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Walking is popular among adults but is it pleasant? A framework for clarifying the link between walking and affect as illustrated in two studies

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Abstract

Objectives: The popularity of walking is assumed to be due to this activity being pleasant. However, evidence of affective beneficence remains scarce. Instead, activities, including walking, that may not exceed certain thresholds of intensity and duration are presumed to lack sufficient potency to improve affect. In anticipation of investigations designed to explore the role of affect in mediating the walking–adherence relationship, we present and test a methodological platform for clarifying the walking–affect link.
Design: Randomized experimental-vs-control group design (Study I) and randomized AB-vs-BA group design (Study II).
Methods: Two studies are described to illustrate the utility of the proposed approach. Affect was conceptualized as a dimensional construct and assessed repeatedly during and after the walks.
Results: Short, self-paced walks increase self-reported energy among active middle-aged and older adults.
Conclusions: The proposed framework could be useful in investigations of the walking–affect–adherence causal chain.

Keywords: Affect; Circumplex model; Adherence

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Introduction

The problem of physical inactivity in industrialized countries is severe, complex, and seemingly highly resistant to research efforts to understand its causes and alter its course. The human toll, according to World Health Organization (2003) estimates, amounts to approximately 1.9 million deaths and 19 million disability-adjusted life-year losses linked to physical inactivity annually. In the United States, in particular, the percentage of adults over 18 who do not participate in any leisure-time physical activity approaches 40% (United States Department of Health and Human Services, 1996, 2000). Those who do not satisfy the current minimum recommendation of 30 min of moderate-intensity activity on 5–7 days per week make up two-thirds of the adult population (Jones et al., 1998). Perhaps more disconcertingly, of those who initiate a program of regular physical activity, 50% on average drop out within the first few months (Dishman & Buckworth, 1997).

The motivational implications of physical activity intensity

Physical activity recommendations issued to the public since the mid-1990s call for activity that is performed at moderate intensity, lasts for a minimum of 30 min daily, and can be accumulated in multiple short bouts during the day (Pate et al., 1995; United States Department of Health and Human Services, 1996). Part of the rationale for calling for this type of activity was the desire to offer activity choices that, in addition to being safe and effective for promoting health, would also be enjoyable or at least tolerable for adults across a wide range of age and fitness levels. The underlying assumption was that lower "doses" of activity would be more likely to be adopted and maintained over the long run. Although the empirical evidence is not voluminous or even entirely consistent, some studies do indicate that the intensity of physical activity, in particular, has an inverse relationship to adherence (Cox, Burke, Gorely, Beilin, & Puddey, 2003; Lee et al., 1996; Perri et al., 2002; Sallis et al., 1986). Thus, intensity has been singled out in several key documents as an attribute of physical activity that could impact adherence. For example, according to the American College of Sports Medicine (2000), "adherence is lower with higher-intensity exercise programs" (p. 145). Likewise, according to the National Institutes of Health Development Panel on Physical Activity and Cardiovascular Health (1996), "moderate-intensity physical activities are more likely to be continued than are high-intensity activities" (p. 243).

Walking for health and adherence

Walking was highlighted in the recent physical activity recommendations as a prime example of an appropriate lifestyle activity, since it can be performed at a "moderate" intensity, is familiar, convenient, inexpensive, and has a low risk of skeletal–muscular injuries. According to the American College of Sports Medicine (2006), "walking may be the activity of choice for many individuals because it is readily accessible, offers tolerable exercise intensity, and is an easily regulated exercise for improving health outcomes and [cardiorespiratory] fitness" (p. 140). Importantly, there is also evidence that walking is associated with higher adherence than more vigorous activities (e.g., Lamb, Bartlett, Ashley, & Bird, 2002; Parkkari et al., 2000).

Walking is already the most popular mode of activity among adults. In the United States, data from the Behavioral Risk Factor Surveillance System show that "the prevalence of walking was two to three times higher than those of the next most frequently reported activities" (Simpson et al., 2003, p. 96). Data from the National Health Interview Survey show that walking is used by 43%, 50%, and 47% of men and 49%, 50%, and 41% of women aged 45–64, 65–74, and 75+ years, respectively (United States Department of Health and Human Services, 1996). In the United Kingdom, according to data from the 2003 Health Survey for England, walking was second among middle-aged and older adults only to heavy housework (a modality of physical activity not included in surveys in the United States until recently). "Fairly brisk" or "fast pace" walking lasting for at least 30 min (continuously) was reported during the past 4 weeks by 34%, 25%, 18%, and 8% of men and 28%, 23%, 15%, and 5% of women aged 45–54, 55–64, 65–74, and 75+ years, respectively (Stamatakis, 2004). Likewise, according to the report of the Chief Medical Officer, "people who are active enough to gain health benefits achieve this level of activity predominantly through walking" (United Kingdom Department of Health, Physical Activity, Health Improvement and Prevention, 2004, p. 12). Commenting on changes in physical activity found in a community sample over a 1-year period, Sallis et al. (1986) noted:

> Very few persons over age 35 are taking up vigorous activity, and intervention programs targeted at persons in those age groups may meet significant resistance. For whatever reasons, adults of all ages were equally likely to increase moderate activities such as walking. Interventions designed to motivate and instruct people in increasing their frequency, duration, and intensity of walking may meet with considerable success, because there is little apparent preexisting resistance to the activity (p. 40).

Is walking pleasant?

Identifying the reasons behind the "little apparent preexisting resistance" to walking could hold considerable promise for addressing the problem of physical inactivity. The most often-cited assumption is that the popularity of walking is due to the fact that it is generally experienced as pleasant (Armstrong & Edwards, 2004; Le Masurier, Sidman, & Corbin, 2003; Rhodes et al., 1999; Wilde, Sidman, & Corbin, 2001). Here, however, is where the problem lies, since research has not provided reliable evidence for such an effect. In fact, based on two early studies that failed to show that bouts of walking resulted in significant decreases in depression (Morgan, Roberts, & Feinerman, 1971) and state anxiety (Sime, 1977), it has been proposed that physical activity must exceed certain vigorous thresholds of intensity (i.e., 70% of maximal aerobic capacity) and duration (i.e., 20 min) to effectively improve how people feel (Berger & Motl, 2000; Dishman, 1986; Kirkcaldy & Shephard, 1990; Ojanen, 1994; Raglin & Morgan, 1985). Yet, the two studies cited as the basis of this "threshold" assumption had considerable methodological limitations. Specifically, the study by Morgan et al. (1971) used a posttest-only design, making it impossible to decipher with certainty whether walking lowered depression. Likewise, Sime (1977) assessed postexercise anxiety only after a 5-min recovery, leaving open the possibility that the effect of walking had dissipated. More recent studies have shown that walking is associated with affective benefits but certain confounds preclude the establishment of a cause-and-effect relationship. In a study of older adults, the participants walked in a group, so it is unclear whether the affective changes (an improvement in positive well-being and a decrease in state anxiety) were due to the activity *per se* or due to social interaction (Katula, Blissmer, & McAuley, 1999; McAuley, Blissmer, Katula, & Duncan, 2000). Likewise, in another study that showed affective benefits, the participants were habitual smokers who walked while experiencing temporary abstinence from smoking (Taylor, Katomeri, & Ussher, 2006).

The intensity–affect–adherence causal chain: untapped potential?

In 1978, Michael Pollock wrote: "People participate in programs they enjoy. The lower-intensity effort makes the programs more enjoyable" (p. 59).[1] In these two sentences, Pollock essentially proposed a simple but powerful conceptual model consisting of a causal chain that links (a) the intensity of physical activity (e.g., walking vs. more demanding activities),[2] (b) affective responses (i.e., pleasure vs. displeasure) and, ultimately, (c) adherence. The intuitive appeal of this model is so strong that it has survived for decades and continues to appear in several key documents. For example, according to the text of the Healthy People 2010 program: "Each person should recognize that starting out slowly with an activity that is enjoyable … [is] central to the adoption and maintenance of physical activity behavior" (United States Department of Health and Human Services, 2000, p. 22-4). It seems reasonable to suggest that this intensity–affect–adherence causal chain holds such promise as a model of physical activity behavior that it will (or should) be subjected to empirical tests in the near future. It is in anticipation of these tests that we wish to outline a methodological platform that will facilitate the investigation of the critical first link, namely the relationship between the intensity of physical activity and affective responses. Experience suggests that, unless certain elements of the methodological approach are critically reconsidered, the relationship between walking and affect could remain obscured.

A methodological platform

The majority of studies examining the affective changes that accompany single bouts of physical activity continue to use a methodological framework that has changed very little since the 1960s. In most cases, this approach has consisted of administering a multi-item questionnaire, usually the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) or the state anxiety subscale of the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), before and after the bout of physical activity. The alternative framework we present focuses on two issues: (a) the measurement of affect and (b) the timing of affect assessments.

[1]Readers should note that enjoyment is not synonymous with pleasure or positive affect. However, positive affect is generally considered a key defining characteristic of enjoyment (Scanlan & Simons, 1992; Wankel, 1993). Furthermore, ratings of affective valence (pleasure–displeasure) obtained during an exercise bout are closely related to enjoyment scores obtained after the bout (Motl, Berger, & Leuschen, 2000; Robbins, Pis, Pender, & Kazanis, 2004).

[2]Although here walking is presumed to entail light to moderate physiological demands (or a "tolerable exercise intensity," according to the American College of Sports Medicine, 2006, p. 140), readers should be aware that walking can be strenuous, as in the case of obese participants (e.g., Mattsson, Larsson, & Rossner, 1997).

The measurement of affect

Even together, the POMS and STAI tap only seven distinct states (tension, depression, anger, vigor, fatigue, confusion, and state anxiety). These seven distinct constructs might not encompass the most salient changes that take place in response to physical activity under various conditions. Thus, by focusing on only these constructs, other affective changes could go undetected. A solution to this problem would be a transition to the dimensional approach to the conceptualization and assessment of affect. According to this approach, affective states are systematically interrelated, such that their relationships can be modeled by a small set of basic dimensions. Although this approach entails sacrificing some degree of specificity, it offers the advantage of a broad scope, theoretically capturing the entire domain of affect (Ekkekakis & Petruzzello, 2000; Gauvin & Brawley, 1993). Of the various dimensional models, one that is supported by extensive evidence is the affect circumplex (Russell, 1980). According to this model, the domain of affect can be defined by two orthogonal and bipolar dimensions, namely affective valence (pleasure–displeasure) and perceived activation (low–high).

Given its broad scope, balance, parsimony, and domain-general nature, the circumplex has been proposed as an appropriate platform for investigating the effects of physical activity (e.g., Ekkekakis & Petruzzello, 2002). These advantages have been demonstrated in several studies examining the affective changes associated with short (between 4 and 18 min) self-paced bouts of walking among young adults. These studies have demonstrated that walking produces significant increases in perceived energy (i.e., shifts toward high-activation pleasant affect) and, in some cases, decreases in tension and tiredness (Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000; Saklofske, Blomme, & Kelly, 1992; Taylor et al., 2006; Thayer, 1987a, 1987b; Thayer, Peters, Takahashi, & Birkhead-Flight, 1993).

The timing of affect assessments

As noted earlier, the methodological paradigm adopted in most studies investigating the affective changes associated with bouts of physical activity consists of administering self-report measures before the bout begins and after the bout ends. Since two points can only define a straight line, this practice appears to have been based on the assumption that any affective changes that take place in the interim are linear. However, evidence suggests that this assumption is often false (Ekkekakis & Petruzzello, 1999). Affect can change quite rapidly (e.g., from the last few seconds of activity to the first few seconds of recovery). Therefore, it is possible that changes taking place during the activity itself might dissipate or even be reversed once the activity is stopped.

Empirical illustrations

Preliminary data based on the framework we have outlined suggest that walking is, in fact, experienced as pleasant. However, previous studies were conducted with college-age participants. This limits the extent to which the results can be assumed to generalize to middle-aged and older adults, for whom walking is a more common form of physical activity. Therefore, here, we provide data illustrating the utility of the methodological platform we presented with two samples of middle-aged and older adults. To demonstrate the broad applicability of the proposed framework, the two studies that follow were intended to be as diverse as possible in several respects while maintaining the two key elements of the proposed methodological approach constant (i.e., use of the circumplex and repeated assessments of affect). Thus, Study I involved a typical experimental-vs.-control group design, walking took place outdoors and in a group, and the participants were from the United Kingdom. On the other hand, Study II involved an AB-vs.-BA design (rest–walk vs. walk–rest), walking took place in solitude in a laboratory, and the participants were from the United States.[3]

Study I

Methods

Participants

Twelve healthy Caucasian adults (8 women, 4 men), with ages ranging from 57 to 74 years (mean age 68 years), volunteered to participate after announcements were made to the members of an organized walking initiative and a center for the elderly. They had all been regular walkers for at least two months prior to participation in the study. They were randomly assigned to a walking (3 women, 3 men) or a control group (5 women, 1 man). The university Ethical Advisory Committee approved the experimental protocol and all participants read and signed an informed consent form prior to their involvement in the study.

Measures

Two sets of self-report measures were used to assess affective responses on the basis of the circumplex model. One set consisted of multi-item scales tapping the dimensions ranging from high-activation pleasant (Energy) to low-activation unpleasant affect (Tiredness) and high-activation unpleasant (Tension) to low-activation pleasant affect (Calmness). The other set consisted of single-item rating scales tapping the dimensions of affective valence and perceived activation.

The Activation Deactivation Adjective Check List (AD ACL; Thayer, 1989) is a 20-item measure of two bipolar dimensions, namely Energetic Arousal (EA) and Tense Arousal (TA). EA extends from Energy (e.g., *energetic*, *lively*) to Tiredness (e.g., *tired*, *drowsy*), and TA extends from Tension (e.g., *tense*, *jittery*) to Calmness (e.g., *calm*, *at rest*). It has been shown that the AD ACL dimensions can be mapped onto the circumplex affective space (Ekkekakis, Hall, & Petruzzello, 2005a). The AD ACL was administered with its standard instructions and its 4-point response scale, which ranges from "definitely feel" to "definitely do not feel". Evidence for the reliability and structural validity of the AD ACL has been provided by Thayer (1978, 1986, 1989). In previous research in the context of physical activity, the scales of the AD ACL have exhibited satisfactory internal consistency, with values of Cronbach's α coefficient ranging from .70 to .96 (Ekkekakis et al., 2000, 2005a).

[3]It should be emphasized that the purpose of conducting two very different studies was to illustrate the applicability of the proposed approach in diverse research contexts. Since the two studies employed different research designs, they should not be interpreted as a cross-cultural comparison or a contrast between walking outdoors vs. in the laboratory.

The dimension of affective valence was assessed by the Feeling Scale (FS; Hardy & Rejeski, 1989). This single-item rating scale ranges from +5 to −5, with anchors at zero ("Neutral") and at all odd integers, ranging from "Very good" (+5) to "Very bad" (−5). Convergent validity information for the FS has been provided by Hardy and Rejeski (1989) and Van Landuyt, Ekkekakis, Hall, and Petruzzello (2000).

The dimension of perceived activation was assessed by the Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985). This single-item rating scale ranges from 1 ("low arousal") to 6 ("high arousal"). The FAS has been used in previous physical activity studies, demonstrating convergent validity with other measures of perceived activation (Van Landuyt et al., 2000).

Finally, the Rating of Perceived Exertion (RPE; Borg, 1998) was used to assess perceptions of effort. The scale ranges from 6 ("Extremely light") to 20 ("Extremely hard"). Borg (1998) has provided extensive reliability and validity information on the RPE.

Procedures

The participants assigned to the walking condition walked for 15 min on a predetermined outdoor route along a canal. As a guideline for selecting a "brisk" walking pace (as per the current physical activity recommendations), they were told to imagine that they were walking to the post office to collect their pension before it closed for the day. Upon the completion of the walk, they entered a lounge area, where they sat for 15 min. The participants assigned to the rest condition remained seated in the lounge area for 15 min, reading from a collection of articles selected by the investigators. The articles had been screened to ensure that they did not include content that could evoke significant affective responses (e.g., jokes or discussions of controversial social issues). After this 15-min period, the participants rested, without reading, for 15 additional min.

The FS, FAS, and AD ACL (in that order) were completed once immediately before each condition. The participants in the walking group then responded to the RPE, FS, FAS, and AD ACL every 5 min during the walk (min 5, 10, 15), as well as every 5 min during the subsequent rest (post 5, 10, 15). Likewise, the participants in the resting group responded to the FS, FAS, and AD ACL every 5 min over the 15-min period of reading and the subsequent 15-min rest (min 5, 10, 15, post 5, 10, 15).

Results

The overall average RPE reported by the participants in the walking group was 9.7. This corresponds to a description of the intensity of the activity between "very light" and "fairly light."

Two sets of analyses were conducted. One involved an analysis of change between pre, min 5, 10, 15, using a 2 (group) by 4 (time) mixed-model analysis of variance. The other involved an analysis of change between pre, post 5, 10, 15, also using a 2 (group) by 4 (time) mixed-model analysis of variance. The purpose of doing these separate analyses was to allow comparisons between the conclusions that would be drawn from pre-to-post assessments as opposed to during-the-task assessments (see Table 1 for pairwise comparisons and effect sizes).

The first analysis of variance for EA (pre, min 5, 10, 15) showed a significant group by time interaction, $F(3, 15) = 9.83$, $p < .01$ (see Fig. 1, panel a). EA was significantly higher at all time points during the walk compared to baseline. Conversely, EA was significantly lower at min 10 than at baseline in the resting group. The first analysis for TA (pre, min 5, 10, 15) showed only a main effect

Table 1
Effect sizes [$d = (M_i - M_j)/SD_{pooled}$] and results of pairwise comparisons between the means for Energetic Arousal (EA) and the Feeling Scale (FS) for Study I

	Pre	Min 5	Min 10	Min 15	Post 5	Post 10	Post 15
EA							
Walk (pre vs.)		.79[a]	−.66	−.76[a]	−.28	−.18	−.12
Rest (pre vs.)	–	.51	.65[a]	.50	.66[a]	.66[a]	.71[a]
Walk vs. rest	.46	.78[a]	.83	.77[a]	.60[a]	.46	.55[a]
FS							
Walk (pre vs.)	–	−.21	−.57[a]	−.50	−.50	−.14	−.33
Rest (pre vs.)	–	−.18	.17	.05	−.05	−.21	−.15

[a]The pairwise comparison was statistically significant after Bonferroni correction.

of group, $F(1, 5) = 11.58$, $p < .05$, with lower scores reported by the resting group (see Fig. 1, panel b). A follow-up analysis separately for the two opposite poles of the TA dimension (i.e., Tension and Calmness) revealed that the walkers reported lower Calmness during the walk (probably associated with their higher level of perceived activation), whereas there were no differences in Tension.

The first analysis of variance for FS (pre, min 5, 10, 15) showed that the group by time interaction approached significance, $F(3, 15) = 3.16$, $p = .056$. Pleasure increased during the walk, reaching a level higher than baseline at min 10. Also, the pleasure ratings were higher in the walk group compared to the rest group at min 15. The first analysis of variance for FAS (pre, min 5, 10, 15) showed only a main effect of group, $F(1, 5) = 10.79$, $p < .05$, with the responses of the walk group being higher than those of the rest group. The responses on the FS and FAS of the walk and rest groups, plotted in circumplex space, are shown in Fig. 2, panel a.

The second analysis of variance for EA (pre, post 5, 10, 15) showed a significant group by time interaction, $F(3, 15) = 6.70$, $p < .05$. In the walking group, there was no significant change in EA from baseline to any time point after the walk. However, in the resting group, EA was significantly reduced at all time points (post 5, 10, 15) compared to baseline. A similar analysis of variance for TA revealed only a main effect of time, $F(3, 15) = 3.51$, $p < .05$, with both groups showing a slight increase toward the end of the procedures.

The second analysis of variance for FS (pre, post 5, 10, 15) showed no significant effects. A similar analysis for FAS showed only a main effect of group, $F(1, 5) = 7.76$, $p < .05$, with the walkers reporting higher levels of perceived activation than the participants in the resting group.

Study II

Methods

Participants

Twenty-nine healthy adults (15 women, 14 men), with ages ranging from 35 to 78 years (mean age 56 years), volunteered to participate in the study. They reported participation in physical activity ($M \pm SD$), 4.11 ± 1.17 days per week, for 47.04 ± 17.49 min per day. They had been

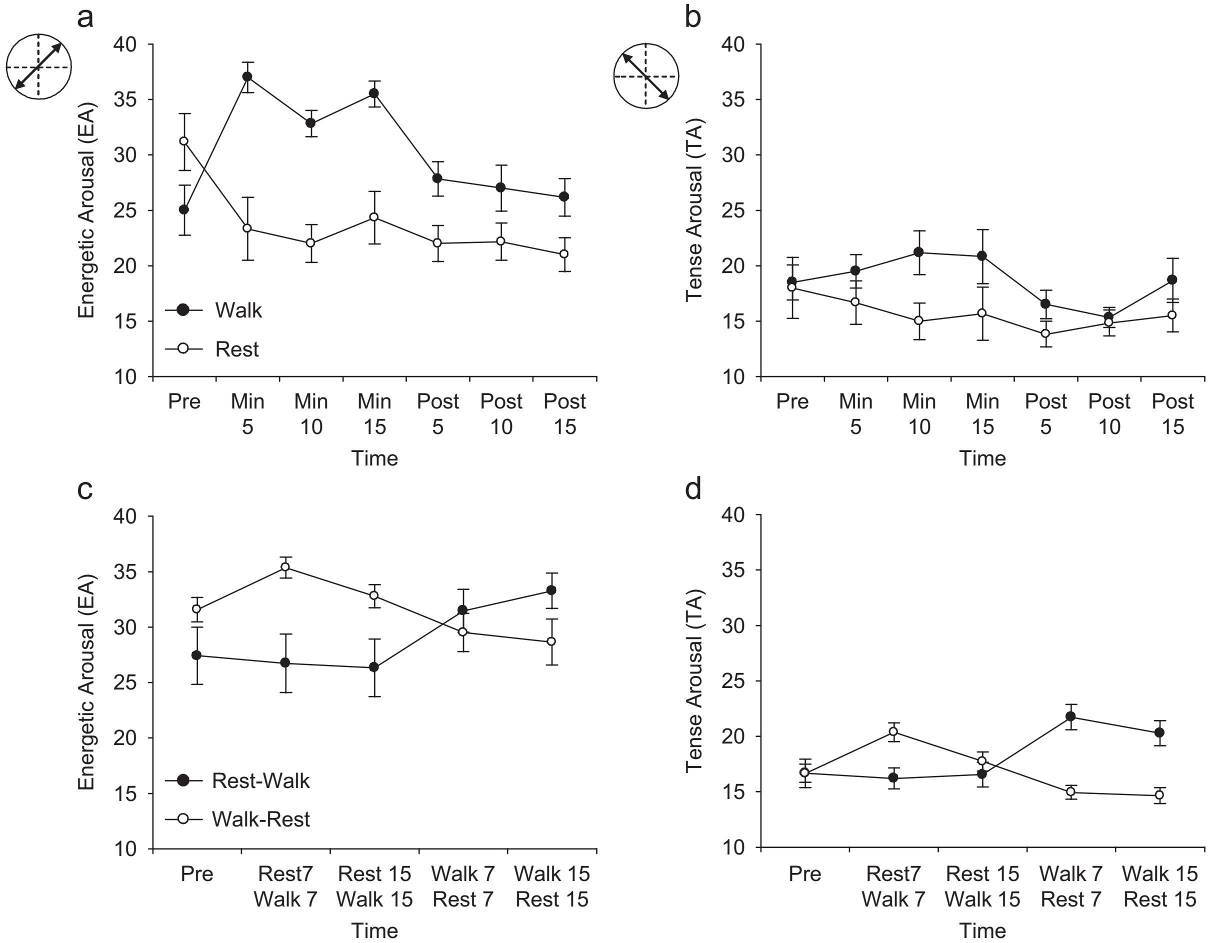

Fig. 1. The responses (means, SEM) to the Energetic Arousal (panels a and c) and Tense Arousal (panels b and d) scales of the AD ACL in Study I (panels a and b) and Study II (panels c and d). The circle inserts indicate the postulated dimensions of the circumplex tapped by the Energetic Arousal (left) and Tense Arousal scales (right).

regularly physically active for 131.52 ± 161.80 months prior to participating in the study. Two participants were African-American and 27 were Caucasian, reflecting area population demographics (according to the 2000 census, 88% of the residents of the local community are Caucasian). Fifteen participants (6 women, 9 men) were randomly assigned to a rest–walk sequence and 14 (9 women, 5 men) to a walk–rest sequence (see below). The Institutional Review Board of the university approved all measures and experimental procedures. All participants read and signed an informed consent form.

Measures

The same measures as those used in Study I were also used in this study. These included the FS, FAS, AD ACL, and RPE.

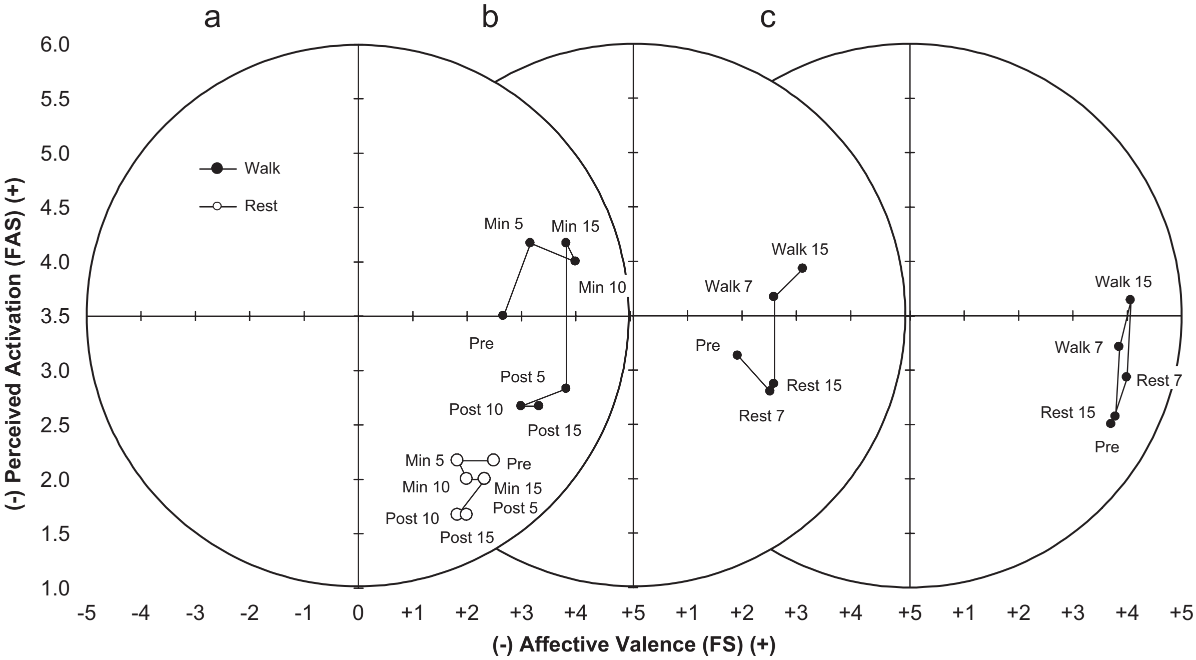

Fig. 2. The responses to the Feeling Scale (FS) and Felt Arousal Scale (FAS) from Study I (panel a) and Study II (panels b and c), plotted in circumplex space. Panel b shows the results for the rest–walk group and panel c shows the results for the walk–rest group.

Procedures

There were two experimental conditions. In one, the participants engaged in (a) a 15-min self-paced treadmill walk and (b) a 15-min quiet rest and, in the other, the order was reversed (i.e., rest–walk). Except for the order of the two tasks, all other procedures were identical between the two conditions. All testing was conducted in a laboratory. The investigator (a) limited communications with the participants to exchanges necessary for carrying out the procedures and (b) used scripted phrases to describe the procedures and provide explanations. All participants were familiar with motorized treadmills and the use of the RPE scale.

Upon arrival at the laboratory, the participants were asked to read and sign the informed consent form. A heart rate transmitter was then placed on their chests with a stretchable band (model Vantage XL, Polar Electro Oy, Finland). Pretest assessments in both the rest–walk and walk–rest conditions included the FS, FAS, and AD ACL. In the rest–walk condition, the participants first rested for 15 min, sitting in a comfortable armchair (no "pass-time" task, such as reading, was provided). Affective responses (FS, FAS, and AD ACL, in that order) were assessed at min 7 and 15. The participants then walked on a treadmill for 15 min at a speed that they selected. They could adjust the speed during the first 3 min and then continued walking at that pace for the remaining 12 min. No specific guidelines for selecting an intensity level were provided in this study. The participants were only told to walk at the same pace they usually select when walking for exercise. During the walk, heart rate was recorded at min 7 and 15. Responses to the

RPE, FS, FAS, and AD ACL were recorded at min 7 and RPE, FS and FAS were recorded at 14:30 min (i.e., completed before the treadmill was stopped). The participants then completed the AD ACL as soon as the treadmill was stopped. This procedure was reversed in the walk–rest condition.

Results

The rest–walk and walk–rest groups did not differ in any demographic, anthropometric, or physical activity characteristics. Also, a chi-square test showed that the proportions of men and women in the two groups did not differ significantly. Furthermore, a series of preliminary analyses of covariance showed that neither the sex nor the age of participants had a significant effect on the results, so these covariates were omitted from further analyses.

The heart rate response to the walks was expressed as a percentage of age-predicted maximal heart rate. Maximal heart rate was estimated using the formula $208-(0.7\times \text{age})$ that was proposed by Tanaka, Monahan, and Seals (2001) as a more accurate alternative to the commonly used 200-age formula. Neither a 2 (groups) by 3 (time points: pre, walk 7, walk 15) analysis of variance on heart rate nor a 2 (groups) by 2 (time points: walk 7, walk 15) on RPE showed a significant main effect of group or a significant group by time interaction. Both showed only significant main effects of time, increasing from min 7 to min 15 of the walks. Heart rate averaged ($\pm SD$) 108 ± 17 beats $\cdot$ min^{-1} (or $64\pm10\%$ of age-predicted maximum) at min 7 and 109 ± 17 beats $\cdot$ min^{-1} (or $65\pm11\%$ of age-predicted maximum) at min 15 of the walk. At the same times, RPE averaged 11.31 ± 1.39 and 11.83 ± 1.47, respectively (between "fairly light" and "somewhat hard").

A series of 2 (order groups: rest–walk, walk–rest) by 5 (time: pre, rest 7, rest 15, walk 7, walk 15 or pre, walk 7, walk 15, rest 7, rest 15) mixed-model analyses of variance were conducted to examine the changes in the affective variables. When significant interactions were found, they were followed up by separate analyses of variance within each group and Bonferroni-corrected pairwise comparisons. Effect sizes and the results of pairwise comparisons for AD ACL, FS, and FAS are shown in Table 2.

The analysis for EA showed a significant group by time interaction, $F(4, 108) = 15.05$, $p<.001$ (see Fig. 1, panel c). The changes over time were significant for both the rest–walk and the walk–rest groups, but the change pattern was different in each. In the rest–walk group, the participants reported higher levels of EA at the 15th min of the walk than at pre, rest 7, and rest 15. In the walk–rest group, EA increased from pre to the 7th min of the walk and then gradually decreased at walk 15, rest 7, and rest 15.

The analysis for TA also showed a significant group by time interaction, $F(4, 108) = 21.68$, $p<.001$ (see Fig. 1, panel d). In the rest–walk group, at both the 7th and 15th min of the walk, TA was higher than at pre, rest 7, and rest 15. In the walk–rest group, TA at the 7th min of the walk was higher than rest 7 and rest 15. Follow-up analyses revealed that the increases in TA were the result of significant decreases in Calmness during the walk (likely associated with the increase in perceived activation, see below) and not increases in Tension (which remained low).

The analysis for FS showed only a significant main effect of group, $F(1, 27) = 11.93$, $p<.01$, with the walk–rest group showing higher scores. On the other hand, the group by time interaction term did not reach statistical significance, $F(4, 108) = 1.56$, $p = .11$. This phenomenon appears to

Table 2
Effect sizes [$d = (M_i - M_j)/SD_{\text{pooled}}$] and results of pairwise comparisons for Energetic Arousal (EA), Tense Arousal (TA), Feeling Scale (FS), and Felt Arousal Scale (FAS) for Study II

	Pre	R7/W7	R15/W15	W7/R7	W15/R15
EA					
Pre		−.95[a]	−.29	.37	.46
R7/W7	.06		.67[a]	1.09[a]	1.08[a]
R15/W15	.10	.04		.60	.66
W7/R7	−.45	−.51	−.56		.12
W15/R15	−.69[a]	−.76[a]	−.81[a]	−.26	
TA					
Pre		−.89	−.25	.44	.50
R7/W7	.13		.81	1.92[a]	1.91[a]
R15/W15	.04	−.08		.96	1.01
W7/R7	−1.27[a]	−1.32[a]	−1.16[a]		.11
W15/R15	−.92[a]	−.99[a]	−.85[a]	.33	
FS					
Pre		−.07	−.29	−.20	.06
R7/W7	−.36		−.23	−.14	.12
R15/W15	−.41	−.04		.07	.31
W7/R7	−.43	−.04	.00		.23
W15/R15	−.79	−.40	−.36	−.38	
FAS					
Pre		−.49	−.78[a]	−.28	.06
R7/W7	.33		−.32	.22	.60
R15/W15	.24	−.07		.53	.91
W7/R7	−.51	−.92[a]	−.76		.37
W15/R15	−.72[a]	−1.11[a]	−.95[a]	−.24	

The results for the rest–walk group are below and the results for the walk–rest group are above the diagonals (R: rest, W: walk).

[a]The pairwise comparison was statistically significant after Bonferroni correction.

have been caused by a ''ceiling'' effect in the walk–rest group, since the FS scores in this group were considerably higher than in the rest–walk group (averaging $\pm SD = 3.79 \pm 1.05$, with a maximum of 5.00). Thus, although there was an increase in reported pleasure, the effect size was small (|.29|).[4]

The analysis for FAS showed a significant group by time interaction, $F(4,\ 108) = 12.64$, $p < .001$. In the rest–walk group, FAS was higher at walk 7 than at rest 7 and at walk 15 than at pre, rest 7, and rest 15. In the walk–rest group, FAS was higher at the end of the walk than at pre. The results for FS and FAS, plotted in circumplex space, are shown in Fig. 2, panels b and c.

[4]Since baseline scores might influence how individuals respond to subsequent treatments, we also performed a 2 (groups) by 4 (time points) analysis of covariance, using the baseline FS ratings as a covariate. The covariate did not interact significantly with time and the group by time interaction remained non-significant.

General discussion

The exercise science literature contains a puzzling contradiction. On the one hand, walking has been shown to be the most popular mode of physical activity among middle-aged and older adults (Simpson et al., 2003; United States Department of Health and Human Services, 1996). This phenomenon has been assumed to be largely due the fact that walking is pleasant. On the other hand, based on a few early studies that yielded null results, walking is also considered by some researchers to be an activity that is unlikely to produce significant affective changes, mainly due to its insufficient intensity (Berger & Motl, 2000; Dishman, 1986; Kirkcaldy & Shephard, 1990; Ojanen, 1994; Raglin & Morgan, 1985). The resolution of this apparent paradox is important, as it can pave the way for the systematic investigation of a heretofore unexplored yet promising model of adherence, namely a causal chain linking the intensity of physical activity to affect and, ultimately, to adherence (Pollock, 1978).

Here, we suggested that the notion of walking being a stimulus of inadequate potency to induce significant changes in affect might have been formulated prematurely, in the absence of extensive and methodologically definitive empirical evidence. We proposed that the relationship between walking and affective responses might be examined more effectively by a transition to a methodological platform that differs from the traditional approach in two important ways. First, affect should be examined from a broad dimensional perspective rather than focusing on a few distinct variables (e.g., depression, state anxiety) that might not reflect the most salient responses resulting from walking. Second, given that affect can change rapidly and dynamically in response to changes in the eliciting stimulus, it seems more sensible to track affective responses both during and after the bout of walking rather than assessing change only from before to after the bout.

Both the intensity and the duration of the walks in the studies described here were below the levels considered the minimum "thresholds" that should be exceeded for significant affective changes to occur (Berger & Motl, 2000; Dishman, 1986; Kirkcaldy & Shephard, 1990; Ojanen, 1994; Raglin & Morgan, 1985). In Study II, in which heart rate was measured directly via telemetry, the intensity was approximately 65% of the age-predicted maximal rate, considerably lower than the postulated 70% of maximal aerobic capacity threshold (i.e., corresponding to approximately 85% of maximal heart rate). Yet, this intensity was within the range recommended by the American College of Sports Medicine (2006) for the development and maintenance of cardiorespiratory fitness, namely between 64%–70% and 94% of maximal heart rate (p. 141, 153). It was also consistent with the levels of intensity reported in other studies for walking at a self-selected pace among active adults (Lind, Joens-Matre, & Ekkekakis, 2005; Murtagh, Boreham, & Murphy, 2002; Spelman, Pate, Macera, & Ward, 1993). The duration of the walks was 15 min, which is again shorter than the postulated 20-min threshold required for significant affective changes.

Significant positive changes in affect were observed in both studies. Walking reliably increased self-reported levels of Energy in both studies. This finding is consistent with those of studies involving young participants (Ekkekakis et al., 2000; Saklofske et al., 1992; Thayer, 1987a, 1987b; Thayer et al., 1993). There was also evidence of significant increases in self-reported pleasure combined with increases in perceived activation, but only in Study I. In Study II, the group by time interaction for FS did not reach statistical significance. This might be attributed to the fact that, in the walk–rest group, the pre-walk level of pleasure was already so high (almost +4 with a maximum of $+5$, on a scale from -5 to $+5$) that there was little room for further improvement (what is commonly described as a "ceiling" effect). Given that the initial assessment of pleasure–displeasure in this group (3.79) was much higher than that obtained at the same time point in the rest–walk group (1.93), we believe that this was the result of an anticipatory effect. Although undesirable from an experimental standpoint, this was unavoidable in this case since the informed consent procedures required that the participants be informed in advance (prior to any baseline assessments) of the exact procedures that were to be followed during the session. Therefore, it is perhaps not surprising that these physically active participants viewed the prospect of immediately engaging in walking as more pleasant and, conversely, the prospect of having to wait for 15 min before being allowed to walk as less pleasant. It should be noted that the average FS ratings obtained at min 7 (3.86) and min 15 (4.07) of the walk in the walk–rest group were considerably higher than those reported at the same time points during the walk in the rest–walk group (2.60 and 3.13, respectively).

It is important to point out that the increases in Energetic Arousal and pleasure were short-lived, showing clear signs of attenuation during recovery. This finding is contrary to previous reports on young participants, summarized by Thayer (1989), in which short walks had positive effects that were still detectable after 2–4 h. This finding is crucial from a methodological standpoint, as it supports our recommendation for assessing affect both during and after the bout. These studies show that affect changes continuously, both over the course of the walk and once the walk ends. Clearly, an assessment protocol limited to one assessment before the walk and one a few minutes afterwards would not provide an accurate depiction of this pattern. In Study I, for example, the analyses of change that were limited to the time points before and after the walk did not show significant changes (which would seem to support the "threshold" assumption), whereas the assessments during the walk revealed a different picture.

The increases in Tense Arousal associated with walking in both studies might seem counterintuitive at first, given the otherwise positive effects of walking. However, this was not an unexpected finding, as it has also been reported among younger adults (Ekkekakis et al., 2000). Importantly, as noted previously, the increase in Tense Arousal did not come about as a result of an increase in Tension but rather reflected only a decrease in Calmness. In the circumplex model, Calmness represents a composite of (positive) valence and (low) activation. Thus, if a person reports feeling less "calm," this could be due to either a change in perceived activation (i.e., an increase, as in from "calm" to "excited") or a change in valence (i.e., a deterioration, as in from "calm" to "exhausted"). Since (a) the scores on FS indicated increases in pleasure and (b) there were increases in perceived activation and Energetic Arousal, it is reasonable to assume that the decreases in Calmness were due to the former rather than the latter phenomenon. It should also be noted that, according to Thayer's (1989) multidimensional theory, at low to moderate levels of energy expenditure, increases in Energetic Arousal typically cooccur with increases in Tense Arousal but these do not necessarily entail that people feel worse. In the present studies, Tense Arousal was relatively low (less than 25 on a scale ranging from 10 to 40), considerably lower than Energetic Arousal (approximately 35).

When interpreting the results of the present study, readers should take into account a series of limitations related to the samples and study designs. First, the studies were conducted with active middle-aged and older adults, so affective changes might have been different had the participants been physically inactive (i.e., just starting a walking program). Given the importance of the early period of participation in physical activity for adherence and the possible linkages between affect and intrinsic motivation for continued participation, future studies should examine whether the findings reported here generalize to sedentary middle-aged and older adults. Second, the participants in the present study were volunteers. Associated with the voluntary nature of their participation is the possibility of expectancy having influenced the results. This is a persistent methodological and interpretational challenge in studies on the affective responses to physical activity, as there can be no placebo physical activity intervention. However, the use of multiple within-subject assessments (i.e., comparing walking to resting conditions) allowed us to screen the data for characteristic signs of expectancy bias. If there were a tendency on the part of the participants to "please" the experimenters by accentuating their positive responses to the walks, we would probably have seen sustained positive changes in our post-walk assessments of affect. Instead, we observed reversals of the initial positive changes. Likewise, if expectancy had played a significant role, the participants would probably have painted an indiscriminately positive picture, without qualitative subtleties. Instead, the shifts towards activated pleasant affect occurred concurrently with decreases in items measuring Calmness. Third, the design of Study II (i.e., AB-vs.-BA) showed that walking and resting had some discernible effects (e.g., Energetic Arousal and perceived activation), but the effects on other variables (e.g., pleasure) were less clear. Perhaps more clarity could have been achieved with a more extensive procedure (e.g., ABA). Also, it was somewhat puzzling that the participants in the rest–walk group reported less positively valenced affect than the participants in the walk–rest condition. It is possible that this was a random occurrence but it is also possible that the initial 15-min rest period (and the expectation of a 15-min rest period) was perceived as undesirable or, conversely, that the expectation of immediately engaging in walking was perceived as desirable. To the extent that this is permissible by informed consent procedures at different institutions, the internal validity of the design could be improved by blinding the participants to the exact nature of the procedure to be followed until the baseline assessments have been obtained. As noted, this was not possible in the present study.

These limitations notwithstanding, the results of the present studies showed that walking can have a significant positive influence on affect among active middle-aged and older adults, complementing previous similar findings among young adults (Ekkekakis et al., 2000; Saklofske et al., 1992; Thayer, 1987a, 1987b; Thayer et al., 1993). If the results of these studies are replicated, their implications could be far-reaching. First, in conjunction with a wealth of recent evidence documenting the numerous health benefits associated with walking (e.g., Lee, Rexrode, Cook, Manson, & Buring, 2001; Manson et al., 2002; Tanasescu et al., 2002), findings that walking can be pleasant should start to put the "no pain, no gain" mentality to rest. This folk notion apparently remains widespread and, thus, "many people … fail to appreciate walking as 'exercise' or to recognize the substantial benefits of short bouts (at least 10 min) of moderate level activity" (National Institutes of Health Consensus Development Panel on Physical Activity and Cardiovascular Health, 1996, p. 243). It is important to reemphasize that studies of self-paced walking have consistently shown that, even without specific instructions, adults select intensities well within current recommendations for the development and maintenance of cardiorespiratory fitness and health (Lind et al., 2005; Murtagh et al., 2002; Spelman et al., 1993). A great challenge for practitioners in the domain of public health lies in the reeducation of the public on what constitutes an "adequate" exercise stimulus. Although "brisk" walking has been highlighted in official documents as an appropriate mode of physical activity for health (Pate et al., 1995; United

Kingdom Department of Health, Physical Activity, Health Improvement and Prevention, 2004; United States Department of Health and Human Services, 1996), a perusal of the lay literature reveals that the public is confronted with conflicting messages. For example, a highly influential best-selling book advises people to exercise ‘‘at the highest intensity that is safe,’’ cautioning that ‘‘when most people are left to their own devices, they will adopt an exercise intensity that is too low’’ (Greene, 2002, pp. 108–109). The recommended intensity is one that induces ‘‘a definite feeling of fatigue’’ (p. 113) and takes people ‘‘past [their] level of comfort’’ (p. 115). Clearly, this recommendation seems to exclude (pleasurable) self-paced walking as an appropriate exercise mode. This phenomenon is not surprising, considering that, even within exercise science, exercise prescription guidelines continue to emphasize only effectiveness and safety, with little or no consideration given to the impact of prescriptions on affect and intrinsic motivation for continued participation.

Second, within exercise psychology, it is becoming increasingly apparent that exercise does not necessarily have to exceed strenuous ‘‘thresholds’’ of intensity and duration (e.g., Dishman, 1986; Raglin & Morgan, 1985) to enable the emergence of positive affective changes. Likewise, the belief that the relationship between exercise intensity and affective benefit can be described by an ‘‘inverted-U’’ (e.g., Kirkcaldy & Shephard, 1990; Ojanen, 1994) seems no longer tenable. In fact, at least on the basis of data from young adults, it appears that low-intensity, self-paced walking is associated with increases in pleasure that are shared by a higher percentage of participants than more vigorous forms of exercise (Ekkekakis, Hall, & Petruzzello, 2005b; Reed & Ones, 2006).

Third, given the pervasive complaints of high fatigue and low energy in industrialized societies, the fact that the most robust effect of shorts walks appears to be an increase in perceived energy could be particularly meaningful. Regular exercise has been shown to have an inverse relationship with feelings of fatigue and a positive relationship with feelings of energy (Puetz, 2006; Puetz, O’Connor, & Dishman, 2006), raising the possibility (open to empirical testing) of a relationship between short-term changes and long-term adaptations.

The agenda for future research includes items of both applied and theoretical interest. From an applied standpoint, the investigation of the postulated causal chain linking walking, affective responses, and adherence should receive high priority. The potential for tapping into a meaningful model of physical activity behavior seems substantial. As noted in the introduction, it is precisely in anticipation of such studies that the present article was written, outlining a framework that should prove instrumental in elucidating the important link between walking and affect.

From a theoretical standpoint, a still-unanswered research question pertains to the mechanism underlying the positive influence of walking on affect. This is a critical issue, given than the identification of a plausible mechanism is a prerequisite for establishing a causal relationship. Furthermore, in the absence of an established mechanistic model, the possibility of a placebo effect cannot be discounted. It is presently unknown whether physical activities performed at an intensity comparable to human walking can engage the brain neurotransmitter systems typically associated with pleasure and reward, such as dopamine and beta-endorphin. Moreover, in data not reported here, we found near-zero correlations between affective responses to walking and self-efficacy, a social-cognitive variable frequently found to share considerable common variance with affective responses to more vigorous exercise stimuli. Therefore, the issue of a mechanistic explanation remains open and presents an intriguing avenue for future research.

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