Changes in Work Affect in Response to Lunchtime Walking in Previously Physically Inactive Employees: A Randomised Trial

Cecilie Thøgersen-Ntoumani[1]*, Elizabeth A. Loughren[2], Florence-Emilie Kinnafick[3], Ian M Taylor[4] Joan L. Duda[5], & Kenneth R. Fox[5]

[1]School of Psychology & Speech Pathology, Curtin University, GPO Box U1987, Perth, Western Australia 6845, Australia
[2]School of Sport and Exercise, University of Gloucestershire, Gloucester, GL2 9HW, United Kingdom
[3]School of Health, University of Northampton, Northampton, NN2 7AL, United Kingdom
[4]School of Sport, Exercise and Health Sciences, Loughborough University, Loughborough LE11 3TU, UK
[5]School of Sport, Exercise, & Rehabilitation Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, United Kingdom

*Corresponding author
Email address:
C.Thogersen@curtin.edu.au
Phone: +61 8 9266 5171
Fax: +61 8 9266 2464

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Abstract

Background: Physical activity may regulate affective experiences at work, but controlled studies are needed and there has been a reliance on retrospective accounts of experience. The purpose of the present study was to examine the effect of lunchtime walks on momentary work affect at the individual and group level. **Methods**: Physically inactive employees (*N* = 56; *M* age = 47.68; 92.86% female) from a large University in the UK were randomised to immediate (IT) or delayed treatment (DT). The DT participants completed both a control and intervention period. During the intervention period participants partook in three weekly 30-minute lunchtime group-led walks for 10 weeks. They completed twice daily affective reports at work (morning and afternoon) using mobile phones on two randomly chosen days per week. Multilevel modelling was used to analyse the data. **Results**: Lunchtime walks improved enthusiasm, relaxation and nervousness at work, although the pattern of results differed depending on whether between-group or within-person analyses were conducted. **Conclusions**: The intervention was effective in changing some affective states and may have broader implications for public health and workplace performance.

Key words: well-being, physical activity, intervention, Ecological Momentary Assessment, workplace, United Kingdom

There is strong causal evidence linking physical inactivity with non-communicable diseases and mortality (Lee et al., 2012). The evidence base linking physical inactivity with mental illness, and physical activity with mental health and well-being, is also accumulating (e.g., Penedo & Dahn, 2005). For example, synthesizing the literature on the acute effects of exercise on energy in healthy populations, Loy, O'Connor and Dishman (2013) found a consistently positive effect of (mainly low-to-moderate intensity) exercise on energy levels, although no consistent effect of acute bouts of exercise on fatigue. Another meta-analysis conducted by Puetz, O'Connor and Dishman (2006) reported a moderate effect of physical activity on increases in energy and reductions in fatigue, although 77% of the effects were based on studies conducted with patient samples. Similarly, Reed and Ones (2006) and Reed and Buck (2009) reported increases in high activation positive affect (e.g., energy) from even low to moderate intensity exercise training over 10-12 weeks (Cohen's d = .47), with those with low energy scores at baseline showing larger effects (Cohen's d = .63). Physical activity may change affective experiences in different spheres of life, such as work. Indeed, according to Hecht and Boies (2009) physical activity may work to recover cognitive and affective resources (such as concentration and energy) that have been depleted during the course of work, and research in the non-work domain has supported the propensity of physical activity in regulating affect (Thayer et al., 1994). Apart from positive affective states including energy and enthusiasm, fatigue is an important constituent of employee well-being (Salanova, Del Libano, Llorens, & Schaufeli, 2014) which also has implications for work performance (Samkoff & Jacques, 1991). The purpose of the present study was to examine the effects of a physical activity intervention on *daily* changes in work-related well-being in University employees who were initially physically inactive.

The Role of Physical Activity in Employee Health and Well-Being

Physical activity can serve as an important driver of employee health and well-being among physically inactive employees. Some evidence suggests that physically inactive employees can be recruited to, adhere to, and benefit from, participation in walking programmes (Authors, in press). Increases in step counts, reductions in Body Mass Index (BMI), waist girths, systolic blood pressure and resting heart rates have been reported as a result of workplace walking interventions (Chan et al., 2004; Dugdill et al., 2008; Gilson et al., 2007). Brown et al. (2011) have recently documented the effects of physical activity interventions on workplace (e.g., job satisfaction, productivity), psychosocial (e.g., anxiety, depression, and other dimensions of affect) and physical (e.g., general health, fatigue, physical functioning) well-being in employees.

There is some evidence from previous research that employees experience greater well-being on physically active days than on inactive days. An observational study by Coulson et al. (2008) with 201 office-based employees showed that on exercise days (but not on non-exercise days), positive affect and feelings of tranquility increased, while negative affect decreased throughout the working day.

The Use of Ecological Momentary Assessment (EMA) in Physical Activity and Well-Being Research

Most work examining the relationship between physical activity and mental well-being has relied on retrospective accounts of experience. This is problematic due to potential memory distortions. Indeed, individuals tend to have trouble recalling the intensity and frequency of particular affective states (Thomas & Diener, 1990). EMA, also referred to as the experience sampling method, allows for the examination of daily contextual effects on affect that is measured in real time (Hektner et al, 2007). Some recent studies adopted momentary assessment techniques to examine the dynamic associations between physical activity and affect in general samples of adult populations which are relevant to the present study. Such studies have demonstrated increases in positive affect (such as valence, energetic arousal and calmness) following bouts of physical activity (Kanning & Schlicht, 2010; Wichers et al., 2011), which, in one study, were sustained up to three hours following the physical activity bout (Wichers et al., 2011). With regard to negative affect, studies with healthy adults have shown mixed effects (Gauvin, Rejeski, & Norris, 1996; Kanning & Schlicht, 2010; Wichers et al., 2011; Giacobbi et al., 2005; Ready et al., 2009)

The extant research reviewed above is characterised by some important limitations. First, the studies all employed observational designs for which causality cannot be inferred. Second, previous studies have used participants who were regular exercisers prior to the beginning of the studies. This means that the potential public health impact of the results is limited in that the results cannot be generalised to physically inactive employees who are at greater risk of ill health. Third, all studies have relied on self-report questionnaires to measure physical activity. Fourth, researchers have not examined the dynamic associations between physical activity and fatigue despite the relevance of fatigue to employee well-being (Salanova, Del Libano, Llorens, & Schaufeli, 2014) and work performance (Samkoff & Jacques, 1991). Finally, EMA based studies examining the relation between physical activity and affective states have not used work-related measures.

To our knowledge, the present study represents the first attempt to address these limitations. Thus, the present study employed a randomised controlled design with physically inactive adults to examine the *causal* effect of physical activity on affective states at work. Further, an EMA methodology using mobile phones, which records time of response, was used to examine momentary affective states during work time. Evidence pertaining to both group-level and intra-individual differences in affective states is presented. In addition, walk attendance records were completed by walk leaders as an objective assessment of behaviour. Finally, Kanning, Ebner-Primer, and Schlicht (2013) have published a position statement on methodological standards recommended for examining the within-subject associations between physical activity and affect. These include 1) repeated measurement to capture the dynamic associations between the variables, 2) the objective assessment of physical activity, and 3) measuring affect in real time. These standards were adopted in the present paper.

In view of the above, the overall purpose of the study was to examine the effects of a lunchtime walking intervention on momentary work-related affective outcomes, controlling for a range of trait characteristics. To test these effects, both between-group and within-person differences were examined. The research design allowed for group comparisons between responses by the Immediate Treatment (IT) group and the Control phase of the Delayed Treatment group (DT-C). Further, within-person differences were examined by comparing responses of the IT and the Intervention phase of the DT (DT-I) by time of day (morning versus afternoon) on active days (when participants had walked at lunchtime) and on active versus inactive days. These analyses were conducted separately for both groups to explore the consistency in responses across the groups who had undergone the intervention at different times of the year. Specifically, the main hypothesis pertained to the between-group comparisons and predicted greater levels of enthusiasm and relaxation in IT than in the DT-C group, above and beyond any influence of trait variables and perceptions of workload on that day (H1). The additional analyses examined within-person changes. The within-person hypothesis relating to time of day predicted that participants (IT and DT-I) would report significantly greater levels of enthusiasm and relaxation in the afternoons than in the mornings on days when they had walked during lunchtime. In contrast, differences were not anticipated in fatigue or nervousness, due to inconsistent effects reported in previous literature (H2). For the Day analysis, it was predicted that levels of enthusiasm and relaxation, but not fatigue and nervousness, at work would be greater in the afternoon when the participants (IT and DT-I) had walked during lunchtime, compared to when they had not (H3).

Materials and Methods

Participants

Following University ethical approval for use of human subjects, participants were recruited through a University workplace well-being health fair, pay slip messages, flyers and posters, a monthly University staff informational magazine, and a specially designed website (for further information on recruitment methods, including a CONSORT diagram, see Authors, 2010; Authors, in press).

Initially, 249 participants were assessed for eligibility to partake in the intervention (see Authors, in press for the results relating to the feasibility of the intervention). Eligible participants had to be employed full-time in a non-academic (i.e., administrative) position, and they had to be physically inactive at baseline (i.e., engage in less than 150 minutes of moderate intensity physical activity per week as assessed by a brief screening questionnaire). A large proportion (n = 174) were excluded because they were sufficiently physically active (they already met physical activity recommendations for health). A total of 75 non-academic administrative University staff members (n = 69 females, n = 6 males) were therefore recruited for the intervention. The participants worked in 32 (out of 43) different University departments or corporate services, and were representative in terms of ethnicity (Pearson χ^2 (1) = .01; p > .05), but not gender (Pearson χ^2 (1) = 28.65; p < .01) as there was an overrepresentation of females. Thirty-five participants (n = 32 females, n = 3 males) were randomised to an immediate treatment (IT) and 40 participants (n = 37 females, n = 3 males) to a delayed treatment (DT) condition.

Eighteen participants who dropped out during the study period did not provide EMA ratings and were therefore not included in the data analyses (for more information about reasons for drop-out, please see Author(s), in press). There were no significant differences between the drop-outs and the adherers in age (t (73) = 1.52; p = .13), positive or negative affective traits measured at baseline (*Pillai's Trace* = .00; *F* (2, 71) = .02; *p* = .98), self-reported physical activity (Pillai's Trace = .07; *F* (4, 70) = 1.21; *p* > .05; partial η^2= .07), or self-reported health (*t* (73) = 1.46; *p* = .15). One further participant, who adhered to the intervention, did not provide EMA data, so was also excluded from the analyses reported in this paper. Thus, for the purpose of this study, data from 56 (*n* = 52 women) participants were used (IT: *n* = 26; DT: *n* = 30). This sample size is deemed to be adequate, as simulation research has shown that approximately 50 level 2 units (i.e., individuals in our study) or more are needed for accurate parameter estimates in multilevel modelling (Maas & Hox, 2005), the analyses used in the present study. The age range of the participants was 24 to 63 years (*M* = 47.68, *SD* = 10.31) with 85.3% White British, 6.7% Asian, 4% Black, 2.7% Chinese, and 1.3% 'Other' in ethnic representation.

Design and Procedure

Intervention. The intervention consisted of 10 weeks of group-led walks and a further six weeks of independently organised walks. The participants were requested to take part in three 30 minute group-led walks during lunchtime per week, and two walks during the weekends which were independently organised. The following six weeks were independently organised by the participants. The participants were encouraged to self-select their own walking intensity/speed for each walk, and were provided with maps of the walks in case they wanted to walk either faster or slower than the rest of the group.

For the present study, only analysed was data pertaining to the first 10 weeks of the programme and only those derived from work days when the participants could sign up and attend lunchtime walks at work. This was because attendance could only be objectively verified in the group phase through walk attendance records kept by the walk leaders. The DT group started the intervention phase once the IT group had finished their intervention (in May 2010). The control phase for the DT group (DT-C; February 2010 start) was thus directly comparable time-wise to the IT intervention which allowed for a true test of intervention effects. Data for the DT group's intervention phase (DT-I) was also used, which meant that the participants in the DT condition were asked to complete twice as many momentary reports compared to participants in the IT condition. During the DT-C, participants in the DT group were requested *not* to change their usual pattern of behaviour.

Prior to the start of the intervention, walk leaders were recruited from the community and trained in the provision of autonomy support (see Authors, 2010 for details). The participants were requested to sign up for lunchtime walks using a Doodle poll. The participants had a range of choices regarding routes in order to provide them with a degree of autonomy and choose the walks they preferred. This was possible as different walks were offered at the same time and a team of walk leaders was available. All participants were asked to wear an unsealed Yamax Digi-Walker 351 pedometer at the beginning of the intervention phase (participants in the DT condition did not acquire these until after the end of the control phase) for monitoring and motivational purposes. They were also requested during the intervention phase to log daily step counts in a booklet. Further, researchers sent twice weekly motivational text messages to the participants during the intervention phase to encourage participation.

Programming for EMA. To minimize the burden on the participants during working hours, the two measurement days were programmed randomly on the phones and could be on days from Monday to Thursday. Using a randomised time table generator, alarm times were programmed to ring once in the morning between 10.00 and 11.00 am and once again on the same day in the afternoon between 14.00 and 15.00 pm. These timings were chosen because participants could take part in walks at different times (12.30 or 1.15 p.m), and therefore it was not possible to prompts participants to respond right before and after each walk. The timing of the prompts was randomised to prevent expectancy effects. Participants were asked to complete the twice weekly scales for the duration of the 10 weeks of group-based walks (including DT-C phase). Nokia 2730 Classics mobile phones were programmed using JAVA Micro Edition (Java ME, Oracle). The programmer uploaded 26 questions for the morning alarms asking whether the participants were at work, and questions related to job affect. The afternoon questions were the same as the morning with the addition of a single question related to perceived work load during that day. Additionally, the phones were programmed to provide a reminder signal 30 minutes later if there was no response to the initial alarm. To avoid multiple responses to the alarm, the phones were programmed to accept data only once within that 30 minute window. The phones were programmed to record the time of completion and questions were presented in a random order to avoid ordering effects.

Measures and Instrumentation

Walk attendance. The walk leaders held attendance records for each walk. The participants who turned up for the walks were asked to provide their ID number which was noted by the walk leader. These data were matched by date and time to affect responses from the phones.

Job Affect. The Job Affect Scale (JAS) was developed by Brief et al. (1988) and consists of 20 items describing positive and negative affect. In a subsequent study employing confirmatory factor analytic techniques, Burke et al. (1989) showed that the 20 mood states were most appropriately identified as four unipolar factors: enthusiasm (six items), relaxation (four items), nervousness (six items), and fatigue (four items). The scale asks participants the extent to which they have experienced each of the 20 mood descriptors at work in the past week. The response scale ranges from 1 (‘very slightly or not at all’) to 5 (‘very much’). In the present study, the traditional version of the scale was used at baseline (to assess trait job-related affect) and was administered via a traditional paper and pencil questionnaire. An adapted state measure of the scale to assess momentary affect was also used. Here, participants were asked to report how they felt ‘right now’. The momentary measure was programmed into the mobile phones. Support for the internal consistency of the original JAS has been reported in previous research (Thøgersen-Ntoumani et al., 2005).

Control variables

Perceived Daily Work Load. This was a single question added to the phones and posed in the afternoon asking the participants to judge how heavy their workload was on that day. The response scale ranged from 1 (‘very heavy’) to 5 (‘very light’), and the scores were reversed before being entered into the analysis.

Positive and negative affectivity. The trait version of the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) was used to assess trait positive and negative affectivity which was assessed at baseline only via a paper and pencil questionnaire. The scale consists of 20 items; 10 measuring positive affect and 10 items assessing negative affect. Participants were asked how often, in *general in their life as a whole*, they experienced each of 10 positive (e.g., enthusiastic, determined, proud, attentive) and 10 negative (e.g., distressed, hostile, nervous, jittery) states. This measure is scored on a scale ranging from 1 (‘not at all’) to 5 (‘very much’). Evidence regarding the reliability and validity of the scale has been reported elsewhere (e.g., Crawford & Henry, 2004).

Motivation to work. The Work Extrinsic and Intrinsic Motivation Scale (WEIMS) (Tremblay et al., 2010) is an 18-item questionnaire used to assess extrinsic and intrinsic work motivation. Participants are asked to respond to what extent each of a number of statements corresponds to the reasons why they are currently involved in their work, with a response scale ranging from 1 (‘does not correspond at all’) to 7 (‘corresponds exactly’). The questionnaire measures amotivation (AM; e.g., ‘I don’t know, too much is expected of us’), external regulation (EX; e.g., ‘for the income it provides me’), introjected regulation (IJ; e.g., ‘because I want to succeed in this job, if not I would be very ashamed of myself’), identified regulation (ID; e.g., ‘because it is the type of work I have chosen to attain certain important objectives’), integrated regulation (INT; e.g., ‘because it has become a fundamental part of who I am’), and intrinsic motivation (IM; e.g., ‘for the satisfaction I experience when I am successful at doing difficult tasks’). For the purpose of the present study, using Tremblay et al.’s (2010) instructions, we converted the scores of each subscale into a work self-determination index. A resultant positive overall score represented self-determined work motivation and a negative score was indicative of a non-self-determined profile. Tremblay et al. (2010) reported a Cronbach’s alpha coefficient of $\alpha = .84$ as well as evidence to support the scale’s construct validity.

Data analyses. Following the calculation of descriptive statistics and bivariate correlations, three sets of main analyses (1 between-group and 2 within-person) were conducted. The between-group analyses compared responses in affect between IT and DT-C on afternoons when the IT group participants had walked at lunchtime. The first set of within-group analyses examined changes in affective states from morning to afternoons on days when the groups (IT and DT-I) had walked at lunchtime. The second set examined differences in affective states on afternoons when the participants had walked at lunchtime compared to days when they had not. For the within-person analyses, the groups (IT and DT-I) were analysed separately to examine whether the intervention worked similarly at different times of the year as the IT group had their intervention in February to April, while the DT group experienced their intervention between May and July.

Multilevel modelling (also called mixed linear modeling), using MLWin (version 2.25) (Rasbash et al., 2012), was used to analyse H1-H3, as there were repeated observations (level 1) nested within individuals (level 2). In these analyses predicted changes were in enthusiasm, relaxation, nervousness and fatigue as a function of group status (binary coded as IT = 1, DT-I = 0), morning vs. afternoon (morning = 0, afternoon = 1), and walking day vs.

non-walking day (walking day = 1, non-walking day = 0). In all models the researchers controlled for the trait equivalent of the outcome affect measure, negative and positive affectivity, and work motivation (and daily workload for H1 and H3). This was because previous research has shown that these variables relate to well-being responses (DeNeve & Cooper, 1998; Heller et al., 1998; Steel et al., 2008). As these variables were measured once and, therefore, entered as Level 2 variables in the multilevel equations, we grand mean centered these variables (Enders & Tofighi, 2007). In addition, perceived daily workload was considered as a potential confounder, so this variable was also taken into account in relevant analyses. This variable was group mean centered to control for the influence of changes in workload relative to each participants' unique mean (Enders & Tofighi, 2007). All variables were treated as fixed effects as we were concerned with average effects across the sample and keeping the models as parsimonious as possible (i.e., the minimum number of parameters to explain variance in the dependent variables).

Results

Preliminary Analyses

N = 1,377 useable phone entries were gathered in total from 56 employees providing a mean entry response of 24.59 per employee. This represented an overall response rate to the mobile phone alarms of 39.70%. Of the entries, n = 807 (58.60%) were recorded on days when participants did not walk, while n = 570 (41.40%) were recorded on days when the participants walked at lunchtime. On average, participants completed 19.88 group-led walks, which represents 66.27% of the total number of walks.

Table 1 presents the descriptive statistics and the bivariate correlations between all the variables in the study. The results provided support for the internal reliability of all the scales. The correlation analyses revealed expected patterns of relationships. For example, the four affective states measured via the mobile phones were most highly correlated with their respective trait equivalents, yet they were distinct. Further, the associations between the affective states were either non-significant or moderate in size which supports the independence of the four affective states. The associations between components of the JAS and positive and negative affectivity from the PANAS were also all small-moderate in size and/or non-significant. This supports the decision to retain all in the main analyses.

(Table 1 about here)

As a randomisation check, the IT and DT groups were compared on all demographic and trait characteristics measured at baseline. Chi-square tests revealed no differences in gender (*Pearson* χ^2 (1, 51) = .18; $p > .05$) or ethnicity (*Pearson* χ^2 (3) = 1.05; $p > .05$) between the conditions. Further, an independent sample t-test showed no differences in age ($t(49) = .03$; $p > .05$). A one-way MANOVA revealed no significant group differences between the groups in baseline work affect (Pillai's Trace = .068; F (4, 69) = 1.26; $p > .05$).

Main Analyses

To test the main hypothesis (H1), afternoon responses on days when participants in the IT condition had walked during lunchtime were compared with afternoon responses of the DT participants in the afternoon of the same day (DT-C phase). The results (see Table 2) showed that participants in the IT condition reported greater levels of enthusiasm and relaxation compared to the other group above and beyond any influence of the control variables. However, there were no differences between the groups in nervousness or fatigue.

(Table 2 about here)

Next, in testing H2, the researchers examined intra-individual variation in changes in responses from morning to afternoons on walking days. These analyses were conducted separately for the two groups. The results revealed some differences between the groups (see Table 3). While nervousness reduced from the morning to the afternoon in both groups, both relaxation and fatigue increased following walks in the IT group only.

(Table 3 about here)

Finally, addressing H3, the results showed that on days in which participants walked during lunchtimes, they experienced significantly greater levels of enthusiasm and relaxation at work during the afternoon compared to afternoons when they had not walked at lunchtime (see Table 4). This was evident in both the IT and the DT group. In addition, delayed treatment participants (DT-I phase) experienced lower levels of nervousness at work on afternoons of walking days compared to afternoons on non-walking days. There were no differences in the remaining outcome variables.

(Table 4 about here)

Discussion

In this study we aimed to examine in a mainly female sample the effects of lunchtime walks on (changes in) job-related affective states during the working day in the context of a randomised trial using an EMA methodology. The hypotheses were largely supported. Specifically, beyond any influence of positive and negative affectivity, equivalent traits, work motivation and perceived workload, participants in the IT group reported greater levels of enthusiasm and relaxation at work in the afternoon compared to participants in the DT condition (DT-C phase) observed in the afternoon of the same day. Walking therefore seems to have both energising and relaxing properties in the workplace, which supports the main hypothesis of the study. The within-person analysis comparing afternoon responses on walking versus non-walking days confirmed the results of the between-group analysis as afternoons following walks were associated with greater levels of enthusiasm and relaxation. Given recent findings from the meta-analysis by Ford et al. (2011) that affective experiences at work are linked to workplace performance, these results may have broader implications for the success of companies.

However, the additional within-person analysis revealed a different pattern of results. Specifically, nervousness decreased from the mornings to the afternoons on walking days in both groups. Thus, a 30 minute group walk appears to have stress reducing properties in physically inactive employees. A similar pattern was found when we compared the afternoons on walking days with afternoons of non-walking days, but only for the DT group. Workplace physical activity interventions can reduce general stress levels (moderate effect of *d* = .33) as reported in a meta-analysis by Conn et al. (2009). This is despite studies which have revealed no association between physical activity and negative affect at the daily level (Wichers et al., 2011; Giacobbi et al., 2005; Ready et al., 2009). Thus, there appears to still be some inconsistency in research examining the effects of physical activity on stress or nervousness. The present study builds on the research by showing nervousness can be reduced within the *same day* as a result of a lunchtime walk.

The findings related to fatigue were largely supportive of the hypotheses. Specifically, there were no group differences in fatigue in the afternoons when the IT group had walked during lunchtime. The within-person analyses also showed no differences in fatigue between afternoons following walking activity compared to afternoons on non-walking days. These results are in accordance with the recent meta-analysis conducted by Loy et al (2013) showing inconsistent effects of acute bouts of low-to-moderate intensity exercise on fatigue. Although a meta-analysis by Puetz et al. (2006) documented moderate sized decreases in fatigue following chronic participation, most of the participants included in the analysis were patient groups. It is possible that the effect of physical activity on fatigue differ between clinical and non-clinical groups, with stronger effects for clinical populations.

However, when levels of fatigue were compared in the mornings versus afternoons on walking days (H2), IT group participants experienced increases, while there were no changes in the DT group. These differences between the groups were unexpected, but the finding may be explained by seasonal variation. A recent EMA study by Kööts et al. (2011) has revealed that momentary ratings of high levels of fatigue were more likely in cold and dark conditions. This explanation may be relevant here as the IT group began their intervention in the cold winter (February) months when the average temperature was 2.4 °C and the DT group started their intervention phase in lighter spring conditions (May) when the average temperature was 10.7 °C. In future, it may also be useful to examine effects on fatigue at various stages of an intervention (e.g., adoption versus adherence phases).

Strength and Limitations

In the present study, statistical approaches including EMA and multilevel techniques were used to control for error and confounding effects of extraneous variables and comparison was made with a randomised control group or participants acted as their own controls for some analyses. The study therefore provides a rigorous examination of the fluctuations and differences in affective states arising as a consequence of physical activity participation. In contrast, previous studies in this area have used observational designs (Kanning & Schlicht, 2010; Wichers et al., 2011; Giacobbi et al., 2005; Ready et al., 2009). Another strength was that attendance in the walking sessions was objectively measured via records kept by the walk leaders unlike previous studies where researchers have relied on self-reported measures (Kanning & Schlicht, 2010; Wichers et al., Hausenblas et al., 2008). Finally, this research was conducted with physically inactive employees, where previous studies have observed already active individuals. Clearly, the public health implications of identifying effective physical activity interventions for those who are at greater risk of disease, obesity, mental health problems etc. (as are the physically inactive) are important. Nonetheless, the intervention may be suitable for all employees regardless of habitual levels of physical activity and it would be important in future research to examine which groups may benefit the most.

Although the findings cannot be generalized to males given the low number of males in the intervention, the sample was representative in terms of ethnicity, and participants represented a range of job roles across the University setting. These factors strengthen the external validity of our results.

However, there are also limitations associated with this study. First, the findings cannot be generalized to male employees. As yet it is unknown whether the affective responses of men differ from those of women as a result of walking interventions as few interventions have been conducted with males. This would be a worthy avenue of future research. The gender imbalance in the intervention is consistent with other reviews showing that females are more likely than males to sign up for employee wellness programmes (Robroek, van Lenthe, vam Empelen, & Burdorf, 2009) or take part in group-based walking interventions (Kassavou, Turner, & French, 2013).

Further, the analyses did not control for diurnal variations in moods. Indeed, Gauvin and Spence (1996) have shown that positive mood tends to be highest around midday while it is lower in the morning, the afternoon and the evening. It is possible that such fluctuations could partly explain the differences in some affect ratings between morning and afternoons on walking days in the present study. However, the fact that two of our main analyses (one between-groups and another within-person) compared affective responses in the afternoons as a function of group and walking versus non-walking day refutes the argument that diurnal variations in affect can explain our results.

Another limitation relates to the relatively low response rates to the signals emitted by the mobile phones. The decision was made to retain all responses. This was because one of the strengths of multilevel modeling analysis is its ability to deal with incomplete data (Singer & Willet, 2003). The fact that the EMA approach was used over a prolonged period of time (twice daily on two days per week for 10 weeks in the IT and for 20 weeks in the DT condition) may have negatively affected the response rates. These intervals may need to be reviewed in future research.

In addition, it is important to note that the JAS used to assess job affect was designed to measure trait affect at work but was adapted for use in the present study to assess states. Although it is well established that affective experiences exist at both trait and state levels (see e.g., the Positive and Negative Affect Scale developed by Watson, Clark and Tellegen, 1988), the effects for the between-group analyses were stronger than for the within-person analyses, which suggests that fluctuations in work affect states may not differ much from their average levels. There were also differences in the results depending on whether between-group or within-person analyses were conducted. It is important in future research to ascertain that the modified JAS is the most appropriate measure for assessing momentary work-related states.

Finally, it is important to emphasize that, as the walks were completed in groups, it is not possible to separate the effects of social interaction versus the walking itself on changes in affective states. Some previous research has examined the effects of moderate intensity physical activity on affective states when done alone versus with one other person (e.g., a friend; Johansson, Hartig, & Staats, 2011; Plante, Coscarelli, & Ford, 2001). These studies have shown that a bout of physical activity on one's own results in improvements in some affective states (e.g., positive affect, energy, revitalisation) but also that this appears to be dependent on where the activity is completed (e.g., in a park versus on streets). Examining the roles of both the social and physical environment to affect regulation using a similar walking intervention to the one reported in this study could be a useful avenue for future research.

Perspective

Improving the health and well-being of employees is a key concern to the Government, public health bodies and global health organisations. The increase in sedentary jobs requires innovative solutions to help get employees more physically active at work. The lunchtime walking programme tested as part of this study targeted to a traditionally hard to reach group (i.e., physically inactive employees) indicated that it was effective in regulating (most) affective states at work. Enthusiasm, relaxation, and nervousness at work improved as a result of the walking intervention, but patterns of results differed depending on whether between-group or within-person analyses were conducted. Thus, the effect of physical activity and affect is complex suggesting that individual factors play an important role. Given the adaptive role of affective states of work and the potential public health and cost saving implications of improving well-being at work, more research should be conducted to examine the longer-term effects of this intervention.

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Table 1. *Descriptive Statistics and Correlations Among the Study Variables*

	α	ICC	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Enthusiasm (state)	.95	.59	2.28	.64		.61	-.06	-.42	.69	.38	-.31	-.38	-.24	.50	.25	-.05
2. Relaxation (state)	.91	.46	2.42	.57			-.11	-.06	.43	.60	-.31	-.21	-.22	.22	.11	-.35
3. Nervousness (state)	.90	.32	1.28	.31				.22	-.11	.01	.37	.28	.35	-.22	.03	.23
4. Fatigue (state)	.92	.38	1.56	.45					-.52	-.22	.25	.62	.25	-.39	-.04	-.01
5. Enthusiasm (trait)	.81		2.58	.71						.46	-.48	-.52	-.36	.61	.31	.05
6. Relaxation (trait)	.82		2.68	.79							-.42	-.02	-.08	.19	.08	-.15
7. Nervousness (trait)	.86		1.75	.78								.37	.62	-.37	.06	.09
8. Fatigue (trait)	.88		2.20	1.04									.37	-.32	-.05	-.03
9. NA (PANAS)	.90		2.16	.70										-.43	-.03	-.07
10. PA (PANAS)	.93		3.19	.75											.38	.26
11. Work motivation	.78		4.03	.77												.18
12. Workload	-		3.42	.60												

Note. r 's ≥.28 are significant at the α = .05 level.

Table 2. *Between-Group Comparisons in Affective Responses on Afternoons following Walking at Lunchtime*

IV	Enthusiasm at work	Relaxation at work	Nervousness at work	Fatigue at work
	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*): *Z*
Group (0=DT; 1=IT)	.45(.12)** (20.33%)	.65(.12)** (53.64%)	.03(.07) (0%)	-.05(.12) (0%)
Trait equivalent	.46(.10)**	.28(.08)**	.20(.06)3**	.34(.07)**
Negative affectivity	.04(.09)	-.07(.08)	.02(.06)	-.11(.09)
Positive affectivity	.18(.12)	.10(.09)	-.05(.05)	-.20(.10)*
Work motivation	.01(.01)	.001(.01)	.01(.01)	.01(.01)
Workload	-.09(.03)**	.14(.04)**	-.10(.03)**	-.01(.04)
	-2*logL			
	639.05	784.70	419.24	789.06
	Δ-2*logL compared to unconditional model			
	58.56**	63.51**	34.45**	31.65**

Notes. IT = Immediate Treatment condition (*n*=26); DT = Delayed Treatment (*n*=30) condition. *=*p*<.05; **=*p*<.01.

For Group, walking afternoons in the IT condition are compared to afternoons in the DT (DT-C phase) condition.

The percentages indicate the reduction in the between-person variability of the intercept due to the inclusion of the group variable (pseudo-R^2 for level 2). The values for pseudo-R^2 for level 1 are zero because the group variable is a purely level 2 explanatory variable. In all models, the variance of level 1 and level 2 residual errors were significantly different from zero.

Table 3. *Within-Person Comparisons of Morning and Afternoon Affective Responses on Walking Days in both Groups*

IV	Enthusiasm at work		Relaxation at work		Nervousness at work		Fatigue at work	
	IT	DT	IT	DT	IT	DT	IT	DT
	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)
Time of Day (0=am; 1=pm)	-.01(.05) (0%)	-.03(.06) (0%)	.17(.06)** (2.9%)	.06(.06) (0%)	-11(.04)** (2.1%)	-.12(.04)** (2.7%)	.11(.05)* (1.4%)	.03(.06) (0%)
Trait equivalent	.61(.17)**	.11(.11)	.38(.10)**	-.004(.11)	.42(.10)**	-.19(.08)*	.16(.07)*	.04(.08)
Negative affectivity	.08(.24)	.07(.09)	-.38(.18)*	-.08(.11)	.14(.14)	.10(.08)	.16(.16)	-.02(.09)
Positive affectivity	.21(.17)	.34(.14)*	-.01(.12)	.28(.13)*	-.06(.09)	-.04(.08)	.08(.11)	-.40(.11)**
Work motivation	.02(.02)	.001(.01)	.02(.01)	-.03(.01)*	.004(.01)	-.01(.01)	-.01(.01)	.01(.01)
					-2*logL			
	488.32	408.81	591.61	445.82	337.26	215.02	490.22	467.34

Δ-2*logL compared to unconditional model								
	19.70**	21.48**	28.17**	8.27	27.76**	13.89*	13.36*	15.86**

Notes. IT = Immediate Treatment condition (n=26); DT = Delayed Treatment condition (n=30). *=p<.05; **=p<.01.

The percentages indicate the reduction in the within-person variability of the intercept due to the inclusion of the time of the day variable (pseudo-R^2 for level 1). The values for pseudo-R^2 for level 2 are zero or negative because the time of day variable is a purely level 1 explanatory variable. In all models, the variance of level 1 and level 2 residual errors were significantly different from zero.

Table 4. *Within-Person Comparisons in Afternoon Affective Responses on Walking Days versus Non-Walking Days in both Groups*

IV	Enthusiasm at work		Relaxation at work		Nervousness at work		Fatigue at work	
	IT	DT	IT	DT	IT	DT	IT	DT
	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*)	β(*SE*): *Z*
Day (0=non-walking day; 1=walking day)	.18(.06)** (8.7%; 2.4%)	.18(.07)** (16.6%; 2.2%)	16(.07)* (5.5%; 1.1%)	.35(.08)** (22.4%; 9.2%)	-.03(.05) (3.4%; 0%)	-.15(.06)* (0%; 2.8%)	-.12(.07) (8.5%; 0%)	-.04(.09) (0%; 0%)
Trait equivalent	.69(.17)**	.39(.13)**	.35(.12)**	.10(.11)	.32(.08)**	-.16(.09)	.22(.08)**	-.05(.12)
Negative affectivity	.12(.22)	-.05(.08)	-.16(.22)	-.03(.10)	.13(.12)	.09(.07)	.05(.20)	.13(.13)
Positive affectivity	.15(.16)	.02(.14)	.07(.16)	.13(.13)	-.04(.08)	.03(.08)	.11(.14)	-.26(.15)
Work motivation	.01(.01)	.001(.01)	.01(.01)	-.018(.01)	.000(.01)	-.01(.01)	-.003(.01)	.01(.01)

Workload	.01(.04)	.004(.05)	.09(.04)*	.22(.05)**	-.11(.03)**	-.05(.04)	.01(.04)	-.01(.07)
				-2*logL				
	395.78	246.43	457.27	283.00	246.79	180.24	464.09	352.89
				Δ-2*logL compared to unconditional model				
	30.89**	26.07**	21.67**	41.75**	36.01**	12.24	10.53	6.06

Notes. IT = Immediate Treatment condition (*n*=26); DT = Delayed Treatment condition (*n*=30). *=*p*<.05; **=*p*<.01.

The percentages indicate the reduction in the within-person variability of the intercept due to the inclusion of the day variable (pseudo-R^2 for level 2; pseudo-R^2 for level 1). In all models, the variance of level 1 and level 2 residual errors were significantly different from zero.