EUROPEAN JOURNAL OF WORK AND ORGANIZATIONAL PSYCHOLOGY
2020, VOL. 29, NO. 5, 664–677
https://doi.org/10.1080/1359432X.2020.1760247

OPEN ACCESS Check for updates

A step away from impaired well-being: a latent growth curve analysis of an intervention with activity trackers among employees

Thomas Lennefer[a], Dorota Reis[b], Elisa Lopper[a] and Annekatrin Hoppe[a]

[a]Department of Psychology, Humboldt University of Berlin, 12489, Berlin, Germany; [b]Saarland University, Campus A2 4, Saarbrücken, Germany

ABSTRACT

The present study evaluated the effectiveness of a workplace intervention combining activity trackers (behavioural approach) with an online coach (cognitive approach) in order to increase employees' number of steps and improve their impaired well-being (i.e., emotional strain and negative affect). To analyse the intervention's effectiveness, the study applied latent growth curve modelling. Moreover, we tested whether work-related and personal resources (i.e., job control and self-efficacy) moderated the intervention's effectiveness and whether an increase in number of steps was associated with an improvement in impaired well-being. During the intervention, data were collected at six measurement points from 108 mainly low active employees. The results revealed that employees increased their number of steps until the second intervention week; this increase was not moderated by job control or self-efficacy. Moreover, the intervention was effective in decreasing emotional strain and negative affect over the course of the intervention. Further analyses showed that the increase in number of steps was related to the decrease in negative affect, whereas no such association was found for the increase in number of steps and the decrease in emotional strain. In conclusion, the findings showed that our intervention was effective in improving physical activity and impaired well-being among employees.

ARTICLE HISTORY
Received 14 August 2019
Accepted 19 April 2020

KEYWORDS
Wearable activity trackers; employees' health; physical activity; eHealth; latent growth curve model (LGCM); workplace health promotion

Introduction

Activity trackers are small electronic devices that can be worn on an individual's body to collect and display health data, such as number of steps, with high validity (Evenson et al., 2015; Hoy, 2016; Huang et al., 2016; Ilhan & Henkel, 2014; Simunek et al., 2016). These devices have become increasingly prominent as a means of improving physical activity, which is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen et al., 1985). As previous research has shown, physical activity is positively related to organizational outcomes such as absenteeism and job satisfaction (Arslan et al., 2019; Fang et al., 2019; Grimani et al., 2019; Parks & Steelman, 2008; Virtanen et al., 2018). Moreover, physical activity affects several well-being outcomes (e.g., stress and negative affect; e.g., Bruin et al., 2017; Conn et al., 2009). Thus, promoting physical activity is desirable from the perspective of the employee as well as the employer.

Particularly, activity trackers seem to be an attractive technology for promoting physical activity due to their accessibility (can be used anywhere, at any time; Borrelli & Ritterband, 2015), which makes them easy to integrate into daily work routines. For this reason, we created a cognitive-behavioural intervention lasting three weeks in total, which aimed to increase physical activity and improve impaired well-being (i.e., emotional strain and negative affect) among employees. The intervention combined activity trackers (behavioural approach) which use common behavioural change techniques such as self-monitoring along with an online coach (cognitive approach) offering advice on how to increase physical activity (e.g., goal setting and planning).

Overall, our study contributes to the existing literature in several ways. First, we tested the effectiveness of a promising technology within a theory-based intervention framework that has rarely been considered in the occupational health promotion context. Furthermore, possible moderators were considered to test whether intervention efficacy depended on work-related (i.e., job control) or personal resources (i.e., self-efficacy). Second, as we recruited at one large company in Germany, we were able to address a specific group of mainly low active employees, which is usually difficult to approach. Finally, data were collected twice a week (Mondays and Fridays) during the intervention, which results in a total of six points of measurement and enabled us to apply latent growth curve modelling (LGCM) to the data. LGCM is a powerful and modern method through which we received a detailed insight into the change of physical activity and impaired well-being during the intervention by modelling flexible growth trajectories (e.g., linear or curvilinear). Moreover, LGCM offers the opportunity to link the growth of one variable (e.g., employees' number of steps) to the growth of another variable (e.g., employees' emotional strain) providing information about the relationship between the variables. Even though LGCM yields new information for intervention research, only few physical activity intervention studies have reported using this technique, and none of them have implemented activity trackers within their interventions (McAuley et al., 1999; Motl et al., 2005; C. Pedersen et al., 2019; Roesch et al., 2010; Staiano et al.,

CONTACT Thomas Lennefer Email thomas.lennefer@hu-berlin.de
Supplemental data for this article can be accessed here.

2013). Hence, our study contributes theoretically and methodically to the existing literature of workplace physical activity intervention studies.

Theoretical background

Enhancing physical activity through activity trackers

Activity trackers are an interesting new technology offering different approaches for increasing motivation to become physically active such as self-monitoring and awareness for health behaviour change (e.g., feedback or gamification elements; Shih et al., 2015; Shuger et al., 2011). Previous research has shown that intrinsic motivation is especially relevant for the maintenance of physical activity (Ryan et al., 1997; Teixeira et al., 2012). According to the Self-Determination Theory (SD-Theory; Ryan, 1982; Ryan & Deci, 2002), motivation is a continuum reaching from amotivation over controlled motivation to autonomous motivation which is the most pure form of intrinsic motivation and therefore most sustainable and desirable. Amotivation is on the one end of the continuum where individuals show no form of extrinsic or intrinsic motivation for certain behaviour (Deci & Ryan, 2008). Individuals who are controlled motivated either perform a behaviour to avoid guilt or obtain social approval or to avoid punishment or obtain a reward (Deci & Ryan, 2008). The most pure form of intrinsic motivation is autonomous motivation where individuals engage in certain behaviour due to experiencing pleasure, obtaining a personal goal, and valuing the outcome of the behaviour (Deci & Ryan, 2008). According to SD-Theory motivation is more autonomous when the three basic psychological needs (i.e., competence, autonomy, and relatedness) are satisfied (Deci et al., 2017; Deci & Ryan, 2000; Vallerand, 1997). Additionally, even extrinsic motives can become more autonomous through the internalization of these motives which is facilitated by meeting the three psychological needs (Ryan, 2009; Ryan & Deci, 2002). Various aspects of activity trackers address these needs. The desire to seek challenges optimally suited to one's capacity (competence; Ryan & Deci, 2002), could be fulfilled by activity trackers through offering a customized activity goal related the user's current activity level. Autonomy refers to the feeling of being the origin of one's own behaviour (Ryan & Deci, 2002), which could be addressed by activity trackers due to the option to individualize activity goals and the information displayed on the activity tracker. Finally, the ability to share achieved activity goals on social networks and to interact with the activity tracker's community could possibly satisfy the need to feel connected to other (relatedness; Ryan & Deci, 2002). Previous research showed that promoting these three basic psychological needs by the activity tracker leads to a higher motivation to use the activity tracker (Rupp et al., 2016, 2018). Thus, it is likely that activity trackers are effective in increasing physical activity by promoting the three basic psychological needs of SD-Theory.

Even though the use of activity trackers seems promising, they have rarely been included in workplace interventions to date. Nevertheless, studies applying activity trackers in other settings have yielded positive results regarding their effect on physical activity. For instance, Cadmus-Bertram et al. (2015) assigned 51 overweight women to two different intervention groups. One group received an activity tracker whereas the other group received a pedometer, which can be seen as a predecessor to activity trackers (i.e., a device that simply tracks steps, providing no further health-related data). The results revealed that participants wearing an activity tracker increased their average number of steps by 789 steps per day, whereas the pedometer group showed no significant increase in number of steps. Further studies have confirmed the positive intervention effect of activity trackers on number of steps in different samples (Abrantes et al., 2017; Finkelstein et al., 2016; Wang et al., 2015). Nevertheless, two studies revealed that the increase in number of steps only occurred in the first weeks of the intervention (O'Brien et al., 2015; Wang et al., 2015). Thus, the increase in number of steps resulting from the use of activity trackers needs to be examined in more detail over an intervention period. Given the evidence set out earlier, we assume:

Hypothesis 1: During the course of the intervention, the number of steps increases.

Work-related and personal resources reinforcing the promotion of physical activity

Given that our intervention will be conducted in a work setting, it is likely that the intervention's efficacy is affected by employees' working conditions. Especially job control seems to be a relevant work-related resource since past research has shown that low job control is positively associated with physical inactivity (Fransson et al., 2012; Griep et al., 2015).

Job control can be defined as the extent to which an employee is able to influence his or her own working conditions, such as the pace of work or the order in which tasks are fulfilled (Semmer et al., 1995). As this definition implies, it is possible that high job control makes it easier for employees to integrate physical activity interventions into their daily work routine. Regarding this assumption, there is encouraging evidence from one qualitative study which evaluated the effectiveness of a treadmill workstation intervention (Cifuentes et al., 2015). Employees reported that they used the treadmill workstation more often if they were working in jobs with higher job control. Thus, it seems that job control is an important resource regarding worksite physical activity interventions.

An important personal resource for health behaviour change is self-efficacy which generally refers to the sense of control over one's environment and behaviour (Schwarzer & Luszczynska, 2007). However, Bandura (2010) proposed that domain-specific self-efficacy (e.g., for physical activity) is desirable when aiming to affect a certain behaviour. Thus, it is possible that employees who believe in their capability to increase their physical activity show a higher amount of physical activity than employees with low self-efficacy regarding physical activity. The Health Action Process Approach (HAPA) by Schwarzer (2008) suggests that self-efficacy is an important factor for different phases of increasing physical activity such as building the intention to become physically active or maintaining physical activity behaviour. Previous research has shown that simply having the intention to become physically active does not sufficiently predict health behaviour change (Rhodes & Bruijn, 2013). According to the HAPA model, self-efficacy may help to bridge the gap between having the intention to become physically active and an actual increase in physical activity (Schwarzer, 2008).

Previous studies support the idea that self-efficacy is an essential factor for enhancing physical activity (Bauman et al., 2012; Prodaniuk et al., 2004; Stutts, 2002; Williams & French, 2011). Conducting a worksite physical activity intervention at two industrial production units, M. M. Pedersen et al. (2013) investigated whether employees with high self-efficacy showed higher intervention compliance than employees with low self-efficacy. The results revealed that employees with high self-efficacy regarding physical activity attended more exercise sessions. Nevertheless, this trend was significant in only one of the two companies. M. M. Pedersen et al. (2013) suggested that working conditions additionally may reinforce or diminish employees' compliance with workplace physical activity interventions. Given the theoretical and empirical evidence, we hypothesize:

Hypothesis 2: Employees having higher job control show a greater increase in number of steps during the intervention than employees with low job control.

Hypothesis 3: Employees having high self-efficacy show a greater increase in number of steps during the intervention than employees with low self-efficacy.

Reducing impaired well-being through physical activity

As indicators for impaired well-being, we used emotional strain and negative affect. Emotional strain is a construct that concentrates solely on the emotional aspect of occupational stress which is defined as an emotionally irritable reaction causing negative interactions between the social environment and the emotionally strained employee (G. Mohr, Müller et al., 2005). Thus, the state of emotional strain occurs if an employee intensely endeavours to achieve a certain goal, but the effort does not result in goal achievement. Due to goal discrepancy, a state of severe mental strain emerges, which can be seen as a direct precursor of depression (G. Mohr et al., 2006).

On the other hand, negative affect reflects the extent to which a person feels various aversive mood states such as anger and nervousness. High negative affect is characterized by a state of distress and unpleasant engagement, whereas people with low negative affect experience a state of calmness and serenity (Watson et al., 1988). Contrary to emotional strain, negative affect is a context-free construct not explicitly focusing on affect displayed within the work setting. Thus, emotional strain and negative affect differ in their relatedness to the work context (work-related vs. general).

We chose emotional strain and negative affect as indicators of impaired well-
being since both constructs are related to important organizational outcomes. For instance, previous studies considering stress indicators (e.g., emotional strain) have shown that employees experiencing stress perform more poorly in their jobs than do employees suffering less from stress (Bashir & Ramay, 2010; Hanif et al., 2011; Jamal, 2011). Moreover, Bowling et al. (2010) showed in a meta-analysis that absence of negative affect is associated with global job satisfaction as well as specific facets such as satisfaction with the work itself, satisfaction with co-workers, and satisfaction with pay. Thus, both constructs need to be addressed with effective interventions conducted at the workplace.

To decrease emotional strain (i.e., stress) and negative affect, promoting physical activity seems to be a promising intervention. According to the transient hypofrontality theory, physical activity is accompanied by an increase in the oxygen supply in the motor and sensory systems of the brain (Dietrich, 2003). Since the oxygen uptake during physical activity remains constant (Ide & Secher, 2000), areas in the prefrontal cortex responsible for cognition and emotions are inhibited. Thus, it is assumed that the diminished activity reduces negative thinking and negative emotional states (Dietrich, 2006; Dietrich & Sparling, 2004) so that consequently physical activity could decrease negative affect and emotional strain.

Previous studies have supported this assumption by showing a negative relationship between physical activity and impaired well-being (Bruin et al., 2017; Hansen et al., 2010; Jonsdottir et al., 2010; Lathia et al., 2017). For instance, Conn et al. (2009) conducted a meta-analysis concentrating on the effectiveness of workplace physical activity interventions to reduce stress. Considering approximately 38,231 subjects, they showed that physical activity effectively decreased job stress with a small effect size ($d = 0.33$). With regard to negative affect, a study by Abrantes et al. (2017) investigated the effect of activity trackers on negative affect in a sample of alcohol-dependent women. Twenty women received an activity tracker which was worn for 12 weeks during the intervention. The results revealed a significant decrease in negative affect whereas there was no significant effect found for positive affect. Based on this evidence, we therefore hypothesize:

Hypothesis 4: During the course of the intervention, employees' emotional strain decrease.

Hypothesis 5: The increase in number of steps is associated with the decrease in employees' emotional strain.

Hypothesis 6: During the course of the intervention, employees' negative affect decrease.

Hypothesis 7: The increase in number of steps is associated with the decrease in employees' negative affect.

Materials and methods

Intervention

The intervention conducted in this study aimed to improve employees' physical activity by combining a behavioural and a cognitive approach. The behavioural approach constituted the activity tracker (i.e., Garmin Vivofit 3). Employees received the activity tracker a few days before the start of the intervention so that they had a chance to accustom themselves to the activity tracker and report possible technical issues. During the intervention, participants were required to wear the activity tracker on their wrist where it collected and monitored health information such as daily steps or energy consumption. Besides providing the health information displayed by the activity tracker, a more detailed summary was presented in the activity tracker's app (i.e., Garmin Connect app). As Shuger et al. (2011) showed, this type of self-monitoring plays a key role in how activity trackers affect health behaviour. In addition to the self-monitoring function, the selected activity tracker has a reminder function, which induces participants to become physically active after an hour of inactivity.

To further raise employees' awareness and motivation to change their behaviour, an online coach was implemented, which constituted the cognitive approach of the intervention. The online coach was a website which provided participants with advice on how to increase their physical activity twice a week (Monday and Friday) over the course of the three weeks of the intervention. Because Taylor et al. (2012) showed that worksite interventions premised on a theoretical foundation are more effective in increasing physical activity among employees, the pieces of advice given by the online coach were based on the HAPA model by Schwarzer (2008) or on current studies (e.g., Bauman et al., 2012; Biagini et al., 2012).

Thus, the first form of advice employees received was a tool for goal setting which required them to set their individual health behaviour goals. As a second step, we asked them to generate a plan as to how they could reach their individual goals. Since the HAPA model states that action planning is essential for intention building, and past research has shown that generating action plans benefits behaviour change (Luszczynska, 2006; Schwarzer, 2008; Wiedemann et al., 2011; Williams & French, 2011), we used this method to motivate employees to increase their physical activity. Further advice by the online coach aimed to support employees in reaching their individual health behaviour goals. For instance, the online coach informed participants about the beneficial effect of coping plans on physical activity (Wiedemann et al., 2011; Ziegelmann et al., 2006). Coping planning is a further method incorporated in the HAPA model (Schwarzer, 2008), which requires individuals to specify the internal and external barriers which prevent them from showing the desired health behaviour (Sniehotta, Schwarzer et al., 2005; Wiedemann et al., 2011). With regard to physical activity, an example of a coping plan could be: "If it is raining and I was planning to go out for a run, I will go to the gym instead." In this example, an anticipated risk situation is linked to a suitable coping response, which helps participants to act according to their intentions (Sniehotta, Schwarzer et al., 2005). Thus, coping plans are important for maintaining a desired health behaviour such as physical activity (Ziegelmann et al., 2006).

Instead of providing advice on physical activity, we conducted a step challenge as a gamification element within the second intervention week of the intervention. The step challenge aimed to increase participants' autonomous and controlled motivation to become physically active by promoting enjoyment and offering a reward (Cugelman, 2013; Deci & Ryan, 2008; Goh & Razikin, 2015; Hamari et al., 2014; Lin et al., 2006; Shameli et al., 2017). It was announced on Monday of the second intervention week and took four days in total. Participants were required to walk more than 40,000 steps within four days, which is a reasonable target for healthy adults (Schneider et al., 2006; Tudor-Locke et al., 2011). A reward was provided for winning the challenge, which required at least 50% of the participants to reach the goal of more than 40,000 steps within the four days. Following the step challenge, the participants received two more pieces of advice on how to increase their physical activity in the last week of the intervention. For a visualization of the intervention procedure, please refer to Figure 1.

Sample and procedure

Before we started recruitment between December 2016 and January 2017, the study was approved by the works council and the data protection officer of the company from which the participants were recruited. Thus, we had to guarantee that confidentiality was given at all times and had to fulfil the data security requirements of the company. Recruitment was conducted within one large mobility company in Germany by using posters, flyers, and an email sent by the executive, which intended to draw employees' attention to a website offering information about the study and the opportunity to register for participation. By advertising the study, the focus was placed explicitly on inactive employees. However, due to the company's requirements, all employees aged 18 or older and not medically required to follow a diet or an activity plan, were eligible to participate. With regard to sample size, we followed the recommendation by Curran et al. (2010) stating that approximately 100 participants are sufficient for applying latent growth curve modelling. Since we expected that some employees would drop out during the study, we recruited

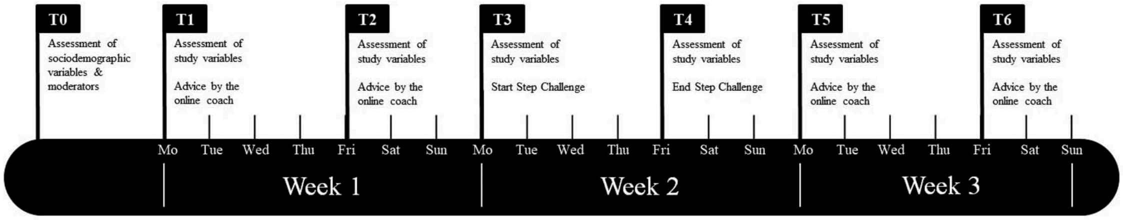

Figure 1. Overview of the intervention procedure and the points of measurements for sociodemographic variables and study variables.

Notes: T0 = 108; T1 = 92; T2 = 71; T3 = 94; T4 = 77; T5 = 93; T6 = 81. **Abbreviations**: T0, Time 0; T1, Time 1; T2, Time 2; T3, Time 3; T4, Time 4; T5, Time 5; T6, Time 6.

a greater number of individuals resulting in a total of 121 employees enlisted for study participation.

Before employees engaged in the intervention activities, we collected their sociodemographic variables and possible moderators (i.e., job control and self-efficacy) in a pre-questionnaire (T0). Next, the intervention was conducted in two waves to which employees were randomly assigned to. The first wave (n = 60) performed the intervention between January and February 2017, whereas the intervention activities of the second wave (n = 61) were started after the employees of the first wave had finished the intervention. To test whether the employees of the two waves differed regarding their sociodemographic variables, we conducted univariate analyses of variance and chi-square tests by using IBM SPSS Statistics 24. The results revealed no significant differences between the sociodemographic variables of the employees of the two waves.

Besides the pre-questionnaire (T0), six questionnaires (T1-T6) assessing the outcome variables (i.e., number of steps, emotional strain, and negative affect) were sent out to the participants on Monday and Friday in each of the three intervention weeks. A visual overview of the study procedure can be found in Figure 1. Employees who completed fewer than two questionnaires during the intervention (T1-T6) were excluded from further analyses so that the final sample consisted of 108 employees. Due to the small number of dropouts (n = 13; 10.74%), no attrition analysis could be conducted. Nevertheless, a comparison of the mean scores of the employees in the final sample and those of the dropouts revealed no major differences regarding their sociodemographic variables.

The employees in the final sample were predominantly male (55.6%), and the age ranged from 19 to 62 years (M = 43.66; SD = 12.56). The majority worked in full-time positions (88.0%) without shift duty (54.6%). Because our goal was to recruit inactive employees, most participants worked in sedentary jobs and showed a low number of steps per day. Thus, 62.0% of the employees in the final sample did not reach the recommended number of more than 10,000 steps per day (Tudor-Locke et al., 2011). Furthermore, 35.9% could even be classified as sedentary or low active according to their daily number of steps (<7,499 steps per day; Tudor-Locke et al., 2008; see Table 1).

Measures

The measures assessed during the intervention (T1-T6) are presented in the following together with the measures of possible moderators included in the pre-questionnaire (T0). At the beginning of each questionnaire, the participants were required to create their personal code to ensure that the different questionnaires they filled in could be matched.

Number of steps

To assess employees' daily number of steps the activity tracker's app (i.e., Garmin Connect app) was used. Due to the data security recruitments of the company from which employees were recruited, we were not allowed to take the number of steps registered by the activity trackers directly from the app. Therefore, employees were required to enter their daily number of steps objectively taken from the app in the six questionnaires during the intervention (T1-T6). Since the number of steps might fluctuate between days, we decided to ask for the number of steps over the past three days to gain more detailed information about the employees' activity level. Thus, the employees reported their daily number of steps over the past three days in each of the six questionnaires. Subsequently, we then aggregated the step counts of the three reported days and calculated the average of number of steps for every measurement point.

Job control

To measure job control, we used the control subscale of the German Instrument for Stress-Oriented Task Analysis (ISTA; Semmer et al., 1995, 1999). The ISTA is a questionnaire focusing on the assessment of stress-related aspects of work. By focusing on the possibility of influencing one's own conditions, the control subscale assesses the decision latitude regarding the pace, the order or the ways in which a task is being carried out (Semmer et al., 1995). Hence, one example item is: "All together, how much possibility for own decision does your job contain?" Overall, the subscale consists of four items with a five-point response scale ranging from 1 (*very little*) to 5 (*very much*). Internal consistency for the job control scale was very good within our sample (Cronbach's α =.82; DeVellis, 2016).

Self-efficacy

To measure self-efficacy, we used a scale specifically related to physical activity (Schwarzer & Luszczynska, 2007; Schwarzer et al., 2007). Based on the HAPA model by Schwarzer (2008), three items were considered, each explicitly focusing on one phase of self-efficacy postulated by the model. Thus, the item for task self-efficacy reads: "I am confident that I am able to be more physically active." Maintenance self-efficacy was assessed with the item: "I am confident to engage in physical activity regularly on a long-term basis, even if I find myself in situations, where this is difficult" and the recovery self-efficacy item reads: "I am confident that I am able to resume performing physical activity, even if I have not been physically active for several days." For each item response alternatives were given on a scale from 1 (*totally disagree*) to 4 (*totally agree*). Based on the participants' ratings, we calculated a global self-efficacy score by aggregating the three items and dividing them by three. The internal consistency for the self-efficacy scale was acceptable within our sample (Cronbach's α = .78; DeVellis, 2016). Additionally, we conducted a confirmatory factor analysis (CFA) including job control and self-efficacy at T0 as two independent but correlated factors. The results showed a good fit for job control and self-efficacy: $\chi^2(103, N = 104) = 18.23$, $p = .149$; CFI = .97; RMSEA = .06; SRMR = .04.

Emotional strain

Emotional strain was measured six times during the intervention (T1-T6). To operationalize emotional strain, we used the five-item emotional irritation subscale of the German version of the Irritation Scale by G. Mohr, Rigotti et al. (2005). The Irritation Scale is a measure that specifically assesses strain in the occupational context. An example item of emotional irritation reads: "When I come home tired after work, I feel rather irritable." (G.

Table 1. Overview of the Sociodemographic Variables and the Activity Level.

Variables		*Mean (Standard Deviation/ %)*
Age		43.66 (12.56)
Min		19
Max		62
Sex		
Female		44.4%
Male		56.6%
Fulltime Work		
Yes		12.0%
No		88.0%
Shift Duty		
Yes		45.4%
No		56.6%
Activity Level (acc. Tudor-Locke et al., 2008)		
Sedentary	(<5,000 Steps per day)	9.8%
Low active	(5,000–7,499 Steps per day)	26.1%
Somewhat active	(7,500–9,999 Steps per day)	26.1%
Active	(10,000–12,499 Steps per day)	22.8%
Highly active	(>12,499 Steps per day)	15.2%

Mohr et al., 2006). On a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), participants rated their individual level of work-related emotional strain. Cronbach's alpha for emotional strain from T1-T6 is presented in Table 2.

Negative affect

Negative affect was measured by implementing the short-form of the positive and negative affect schedule (PANAS) at all six measuring points during the intervention (T1-T6; Krohne et al., 1996; Thompson, 2007; Watson et al., 1988). The participants received a list of five adjectives describing negative emotional states (e.g., upset) and were required to indicate how intensely they had experienced these states within the last two days. The response alternatives were given on a scale from 1 (*never*) to 5 (*always*). Cronbach's alpha for negative affect from T1-T6 is shown in Table 2. Besides the analyses of internal consistency, we conducted a CFA considering emotional strain and negative affect at T1. With regard to the two-factor model with correlated but independent factors, the CFA revealed a good fit for emotional strain and negative affect: $\chi^2(90, N = 91) = 44.35$, $p = .110$; CFI = .95; RMSEA = .06; SRMR = .08.

Statistical analyses

To test the pattern of change proposed in our hypotheses, we used latent growth curve model (LGCM) within the structural equation modelling framework. LGCM is a flexible method for estimating inter-individual variability in intra-individual patterns of change over time (Curran et al., 2010). This involves modelling individual complex trajectories, which can be in a linear or a curvilinear form (Curran et al., 2010). In comparison to traditional methods such as analysis of variance (ANOVA), LGCM can be based on latent variables. By considering latent variables, LGCM renders patterns of change which are free of measurement errors (McArdle, 2009). Additionally, it is possible to consider measurement invariance over time about which traditional methods offer no information.

To test Hypotheses 5 and 7, we used parallel process growth modelling which is a specific form of LGCM which relates the slope of one variable to the slope of another variable so that it is possible to link the growth of one variable to the growth of another variable. Thus, using Mplus version 8 (Muthén & Muthén, 2017), we fitted a total of five latent growth curve models to the data, testing every hypothesis within a separate model. We tested all hypotheses in separate models because testing different hypotheses with one model would result in partial regression coefficients which were not described within our hypotheses. Only Hypotheses 4 and 5 and Hypotheses 6 and 7 were tested within one model, respectively, since these hypotheses included the same variables so that testing them within one model not produced partial regression coefficients. All hypotheses were tested with second-order LGCM using latent variables. For hypothesis 1 only, we used a first-order LGCM due to the manifest nature of the construct number of steps. Second-order LGCMs were computed by building item parcels and estimating strong measurement invariance. As an addition to LGCM, we used latent change score modelling (LCS)

Table 2. Zero-Order Correlations and Reliability of Study Variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Number of Steps T1	-																	
2. Number of Steps T2	.48**	-																
3. Number of Steps T3	.59**	.50**	-															
4. Number of Steps T4	.42**	.50**	.59**	-														
5. Number of Steps T5	.58**	.36**	.63**	.61**	-													
6. Number of Steps T6	.35**	.47**	.61**	.58**	.59**	-												
7. Emotional Strain T1	−.07	.10	.08	−.00	.01	−.04	(.86)											
8. Emotional Strain T2	.10	.10	.15	.21	.11	−.00	.72**	(.90)										
9. Emotional Strain T3	−.10	.21	−.04	−.09	−.05	.01	.76**	.81**	(.91)									
10. Emotional Strain T4	−.06	.26	.05	−.07	−.07	−.01	.77**	.91**	.89**	(.92)								
11. Emotional Strain T5	−.05	.17	−.04	−.11	−.12	.05	.74**	.75**	.88**	.87**	(.92)							
12. Emotional Strain T6	.06	.32*	.19	−.02	.10	−.00	.73**	.72**	.84**	.83**	.81**	(.86)						
13. Negative Affect T1	−.10	.33*	−.05	.07	−.04	.21	.53**	.35**	.52**	.53**	.42**	.47**	(.61)					
14. Negative Affect T2	.12	.23	.09	.32*	.21	.12	.30*	.55**	.46**	.49**	.36**	.34**	.40**	(.77)				
15. Negative Affect T3	−.21	.22	−.11	.01	−.11	.02	.42**	.54**	.68**	.68**	.54**	.51**	.45**	.33**	(.83)			
16. Negative Affect T4	−.03	.19	.05	−.01	−.06	−.02	.57**	.56**	.63**	.69**	.57**	.63**	.38**	.25	.64**	(.77)		
17. Negative Affect T5	.03	.38**	.07	.08	.05	.01	.64**	.54**	.53**	.55**	.64**	.63**	.36**	.36**	.46**	.59**	(.75)	
18. Negative Affect T6	.03	.25	.08	.08	.02	−.03	.62**	.64**	.67**	.78**	.64**	.69**	.50**	.50**	.57**	.72**	.67**	(.80)

Notes: *p <.05. **p <.01.
Abbreviations: T1, Time 1; T2, Time 2; T3, Time 3; T4, Time 4; T5, Time 5; T6, Time 6.

to answer further questions about the intervention efficacy which are not proposed in our hypotheses (e.g., when the intervention begins to have an effect). The results of LCS are presented in the supplementary material.

Within all analyses, full information maximum likelihood (FIML) was used to handle missing data. Additionally, we used the cut-off criteria for the following goodness-of-fit indices by Brown (2006) to approximately evaluate the model fit: Comparative Fit Index (CFI) = close to .95; Root Mean Square Error of Approximation (RMSEA) = close to .06; Standardized Root Mean Square Residual (SRMR) = close to .08. As an interpretation for the relevance of the effects, we used standardized regression coefficients (β). A small effect was taken to be $\beta \leq .1$, a medium effect, $\beta \leq .5$, and a large effect $\beta \geq .5$ (Cohen, 1988). We decided to interpret the standardized regression coefficients because some of our measurements used smaller scales (e.g., emotional strain) whereas other measurements produced scores in the thousands (e.g., number of steps). However, unstandardized regression coefficients of all analyses can be found in Table 3.

Results

The zero-order correlations and Cronbach's alphas are shown in Table 2. The means and standard deviations of all study variables at all points of measurement are presented in Table 3. According to the recommendations of Stride (2014), we first looked at the development of each study variable visually before defining trajectories. Based on the development of each variable, we then defined the trajectories for the growth curve model resulting in one slope for every model. The development of the number of steps, emotional strain, and negative affect are displayed in Figures 2–4. However, regardless of the development of each variable, the intercept was coded with 0 in every model.

Patterns of change in number of steps

Our first hypothesis proposed that employees' number of steps increases during the intervention. Thus, we assumed that we would find a significant slope in a model showing increasing trajectories. To define the trajectories, we first looked at the development of the number of steps. As Figure 2 shows, the number of steps increased during the intervention. The greatest increase was in the second intervention week between T3 and T4 (see Figure 2 and supplementary material). Moreover, the development of the number of steps peaked at T4. To consider this development within the model slope, the trajectories of the growth curve were defined so that they show a linear increase in number of steps until T4 but no further increase afterwards. The defined model fitted the data acceptable, $\chi^2(16, N = 108) = 21.75$, $p = .151$; CFI = .97; RMSEA = .06; SRMR = .10. The model results revealed a significant positive slope with a medium effect size, $\beta = 0.43$, $p = .025$. Thus, with regard to Table 4, on average employees showed a significant increase of 290 steps between points of measurement. However, the analyses showed a significant slope variance, $\sigma^2_{slope} = 0.48$, $p = .045$, indicating that employees differed in their increase in number of steps during the intervention. Furthermore, the significant intercept variance revealed that employees showed a difference in their numbers of steps at the beginning of the intervention ($\sigma^2_{intercept} = 7.941$, $p = .000$). Additionally, the slope and the intercept of the number of steps correlated significantly ($\beta = -0.41$, $p = .028$). Thus, employees who already had a high number of steps at the beginning of the intervention showed a smaller increase in number of steps than did employees with a small number of steps at the beginning of the intervention. Based on these results, Hypothesis 1 was supported.

Table 3. Means and Standard Deviation for Study Variables at All Points of Measurement.

	Means (Standard Deviation)						
Variable	T0	T1	T2	T3	T4	T5	T6
Number of Steps	/	8,973 (3,526)	9,558 (3,291)	9,604 (3,552)	10,311(3,334)	9,705 (3,933)	9,733 (3,294)
Job Control	3.27 (.86)	/	/	/	/	/	/
Self-Efficacy	3.23 (.60)	/	/	/	/	/	/
Emotional Strain	/	2.24 (.96)	2.10 (.96)	2.12 (1.09)	2.04 (1.09)	2.05 (1.13)	1.94 (.90)
Negative Affect	/	1.65 (.55)	1.64 (.65)	1.62 (.73)	1.48 (.60)	1.40 (.52)	1.44 (.55)

Notes: T0 = 108; T1 = 92; T2 = 71; T3 = 94; T4 = 77; T5 = 93; T6 = 81.
Abbreviations: T0, Time 0; T1, Time 1; T2, Time 2; T3, Time 3; T4, Time 4; T5, Time 5; T6, Time 6.

Table 4. Unstandardized Model Results.

	Intercept		Slope		Moderator on Intercept		Moderator on Slope		Slope with Slope	
Variables	*B*	*(p)*	*B*	*(p)*	*B*	*(p)*	*B*	*(p)*	*B*	*(p)*
Number of Steps	9.02	.000**	0.29	.008**	/	/	/	/	/	/
Job Control on Number of Steps	/	/	/	/	0.89	.135	−0.23	.208	/	/
Self-Efficacy on Number of Steps	/	/	/	/	1.50	.084	0.29	.314	/	/
Emotional Strain	1.64	.000**	−0.06	.000**	/	/	/	/	/	/
Number of Steps with Emotional Strain	/	/	/	/	/	/	/	/	−0.01	.394
Negative Affect	2.22	.000**	−0.05	.000**	/	/	/	/	/	/
Number of Steps with Negative Affect	/	/	/	/	/	/	/	/	−0.03	.012*

Notes: *p <.05. **p <.01.
Abbreviation: The indication for number of steps is given in thousands. *B*, unstandardized regression coefficient.

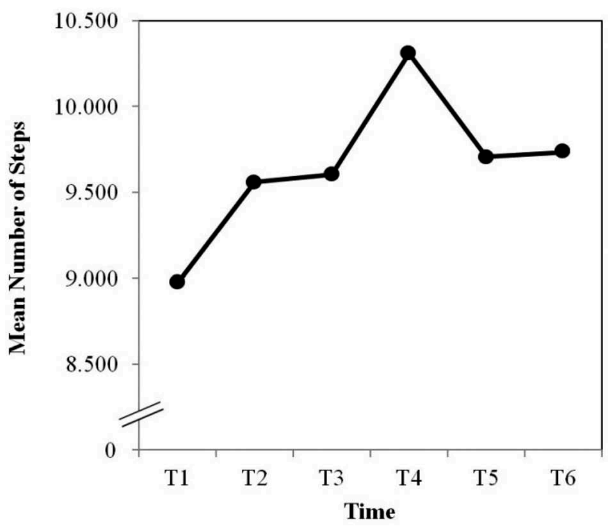

Figure 2. Development of means for number of steps between T1, T2, T3, T4, T5, and T6.

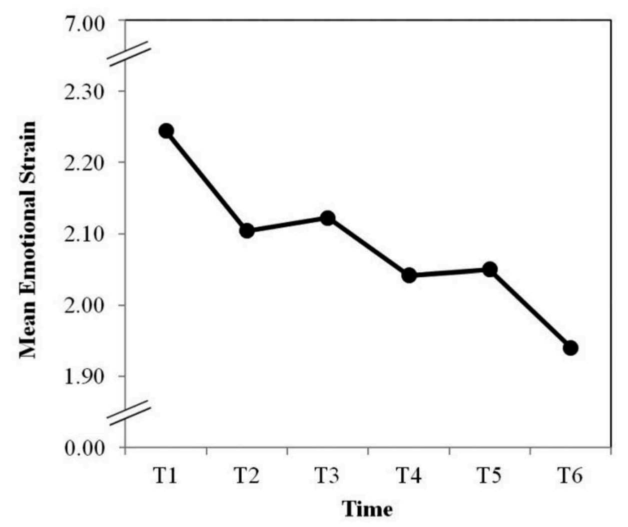

Figure 3. Development of means for emotional strain between T1, T2, T3, T4, T5, and T6.

Patterns of change in number of steps in relation to job control

In the second hypothesis, we assumed that employees with a higher level of job control show a higher increase in number of steps than employees with a low level of job control. Therefore, job control was expected to be significantly associated with the slope representing number of steps. The model showed an adequate fit to the data, $\chi^2(30, N = 108) = 41.55$, $p = .078$; CFI = .95; RMSEA = .06; SRMR = .11. Nevertheless, the analyses revealed an association between the intercept ($\beta = 0.23$, $p = .077$) and the slope of number of steps ($\beta = -0.25$, $p = .277$) with a medium effect size which was not, however, significant. Hence, in our sample, Hypothesis 2 was not supported.

Patterns of change in number of steps in relation to self-efficacy

To test Hypothesis 3, we analysed whether self-efficacy at T0 was related to the slope of the number of steps. The defined model fitted the data sufficiently, $\chi^2(31, N = 108) = 36.72$, $p = .221$; CFI = .97; RMSEA = .04; SRMR = .12. The model results showed a relation to the intercept of the number of steps ($\beta = 0.27$, $p = .073$) and the slope of number of steps ($\beta = 0.21$, $p = .307$) which did not reach significance within our sample. Thus, Hypothesis 3, the assumption that self-efficacy moderates the increase in number of steps, was not supported.

Patterns of change in emotional strain

Hypotheses 4 and 5 were tested within one model, which showed a good fit to the data, $\chi^2(146, N = 108) = 201.52$, $p = .002$; CFI = .96; RMSEA = .06; SRMR = .08. Our fourth hypothesis proposed that emotional strain decreases over the course of the intervention. With regard to Figure 3, we defined the linear trajectories decreasing from T1 to T6 for emotional strain. The model results revealed a significant decrease in emotional strain from T1 to T6 with a large effect size, $\beta = -0.79$, $p = .011$. On average employees decreased their emotional strain by 0.06 points between measurement points on the Irritation Scale by Mohr, G. Mohr, Müller et al. (2005; see Table 4). Given that the slope variance was small, there was no significant variation in the decrease in emotional strain during the intervention ($\sigma^2_{slope} = 0.01$, $p = .094$). However, the model results showed a significant intercept variance, $\sigma^2_{intercept} = 0.92$, $p = .000$, indicating that employees differed in their levels of emotional strain at the beginning of the intervention. Based on the results pointed out earlier, Hypothesis 4 was supported.

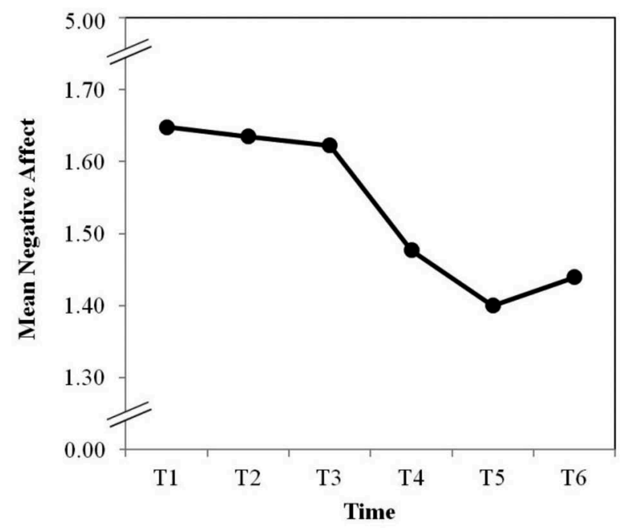

Figure 4. Development of means for negative affect between T1, T2, T3, T4, T5, and T6.

Hypothesis 5 was that the decrease in emotional strain is associated with the increase in number of steps. Hence, we tested whether the slope of the number of steps is related to the slope of emotional strain. The analyses revealed a negative association between the slope of number of steps and the slope of emotional strain with a medium effect size, which did not reach significance within our sample, $\beta = -0.26$, $p = 0.397$. Thus, in our sample, Hypothesis 5 was not supported.

Patterns of change in negative affect

The model to test Hypotheses 6 and 7 showed an adequate model fit to the data, $\chi^2(146, N = 108) = 210.27$, $p = .000$; CFI = .91; RMSEA = .06; SRMR = .11. The sixth hypothesis proposed that negative affect decreases during the intervention. Therefore, we defined decreasing trajectories for the growth model with regard to Figure 4. The analyses revealed a significant negative slope with a large effect size showing that negative affect decreased over the course of the intervention, $\beta = -0.76$, $p = .020$. With regard to Table 4, employees reduced their negative affect by an average of 0.05 points between points of measurement. Additionally, the model showed no significant slope variance ($\sigma^2_{slope} = 0.00$, $p = .136$), which indicates that there is no significant variation in the reduction of negative affect within our sample. Nevertheless, the analyses revealed a significant intercept variance, $\sigma^2_{intercept} = 0.12$, $p = .004$, showing that employees differed in their negative affect at the beginning of the intervention. Given the results pointed out earlier, Hypothesis 6 was supported.

To test Hypothesis 7, which was that the decrease in negative affect is associated with the increase in number of steps, we analysed whether the slope of the number of steps was related to the slope of negative affect. The model results revealed a significant association between the slope of the number of steps and the slope of negative affect with a large effect size, $r = -0.74$, $p = .028$. As shown in Table 4, on average, one unit increase in steps (i.e., 1000 steps) went along with a decrease in employees' negative affect equal to 0.03 points on the PANAS. Thus, Hypothesis 7 was supported.

Discussion

The present study aimed to evaluate the effect of an intervention including activity trackers on employees' number of steps and impaired well-being (i.e., emotional strain and negative affect). By applying LGCM to intervention data collected from mainly low active employees, we were able to obtain a detailed insight into the development of physical activity and impaired well-being during the intervention. Thus, we furthermore tested whether the increase in number of steps was moderated by job control and self-efficacy and if the increase in number of steps was associated with the decrease in impaired well-being. In the following sections, the effect of the cognitive-behavioural intervention on number of steps, emotional strain, and negative affect will be discussed in detail.

Intervention effect on number of steps

In line with previous intervention studies that included activity trackers, the employees in our study showed an increase in number of steps (Abrantes et al., 2017; Cadmus-Bertram et al., 2015; Finkelstein et al., 2016; Wang et al., 2015). By considering six points of measurement during the intervention, we additionally showed that employees' number of steps increased until the end of the second intervention week (T4). This finding confirms the results of the studies by O'Brien et al. (2015) and Wang et al. (2015) showing that number of steps mainly increased in the first weeks of an intervention. It might be possible that this effect was caused by the novelty or initial excitement about the intervention. Nevertheless, this explanation is not very likely because the employees walked more steps at all points of measurement than at the beginning of the intervention. Thus, we rather assume that the step challenge, which we conducted in the second intervention week, was especially effective in motivating employees, which in turn may have caused the pattern of change in number of steps. As previous studies have shown that different social challenges or competitions can be an effective tool for increasing the number of steps (Foster et al., 2010; Leininger et al., 2014; Prestwich et al., 2017), future studies might include a challenge as an extra motivational component to increase employees' physical activity.

Moderation effect of job control and self-efficacy

Contrary to our hypotheses, we could not find an effect of job control or self-efficacy on the increase in employees' number of steps. With regard to job control, this might be because the intervention activities could also be performed away from work. In contrast to our study, Cifuentes et al. (2015) found a positive relationship between intervention effectiveness and high job control used in an intervention which could only be conducted during working hours. Thus, the potential effect of an intervention integrated into daily work routines could be higher for employees with high job control might be reduced in our study because employees might have also performed the intervention outside of work.

In relation to self-efficacy, we also found no significant relation between self-efficacy and the increase in number of steps. It is possible that our intervention alone increased self-efficacy among employees. Since previous studies have shown that behavioural change techniques such as self-monitoring or action planning benefit self-efficacy (Gleeson-Kreig, 2006; Olander et al., 2013; Williams & French, 2011), our intervention might not only have improved physical activity but also have increased self-efficacy. Another possible explanation why we could not find a significant relationship between self-efficacy and employees' increase in number of steps might be that self-efficacy fluctuated over the course of the intervention. We only measured self-efficacy related to physical activity before the intervention (T0). However, previous studies found that 38–63% of the variance in self-efficacy fluctuates on a daily basis (Tims et al., 2011; Xanthopoulou et al., 2008). Thus, it is likely that self-efficacy regarding physical activity also fluctuates over time. Therefore, future studies should include measurements of self-efficacy at the time point when physical activity data are collected.

Intervention effects on impaired well-being

In agreement with our hypotheses, we found a significant improvement in employees' impaired well-being (i.e., emotional strain and negative affect). Thus, our findings confirm the results of previous studies showing that negative affect and stress indicators such as emotional strain can be reduced through workplace interventions related to physical activity (Bruin et al., 2017; Conn et al., 2009). Because the study had a longitudinal design with six points of measurement, we were able to show that employees improved their impaired well-being over the course of the intervention. Further analyses showed that the increase in number of steps was significantly associated with decrease in negative affect, but that no such association could be found for emotional strain. A possible explanation for this finding could be that the Irritation Scale by G. Mohr, Rigotti et al. (2005) which we used to operationalize emotional strain is rather work oriented. As proposed by the triple-match principle (TMP), associations between variables are more likely to be found when concepts are considered to be related to an identical dimension (De Jonge & Dormann, 2003, 2006). Since the number of steps is a rather general variable whereas emotional strain is a work-focused stress indicator, it might be more difficult to find an association between these two variables.

Another explanation for why the observed reduction in emotional strain was not associated with increase in number of steps could be that our intervention included several features which may have reduced employees' emotional strain. In particular, the activity tracker provides various features besides collecting and monitoring information in relation to physical activity (e.g., number of steps and energy consumption) which could also be used to improve other health behaviours. For instance, the activity tracker also provides information about sleep. Previous studies have shown that sleep deprivation is associated with higher stress among employees (Meerlo et al., 2008; Minkel et al., 2012; Schwarz et al., 2018). Thus, it might be possible that employees not only focused on increasing their number of steps but also tried to improve their sleep quality so that the decrease in emotional strain might be caused by other mechanisms. Because we do not have any data on how employees used the features of the activity tracker, future studies should further investigate which features are effective in improving impaired well-being among employees.

Limitations and future research

Our study is not without limitations which will be discussed together with implications for future research in the following. Even though our study design enabled us to apply LGCM to the data, which gave us a detailed insight into the development of physical activity and impaired well-being during the intervention, we did not include a control group in our study. Thus, it is not possible to fully rule out the possibility that the intervention effects were influenced by contextual factors (e.g., time of the year when the study started). To reduce this confounding influence, we conducted the intervention in two randomized groups that participated consecutively in the intervention activities, making the possible influence of the time of year less likely. Nevertheless, future studies should include a control group in their study design so that the influence of contextual factors can be fully excluded. Additionally, we have no information as to whether the employees maintained the improvement in number of steps and impaired well-being after the end of the intervention. Thus, future studies should also examine long-term effects to determine the sustainability of the intervention effects on the considered outcome variables.

One major strength of our study was that we used the activity data collected by the activity tracker to operationalize physical activity. Nevertheless, due to the regulations of the data security policy and the works council of the company in which we recruited participants, this objectively recorded data could only be assessed through self-report. It would be desirable if future studies could take the registered activity data directly from the activity tracker (or the activity tracker's app) to further increase the objectivity of the activity data. Additionally, although overall all measures considered in this study showed a satisfactory reliability, negative affect had a rather low Cronbach's alpha at T1 which may have reduced the precision of this specific measurement at that particular point of measurement.

Since there were no previous studies providing information about the effect sizes yielded by an intervention using equivalent elements (i.e., activity tracker and online coach) in a workplace setting, we were not able to calculate the optimal sample size. However, a meta-analysis evaluating the effect of pedometers (the predecessor of activity trackers; i.e., a device that simply tracks steps, no further health-related data) on the number of steps in a non-workplace setting offers an effect size of 0.84 (Kang et al., 2009). Compared to our study, we found much smaller effect sizes, which, despite having high data quality (e.g., objectively reported activity data) did not reach significance in our sample. This discrepancy is in line with recent research showing that meta-analyses tend to overestimate effect sizes (Kvarven et al., 2019). Thus, researchers planning future studies should note that, in spite of the fact that high-quality data allow for higher precision, and hence power, large sample sizes are still necessary to detect smaller effects. Additionally, the effects found in our study could serve as a guideline for calculating the optimal sample size for future high-powered replication studies. Furthermore, given the considerable slope variance in our study, future studies having larger sample size could also use latent class analysis (LCA) for identifying groups of employees who are similar in their behaviour change during the intervention (Nylund et al., 2007). Explaining these latent classes could be an interesting research question for future studies.

Another possible limitation of our study might be that the generalizability of our results could be reduced because the sample was recruited from only one company in Germany. However, by recruiting from one large company in Germany, we were able to access a population of mainly low active employees which is rarely considered in intervention studies. Nevertheless, future studies should question whether an intervention with activity trackers is suitable for improving physical activity and health in a different population. It is possible that increasing self-monitoring of health data through activity trackers among healthy employees, who are already physically active, is less effective than among mainly low active employees.

Practical implications and conclusion

The results of our study show that the use of activity trackers supported by a cognitive approach benefits employees' physical activity and impaired well-being (i.e., emotional strain and negative affect). Because these outcomes are related to employees' job satisfaction, absenteeism, and performance (Bashir & Ramay, 2010; Bowling et al., 2010; Leontaridi & Ward, 2002; Parks & Steelman, 2008; Shockley et al., 2012), we created an intervention that is highly valuable for employers as well as employees. Given that activity trackers are not expensive and that the online coach could be programmed at a relatively low cost, the intervention is a cost-effective approach to improve physical activity and impaired well-being in the work setting. Moreover, activity trackers are easily accessible (can be used anywhere, at any time; Borrelli & Ritterband, 2015), so that they constitute a cost-effective new technology which can possibly be used by employees doing different jobs. However, although we did not find a moderation effect of job control, a health-oriented working environment could help employees to reach the recommended activity goals (Fransson et al., 2012; Griep et al., 2015; Heikkilä et al., 2013). Thus, practitioners need to focus on creating a health-oriented workplace as well as promoting effective interventions, such as the one presented in this study, to improve health among employees.

In summary, our study reveals that employees performing the cognitive-behavioural intervention showed an increase in number of steps taken with a medium effect size and an improvement in impaired well-being (i.e., emotional strain and negative affect) with a large effect size. Moreover, job control and self-efficacy did not seem to have an influence on the increase in the number of steps within our sample. Additionally, this study contributes to the existing literature on workplace physical activity interventions by analysing the development of physical activity, emotional strain, and negative affect during an intervention. We showed that employees increased their number of steps up to the second intervention week and that the general increase in number of steps over the course of the intervention was not related to the decrease in emotional strain but significantly associated with the decrease in negative affect. Overall, we therefore conclude that the use of activity trackers combined with a cognitive approach constitutes an effective intervention to improve physical activity and impaired well-being among employees.

Acknowledgments

We would like to thank Tim Vahle–Hinz for reading a former version of the manuscript and his helpful feedback. Additionally, we acknowledge support by the Open Access Publication Fund of Humboldt–Universität zu Berlin.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the DFG Forschergruppe "Social stress as a cause for abnormal eating behaviour and body weight change" [0220040399].

References

Abrantes, A. M., Blevins, C. E., Battle, C. L., Read, J. P., Gordon, A. L., & Stein, M. D. (2017). Developing a fitbit-supported lifestyle physical activity intervention for depressed alcohol dependent women. *Journal of Substance Abuse Treatment*, *80*, 88–97. https://doi.org/10.1016/j.jsat.2017.07.006

Arslan, S. S., Alemdaroğlu, İ., Karaduman, A. A., & Yilmaz, Ö. T. (2019). The effects of physical activity on sleep quality, job satisfaction, and quality of life in office workers. *Work (Reading, Mass.)*, *63*(1), 3–7. https://doi.org/10.3233/WOR-192902

Bandura, A. (2010). Self-efficacy. In I. B. Weiner, W. E. Craighead, & R. J. Corsini (Eds.), *The corsini encyclopedia of psychology* (4th ed., pp. 1534–1536). Wiley.

Bashir, U., & Ramay, M. I. (2010). Impact of stress on employees job performance a study on banking sector of pakistan. *International Journal of Marketing Studies*, *2*(1), 122–126. https://doi.org/10.5539/ijms.v2n1p122

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J. F., & Martin, B. W. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet*, *380*(9838), 258–271. https://doi.org/10.1016/S0140-6736(12)60735-1

Biagini, M. S., Brown, L. E., Coburn, J. W., Judelson, D. A., Statler, T. A., Bottaro, M., … Longo, N. A. (2012). Effects of self-selected music on strength, explosiveness, and mood. *Journal of Strength and Conditioning Research*, *26*(7), 1934–1938. https://doi.org/10.1519/JSC.0b013e318237e7b3

Borrelli, B., & Ritterband, L. M. (2015). Special issue on eHealth and mHealth: challenges and future directions for assessment, treatment, and dissemination. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, *34*(Suppl), 1205–1208. https://doi.org/10.1037/hea0000323

Bowling, N. A., Eschleman, K. J., & Wang, Q. (2010). A meta-analytic examination of the relationship between job satisfaction and subjective well-being. *Journal of Occupational and Organizational Psychology*, *83*(4), 915–934. https://doi.org/10.1348/096317909X478557

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. The Guilford Press.

Bruin, E. I., De, Formsma, A. R., Frijstein, G., & Bögels, S. M. (2017). Mindful2Work: effects of combined physical exercise, yoga, and mindfulness meditations for stress relieve in employees. a proof of concept study. *Mindfulness*, *8*(1), 204–217. https://doi.org/10.1007/s12671-016-0593-x

Cadmus-Bertram, L. A., Marcus, B. H., Patterson, R. E., Parker, B. A., & Morey, B. L. (2015). Randomized trial of a fitbit-based physical activity intervention for women. *American Journal of Preventive Medicine*, *49*(3), 414–418. https://doi.org/10.1016/j.amepre.2015.01.020

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports*, *100* (2), 126–131. *Washington, D.C.: 1974*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1424733/

Cifuentes, M., Qin, J., Fulmer, S., & Bello, A. (2015). Facilitators and barriers to using treadmill workstations under real working conditions: A qualitative study in female office workers. *American Journal of Health Promotion: AJHP*, *30*(2), 93–100. https://doi.org/10.4278/ajhp.140123-QUAL-43

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2. ed.). Erlbaum.

Conn, V. S., Hafdahl, A. R., Cooper, P. S., Brown, L. M., & Lusk, S. L. (2009). Meta-analysis of workplace physical activity interventions. *American Journal of Preventive Medicine*, *37*(4), 330–339. https://doi.org/10.1016/j.amepre.2009.06.008

Cugelman, B. (2013). Gamification: what it is and why it matters to digital health behavior change developers. *JMIR Serious Games*, *1*(1), e3. https://doi.org/10.2196/games.3139

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. *Journal of Cognition and Development: Official Journal of the Cognitive Development Society*, *11*(2), 121–136. https://doi.org/10.1080/15248371003699969

De Jonge, J., & Dormann, C. (2003). The DISC model: demand-induced strain compensation mechanisms in job stress. In M. F. Dollard & A. H. Winefield (Eds.), *Occupational stress in the service professions* (pp. 43–74). Taylor & Francis.

De Jonge, J., & Dormann, C. (2006). Stressors, resources, and strain at work: A longitudinal test of the triple-match principle. *The Journal of Applied Psychology*, *91*(6), 1359–1374. https://doi.org/10.1037/0021-9010.91.5.1359

Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: the state of a science. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*(1), 19–43. https://doi.org/10.1146/annurev-orgpsych-032516-113108

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie Canadienne*, *49*(3), 182–185. https://doi.org/10.1037/a0012801

DeVellis, R. F. (2016). Scale development: theory and applications. In Fourth edition, *Applied social research methods series* (Vol. 26, 108–110).SAGE Publication

Dietrich, A. (2003). Functional neuroanatomy of altered states of consciousness: the transient hypofrontality hypothesis. *Consciousness and Cognition*, *12*(2), 231–256. https://doi.org/10.1016/S1053-8100(02)00046-6

Dietrich, A. (2006). Transient hypofrontality as a mechanism for the psychological effects of exercise. *Psychiatry Research*, *145*(1), 79–83. https://doi.org/10.1016/j.psychres.2005.07.033

Dietrich, A., & Sparling, P. B. (2004). Endurance exercise selectively impairs prefrontal-dependent cognition. *Brain and Cognition*, *55*(3), 516–524. https://doi.org/10.1016/j.bandc.2004.03.002

Evenson, K. R., Goto, M. M., & Furberg, R. D. (2015). Systematic review of the validity and reliability of consumer-wearable activity trackers. *The International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 159. https://doi.org/10.1186/s12966-015-0314-1

Fang, -Y.-Y., Huang, C.-Y., & Hsu, M.-C. (2019). Effectiveness of a physical activity program on weight, physical fitness, occupational stress, job satisfaction and quality of life of overweight employees in high-tech industries: A randomized controlled study. *International Journal of Occupational Safety and Ergonomics: JOSE*, *25*(4), 621–629. https://doi.org/10.1080/10803548.2018.1438839

Finkelstein, E. A., Haaland, B. A., Bilger, M., Sahasranaman, A., Sloan, R. A., Nang, E. E. K., & Evenson, K. R. (2016). Effectiveness of activity trackers with and without incentives to increase physical activity (TRIPPA): A randomised controlled trial. *The Lancet Diabetes & Endocrinology*, *4*(12), 983–995. https://doi.org/10.1016/S2213-8587(16)30284-4

Foster, D., Linehan, C., Kirman, B., Lawson, S., & James, G. (2010). Motivating physical activity at work. In A. Lugmayr, H. Franssila, O. Sotamaa, C. Safran, & T. Aaltonen (Eds.), *Proceedings of the 14th international academic mindtrek conference envisioning future media environments* (p. 111). New York, NY: ACM. https://doi.org/10.1145/1930488.1930510

Fransson, E. I., Heikkilä, K., Nyberg, S. T., Zins, M., Westerlund, H., Westerholm, P., … Kivimäki, M. (2012). Job strain as a risk factor for leisure-time physical inactivity: an individual-participant meta-analysis of up to 170,000 men and women: The IPD-work consortium. *American Journal of Epidemiology*, *176*(12), 1078–1089. https://doi.org/10.1093/aje/kws336

Gleeson-Kreig, J. M. (2006). Self-monitoring of physical activity: effects on self-efficacy and behavior in people with type 2 diabetes. *The Diabetes Educator*, *32*(1), 69–77. https://doi.org/10.1177/0145721705284285

Goh, D. H.-L., & Razikin, K. (2015). Is gamification effective in motivating exercise? In M. Kurosu (Ed.), *Lecture notes in computer science information systems and applications, incl. Internet/web, and HCI: vol. 9170. human-computer interaction: 17th international conference, HCI international 2015, Los Angeles, CA, USA*, August 2–7; proceedings (pp. 608–617). Cham: Springer.

Griep, R. H., Nobre, A. A., Alves, M. G. D. M., da Fonseca, M. D. J. M., Cardoso, L. D. O., Giatti, L., & Chor, D. (2015). Job strain and unhealthy lifestyle: results from the baseline cohort study, Brazilian longitudinal study of adult health (ELSA-Brasil). *BMC Public Health*, *15*(1), 309. https://doi.org/10.1186/s12889-015-1626-4

Grimani, A., Aboagye, E., & Kwak, L. (2019). The effectiveness of workplace nutrition and physical activity interventions in improving productivity, work performance and workability: A systematic review. *BMC Public Health*, *19*(1), 1676. https://doi.org/10.1186/s12889-019-8033-1 Thttps://doi.org/10.1136/oemed-2018-ICOHabstracts.1116

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? – a literature review of empirical studies on gamification. In *47th Hawaii international conference on system sciences* (pp. 3025–3034), Waikoloa: IEEE. https://doi.org/10.1109/HICSS.2014.377

Hanif, R., Tariq, S., & Nadeem, M. (2011). Personal and job related predictors of teacher stress and job performance among school teachers. *Pakistan Journal of Commerce and Social Sciences*, *5*(2), 319–329. http://hdl.handle.net/10419/188034

Hansen, A. M., Blangsted, A. K., Hansen, E. A., Søgaard, K., & Sjøgaard, G. (2010). Physical activity, job demand-control, perceived stress-energy, and salivary cortisol in white-collar workers. *International Archives of Occupational and Environmental Health*, *83*(2), 143–153. https://doi.org/10.1007/s00420-009-0440-7

Heikkilä, K., Fransson, E. I., Nyberg, S. T., Zins, M., Westerlund, H., Westerholm, P., … Kivimäki, M. (2013). Job strain and health-related lifestyle: Findings from an individual-participant meta-analysis of 118,000 working adults. *American Journal of Public Health*, *103*(11), 2090–2097. https://doi.org/10.2105/AJPH.2012.301090

Hoy, M. B. (2016). Personal activity trackers and the quantified self. *Medical Reference Services Quarterly*, *35*(1), 94–100. https://doi.org/10.1080/02763869.2016.1117300

Huang, Y., Xu, J., Yu, B., & Shull, P. B. (2016). Validity of FitBit, Jawbone UP, Nike+ and other wearable devices for level and stair walking. *Gait & Posture*, *48*, 36–41. https://doi.org/10.1016/j.gaitpost.2016.04.025

Ide, K., & Secher, N. H. (2000). Cerebral blood flow and metabolism during exercise. *Progress in Neurobiology*, *61*(4), 397–414. https://doi.org/10.1016/S0301-0082(99)00057-X

Ilhan, A., & Henkel, M. (2014). 10,000 steps a day for health? user-based evaluation of wearable activity trackers. In *47th Hawaii international conference on system sciences*., Waikoloa:IEEE. https://doi.org/10.24251/HICSS.2018.428

Jamal, M. (2011). Job stress, job performance and organizational commitment in a multinational company: an empirical study in two countries. *International Journal of Business and Social Science*, *2*(20), 20–29.

Jonsdottir, I. H., Rödjer, L., Hadzibajramovic, E., Börjesson, M., & Ahlborg, G. (2010). A prospective study of leisure-time physical activity and mental health in Swedish health care workers and social insurance officers. *Preventive Medicine*, *51*(5), 373–377. https://doi.org/10.1016/j.ypmed.2010.07.019

Kang, M., Marshall, S. J., Barreira, T. V., & Lee, J.-O. (2009). Effect of pedometer-based physical activity interventions: A meta-analysis. *Research Quarterly for Exercise and Sport*, *80*(3), 648–655. https://doi.org/10.1080/02701367.2009.10599604

Krohne, H. W., Egloff, B., Kohlmann, C.-W., & Tausch, A. (1996). Untersuchungen mit einer deutschen Version der „Positive and Negative Affect Schedule" (PANAS). *Diagnostica*, *42*(2), 139–156. https://doi.org/10.1037/t49650-000

Kvarven, A., Strømland, E., & Johannesson, M. (2019). Comparing meta-analyses and preregistered multiple-laboratory replication projects. *Nature Human Behaviour*, Advance online publication, 4, 423–434. https://doi.org/10.1038/s41562-019-0787-z

Lathia, N., Sandstrom, G. M., Mascolo, C., & Rentfrow, P. J. (2017). Happier people live more active lives: using smartphones to link happiness and physical activity. *PloS One*, *12*(1), e0160589. https://doi.org/10.1371/journal.pone.0160589

Leininger, L., Orozco, B., & Adams, K. J. (2014). Evaluation of a worksite based walking competition on perceived stress and physical activity level among female university employees. *Journal of Fitness Research*, *1* (3), 32–38.

Leontaridi, M. R., & Ward, E. M. (2002). Work-related stress, quitting intentions and absenteeism. *IZA Discussion Paper*, *2*(493), 1–25. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=314207

Lin, J. J., Mamykina, L., Lindtner, S., Delajoux, G., & Strub, H. B. (2006). Fish'n'Steps: encouraging physical activity with an interactive computer game. In D. Hutchison, T. Kanade, J. Kittler, J. M. Kleinberg, F. Mattern, J. C. Mitchell, & A. Friday (Eds.), *Lecture notes in computer science. ubicomp 2006: ubiquitous computing* (Vol. 4206, pp. 261–278). Springer Berlin Heidelberg. https://doi.org/10.1007/11853565_16

Luszczynska, A. (2006). An implementation intentions intervention, the use of a planning strategy, and physical activity after myocardial infarction. *Social Science & Medicine (1982)*, *62*(4), 900–908. https://doi.org/10.1016/j.socscimed.2005.06.043

McArdle, J. J. (2009). Latent variable modeling of differences and changes with longitudinal data. *Annual Review of Psychology*, *60*(1), 577–605. https://doi.org/10.1146/annurev.psych.60.110707.163612

McAuley, E., Katula, J., Mihalko, S. L., Blissmer, B., Duncan, T. E., Pena, M., & Dunn, E. (1999). Mode of physical activity and self-efficacy in older adults: a latent growth curve analysis. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *54*(5), 283–292. https://doi.org/10.1093/geronb/54B.5.P283

Meerlo, P., Sgoifo, A., & Suchecki, D. (2008). Restricted and disrupted sleep: effects on autonomic function, neuroendocrine stress systems and stress responsivity. *Sleep Medicine Reviews*, *12*(3), 197–210. https://doi.org/10.1016/j.smrv.2007.07.007

Minkel, J. D., Banks, S., Htaik, O., Moreta, M. C., Jones, C. W., McGlinchey, E. L., ... Dinges, D. F. (2012). Sleep deprivation and stressors: Evidence for elevated negative affect in response to mild stressors when sleep deprived. *Emotion*, *12*(5), 1015–1020. https://doi.org/10.1037/a0026871

Mohr, G., Müller, A., & Rigotti, T. (2005). Normwerte der Skala Irritation: Zwei Dimensionen psychischer Beanspruchung1. *Diagnostica*, *51*(1), 12–20. https://doi.org/10.1026/0012-1924.51.1.12

Mohr, G., Müller, A., Rigotti, T., Aycan, Z., & Tschan, F. (2006). The assessment of psychological strain in work contexts. *European Journal of Psychological Assessment*, *22*(3), 198–206. https://doi.org/10.1027/1015-5759.22.3.198

Mohr, G., Rigotti, T., & Müller, A. (2005). Irritation - ein Instrument zur Erfassung psychischer Beanspruchung im Arbeitskontext. Skalen- und Itemparameter aus 15 Studien. *Zeitschrift für Arbeits- und Organisationspsychologie A&O*, *49*(1), 44–48. https://doi.org/10.1026/0932-4089.49.1.44

Motl, R. W., Konopack, J. F., McAuley, E., Elavsky, S., Jerome, G. J., & Marquez, D. X. (2005). Depressive symptoms among older adults: long-term reduction after a physical activity intervention. *Journal of Behavioral Medicine*, *28*(4), 385–394. https://doi.org/10.1007/s10865-005-9005-5

Muthén, L. K., & Muthén, B. O. (2017). *Mplus 8 user's guide: statistical analysis with latent variables*.

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: a monte carlo simulation study. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*(4), 535–569. https://doi.org/10.1080/10705510701575396

O'Brien, T., Troutman-Jordan, M., Hathaway, D., Armstrong, S., & Moore, M. (2015). Acceptability of wristband activity trackers among community dwelling older adults. *Geriatric Nursing*, *36*(2), 21–25. https://doi.org/10.1016/j.gerinurse.2015.02.019

Olander, E. K., Fletcher, H., Williams, S., Atkinson, L., Turner, A., & French, D. P. (2013). What are the most effective techniques in changing obese individuals' physical activity self-efficacy and behaviour: A systematic review and meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity*, *10*(29), 29. https://doi.org/10.1186/1479-5868-10-29

Parks, K. M., & Steelman, L. A. (2008). Organizational wellness programs: A meta-analysis. *Journal of Occupational Health Psychology*, *13*(1), 58–68. https://doi.org/10.1037/1076-8998.13.1.58

Pedersen, C., Halvari, H., Solstad, B. E., & Bentzen, M. (2019). Longitudinal trajectories of physical activity among employees participating in a worksite health promotion intervention: A latent class growth approach. *Psychology of Sport and Exercise*, *43*, 311–320. https://doi.org/10.1016/j.psychsport.2019.03.007

Pedersen, M. M., Zebis, M. K., Langberg, H., Poulsen, O. M., Mortensen, O. S., Jensen, J. N., ... Andersen, L. L. (2013). Influence of self-efficacy on compliance to workplace exercise. *International Journal of Behavioral Medicine*, *20*(3), 365–370. https://doi.org/10.1007/s12529-012-9239-0

Prestwich, A., Conner, M., Morris, B., Finlayson, G., Sykes-Muskett, B., & Hurling, R. (2017). Do web-based competitions promote physical activity? Randomized controlled trial. *Psychology of Sport and Exercise*, *29*, 1–9. https://doi.org/10.1016/j.psychsport.2016.11.003

Prodaniuk, T. R., Plotnikoff, R. C., Spence, J. C., & Wilson, P. M. (2004). The influence of self-efficacy and outcome expectations on the relationship between perceived environment and physical activity in the workplace. *The International Journal of Behavioral Nutrition and Physical Activity*, *1*(1), 7. https://doi.org/10.1186/1479-5868-1-7

Rhodes, R. E., & Bruijn, G.-J. D. (2013). How big is the physical activity intention-behaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology*, *18*(2), 296–309. https://doi.org/10.1111/bjhp.12032

Roesch, S. C., Norman, G. J., Villodas, F., Sallis, J. F., & Patrick, K. (2010). Intervention-mediated effects for adult physical activity: A latent growth curve analysis. *Social Science & Medicine (1982)*, *71*(3), 494–501. https://doi.org/10.1016/j.socscimed.2010.04.032

Rupp, M. A., Michaelis, J. R., McConnell, D. S., & Smither, J. A. (2016). The impact of technological trust and self-determined motivation on intentions to use wearable fitness technology. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *60*(1), 1434–1438. https://doi.org/10.1177/1541931213601329

Rupp, M. A., Michaelis, J. R., McConnell, D. S., & Smither, J. A. (2018). The role of individual differences on perceptions of wearable fitness device trust, usability, and motivational impact. *Applied Ergonomics*, *70*, 77–87. https://doi.org/10.1016/j.apergo.2018.02.005

Ryan, R. M. (1982). Control and information in the intrapersonal sphere: an extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, *43*(3), 450–461. https://doi.org/10.1037/0022-3514.43.3.450

Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: an organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). University of Rochester Press.

Ryan, R. M. (2009). *Self-determination theory and wellbeing. retrieved from wellbeing in developing countries research (wed) website*: https://richarddehoop.nl/upload/file/self-determination.pdf

Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology*, *28*(4), 335–354.

Schneider, P. L., Bassett, D. R., Thompson, D. L., Pronk, N. P., & Bielak, K. M. (2006). Effects of a 10,000 steps per day goal in overweight adults. *American Journal of Health Promotion: AJHP*, *21*(2), 85–89. https://doi.org/10.4278/0890-1171-21.2.85

Schwarz, J., Gerhardsson, A., van Leeuwen, W., Lekander, M., Ericson, M., Fischer, H., ... Åkerstedt, T. (2018). Does sleep deprivation increase the vulnerability to acute psychosocial stress in young and older adults? *Psychoneuroendocrinology*, *96*, 155–165. https://doi.org/10.1016/j.psyneuen.2018.06.003

Schwarzer, R., & Luszczynska, A. (2007). Self-efficacy. In M. Gerrard & K. D. McCaul (Eds.), Health behavior constructs: Theory,measurement, and research: National Cancer Institute Website.https://cancercontrol.cancer.gov/brp/research/constructs/self-efficacy.pdf.

Schwarzer, R. (2008). Modeling health behavior change: how to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology*, *57*(1), 1–29. https://doi.org/10.1111/j.1464-0597.2007.00325.x

Schwarzer, R., Schüz, B., Ziegelmann, J. P., Lippke, S., Luszczynska, A., & Scholz, U. (2007). Adoption and maintenance of four health behaviors: Theory-guided longitudinal studies on dental flossing, seat belt use, dietary behavior, and physical activity. *Annals of Behavioral Medicine*, *33*(2), 156–166. https://doi.org/10.1007/BF02879897

Semmer, N., Zapf, D., & Dunckel, H. (1995). Assessing stress at work: A framework and an instrument. In O. Svane & C. Johansen (Eds.), *Work and health - scientific basis of progress in the working environment* (pp. 105–113). Office for Official Publications of the European Communities.

Semmer, N., Zapf, D., & Dunckel, H. (1999). Instrument zur Stressbezogenen Tätigkeitsanalyse (ISTA) [Stress-oriented Task Analysis]. In H. Dunckel (Ed.), *Handbuch psychologischer Arbeitsanalyseverfahren* (pp. 176–204). vdf Hochschulverlag.

Shameli, A., Althoff, T., Saberi, A., & Leskovec, J. (2017, April). How gamification affects physical activity. In R. Barrett (Ed.), *Proceedings of the 26th international conference on world wide web companion* (pp. 455–463), Perth: New York: Association for Computing Machinery. https://doi.org/10.1145/3041021.3054172

Shih, P. C., Han, K., Poole, E. S., Rosson, M. B., & Carroll, J. M. (2015). *Use and adoption challenges of wearable activity trackers*. Newport Beach.

Shockley, K. M., Ispas, D., Rossi, M. E., & Levine, E. L. (2012). A meta-analytic investigation of the relationship between state affect, discrete emotions, and job performance. *Human Performance*, *25*(5), 377–411. https://doi.org/10.1080/08959285.2012.721832

Shuger, S. L., Barry, V. W., Sui, X., McClain, A., Hand, G. A., Wilcox, S., … Blair, S. N. (2011). Electronic feedback in a diet- and physical activity-based lifestyle intervention for weight loss: A randomized controlled trial. *The International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 41. https://doi.org/10.1186/1479-5868-8-41

Simunek, A., Dygryn, J., Gaba, A., Jakubec, L., Stelzer, J., & Chmelik, F. (2016). Validity of garmin vivofit and polar loop for measuring daily step counts in free-living conditions in adults. *Acta Gymnica*, *46*(3), 129–135. https://doi.org/10.5507/ag.2016.014

Sniehotta, F. F., Schwarzer, R., Scholz, U., & Schüz, B. (2005). Action planning and coping planning for long-term lifestyle change: Theory and assessment. *European Journal of Social Psychology*, *35*(4), 565–576. https://doi.org/10.1002/ejsp.258

Staiano, A. E., Abraham, A. A., & Calvert, S. L. (2013). Adolescent exergame play for weight loss and psychosocial improvement: a controlled physical activity intervention. *Obesity*, *21*(3), 598–601. https://doi.org/10.1038/oby.2012.143

Stride, C. (2014). *Latent growth curve modelling using mplus*. University of Sheffield

Stutts, W. C. (2002). Physical activity determinants in adults: perceived benefits, barriers, and self efficacy. *AAOHN Journal*, *50*(11), 499–507. https://doi.org/10.1177/216507990205001106

Taylor, N., Conner, M., & Lawton, R. (2012). The impact of theory on the effectiveness of worksite physical activity interventions: A meta-analysis and meta-regression. *Health Psychology Review*, *6*(1), 33–73. https://doi.org/10.1080/17437199.2010.533441

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *The International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 78. https://doi.org/10.1186/1479-5868-9-78

Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the positive and negative affect schedule (PANAS). *Journal of Cross-cultural Psychology*, *38*(2), 227–242. https://doi.org/10.1177/0022022106297301

Tims, M., Bakker, A. B., & Xanthopoulou, D. (2011). Do transformational leaders enhance their followers' daily work engagement? *The Leadership Quarterly*, *22*(1), 121–131. https://doi.org/10.1016/j.leaqua.2010.12.011

Tudor-Locke, C., Craig, C. L., Brown, W. J., Clemes, S. A., Cocker, K. D., Giles-Corti, B., & Hatano. (2011). How many steps/day are enough? For adults. *The International Journal of Behavioral Nutrition and Physical Activity*, *8* (79), 1–19. https://doi.org/10.1186/1479-5868-8-79

Tudor-Locke, C., Hatano, Y., Pangrazi, R. P., & Kang, M. (2008). Revisiting "how many steps are enough?". *Medicine and Science in Sports and Exercise*, *40*(7 Suppl), 537–543. https://doi.org/10.1249/MSS.0b013e31817c7133

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. P. Zanna (Eds.), *Advances in experimental social psychology* (Vol. 29, pp. 271–360). Elsevier. https://doi.org/10.1016/S0065-2601(08)60019-2

Virtanen, M., Ervasti, J., Head, J., Oksanen, T., Salo, P., Pentti, J., … Kivimäki, M. (2018). Lifestyle factors and risk of sickness absence from work: A multicohort study. *The Lancet Public Health*, *3*(11), e545–e554. https://doi.org/10.1016/S2468-2667(18)30201-9

Wang, J. B., Cadmus-Bertram, L. A., Natarajan, L., White, M. M., Madanat, H., Nichols, J. F., … Pierce, J. P. (2015). Wearable sensor/device (fitbit one) and sms text-messaging prompts to increase physical activity in overweight and obese adults: a randomized controlled trial. *Telemedicine Journal and E-Health: The Official Journal of the American Telemedicine Association*, *21*(10), 782–792. https://doi.org/10.1089/tmj.2014.0176

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Wiedemann, A. U., Lippke, S., Reuter, T., Ziegelmann, J. P., & Schüz, B. (2011). The more the better? the number of plans predicts health behaviour change. *Applied Psychology. Health and Well-being*, *3*(1), 87–106. https://doi.org/10.1111/j.1758-0854.2010.01042.x

Williams, S. L., & French, D. P. (2011). What are the most effective intervention techniques for changing physical activity self-efficacy and physical activity behaviour—and are they the same? *Health Education Research*, *26*(2), 308–322. https://doi.org/10.1093/her/cyr005

Xanthopoulou, D., Bakker, A. B., Heuven, E., Demerouti, E., & Schaufeli, W. B. (2008). Working in the sky: A diary study on work engagement among flight attendants. *Journal of Occupational Health Psychology*, *13*(4), 345–356. https://doi.org/10.1037/1076-8998.13.4.345

Ziegelmann, J. P., Lippke, S., & Schwarzer, R. (2006). Adoption and maintenance of physical activity: planning interventions in young, middle-aged, and older adults. *Psychology & Health*, *21*(2), 145–163. https://doi.org/10.1080/1476832050018891