{partial} = .052$. Perceived activation was higher than preexercise at 5-min postexercise in both indoor ($d = 1.57$) and outdoor ($d = 0.67$) trials, and at 15 min only following the outdoor trial ($d = 0.54$).

Attentional Focus

For the attentional focus, there was an effect of the environmental setting, $F(1, 37) = 18.31$, $p < .001$, $\eta^2_{partial} = .331$, time, $F(2.81, 104.12) = 30.88$, $p < .001$, $\eta^2_{partial} = .455$, and an environmental setting by time interaction, $F(3.77, 139.47) = 3.45$, $p = .01$, $\eta^2_{partial} = .085$. Attentional focus was higher (more externally focused) in the outdoor trial at 20 ($d = 0.29$), 25 ($d = 0.38$), and 30 min ($d = 0.46$), despite the decrease over time in both trials (see Figure 4).

Enjoyment and Intention to Walk for Exercise in the Future

Paired-sample *t*-test analyses revealed that participants reported greater enjoyment and higher intentions to walk in the future following the outdoor trial compared with the indoor trial with a large ES (see Table 3).

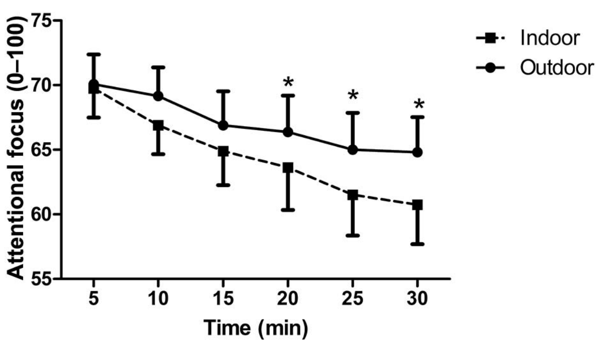

Figure 4 — Attentional focus during an indoor (treadmill) and outdoor (lap track) walking at a self-selected pace. Data are shown as mean and 95% confidence interval. *Difference between environmental settings ($p < .001$).

Correlation Between Psychological Responses and Future Intention to Walk for Exercise

Table 4 displays the correlations between future intentions to walk; affective responses during, pretask, and posttask; RPE; attentional focus; perceived activation; and enjoyment in the indoor and outdoor environment settings. In both trials, future intention to walk was only correlated with enjoyment and attentional focus. The strongest correlation was found between future intention to walk and attentional focus in the outdoor trial.

Additionally, simple linear regression was calculated to predict future intentions based on attentional focus and enjoyment for the indoor and outdoor settings. For the indoor setting, the only significant predictor of future intention was attentional focus, $b = .48$, 95% CI [.08, .88], $p = .02$, but not enjoyment, $b = .31$, 95% CI [–.26, .89], $p = .27$, with an adjusted $R^2 = 25.3\%$, standard error of the estimate (SEE) = 7.69, $p = .002$. Similarly, only the attentional focus, $b = .96$, 95% CI [.77, 1.15], $p < .001$, but not enjoyment, $b = -.25$, 95% CI [–.24, .19], $p = .81$, predicted future intentions in the outdoor setting with an adjusted $R^2 = 79.0\%$, SEE = 3.51, $p < .001$. Furthermore, when the models were controlled for pretask, intask, and posttask affective responses, RPE, and perceived activation, it became nonsignificant for the indoor condition (adjusted $R^2 = 15.6\%$, SEE = 8.17, $p = .09$). In contrast, the results for the outdoor condition were unaffected when controlling for the aforementioned confounding variables (adjusted $R^2 = 79.6\%$, SEE = 3.46, $p < .001$).

Discussion

The main findings of this study were that (a) the physiological responses (%VO_{2max}, %VO_{2VT}, and %HR_{max}) were similar between indoor and outdoor self-paced walking trials; (b) the environmental setting influenced the psychological responses during and postexercise—specifically, participants in the outdoor condition displayed increased externally focused attention, reduced RPE, a more favorable pleasant affective state, and greater enjoyment; (c) participants reported a greater future intention to walk in the outdoor condition; and (d) the attentional focus during the exercise session predicted future intentions to walk.

The American College of Sports and Medicine recommends adults to perform aerobic exercise for at least 30 min/day of moderate intensity (64–76% HR_{max}

Table 3 Ratings of Enjoyment and Future Intentions to Walk Following 30 Min of Self-Paced Walking Outdoor and on a Treadmill in Women With Obesity ($n = 38$)

Outcome	Outdoor	Indoor	*t*	*p*	Cohen's *d*
Enjoyment (0–126)	94.9 [92.8, 97.1]	86.1 [84.3, 87.9]	–9.36	<.001	–1.46
Future intention (0–100)	62.0 [59.4, 64.4]	48.6 [45.8, 51.6]	–9.10	<.001	–1.01

Note. Data are displayed as mean and 95% confidence interval [lower limit, upper limit].

Table 4 Descriptive Statistics and Correlations Among Intention to Perform Exercise in the Future and Pre-, During-, and Posttask Affective Responses, RPE, Attentional Focus, Perceived Activation and Enjoyment in Indoor (Treadmill) and Outdoor (Lap Track) Environments

Measure	Mean and 95% CI [LL, UL]	Min	Max	1	2	3	4	5	6	7	8
Indoors											
1. Pretask FS	2.61 [2.19, 3.02]	.0	5.0		−.13	.83**	−.61**	.17	−.12	.13	.10
2. In-task FS	1.07 [.86, 1.29]	−.5	2.8			−.11	.16	−.16	.22	.08	−.05
3. Posttask FS	3.03 [2.57, 3.48]	.0	5.0				−.59**	.04	.00	.03	−.02
4. RPE	12.2 [11.9, 12.5]	10.0	13.7					-.15	.08	-.14	.01
5. Attentional focus	64.6 [62.0, 67.1]	53.7	83.3						−.11	.56**	.52**
6. Activation	3.74 [3.52, 3.97]	2.2	5.0							.30	.01
7. Enjoyment	86.1 [84.3, 87.9]	75.0	98.0								.42**
8. Future intentions	48.7 [45.8, 51.6]	32.0	70.3								–
Outdoors											
1. Pretask FS	2.58 [2.18, 2.97]	.0	5.0		.30	.58**	.07	−.18	.03	.00	−.06
2. In-task FS	1.52 [1.21, 1.83]	−.3	2.7			.59**	−.02	.06	.38*	−.04	.08
3. Posttask FS	3.26 [2.84, 3.67]	1.0	5.0				.00	−.18	.12	.02	−.11
4. RPE	11.6 [11.4, 11.9]	10.0	13.0					−.03	−.30	.09	.12
5. Attentional focus	67.1 [64.7, 69.4]	54.8	80.5						.22	.53**	.90**
6. Activation	3.40 [3.15, 3.65]	1.8	5.0							.04	.15
7. Enjoyment	94.9 [92.8, 97.1]	80.0	103.0								.46**
8. Future intentions	61.9 [59.4, 64.4]	45.0	77.5								–

Note. CI [LL, UL] = confidence intervals [lower limit, upper limit]; FS = Feeling Scale; RPE = ratings of perceived exertion.
$^*p < .05$. $^{**}p < .001$.

or 46–63% VO_{2max}) on ≥ 5 days/week or at least 20 min/day of vigorous intensity (77–95% HR_{max} or 64–90% VO_{2max}) on ≥ 3 days/week (Garber et al., 2011). Our data show that in both indoor (M = 72.8, SD = 6.8% HR_{max} and M = 65.1, SD = 6.2% VO_{2max}) and outdoor (M = 72.8, SD = 6.7% HR_{max} and M = 65.2, SD = 5.8% VO_{2max}) trials, the participants self-selected an exercise intensity that meets the ACSM recommendations to improve fitness and health. On average, participants self-selected an exercise intensity slightly below their VT (~92% VO_{2VT}) in both environmental settings, which provides a lower physiological homeostasis perturbation, thus favoring exercise maintenance (DaSilva et al., 2011; Elsangedy et al., 2013). Our data give support to the findings of previous laboratory-based studies (DaSilva et al., 2010, 2011).

Interestingly, despite similar physiological demand shown in both environments, participants self-selected a higher pace during outdoor walking, with a moderate ES (.60). This finding may be explained due to a greater familiarity with the task of walking on the ground, which is considered a more natural way of walking compared with treadmill exercise (Gladwell et al., 2013) and is consistent with previous studies using self-paced exercise (Focht, 2009). Further, Berryman et al. (2012) suggest that walking on a treadmill with the same over ground speed requires greater balance and coordination, resulting in higher oxygen uptake. However, because our participants used a higher self-selected pace during outdoor walking, the physiological responses were similar to those obtained in treadmill walking.

In addition, participants reported lower RPE values during outdoor walking compared with treadmill walking with a moderate ES (.61–.68). This result is consistent with research involving normal-weight and physically active individuals (ES ranges from .35 to .76; Dasilva et al., 2011; LaCaille, Masters, & Heath, 2004). Moreover, participants reported a more positive affective experience from 15th to 30th min in outdoor walking compared with treadmill walking with a large ES (1.0–1.4), similar to the moderate to large ES found in previous studies (.40–.85; LaCaille et al., 2004).

The increased positive affect and lower RPE could be related to a more dissociative attentional focus in the outdoor setting (ES ranges from .29 to .46) due to the presence of greater external stimuli (e.g., birds, trees, weather, breeze on the face; Dasilva et al., 2011; Focht, 2009; Harte & Eifert, 1995) and distraction from afferent feedback of diverse systems during exercise (i.e., physiological, psychological, and cognitive; Gladwell et al., 2013; Hampson, St Clair Gibson, Lambert, & Noakes, 2001; Jones et al., 2014; Lacharité-Lemieux et al., 2015). Another explanation for the less positive affective response for the indoor condition is that treadmill walking may be perceived as tedious and that unfamiliarity with laboratory equipment generates unpleasant emotions such as anxiety, which could result in worse psychological responses in the indoor condition (Dunton et al., 2009; McAuley, Mihalko, & Bane, 1996). After exercise, participants reported a greater positive affect, enjoyment, and future intentions to exercise in the outdoor setting, all with a large ES (>1.00); this is consistent with previous work in physically active normal-weight women (ES ranges from .9 to 1.03; Focht, 2009). Taken together, these results confirm that self-paced outdoor walking generates more positive affect, reduced RPE, and internal attentional focus in sedentary obese women. Surprisingly, no correlations were found between attentional focus and affective response or RPE in either environment (see Table 4).

The dual-mode model seeks to explain why affective responses to exercise differ according to exercise intensity (Ekkekakis, 2003, 2009). According to this theory, cognitive processes such as self-efficacy, self-presentation concerns, goals, and attributes predominantly influence affective responses at an intensity below VT (Ekkekakis, 2003, 2009). In contrast, affective responses at an intensity equal to or above VT are thought to be primarily influenced by interoceptive signals such as muscular, temperature, respiratory, and acidosis (Ekkekakis, 2003, 2009). In this regard, the finding that participants self-selected an exercise intensity below VT (~92% of $\%VO_{2VT}$) and that this intensity tends to result in positive affective responses is consistent with the dual-mode model (Ekkekakis, Backhouse, Gray, & Lind, 2008). The greater externally focused attention in the outdoor condition is also consistent with the dual-mode model, whereby cognitive variables such as expectations, self-efficacy, and attentional focus are more important and account for variability in the affect observed during exercise below or at the VT (Ekkekakis et al., 2008). However, the dual-mode model does not readily account for the difference in affect and RPE during exercise between the conditions, given that the exercise intensity selected was similar. Previous research has also demonstrated variability in affective responses to self-paced exercise (e.g., Parfitt, Rose, & Burgess, 2006; Rose & Parfitt, 2007). Furthermore, the dual-mode model does not offer an adequate framework for understanding how affective responses impact on future exercise intentions and exercise adherence (Williams, 2008). A full discussion of the merits and limitations of the dual-mode model is beyond the remit of the present paper. However, it appears that a more comprehensive model needs to be developed that more fully accounts for the physiological and psychological responses to exercise at different intensities and in differing environments, and how such responses may subsequently affect physical activity participation and adherence. There is a gap in knowledge concerning how the acute effects of exercise (during and postexercise) affect subsequent exercise intentions (motivation) and participation.

Hedonic theories may offer some insights regarding both the variability in affective responses during exercise between the conditions and the link between affective responses and future exercise intentions. For example, various hedonic theories including expected pleasure theory (Mellers, Schwartz, & Ritov, 1999) and response expectancy theory (Kirsch, 1997) posit that one's affective responses or anticipated affective responses will determine whether or not one will repeat the behavior (Kahneman, 1999; Kirsch, 1997; Mellers et al., 1999). Accordingly, it could be the case that participants in the outdoor exercise condition anticipated greater enjoyment, higher pleasure, and lower exertion, which would have influenced experiences of affect and enjoyment during exercise, which in turn improves intentions to exercise in the future. There is some research to support hedonic theories, and the interplay between pleasure and displeasure from affective response felt during exercise has been shown to predict concurrent and future behavior (Williams, Dunsiger, Jennings, & Marcus, 2012). Clearly, more comprehensive theories are needed to more fully understand and account for physiological and psychological responses to exercise, and how these affect subsequent exercise participation.

The results of the correlation and linear regression analysis partially contradict those propositions of hedonic theories. An astonishing result was that neither affective response measures (pre-, in-, and posttask) nor RPE were related to future intention to exercise in either environment (see Table 4). This was surprising, given that previous research has shown that at least the in-task affective responses are predictive of future adherence to exercise (Kwan & Bryan, 2010; Rhodes & Kates, 2015; Schneider, Dunn, & Cooper, 2009; Williams et al., 2012), and that perception of effort has been reported as the most common barrier to exercise participation in women presenting overweight and obesity (Sharifi et al., 2013; Thomson et al., 2016). Interestingly, a strong positive correlation was found between future intentions and attentional focus in the outdoor setting ($r = .90$), while a moderate positive correlation was found in the indoor setting ($r = .52$). Additionally, the linear regression analysis showed that enjoyment and attentional focus accounted for 79% of the variability in future intentions to exercise in the outdoor condition, whereas the same variables accounted for only 25% in the indoor condition. The only significant predictor of future intention to walk was attentional focus in both environments.

It is somewhat surprising that affective responses were not associated with future exercise intentions, but this would support the notion that affect may not directly impact on intentions and behavior per se. It seems likely that individual differences such as attention style, personality, and self-determination, in addition to the exercise dose and context, may impact the relationship among affect, motivation, and behavior. The nature of the relationships between attention, affective response, and motivation in exercise contexts requires further research. Psychographic profiling could be used to develop more effective and tailored interventions to maximize affect, motivation, and subsequent adherence (Hardcastle & Hagger, 2016). In relation to attentional focus, little is known about how attentional style may influence affective and behavioral outcomes (Lind, Welch, & Ekkekakis, 2009). The present results lend support to the notion that attention is associated with motivation (i.e., future intentions) and that sedentary obese women may favor an externally focused attention style. As such, physical activity promotion efforts should focus on enhancing an external attentional focus by way of promoting physical activity outdoors, with others or undertaken while listening to music. These approaches would likely promote a greater external attentional focus and perhaps, in turn, lead to stronger intentions to exercise and subsequent participation.

To the best of our knowledge, no study has analyzed the predictors of future intentions to exercise in different environmental settings in individuals with obesity. The results of the present study suggest that the future intentions to exercise are mediated by the attentional focus during exercise, and not directly by affective responses and perceived exertion during an exercise session, and this is a novel finding. Some strengths and limitations of this study warrant mention. First, we used a randomized counterbalanced design to compare the psychophysiological responses to self-paced walking on a treadmill and in an outdoor setting to reinforce the internal validity of this study. Second, understanding the psychophysiological responses in walking outdoors provides practical applications for health care professionals regarding exercise prescription for sedentary obese women and adds ecological validity to the findings. However, it is important to highlight that generalizations from our findings should be carried out cautiously regarding other populations (e.g., men, younger or elder participants, fit individuals). Additionally, a lack of control regarding the effects of individual differences (e.g., personality, behavioral regulation) on psychological responses may be considered as a limitation.

Although this is not an exhaustive list, we recommend that future studies be conducted in other natural environments (e.g., parks, trails) to further clarify the psychophysiological responses of obese participants in indoor and outdoor settings. Moreover, the findings in the present study call for studies to compare the long-term effects of outdoor and indoor moderate-to-vigorous-intensity physical activity on physiological and psychological responses and adherence to exercise in women with obesity. Finally, future investigations should examine aspects related to self-efficacy, attitudes, perceived behavioral control, individual differences (personality, behavioral regulation, and attentional focus), and hedonic theory constructs such as anticipated affective response to further explore the cognitive pathways that mediate the impact of self-paced exercise on affective responses to exercise and future exercise behavior in different environmental scenarios.

From a practical perspective, the results of the present study suggest that self-paced walking outdoors has the potential to improve health, fitness, and weight loss of women with obesity. Moreover, self-paced walking outdoors is associated with positive psychological responses, which may improve long-term exercise adherence (Rhodes & Kates, 2015). Regarding the clinical significance of this difference, it is important to note that the in-task but not the posttask affective responses have been reported to be related to exercise adherence (Kwan & Bryan, 2010; Rhodes & Kates, 2015; Schneider et al., 2009; Williams et al., 2012). In fact, Williams et al. (2008) found that a shift of only one point on the FS during exercise was associated with an increase of 38 and 41 min of physical activity/week at 6 and 12 months later, respectively. Therefore, even the seemingly small difference found in the present study might play an important role in exercise adherence.

In conclusion, the present study found that across exercise contexts, participants self-selected a sufficient exercise intensity to improve fitness and health, and that physiological responses of self-paced walking were similar across exercise settings. Also, participants showed psychological advantages during self-paced outdoor walking (i.e., increased externally focused attention, reduced perceived exertion, higher positive affective response, and enjoyment, followed by a stronger intention to walk in the future). Further, an external attentional focus predicted future intentions to walk. Because attention appears to be associated with motivation, physical activity promotion efforts should focus on enhancing an external attentional focus by way of promoting physical activity that is outdoors, with others or undertaken while listening to music. These approaches would likely promote an external attentional focus and greater enjoyment and perhaps, in turn, lead to stronger intentions to exercise and subsequent participation among sedentary obese women unaccustomed to exercise.

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