Title: Pilot testing of a personalised digital intervention to improve sedentary behaviour and wellbeing in the workplace

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Manuscript word count: 4673 words (excl title page, abstract, declarations and references)

Abstract word count: 247 words

Abstract:

Welbot is a cross-platform, personalised, digital intervention that delivers regular nudges to reduce sedentary behaviour and improve mental wellbeing at work. **Objective:** To explore the effect of the Welbot intervention on sedentary behaviour and mental wellbeing. **Methods:** A single arm repeated measures trial was conducted over three weeks of intervention delivery. The primary outcome was sedentary behaviour measured using subjective (Occupational Sitting and Physical Activity Questionnaire) and objective (Activpal measurement on a subset of participants (n=6)). Mental wellbeing variables collected were: depression, anxiety, stress, procrastination, wellbeing and work engagement. A subset of participants (n=6) were interviewed with a view to gaining a contextualised understanding of participants' experiences of using the Welbot intervention. **Results:** Forty-one (6M/35F) university staff members with mean age of 43 years (range 22-63 years) participated. Following the intervention, participants self-reported significantly less time sitting and more time standing, and objectively recorded more steps at week-1 follow-up ($p<.05$). The change in all mental wellbeing outcomes were in the expected direction. However, only scores on the Depression Anxiety Stress Scale (DASS) showed significant changes ($p<.05$) with a decrease in the total DASS score and depression, anxiety and stress subscale scores between baseline and follow up. After using the Welbot intervention participants perceived they had a positive behaviour change, increased awareness of unhealthy behaviours at work, and provided suggestions for intervention improvement. **Conclusions:** Findings support the use of the Welbot digital intervention as an acceptable and practical way to improve employees' physical and mental wellbeing at work.

Keywords: Sedentary behaviour; wellbeing; physical activity; digital health; workplace; behaviour change; occupational health; nudge theory

INTRODUCTION

Research exploring the impact of employee wellbeing in the workplace has advanced substantially over the last two decades. There is growing evidence linking workplace performance and productivity with mental and physical health issues among employees.[1] Research has shown that implementing interventions in the workplace designed to improve employee health and wellbeing have frequently resulted in health status improvements and enhanced work performance.[2-3] While, such interventions vary in duration, composition and intensity, they are all designed to promote an increase in healthy lifestyle behaviours, including stress management, improved nutrition and reducing sedentary behaviour.[4]

Sedentary behaviour can be defined as any waking behaviour that occurs in a sitting or lying position and results in an energy expenditure of 1.5 METs or lower.[5] Sedentary behaviour has a negative impact on health, being associated with increased risk of diabetes, obesity, cardiovascular problems as well as mental health issues and some types of cancer.[6] Research suggests metabolic health is compromised in those who spend the majority of their days engaged in sedentary behaviour, even if they are engaging in moderate/vigorous physical activity.[7] In other words, sedentary behaviour is an independent risk factor for obesity and chronic disease.

Research suggests that breaking up prolonged sedentary time can have positive health outcomes for an individual. Short-term laboratory-based experiments have reported that when sitting is interrupted every 30 minutes by brief activity breaks (i.e., two minutes of treadmill walking or light resistance activity), postprandial glucose and insulin levels are significantly reduced.[8-9] Moreover, research has demonstrated a significant relationship between health outcomes (i.e., triglycerides, glucose, waist circumference) and the total number of breaks from sitting, independent of total sedentary time.[10]

As society has progressed and technology has advanced, there has been a decline in demand for manual labour based jobs, with these being replaced by more office or sedentary based occupations. In a sample of UK full-time office workers, 65% of time at work was sedentary, and sitting at work accounted for 63% of total daily sitting time.[11] With such a large proportion of an adult's day being spent at work, the importance of reducing sedentary behaviour in the workplace is highlighted. Therefore, interventions designed to target sedentary behaviour in the workplace are specifically needed.

Recent reviews of interventions to reduce sedentary behaviour in the workplace include strategies such as educational/behavioural, environmental and multi-component, including the use of computer based or mobile health technologies.[12-14] All of these strategies have shown some success at improving sedentary behaviour and physical and mental wellbeing. Indeed, research has documented that computer based, mobile and wearable technology based interventions targeting workplace sitting, compared to non-work based sitting, were more effective at medium-term (3-6 month) follow-up.[13] A number of limitations have been documented in these published reviews including limited description of the intervention, in addition to a lack of qualitative measures to explore participant experiences. Cost of intervention delivery is also a limiting factor for large scale implementation and impact.

Digital based interventions have potential to reach large populations at a low cost. They also offer potential to tailor interventions to the needs of individuals or specific groups of office workers. However, a large decline in technology use and engagement is often observed.[14]

There is evidence that a nudge or prompt driven approach can yield high engagement in intervention components as well as reduce sitting time and increase light activity at work.[15-16]

The aim of this study was to pilot test a personalised digital intervention to improve sedentary behaviour and wellbeing in the workplace.

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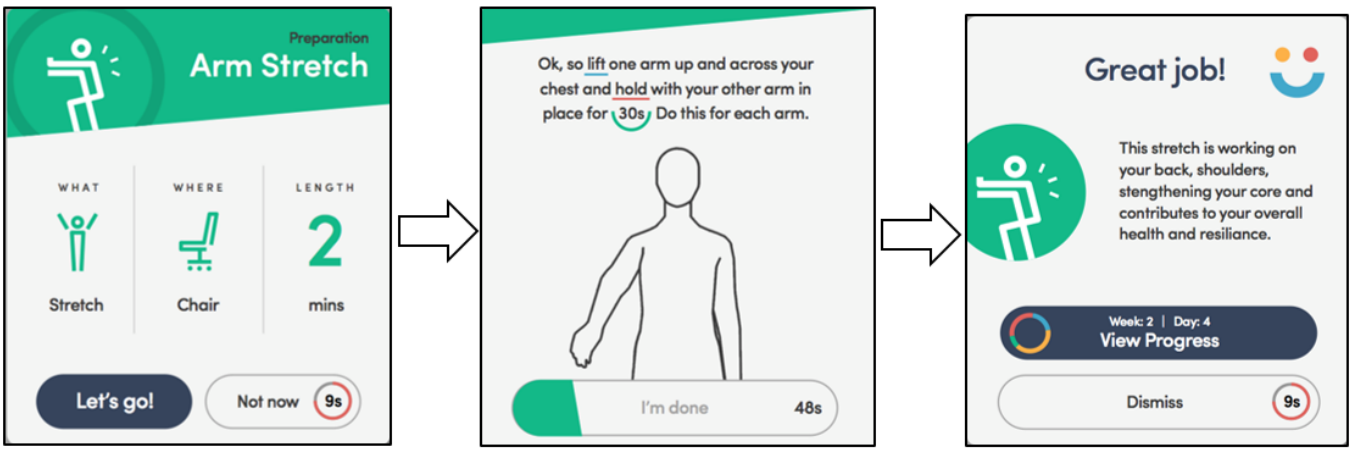
METHODS

Intervention: Welbot

Welbot is a cross-platform, personalised, digital intervention[17] that aims to reduce sedentary behaviour, and improve physical and mental wellbeing at work. It incorporates activities such as stretching, screen breaks, exercises, mindfulness, hydration tips, breathing exercises etc. which are delivered to users in the form of 'nudges' (see Figure 1). A nudge is a notification that asks users to engage in a simple 1-3-minute activity (e.g. an arm stretch, a mindful cup of tea, or a screen break) that progresses from a preparation card (i.e. what the nudge will entail), to a doing card (i.e. how to perform the nudge), to a done card (i.e. why the nudge is good for our physical and/or mental wellbeing). These nudges are delivered at regular intervals and are designed to boost an employee's overall wellbeing.

Figure 1: Example of nudge delivered during the intervention



A UK University has been working closely with the Welbot company to further develop the digital intervention ('Welbot'). The ultimate aim of this collaboration was to create a digital intervention that was evidence-based and uniquely tailored to each individual user. Through this collaboration, the University research team had 3 primary roles: 1) to validate and evidence-base Welbot's hypotheses (as stated below); 2) to validate, create and analyse intervention content; and 3) to conduct a pilot test of Welbot.

Stage 1 – Hypothesis Validation

This phase involved conducting a literature review in order to evidence-base Welbot's 3 key hypotheses: i) sedentary computer-bound workstyles produce unhealthy outcomes (e.g. decline in eyesight, musculoskeletal problems, poor mental wellbeing); ii) there are strategies and interventions that can produce healthier behaviours in the workplace (e.g. stretching, mindfulness, screen breaks); and iii) real-time computer prompts can deliver effective interventions that change behaviours. Stage 1 of the project culminated in a comprehensive report of the evidence, which helped to guide refinements and future developments with the digital intervention.

Stage 2 – Content Validation, Creation, and Analysis

This section formed the largest part of the project and its purpose was threefold: to validate, create and analyse Welbot content. Firstly, the research team validated previously developed content including stretches, exercises and mindfulness nudges. This involved providing a quality score, correlating specific nudges with the evidence-base, and suggesting recommendations for improvement. Secondly, the research team created new content for the digital intervention, which resulted in approximately 532-new nudges. The final phase of stage 2 was content analysis. This involved collating all content into 4-week progressive journeys that were either more physically orientated (e.g. 'Stand Up, Sit Less, and Move More' or 'Less Time on Screens') or mentally orientated (e.g. 'Reduce Stress', or 'Reduce Procrastination').

Stage 3 – Pilot Testing

The final stage, which is the focus of this paper was a pilot test of Welbot. This involved assessing the efficacy of Welbot on improving sedentary behaviour, physical and mental wellbeing and exploring participants' experiences of using Welbot, with quantitative and qualitative findings presented.

Design

The design of the pilot testing was a single arm repeated measures study of a three week intervention period using Welbot. The primary dependant variable was sedentary behaviour with health and mental wellbeing as a secondary variable. The variables comprising mental wellbeing were: depression, anxiety, stress, procrastination, wellbeing and work engagement.

Procedures

Ethical approval was obtained from the University Ethics Committee. Participants were recruited through opportunity sampling via posters distributed around the University campus, emails sent directly to staff members, and University bulletin board advertisements. Interested participants were eligible if they met the following criteria: i) aged between 22-65-years; ii) full time or part time employee of the University; iii) worked in an office-based environment; iv) understood the requirements of the study; and v) had no physical health issue (e.g. severe back pain) which would affect their ability to alter their sedentary behaviour.

Participants firstly provided informed consent and then completed an online questionnaire (see outcome measures). Following completion of the pre-intervention online questionnaire, participants were then provided access to the digital intervention and instructed to use this product for 2-weeks. Objective measurement of sedentary behaviour was obtained on a subset of participants (n = 6) for a continuous 3-week period (1-week baseline, 2-weeks intervention). Following the 2-week intervention period, participants competed the online post-intervention questionnaire. An additional subset of participants (n = 6) were then asked to take part in an audio recorded one-to-one semi-structured interview to explore their experiences of using the Welbot digital intervention.

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Outcome measures

Demographics

A series of demographics were collected including: gender, age, height, weight, ethnicity, health status, working status and occupation.

Primary outcome measures

The Occupational Sitting and Physical Activity Questionnaire (OSPAQ)[18] was used to subjectively measure behaviour. This questionnaire measured the time spent sitting, standing, walking and doing physically demanding tasks or heavy labour. The OSPAQ shows a moderate criterion validity for sitting (ρ = 0.65) and excellent test-retest reliability (ICC = 0.89).[18] Comparison of sitting measures with accelerometers showed higher Spearman correlations for the OSPAQ (r = 0.65) compared to a modified version of the MONICA Optional Study on Physical Activity Questionnaire (modified MOSPA-Q). Criterion validity correlations for occupational standing and walking measures were comparable for both instruments with accelerometers (standing: r = 0.49; walking: r = 0.27–0.29).

Sedentary behaviour was measured objectively using the activPAL accelerometer.[19] Participants were asked to wear the activPAL for 3 weeks continuously. The activPAL was made waterproof and attached to the midline anterior aspect of the upper thigh using tegaderm tape. In addition, participants were asked to complete a diary recording the times they started and finished work each day as well as their bed and wake times. Participants were included in the waking day analysis if they provided a complete wear time diary and at least 3 days of valid wear per week (i.e., 3 days with more than 600 minutes of wear per day). ActivPAL event files were created using the activPAL software provided by the manufacturer. A specialized macro (available from XJ upon request) was then used calculate time spent sitting, standing or stepping per waking and working day as well as the average % of time (to account for differences in wake/work times). Moreover, to measure any changes in patterns of sedentary behaviour the number of bouts between 10-19.99 minutes, 20-29.99 minutes and >30 minutes were calculated.

Secondary outcome measures

The Warwick-Edinburgh Wellbeing Scale (WEMWBS)[20] was used to subjectively measure mental wellbeing. This scale has 14-items and it is scored on 5-point scales (*1 = None of the time – 5 = All of the time*), where higher scores indicate higher levels of mental wellbeing. WEMWBS has demonstrated both high internal consistency (Cronbach's α = 0.89-0.91) and high test-retest reliability (0.83).[20]

Five items from the 20-item General Procrastination Scale (GPS)[21] were used to measure participants levels of procrastination (i.e., the tendency to delay starting an important task for a more trivial or less important task). This scale was scored on 5-point scales (*1 = Does not describe me at all – 5 = Describes me a great deal)*, such that higher scores reflect higher levels of procrastination. The full version of this scale has shown good levels of reliability (Cronbach's α = 0.87) in previous research.[22]

The Depression, Anxiety and Stress Scale (DASS-21)[23] was used as a measure of mental health. . It is a 21-item measure that is scored via 4-point scales (*0 = Did not apply at all – 3 = Applied to me very much, or most of the time),* whereby higher scores reflect higher levels of distress. This measure calculates a total score plus 3 subscales including: depression, anxiety, and stress. Previous research has shown the DASS-21 to have good psychometric properties (Cronbach's α = .82-.88).[24]

The Utrecht Work Engagement Scale (UWES)[25] was utilised to assess the extent to which participants reported feeling positive, fulfilled and in a work-related state of mind characterised by vigor, dedication and absorption. It is a 17-item measure scored via 7-point scales (*0 = Never – 6 = Always*), whereby higher scores exhibit higher levels of work engagement. The UWES calculates a total score plus 3 subscale scores including: i) vigour (i.e. high levels of energy, persistence, and resilience towards one's work activities), dedication (i.e. high levels of enthusiasm and investment in one's work, with a sense it has meaning and purpose), and absorption (i.e. being fully and happily engrossed in one's work). This scale has documented high psychometric properties (Cronbach's α = 0.80-0.90) in research.[25]

Analysis

Descriptive analyses were conducted on questionnaire and activPAL data. Paired t-tests were used to examine changes between baseline and follow-up for any of the questionnaire outcomes. A Friedman non-parametric test was conducted to examine changes between baseline, follow-up week 1 and follow-up week 2 in time spent sedentary, standing and stepping, and the number of bouts of sedentary behaviour as measured by the activPAL. All statistical analysis were conducted in SPSS version 25,[26] and the level of statistical significance was set at $p < .05$.

Interviews were examined independently by one member of the research team (AMG) and subsequently cross-checked by an additional member of the research team (AK). Interviews were analysed with a view to gaining a contextualised understanding of participants' experiences of using the Welbot intervention using a thematic analysis framework.[27] Meaning unitsthat included words, sentences or phrases relating to the research aim were identified within each transcript and were grouped together based on similar meanings, creating first-order themes[28]. Relationships between these first-order themes were then identified resulting in overall themes. To ensure quality in the analysis, the research team discussed the thematic analysis and agreed on the themes developed and quotations from the original transcripts are used in the presentation of the findings to demonstrate that the first-order themes did emerge from the interview data.

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RESULTS

Participant Characteristics

Forty-one staff members from a University in the UK participated in this study. A subset of participants (n = 6) wore an activPAL as part of the study in order to analyse activity data; while another subset of participants (n = 6) completed a qualitative semi-structured interview to ascertain user's experiences of utilising the Welbot intervention. See table 1 for participant characteristics.

Table 1: Participant Characteristics

	Whole sample (N = 41)	activPAL sample (n = 6)	Interview sample (n = 6)
Demographics			
M age (SD)	43-years (10.40)	46-years (8.26)	42-years (13.10)
Age range	22-63-years	30-53-years	29-58-years
M BMI (SD)	24.82 (3.79)	27.41 (8.68)	23.07 (2.46)
Males (%)	6 (14.63%)	1 (16.67%)	1 (16.67%)
Females (%)	35 (85.37%)	5 (83.33%)	5 (83.33%)
Ethnicity			
White	95.12%	100%	100%
Other	4.88%	0%	0%
Working hours			
Part-time (%)	2 (4.88%)	0%	0%
Full-time (%)	39 (95.12%)	100%	100%
Occupations			
Managers, directors and senior officials	14.63%	0%	0%
Professional occupations	39.02%	50%	50%
Associate professional and technical occupations	9.76%	16.67%	33.33%
Administrative and secretarial occupations	36.59%	33.33%	16.67%

Self-reported sitting time and physical activity

Thirty-nine participants completed the occupational sitting and physical activity questionnaire (Table 2). At baseline, participants reported 6.5 ± 1.2 hrs/working day seated, 0.5 ± 0.4 hrs/working day standing, 0.74 ± 0.4 hrs/working day walking, and 0.03 ± 0.1 hrs/working day in heavy labour. After the intervention, self-reported sitting time decreased significantly to 5.6 ± 1.5 hrs/ working day ($p<.001$) and time spent standing increased significantly to 0.8 ± 0.8 hrs/working day ($p=.009$). Time spent stepping and in heavy labour increased to 0.9 ± 0.6 hrs/ working day ($p=.175$), and 0.04 ± 0.2 hrs/working day ($p=.696$), respectively, but this was non-significant.

Table 2: Occupational sitting and PA questionnaire (mean ± SD; n=39)

	Baseline	Follow-up	p-value*
Sitting time (hr/working day)	6.5 (1.2)	5.6 (1.5)	<.001
Standing time (hr/working day)	0.5 (0.4)	0.8 (0.8)	.009
Stepping time (hr/working day)	0.7 (0.4)	0.9 (0.6)	.175
Heavy labour (hr/working day)	0.03 (0.1)	0.04 (0.2)	.696

*paired sample t-test for baseline and follow-up measures

Whole day sedentary behaviour

ActivPAL data is displayed in Table 3. Six participants provided valid data for three weeks.

Sedentary behaviour did not change significantly over the course of the intervention. Participants spent an average of 59.8 ± 6.4% of their waking day sedentary at baseline (8.7 ± 0.9 hr/day), this decreased to 57.2 ± 9.2% during week 1 of the intervention (8.3 ± 1.4 hr/day) and increased to 59.7% during week 2 of the intervention (8.6 ± 1.0 hr/day). At baseline, participants accumulated 5.0 ± 1.2 bouts of sedentary behaviour greater than 30 minutes per day, this decreased significantly to 4.8 ± 1.9 bouts per day during week 1 of the intervention, and increased to 5.3 ± 2.1 bouts par day during week 2 of the intervention.

Table 3: Intervention outcomes whole day (mean ± SD; n=6)

	Baseline	Follow-up week 1	Follow up week 2	p-value*
Sedentary time (%)	59.8 (6.4)	57.2 (1.4)	59.7 (8.7)	.846
Standing time (%)	25.2 (5.0)	26.2 (6.7)	24.8 (6.1)	.846
Stepping time (%)	14.9 (2.7)	16.6 (3.3)	15.5 (3.5)	.069
Bouts 10-19.99 min	6.2 (2.3)	6.0 (2.1)	5.7 (2.9)	.607
Bouts 20-20.99 min	3.3 (0.8)	2.7 (0.6)	2.7 (0.7)	.200
Bouts >30 min	5.0 (1.2)	4.8 (1.9)	5.3 (2.1)	.827

* friedman's non-parametic test for between time point differences;

Working day sedentary behaviour

Intervention results during the working day are displayed in Table 4. Sedentary behaviour did not change significantly over the course of the intervention. Participants spent an average of 60.6 ± 8.4% of their working day sedentary at baseline (4.5 ± 1.2 hr/working day), this decreased to 54.8 ± 10.8% during week 1 of the intervention (4.1 ± 1.2 hr/working day) and increased to 60.5 ± 7.4% during week 2 of the intervention (4.2 ± 1.6 hr/working day; p=.846). A significant change in stepping time was found over the course of the intervention. At baseline participants spent 15.8 ± 4.4% (1.1 ± 0.3 hr/working day) of their working day stepping, this increased to 19.4 ± 4.2% (1.4 ± 0.3 hr/working day) at follow up 1, and decreased again to 15.6 ± 2.9% (1.1 ± 0.4 hr/working day) at follow up 2 (p=.042).

Table 4: Intervention outcomes working day (mean ± SD; n=6)

	Baseline	**Follow-up week 1**	**Follow up week 2**	**p-value***
Sedentary time (%)	60.6 (8.4)	54.8 (10.8)	60.5 (7.4)	.846
Standing time (%)	23.6 (5.9)	25.8 (8.0)	23.9 (5.6)	.513
Stepping time (%)	15.8 (4.4)	19.4 (4.2)[a]	15.6 (2.9)	.042
Bouts 10-19.99 min	3.1 (1.1)	3.0 (1.5)	2.5 (1.5)	.607
Bouts 20-20.99 min	1.9 (0.7)	1.2 (0.5)	1.4 (0.7)	.311
Bouts >30 min	2.8 (1.2)	2.5 (1.3)	2.8 (1.4)	.467

* friedman's non-parametic test for between time point differences; [a] significantly different from baseline and follow up week 2.

Health and well-being outcomes

Forty-one participants completed the health and well-being questionnaires, and results are shown in Table 5. Briefly, the change for all outcomes were in the expected direction. However, only DASS scores showed significant changes. The total DASS score decreased by 3.46 ± 6.26 between baseline and follow up (p=.001). In addition, the depression, anxiety and stress scores decreased by 1.05 ± 2.59, 0.83 ± 1.95 and 1.59 ± 0.46 points, respectively (p<.05 for all).

Table 5: Health and well-being questionnaire (mean ± SD; n=41)

	Baseline	Follow-up	p-value*
WEMWBS	49.05 (7.44)	50.07 (6.49)	.265
GPS-S score	14.39 (4.78)	13.41 (4.60)	.060
UWES total score	3.53 (0.69)	3.63 (0.86)	.237
UWES vigour score	3.53 (0.66)	3.63 (0.88)	.238
UWES dedication score	3.72 (0.93)	3.75 (1.03)	.751
UWES absorption score	3.39 (0.72)	3.51 (0.85)	.111
DASS total score	11.00 (7.30)	7.54 (4.81)	.001
DASS depression score	3.22 (3.20)	2.17 (2.14)	.013
DASS anxiety score	2.15 (2.14)	1.32 (1.57)	.009
DASS stress score	5.63 (3.08)	4.05 (2.33)	.001

*paired sample t-test for baseline and follow-up measures

Individual interviews

Thematic analysis of the interviews identified ten first-order themes and three overall themes relating to participants' experiences of using the Welbot intervention. Participant quotations highlighting each first-order theme and the three overall themes relating to positive attributes of the Welbot intervention; negative attributes of the Welbot intervention and suggested improvements are shown in Figure 2.

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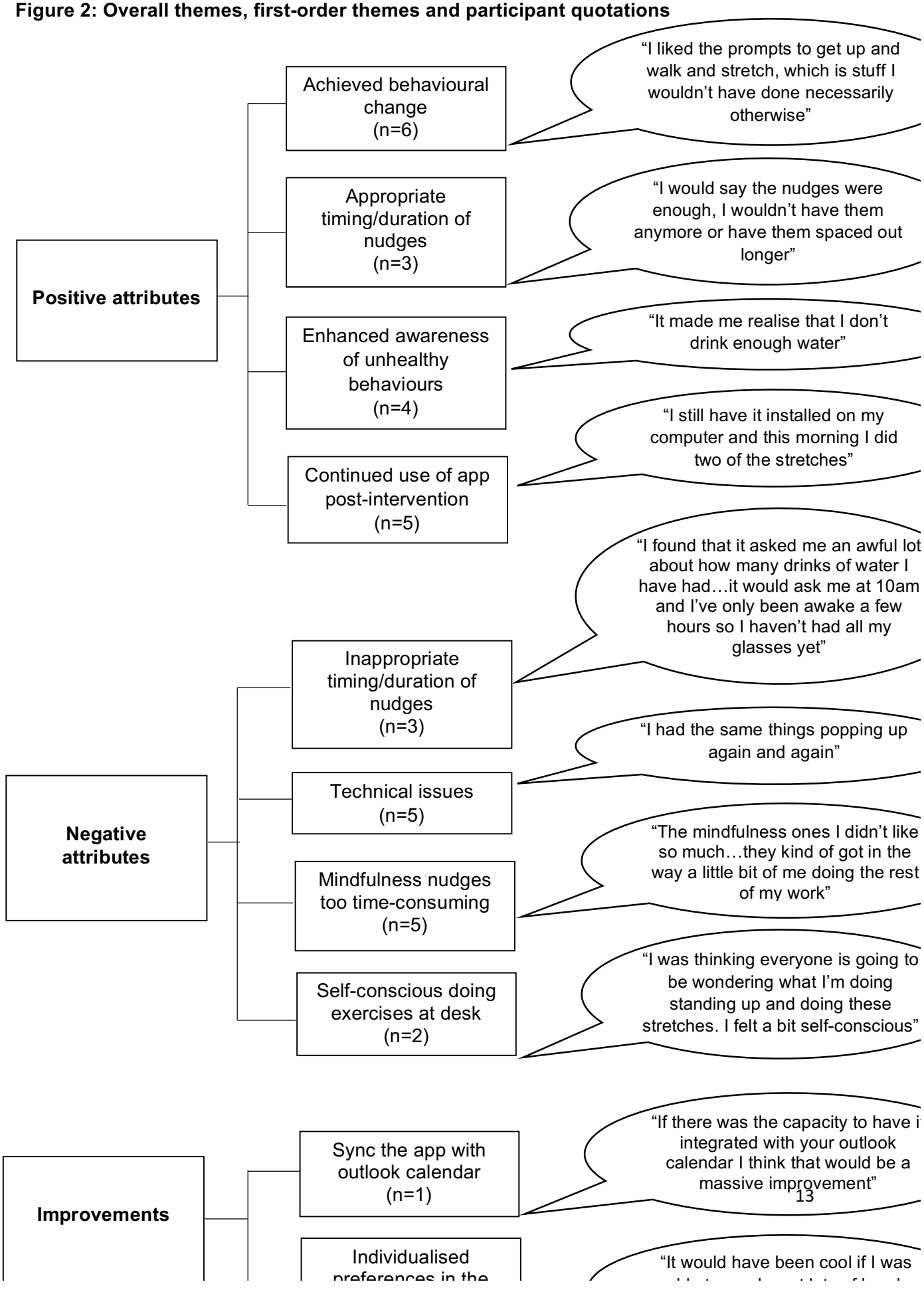
Figure 2: Overall themes, first-order themes and participant quotations



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DISCUSSION

This study evaluated the effectiveness of a new and innovative digital intervention – 'Welbot' that aims to improve physical and mental wellbeing at work. Following the intervention, participants self-reported significantly less time sitting and more time standing, and objectively recorded more steps at week-1 follow-up and less prolonged sedentary behaviour (>30 minutes). A number of outcomes relating to objective measurement of sedentary behaviour (sedentary time, standing time, bouts of sedentary behaviour) showed a trend towards improvement at week-1 follow-up, however these improvements were not maintained by week-2 follow-up, and hence were not coherent with subjective measures. In a recent systematic review[14] of mobile health interventions to promote physical activity and reduce sedentary behaviour in the workplace, the need to explore the reasons for decline in engagement was highlighted. Future research with the Welbot intervention should explore how participants use the programme over time, and which components are most effective in promoting sedentary behaviour change to enhance the effect of the intervention.

Following the intervention, participants reported significant improvements in depression, anxiety and stress. Such results are congruent with previous research which have exhibited digital interventions as an effective avenue for improving employees' mental wellbeing at work.[29] This is crucial given the significant levels of psychological difficulties in the current working population, with occupational-related stress, anxiety and/or depression affecting 526,000 employees living in Britain in 2016/17.[30] Perhaps Welbot functions to improve employees' depression, anxiety and stress via its emphasis on mindfulness. An abundance of previous literature has highlighted the benefits of mindfulness in the workplace, with improvements in depression, fatigue, stress, anxiety, burnout, job performance, and work-life equilibrium.[31-34] Contrastingly, such improvements may also be resultant from its focus on decreasing sedentary behaviour. Indeed, research has exhibited that prolonged occupational sitting is associated with higher levels of psychological distress.[35] Hence, a nudge-based digital intervention that aims to reduce this adverse behaviour may secondarily also improve mental wellbeing. Alternatively, these improvements could merely be due to the simple act of taking a break from work tasks. Such breaks have been shown to reduce levels of fatigue and improve employees' sense of vitality.[36] Regardless of what specific elements are driving this change, it is clear that Welbot, as a digital intervention, can enhance mental wellbeing in the workplace.

Results exhibited that levels of mental wellbeing, procrastination, and work engagement failed to significantly alter post-intervention. This is a novel finding in the emerging field of nudge-based digital interventions, and although it was somewhat unexpected, it indicates that the introduction of Welbot to the workplace did not impair occupational functioning. In particular, the lack of change with regards to employees work engagement is of importance. Despite Welbot interrupting employees every 40-minutes and asking them to participate in a nudge, this "time-out" from work tasks did not correspond to a detriment in work engagement, and can result in improvements in aforementioned areas such as depression, anxiety and stress. Previous research has shown that digital interventions are in fact capable of enhancing job performance and employee health.[37, 29] Therefore, although it is positive that Welbot did not impair employees' mental wellbeing, procrastination, or work engagement; prospective research should now focus on investigating how the digital intervention can be further refined to optimise its effect on occupational functioning.

Several positive attributes of the digital intervention were identified by the participants, including a perception of positive behaviour change as a result of using Welbot. These perceptions were partially supported by the quantitative findings where self-reported sitting time during the working day significantly decreased over the two weeks. Participants also reported that their awareness of unhealthy behaviours at work increased as a result of using the digital intervention, which has been echoed in a recent systematic review exploring factors affecting patient and public engagement with digital interventions.[38] In relation to the negative attributes of the digital intervention, feeling self-conscious whilst carrying out the activities at their desk has also been reported in previous studies that specifically used health interventions in the workplace. Indeed, research has found that not having a private space within the workplace to access a digital mental health intervention and feeling exposed using the intervention whilst sat at their desk were barriers to engagement.[39] Whilst participants reported on the positive and negative attributes of Welbot, they did offer useful suggestions for improvements to the digital health intervention. Several participants voiced a preference for Welbot to allow individualised preferences in relation to the frequency and timing of nudges and the option to sync these to online calendars. Personalised tailoring of information within digital health interventions has been reported by users in previous research as an important facilitator to continued engagement.[38-40]

Limitations of study and directions for future work

Several limitations to this study relate to the participant demographical characteristics and study design. The majority of participants were white, female, full time workers. Given that the sample was small, future studies would benefit from a larger sample size and include participants with more diverse demographical characteristics. A power analysis is needed to determine the appropriate sample size to explore the potential efficacy of Welbot in reducing sedentary behaviour and improving wellbeing in the workplace. The study used a single-arm repeated measure design; there was no control group. Future research should utilise a two arm, repeated measures with a control group and participants randomly allocated to each arm of the study. It would also be helpful to have a longer follow up period (e.g., 6 months) to ascertain whether the benefits of using the digital intervention are maintained over time.

A further limitation may be the use of the activPAL research device which may have encouraged participate to change their behaviour. The possibility of aligning Welbot with personal activity trackers could be explored as a means of capturing and integrating such feedback. Finally, it remains unclear which elements of this multi-component intervention are most important for maximising health and wellbeing gains. An in-depth analysis of user engagement patterns alongside the use of standardised outcome measures and improved reporting of ‘active’ components of Welbot would enhance the future evaluation of this digital intervention.

CONCLUSIONS

Overall, findings from this pilot study support the use of the Welbot digital intervention as an acceptable and practical way to improve employees' physical and mental wellbeing at work. Adopting a multi-method approach, using objective activity measurement, standardised outcome measures alongside qualitative data detailing users' experiences of Welbot provided rich data which showed this digital intervention to have promise as a method for improving various aspects of employee health. Further research and refinements to the digital intervention are needed. Capturing data as to how participants use and engage with Welbot is necessary. Detailing the amount of time users spend on each component of the application and which components were used the most is important and could be explored in future work. Overall, these results provide a useful baseline for further intervention development and for a large scale study, specifically a randomised controlled trial with a control group and across a range of work settings.

DECLARATIONS

Conflicting interests: AK, XJ, NC, AMG, ST and MR were awarded a grant (see below) with Welbot to assist in the development and pilot testing of the intervention.
Funding: This work was supported by a Scottish Funding Council Follow on Innovation Voucher grant.
Ethical approval: The ethics committee of the School of Psychological Sciences and Health, University of Strathclyde approved this study.
Guarantor: Dr Alison Kirk
Contributorship: AK, XJ, NC, CH and AMG researched literature and conceived the study. All authors were involved in protocol development, gaining ethical approval, patient recruitment and data analysis. CH wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript
Acknowledgements: We would like to thank Miss Lauren McTrustry, Miss Emma Williams and Miss Christina Dunipace for their assistance in this research and Welbot for providing participants with access to the Welbot intervention.

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