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Running Head: Competition and Physical Activity

Do web-based competitions promote physical activity? Randomized controlled trial

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Do web-based competitions promote physical activity? Randomized controlled trial

Highlights

- This study isolates the unique effect of competition on physical activity promotion
- Competition increased physical activity relative to self-monitoring and control
- Competition effects mediated by motivation (identified, intrinsic, importance)
- Self-monitoring with basic feedback had limited effects on physical activity

Abstract

Objectives: Introducing competitions may inspire positive behaviour change but they tend to be implemented alongside other strategies. Thus, the study examined the effectiveness of a competitive web-based intervention to promote physical activity, disentangled the effects of competition from other behaviour change techniques, and identified underlying mediators.

Design: Randomized controlled trial.

Methods: Physically inactive adults living or working in a UK city (*n* = 281) were recruited. Participants were randomized to one of three web-based conditions: a control group; a group encouraged to self-monitor their steps and who received basic feedback; a group encouraged to self-monitor their steps who received basic feedback plus additional feedback to instigate competition. Participants' physical activity was monitored through pedometers for one-week pre-intervention and for four-weeks during the intervention period. Participants completed the BREQ-2 and measures of intention, planning, goal conflict, goal importance, effort, commitment, perceived behavioural control and self-efficacy pre- and post-intervention.

Results: Participants in the competition condition increased their steps significantly more than those in the control group with the effect being mediated by increased goal importance, identified motivation and intrinsic motivation. Participants in the competition condition increased their steps more than those in the self-monitoring condition. There was weaker evidence that the self-monitoring group increased their steps more than those in the control condition.

Conclusions: Self-monitoring and feedback can increase physical activity but adding a competitive component, implemented via the web, can boost goal importance, identified motivation and intrinsic motivation that mediate these increases in physical activity.

Keywords: UK; competition; self-monitoring; physical activity; Control Theory

Do web-based competitions promote physical activity? Randomized controlled trial

There are physical (Warburton, Bredin, & Nicol, 2006) as well as psychological (Penedo & Dahn, 2005) benefits of increasing physical activity. However, strategies to promote physical activity are required given many adults fail to meet the requisite physical activity level guidelines (e.g., Health and Social Care Information Centre, 2008). Physical activity-related competitions have been promoted on a national scale (CSP Network, 2016; SPARK, 2016), thus they have the potential to improve health at a population level. However, these particular interventions have not been evaluated with randomized controlled trials, are commonly accompanied by other behaviour change techniques (including incentives in the form of prizes for success), and in some instances require significant organisation (Parkrun, 2016). A systematic evaluation of the effects of competition, while partialling out the effect of other behaviour change techniques, is needed to establish whether or not competitions promote physical activity. If such interventions can be delivered online as well, they have the potential to improve health at relatively low cost (Southard, Southard, & Nuckolls, 2003).

The evidence regarding the benefits of competition, however, is not clear. For example, while competition may be beneficial for some individuals, it may be detrimental for those who have low achievement orientation (Epstein & Harackiewicz, 1992), feel pressured by competition, or lose (Reeve & Deci, 1996). Indeed, in a review of the effect of competition on performance, Murayama and Elliot (2012) concluded that there was no overall benefit of competition on performance. However, the majority of the studies included in their review concerned performance over a single day, were conducted in the laboratory and did not relate to sports or physical activity. Of the few that did relate to sports or physical activity, only one study was related to the latter (Lerner & Locke, 1995).

In Lerner and Locke's (1995) study, participants were set either hard goals (52, 51 and 48 sit-ups across three trials) or moderate goals (44, 43 and 38 sit-ups across three trials) in a one-minute endurance task. Within each goal-setting group, participants were either allocated to a competitive context, in which participants watched a confederate do the task before trying the task themselves, or a non-competitive context in which participants performed alone. While goal-setting increased sit-ups with those in the hard goal group doing more sit-ups, the competition manipulation did not impact on sit-ups. However, the form of competition in this study was unusual in three ways. First, the competition was sequential; the participant always performed after the confederate rather than performing the sit-ups simultaneously. Second, participants always knew exactly what they needed to achieve to 'win', which is not usual in competitive situations. Third, the confederate always achieved the exact number of sit-ups set within the goal thus there was little extra incentive to go beyond the set goal, potentially explaining why competition did not lead to additional benefit beyond goal-setting. A more recent review suggests, however, that head-to-head competition can improve endurance performance in constant workload tests and it improved time trial performance in one of two studies (McCormick, Meijen, & Marcora, 2015).

Studies that have incorporated specific physical activity competitions typically use other techniques, failing to isolate the effects of competition. For instance, Duru, Sarkisian, Leng, and Mangione's (2010) small group-based weekly pedometer competition increased steps by over 1,000 steps/day more than a control group but the intervention also included other behaviour change techniques including prize incentives and goal-setting. While Johannesson, Östling, and Ranehill's (2010) step contests increased steps by about 10% (or 1,000 steps/day), the intervention also comprised team elements and a symbolic reward (cup) for winners. Other studies have similarly failed to isolate the competition element. Foster, Linehan and Lawson (2010) reported that when participants were able to access a league table comparing their steps against others, participants walked nearly 800 steps/day extra compared to when they could only view their own personal step data. However, alongside the league table there was a feature enabling comments to be posted thus other social influence factors besides competition could impact on the findings (see also Behrens, Domina, & Fletcher, 2007; Buis et al., 2009; Carr et al., 2013; Consolvo, Everitt, Smith, & Landay, 2006; Lin, Mamykina, Lindtner, Delajoux, & Strub, 2006). In addition, several of these studies (e.g., Behrens et al., 2007; Buis et al., 2009; Foster et al., 2010) did not employ a control group meaning it is difficult to draw firm conclusions about intervention effectiveness.

Most recently, Zuckerman and Gal-Oz (2014) compared three versions of a mobile application to increase walking: a basic version that incorporated goal-setting, self-monitoring and feedback; a version that incorporated the features of the basic version and added virtual rewards (points related to walking time); and a version that incorporated the features of the basic version, virtual rewards and the presentation of a league that ranked users from first to last based on their accumulated points. They reported no difference in physical activity across the three conditions. Although the design of this study did permit the isolation of a competition-related feature for physical activity, there were several prominent limitations: the sample size was relatively small (59 participants across three conditions) and thus the study lacked power to detect differences across groups, there was no baseline physical activity phase, the intervention period lasted only ten days, and the basic version incorporated several components linked with behaviour change. The study also did not measure potential mediators such as changes in motivation.

In sum, with the exception of the study by Zuckerman and Gal-Oz (2014), to our knowledge, no other study has managed to isolate the effect of competition on daily physical activity outside of the laboratory. Studies testing the effect of competition on daily physical activity typically compare multi-component interventions (of which competition is one component) against a control group; and some studies do not use a control group. The study presented here addressed each of these issues. Participants were allocated to one of three conditions: a control group; a group asked to self-monitor their pedometer steps by logging them into a study website and who subsequently received basic feedback on how their physical activity changed through the course of the study (self-monitoring group); a group who also self-monitored and received basic feedback but also received additional feedback relating to how their steps compared to others in their study condition to stimulate competition (competition group). Consequently, the design allowed the disentangling of competition effects from those achieved through self-monitoring and individual feedback.

According to Control Theory (Carver & Scheier, 1982), individuals can monitor their current performance against a standard or goal. When there is a discrepancy between these, a negative feedback loop serves to minimise the discrepancy such that an individual increases their effort if they are behind their target. Hence, incorporating goal-setting to create a formal standard or target, self-monitoring progress towards this target and feedback that illuminates any discrepancy between the set-goal and performance should change behaviour. Harkin et al. (2016) provide meta-analytic support demonstrating positive effects of self-monitoring augmented by goal-setting and feedback including that which identifies a discrepancy between current and desired performance. Control Theory has also been supported in the context of physical activity promotion (Prestwich et al., 2016).

In the study presented here, participants were randomized to one of three conditions: a competition group, a self-monitoring group or a control group. We manipulated feedback to be competitive by presenting an individual's physical activity levels (indexed by pedometer step counts) alongside others in the form of a league table. It was anticipated that in this instance, in keeping with Control Theory, the feedback loop would be particularly strong, driving individuals to make upward comparisons and subsequently minimising the discrepancies between one's own performance and that achieved by high-performing others.

On this basis, it was predicted that those in the competition group would increase their number of steps more than those in the control group (hypothesis 1) and those in the self-monitoring group that received standard feedback (hypothesis 2). It was also predicted that those in the self-monitoring group would increase their steps more than those in the control group (hypothesis 3). In addition, in this study, we examined the potential mediators of the interventions. McCormick et al. (2015) argued that competition could impact on behaviour through enhancing both motivation and self-efficacy, but that studies were needed to test these mediating variables. Thus, we predicted and tested that increases in different forms of motivation (intention, planning, effort, commitment, goal importance, goal conflict, motivation type) and perceptions of control (self-efficacy, perceived behavioural control) would mediate the effect of competition on step counts.

Method

Participants

To be eligible for the study, participants had to be aged 18-65, live and/or work in the same city that the study was conducted in, have access to the internet at home and have sufficient English language skills in order to complete the questionnaires. Participants were excluded if there was any indication that they were not ready to be physically active (assessed through the Physical Activity Readiness Questionnaire), were taking part in any other studies, or were categorized as moderate (category 2) or high (category 3) on the International Physical Activity Questionnaire (IPAQ). In addition, participants were excluded if they reported being pregnant, planning to become pregnant or breastfeeding. All participants were recruited between October 2012 and November 2014 via mailing lists, advertisements in local media sources and direct approaches.

In the absence of an equivalent randomized trial testing the specific effect of competition on physical activity when the trial begun, the sample size was calculated a-priori based on previous research testing the effect of self-monitoring plus other techniques of self-regulation on physical activity. On this basis, an effect size of .38 was estimated (based on only the physical activity studies included in Michie et al.'s, 2009, review), requiring a total sample size of 261 to have 80% power to detect a significant effect ($p < .05$, one-tailed). Anticipating a dropout rate of 15%, 300 participants was the target number of participants for recruitment. The actual dropout rate was lower (6.4%) thus two hundred and eighty-three participants were recruited who met the inclusion/exclusion criteria. Of these, 2 participants did not arrive for the first lab session and withdrew, 5 participants dropped out during phase 1 (between lab sessions 1 and 2) and 11 participants withdrew during phase 2 (between lab sessions 2 and 3). The 265 participants completing the study received £40 Love to Shop vouchers. The trial was ended once the target number of participants completed the study.

Design

In a parallel groups design with an equal chance of allocation to any group, participants were allocated to one of three conditions, using simple randomization, through the study website: control; self-monitoring (+basic feedback); competition. Through this process, the research assistants screening the participants were not aware of the allocation sequence. The same group of research assistants screened and tested participants. All were trained, in advance, by the lead author and one co-author, to maximise the likelihood of consistent delivery of the study. Participants completed measures at three time points (baseline/Time 1: 0 weeks; Time 2: 1- week after baseline; Time 3: 5-weeks after baseline). Participants were not informed that they were part of a randomized controlled trial or that participants were allocated to different conditions. In this sense, participants were blinded to condition. As the experimenters could access the system while testing participants, they were not blinded to study condition. The trial was registered prior to participant recruitment (details to be entered here following masked review). All procedures performed in the study were in accordance with the ethical standards of the institutional research committee that approved the project and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Manipulations

In the control condition, participants were asked to try to walk at least 10,000 steps per day and wear a pedometer. They were asked to log-on to a study web-site at least once every 7 days to answer a question regarding how much activity they did while not wearing their pedometer.

In the self-monitoring (+ basic feedback) condition, participants received the same instructions as those in the control group but were also asked to log onto the study website at least once every 7 days to record their number of pedometer steps. Participants in this condition were also able to track changes in their pedometer steps over the course of the study via graphical and tabular feedback.

In the competition condition, participants received the same instructions as those in the self-monitoring condition. In addition, they also received feedback relating to how their pedometer steps compared to other participants in their condition. Their position relative to other participants, in terms of pedometer steps, was presented in the form of a league table.

Measures

Primary Outcomes. Physical activity was measured objectively, outside of the laboratory, using Yamax CW-300 pedometers. The Yamax range has good evidence of reliability and validity (e.g., Crouter, Schneider, Karabulut & Bassett, 2003). Pedometer steps/day (*non-adjusted*) were calculated by dividing the number of steps on the pedometer by the period of days that the pedometer was worn (first day to last day). As participants reported the number of hours that they didn't wear the pedometer, this was used to adjust the pedometer step count for non-wear time. Specifically, the number of hours that the pedometer was worn was calculated by multiplying the period of days worn by 16 (on the basis of 8 hours sleep/night) then subtracting the reported hours that the pedometer was not worn. The pedometer steps were then divided by the hours that the pedometer was worn before multiplying by 16 to convert to an *adjusted* average pedometer steps/day.

Secondary Outcomes (Possible Mediators). All of the self-report measures were assessed in the laboratory and were shown to be reliable (see Table 3). Type of motivation was measured using the BREQ-2 (Markland & Tobin, 2004). Intention, perceived behavioural control (PBC; Ajzen, 2002) and self-efficacy were assessed through multiple item rating scale measures. Planning, effort, commitment, goal importance, goal conflict and self-monitoring were assessed through single items. Other measures were taken (available from the first author upon request) as potential intervention moderators but not reported.

Procedure

At Time 1 (0 weeks), the participants read the Volunteer Information Sheet, completed the screening and informed consent forms and were fitted with an open pedometer. As a relatively large proportion failed to meet the inclusion/exclusion criteria due to being too active, the procedure was amended slightly part-way through the recruitment process in order to pre-screen participants before the first laboratory session. There were no other changes to the methods following trial commencement.

Between Time 1 (0 weeks) and Time 2 (1 week), all participants were required to log onto the study website at least once a week (and preferably on a daily basis) over the next week noting the times that they did not wear their pedometer while awake, and the physical activity that they did during these times. During this period, the *baseline measure of average daily steps* was taken.

At Time 2 (1 week), all participants completed a questionnaire comprising measures of social comparison, conscientiousness, competitiveness, various motivational variables, perceived behavioural control (PBC) and self-efficacy in doing at least 10000 steps per day. They were then randomized to condition.

Between Time 2 (1-week) and Time 3 (5-weeks), participants were required to regularly log-in to the study website (at least once per week and preferably daily) and followed the instructions specific to the condition to which they were randomly allocated. During this period, the *post-intervention measure of average daily steps* was taken.

At Time 3 (5 weeks), all participants returned to the lab to complete the same motivation, PBC and self-efficacy measures completed at Time 2; as well as measures of self-monitoring, contamination, and adverse consequences. The participants were also given the opportunity to provide other comments and to return the pedometers.

Statistical Methods

ANOVA and chi-square analyses examined baseline differences between the three conditions and between those completing the study and those who did not. ANCOVA analyses, conducted on the basis of the group to which participants were randomized, tested whether the changes in the outcome variables varied across the three conditions. The pre-intervention responses were entered as co-variates. Two-tailed *p*-values are reported throughout. Effect sizes (*g*) are reported for all primary and secondary outcomes. Mediation analyses were conducted consistent with Preacher and Hayes's (2004) who suggest that a powerful indication of mediation would be demonstrate, first, that there is an effect to be mediated (i.e., that the interventions significantly increase the number of steps) and, second, that the indirect effect (i.e., the effect of the intervention on the mediator x the effect of the mediator on the number of steps) is significant in the predicted direction.

Results

The flow of participants through the study is illustrated in Figure 1. Following exposure to the interventions, the rates of attrition did not differ across the three conditions,

$\chi^2(2) = 0.96$, $p = .62$. Across all eligible participants, there were no differences between those who completed the study and those who did not in baseline physical activity (adjusted steps, $F(1, 270) = 0.05$, $p = .83$; non-adjusted steps: $F(1, 273) = 0.70$, $p = .40$), the amount of time that participants wore their pedometers during the baseline phase, $F(1, 270) = 0.21$, $p = .65$, the proportion of participants reporting doing at least some physical activity while not wearing the pedometer pre-intervention, $\chi^2(1) = 0.94$, $p = .34$, sex, $\chi^2(2) = 0.05$, $p = .83$, or age, $F(1, 274) = 0.26$, $p = .61$. Those who dropped out reported lower baseline levels of goal importance, $F(1, 271) = 5.16$, $p = .02$, external motivation, $F(1, 272) = 4.05$, $p < .05$, identified motivation, $F(1, 272) = 5.24$, $p = .02$, and intrinsic motivation, $F(1, 272) = 4.53$, $p = .03$, than those who completed the study. There were no other differences in the remaining psychosocial constructs (all *F*'s < 2.40, *ps* > .12).

Randomization checks

There were no differences across groups in baseline physical activity (adjusted steps, $F(2, 269) = 1.91$, $p = .15$; non-adjusted steps, $F(2, 272) = 0.72$, $p = .49$), the amount of time that participants failed to wear their pedometers during the baseline phase, $F(2, 272) = 0.63$, $p = .54$, and the proportions of participants reporting doing at least some physical activity while not wearing the pedometer pre-intervention, $\chi^2(2) = 1.98$, $p = .37$. There were no differences across the groups in the proportion of males : females, $\chi^2(2) = 0.23$, $p = .89$, in terms of age, $F(2, 272) = 1.50$, $p = .23$, or in any of the psychosocial constructs (all *F*'s < 1.94, *ps* > .13). In sum, randomization was successful.

Potential confounds

As well as similar proportions of individuals reporting that they did some physical activity while not wearing the pedometer across conditions at baseline (see above), the rates were similar across conditions at follow-up (control: 44%; self-monitoring: 47%; competition: 40%), $\chi^2(2) = 0.84$, $p = .66$. Similar to baseline, there were no differences across the three conditions in the total number of hours, over the 4-week intervention period, that the pedometer was not worn (control: *M* = 21.53, *SD* = 37.15; self-monitoring: *M* = 27.85, *SD* = 43.12; competition: *M* = 31.36, *SD* = 48.42), $F(2, 265) = 1.27$, $p = .28$.

Regarding contamination, the proportion of participants who knew at least one other person participating in the study did not differ across groups, $\chi^2(2) = 1.46$, $p = .48$, nor did the average number of participants known, $F(1, 253) = 0.23$, $p = .80$, the proportion of participants who reported discussing the trial with other participants, $\chi^2(2) = 2.13$, $p = .35$, or knowing what other participants were required to do, $\chi^2(2) = 0.34$, $p = .84$. Regarding the latter, 8.6% reported they knew what at least one other participant was required to do but half of these participants (4.3%) only mentioned things which all participants were required to do (e.g., wear a pedometer for 4 weeks). The proportion of participants who noted components unique to the experimental conditions (the self-monitoring and/or competition groups) was relatively low (4.3%) and also did not vary across groups, $\chi^2(2) = 0.41$, $p = .81$ (see ancillary analyses).

Manipulation Check

The frequency of self-reported levels of self-monitoring during the follow-up phase varied significantly across the three conditions, $F(2, 253) = 27.32$, $p < .001$. The participants in the competition group self-monitored more than those in the control group ($p < .001$), and those in the self-monitoring group also self-monitored more than those in the control group ($p < .001$). There was no difference in the level of self-monitoring between those in the competition and self-monitoring groups ($p = 1.00$).

Effect of the interventions on pedometer steps

As shown in Table 2, pedometer steps were significantly influenced by the manipulations (adjusted steps: $F(2, 257)= 6.27$, $p = .002$; non-adjusted steps: $F(2, 259)= 3.71$, $p = .03$). The participants randomized to the competition group increased their steps significantly more than those in the control group (both adjusted and non-adjusted step measures: $p < .001$, $g = 0.52$, $CI = 0.23 – 0.82$, and $p = .007$, $g = 0.40$, $CI = 0.11 – 0.70$, respectively) and those in the self-monitoring group (adjusted steps only: $p = .04$, $g = 0.32$, $CI = 0.02 – 0.63$; non-adjusted steps: $p = .15$, $g = 0.23$, $CI = -0.08 – 0.53$). There were no differences between the self-monitoring and control groups on the step measures (adjusted steps: $p = .19$, $g = 0.20$, $CI = -0.10 – 0.49$; non-adjusted steps: $p = .25$, $g = 0.17$, $CI = -0.12 – 0.47$).

Effect of the interventions on psychosocial variables

There was a significant effect of the manipulations on introjected motivation (e.g., I feel ashamed when I don't do at least 10,000 steps/day), $F(2, 255) = 8.06$, $p < .001$; identified motivation (e.g., It's important to me to do at least 10,000 steps/day), $F(2, 255) = 5.37$, $p = .005$; and intrinsic motivation (e.g., I enjoy doing at least 10,000 steps/day), $F(2, 255) = 13.58$, $p < .001$. While there was no difference in changes in these motivational variables between the competition and self-monitoring groups, those in the competition and self-monitoring groups reported greater increases in these motivational variables than those in the control group (see Table 3).

There was a marginal change in commitment across the conditions, with those in the competition group reporting higher levels of commitment at Time 3 (controlling for commitment at Time 2) than those in the self-monitoring and control groups. Similarly, for goal importance, those in the competition group reported higher levels of goal importance at Time 3 (controlling for goal importance at Time 2) than those in the control group.

While the main effects of the manipulations on effort and goal conflict were non-significant, the post-hoc tests detected marginal differences across groups. Those in the control group experienced relatively higher levels of goal conflict than those in the competition group at Time 3 (controlling for goal conflict at Time 2). Those in the competition group were willing to exert more effort into doing at least 10,000 steps per day than those in the control group at Time 3 (controlling for effort at Time 2).

The manipulations had no effect on intention, planning, external motivation (e.g., I do at least 10,000 steps/day because other people want me to), amotivation (e.g., I don't see the point in doing at least 10,000 steps per day), PBC or self-efficacy, *p*s > .37.

Mediation Analyses

Where there were significant effects to be mediated (i.e., competition vs. control on adjusted and non-adjusted steps; competition vs. self-monitoring on adjusted steps only), the significance of the indirect paths were tested. The results of both the Sobel test (which assumes normality in the indirect effect) and bootstrap results of the indirect effect (which does not assume normality) are presented. Where the Sobel test was non-significant, the 95% confidence interval of bootstrap results of the indirect effect were considered, with a mediated relationship noted when the confidence intervals did not cross zero. The effect of the competition intervention versus the control condition was mediated by changes in goal importance, identified motivation and intrinsic motivation. There was no evidence of significant mediation of the effect of the competition intervention versus the self-monitoring intervention by any of the measured variables (see Table 4).

Ancillary analyses

A series of sensitivity analyses were conducted to examine the separate impact of excluding outliers on the primary outcome measures ($z > |3.5|$; $n = 3$ on the adjusted steps measure; $n = 2$ on the non-adjusted steps measure), those who achieved more than 10,000 steps/day in the baseline phase ($n = 26$), or those who reported knowing what the experimental group participants in the study was required to do ($n = 11$).

Across all sensitivity analyses, those in the competition group still significantly outperformed those in the control group. There was still evidence suggesting that those in the competition group increased their steps more than those in the self-monitoring condition on the adjusted steps measure (excluding outliers, $p = .05$; excluding those who achieved 10,000 steps at baseline, $p = .04$; excluding those evidencing contamination, $p = .09$) but now there was also some marginal evidence on the non-adjusted steps measure (excluding outliers, $p = .08$; excluding those who achieved 10,000 steps at baseline, $p = .06$; excluding those evidencing contamination, $p = .17$). The sensitivity analyses also provided some evidence suggesting that those in the self-monitoring group increased their steps more than those in the control group on the adjusted steps measure (excluding outliers, $p = .05$; excluding those who achieved 10,000 steps at baseline, $p = .08$; excluding those evidencing contamination, $p = .02$) with weaker effects on the non-adjusted steps measure (excluding outliers, $p = .12$; excluding those who achieved 10,000 steps at baseline, $p = .11$; excluding those evidencing contamination, $p = .04$).

ANCOVA analyses revealed that the number of study website visits during the 4-week intervention period, while controlling for study visits during the baseline period, differed significantly across groups, $F(2, 273) = 10.13$, $p < .001$ (competition: $M = 13.16$, $SE = 0.55$; self-monitoring: $M = 12.45$, $SE = 0.56$; control: $M = 9.94$, $SE = 0.52$). Those in the intervention conditions visited the website more than those in the control group (competition: $p < .001$; self-monitoring: $p = .001$) with no difference in the visits between the interventions ($p = .37$).

At the end of the study, in their feedback, the proportion of participants providing a positive comment about the study (e.g., it was enjoyable or useful) varied significantly across the three groups, $\chi^2(2) = 7.69$, $p = .02$. Those in the competition group providing positive comments more often (20.7% participants) compared to those in the self-monitoring (9.9%) or control (7.5%) groups. The proportion of individuals specifying the study was enjoyable or interesting also varied across groups, $\chi^2(2) = 7.79$, $p = .02$. Those in the competition group

(13.4%) reported the study to be enjoyable most often; those in the control group were least likely to say the study was enjoyable (2.2%) with those in the self-monitoring group between the two (8.6%). The proportion of individuals reporting anything negative about the study were few (*n* = 5) and did not vary across groups, $\chi^2(2) = 1.24$, *p* = .54. The negative comments/suggestions for improvements related to finding the pedometer uncomfortable to wear, the graphical feedback, 10,000 steps being difficult to achieve, feeling disappointed by not achieving the 10,000 steps target, and the need for more email reminders to come back into the laboratory at follow-up (all *n* = 1).

Adverse Events

Nearly ten per-cent (9.8%) of participants reported some form of ill health during the study and this did not vary across groups, $\chi^2(2) = 2.01$, *p* = .37. No participants explicitly attributed their ill health to participation in the study.

Discussion

There was robust evidence, across all relevant analyses, that those in the competition group increased their physical activity, as measured by pedometer steps, more than those in the control group (supporting hypothesis 1). Changes in goal importance, identified motivation and intrinsic motivation each mediated this effect. There was some evidence, particularly on the adjusted steps measure, that those in the competition group also increased their steps more than those in the self-monitoring condition (supporting hypothesis 2). While there was no difference in changes in pedometer steps between those in the self-monitoring and control groups in the main analyses, some supportive evidence did emerge in the sensitivity analyses (supporting hypothesis 3). A range of potential confounds that could threaten the internal validity of the inferences, such as possible differences in pedometer wear time across groups, were ruled out.

The benefits of combining self-monitoring and feedback, as demonstrated by some significant differences between the ‘self-monitoring’ and control groups provides support for Control Theory (Carver & Scheier, 1982) and recent work supporting this model (Prestwich et al., 2016). In our study, participants were set a target to achieve at least 10,000 steps/day, were required to self-monitor their steps and log them in the study website to receive feedback on how their steps changed over the course of the study. Consequently, in keeping with Control Theory, participants (identified at the start of the study as being relatively physically inactive) were encouraged to monitor and regulate their behaviour upwards, on the basis of feedback, to achieve the challenging step target. The results of our study support, in at least some analyses, combining these techniques.

A recent review of self-monitoring interventions has noted its power to change behaviour (Harkin et al., 2016). Importantly the present research shows that these consistent effects from self-monitoring can be further enhanced by adding a competition element. According to Control Theory, individuals monitor discrepancies between one’s own performance and set goals and, through a feedback loop, act to reduce such discrepancies. By providing public feedback in relation to how one’s own performance compares to that of others, it was anticipated that individuals would become particularly motivated, by increased threat to sense of well-being, to minimize discrepancies between their own performance and the set goal as well as the number of steps of better performing others (i.e., by increasing steps). Increases in commitment by those in the competition condition relative to those in the self-monitoring condition provides some support for this although there was no evidence of mediation under the bootstrap approach.

Qualitative feedback regarding the competition intervention, in particular, was positive with several participants in this condition noting the study was enjoyable. Dropout rates in the competition condition, following exposure to the intervention, were low and did not differ from the dropout rates in the other conditions. This may imply that the competitive intervention was not overtly off-putting. Indeed, none of the participants provided any negative comment about the competitive component of the intervention. However, the low dropout rates in all conditions were probably influenced by the voucher payment at the end of the study, short study duration and minimal participant requirements. Further research is needed to consider user engagement without such incentives.

It is important to consider further limitations of the study. First, the intervention period was quite brief (4-weeks). However, this period of time exceeds the intervention period used in the study most similar to that reported here (10 days in the Zuckerman & Gal-Oz's, 2014, study). Moreover, the competition manipulation enhanced intrinsic motivation relative to the control group and such changes have been shown to explain sustained behaviour change (Ryan, Patrick, Deci & Williams, 2008). In addition, participants in the competition group were most likely to report the study was enjoyable suggesting that users may continue to engage with the system relatively long-term.

Second, by using pedometers as an objective measure of physical activity, a range of physical activities (e.g., swimming) were not reflected in the primary outcome measure. We attempted to work around this by adjusting the primary outcome measure for non-wear time (see adjusted steps) and also by demonstrating that the proportion of individuals reporting physical activity not captured by their pedometer did not differ across groups.

Third, some of the effects were not conventionally significant under a two-tailed test (though several would have been under a one-tailed test) and, in some cases, were non-significant. However, the direction of the effects were broadly consistent (competition > self-monitoring > control) and in line with the underlying hypotheses. Future research could attempt to replicate the study but employ a longer follow-up period. Moreover, to capture a greater range of physical activity, alternative means of collecting objective measures of physical activity could be used (e.g., accelerometers).

Fourth, the key manipulation was designed to stimulate competition, at least implicitly. To do this, the website included text that prompted participants to view a league table and to see 'how well' they were doing 'compared to others taking part in the study'. However, in the absence of a more explicit request to compete, the manipulation may be seen more as a normative feedback manipulation. Nevertheless, given we provided 'fine-grained' feedback containing individual-level information on the performance of each participant in the 'competition' condition rather than a group average or physical activity guideline, our manipulation is quite different to those employed in related studies (e.g., Vandelanotte, De Bourdeaudhuij, Sallis, Spittaels, & Brug, 2005; Smeets, Brug, & de Vries (2008).

Further limitations included the fact that, due to the nature of the content of the interventions, we were unable to employ a full-factorial design (e.g., to provide feedback- competitive or otherwise- without some form of self-monitoring). As a consequence, we were unable to identify the effects of each specific behaviour change technique when used in isolation and alongside other behaviour change techniques. The study could have been powered a-priori on the basis of a two-tailed hypothesis but on the weight of the literature we felt that a one-tailed, directional hypothesis was justified. While a larger sample size may have yielded more consistent significant effects for the self-monitoring manipulation, the study appeared to be sufficiently powered for our primary hypothesis concerning the effect of competition. All participants had the opportunity to self-monitor their steps given they were all provided with an open pedometer and as a result, this may have reduced the effect sizes of the interventions relative to the control group in promoting pedometer steps. However, technically those in the control group were not exposed to a self-monitoring of behaviour manipulation because, unlike those in the intervention conditions, were not requested to record or log their steps. Related to this, participants in the control group may perceive that their behaviour was being monitored by others without feedback. However, given the pedometers were used as part of the data collection procedure, consistent with Michie et al.'s (2013) taxonomy, use of the pedometer should not be treated as a behaviour change technique in itself. There are also a number of issues related to generalisability and implementation. First, the sample was predominately female, aged under 30 years and had the internet at home, so it is unclear the extent to which the results will generalize to other populations. Second, while the percentage of households with internet access at home is 89% in Great Britain in 2016 and increasing, the figure falls below 100% particularly amongst single pensioners (Office for National Statistics, 2016). Thus, there is some degree of restricted reach. Finally, given competition can have adverse effects for some (e.g., low achievers), this should be considered before the implementation of widespread public health campaigns; some degree of tailoring may be required.

In summary, a web-based intervention that encourages competition appears effective in increasing pedometer steps over a 4-week period. Given there was evidence that the competition group outperformed the self-monitoring group, it appears that this effect is attributable specifically to competition as opposed to techniques that often accompany competition such as self-monitoring and feedback. The positive effects of the competition intervention on increased physical activity were partly attributable to increased motivation but not enhanced confidence (PBC or self-efficacy).

References

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology*, *32*, 665-683.

Behrens, T.K., Domina, L., & Fletcher, G. M. (2007). Evaluation of an employer-sponsored pedometer-based physical activity program. *Perceptual and Motor Skills*, *105*, 968-976.

Buis, L. R., Poulton, T. A., Holleman, R. G., Sen, A., Resnick, P. J., Goodrich, D. E., Palma-Davis, L., & Richardson, C. R. (2009). Evaluating Active U: an Internet-mediated physical activity program. *BMC Public* Health, *9*, 331.

Carr, L. J., Dunsiger, S. I., Lewis, B., Ciccolo, J. T., Hartman, S., Bock, B., Dominick, G., & Marcus, B. H. (2013). Randomized controlled trial testing an internet physical activity intervention for sedentary adults. *Health Psychology, 32*, 328-336.

Carver, C. S., & Scheier, M. F. (1982). Control theory: A useful conceptual framework for personality–social, clinical, and health psychology. *Psychological Bulletin*, *92*, 111-135.

Consolvo, S., Everitt, K., Smith, I., & Landay, J. A. (2006). Design requirements for technologies that encourage physical activity (CHI 2006). Paper presented at: Proceedings of the SIGCHI conference on Human Factors in computing systems 2006; New York.

Crouter, S., Schneider, P., Karabulut, M., Bassett, D. (2003). Validity of 10 electronic pedometers for measuring steps, distance, and energy cost. *Medicine and Science in Sports and Exercise, 35,* 1455-1460.

CSP Network. Workplace Challenge. 2016; http://www.workplacechallenge.org.uk. Accessed August 17, 2016.

Duru, O.K., Sarkisian, C.A., Leng, M., & Mangione, C.M. (2010). Sisters in Motion: A Randomized Controlled Trial of a Faith-Based Physical Activity Intervention. *Journal of the American Geriatrics Society*, 58, 1863-1869.

Epstein, J.A., & Harackiewicz, J.M. (1992). Winning is not enough: The effects of competition and achievement orientation on intrinsic interest. *Personality and Social Psychology Bulletin*, *18*, 128-138.

Foster, D., Linehan, C., & Lawson, S. (2010). Motivating physical activity at work: using persuasive social media extensions for simple mobile devices. Mobile HCI 2010; Lisboa, Portugal.

Harkin, B., Webb, T.L., Chang, B.P., Prestwich, A., Conner, M., Kellar, I., Benn, Y., & Sheeran, P. (2016). Does Monitoring Goal Progress Promote Goal Attainment? A Meta-Analysis of the Experimental Evidence. *Psychological* Bulletin, *142*, 198-229.

Health and Social Care Information Centre (2008). *Health Survey for England: Physical Activity and Fitness.* London.

Johannesson, M., Östling, R., & Ranehill, E. (2010). The effect of competition on physical activity: a randomized trial. *The BE Journal of Economic Analysis & Policy*, *10*(1).

Lerner, B.S. & Locke, E. A. (1995). The effects of goal setting, self-efficacy, competition, and personal traits on the performance of an endurance task. *Journal of Sport and Exercise Psychology*, *17*, 138-138.

Lin, J. J., Mamykina, L., Lindtner, S., Delajoux, G., & Strub, H. B. (2006). Fish’n’Steps: Encouraging physical activity with an interactive computer game. *UbiComp 2006: Ubiquitous Computing*, 261-278.

Markland, D., & Tobin, V. (2004). A modification to the behavioural regulation in exercise questionnaire to include an assessment of amotivation. *Journal of Sport and Exercise Psychology*, *26*, 191-196.

McCormick, A. Meijen, C., & Marcora S. (2015). Psychological determinants of whole-body endurance performance. *Sports Medicine*, *45*, 997-1015.

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Health Psychology*, *28*, 690-701.

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M.P., Cane, J., & Wood, C.E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, *46*, 81-95.

Murayama, K. & Elliot, A.J. (2012). The competition–performance relation: A meta-analytic review and test of the opposing processes model of competition and performance. *Psychological Bulletin*, *138*, 1035-1070.

Office for National Statistics (2016, August). Internet access- households and individuals: 2016. Retrieved from: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2016#household-internet-access

Parkrun. 2016; http://www.parkrun.org.uk/. Accessed August 17, 2016.

Penedo, F.J. & Dahn, J.R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, *18*, 189-193.

Preacher, K.J., & Hayes, A.F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, *36*, 717-731.

Prestwich, A., Conner, M., Hurling, R., Ayres, K., & Morris, B. (2016). An experimental test of control theory-based interventions for physical activity. *British Journal of Health Psychology*, *21*, 812-826.

Reeve, J., & Deci, E.L. (1996). Elements of the competitive situation that affect intrinsic motivation. *Personality and Social Psychology Bulletin*, *22*, 24-33.

Ryan, R.M., Patrick, H., Deci, E. L., & Williams, G. C. (2008). Facilitating health behaviour change and its maintenance: Interventions based on self-determination theory. *European Health Psychologist*, *10*, 2-5.

Smeets, T., Brug, J., & de Vries, H. (2008). Effects of tailoring health messages on physical activity. *Health Education Research*, *23*, 402-413.

Southard, B.H., Southard, D.R., & Nuckolls, J. (2003). Clinical trial of an internet-based case management system for secondary prevention of heart disease. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *23*, 341-348.

SPARK. 25 day challenge. 2015; http://www.sparkpe.org/25-day-physical-activity-challenge/25-day-challenge-details/. Accessed August 17, 2016.

Vandelanotte, C., De Bourdeaudhuij, I., Sallis, J.F., Spittaels, H., & Brug, J. (2005). Efficacy of sequential or simultaneous interactive computer-tailored interventions for increasing physical activity and decreasing fat intake. *Annals of Behavioral Medicine*, *29*, 138-146.

Warburton, D.E., Nicol, C.W. & Bredin, S.S. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal*, *174*, 801-809.

Zuckerman, O., & Gal-Oz, A. (2014). Deconstructing gamification: evaluating the effectiveness of continuous measurement, virtual rewards, and social comparison for promoting physical activity. *Personal and Ubiquitous Computing*, *18*, 1705-1719.

Table 1

Baseline characteristics of participants: Mean (Standard deviation)

Measure	Competition	Self-Monitoring	Control	*p*
Age (years)	23.94 (9.16)	21.98 (5.97)	23.09 (6.96)	.23
Age range	18-60	18-52	18-55	-
Sex (% male)	22.7	24.4	25.7	.89
Baseline steps (non-adjusted)	5162 (2582)	5675 (2918)	5451 (2957)	.49
Baseline steps (adjusted)	5340 (3728)	6417 (3753)	5970 (3485)	.15
Total hours not worn pedometer	9.55 (18.39)	11.04 (16.07)	8.26 (16.07)	.54
% doing some physical activity without wearing pedometer	25.8	34.9	27.5	.37
Intention (1-7)	4.86 (1.49)	4.95 (1.45)	4.88 (1.52)	.92
Planning (1-7)	4.78 (1.62)	4.60 (1.78)	4.60 (1.67)	.71
Effort (1-7)	4.98 (1.65)	4.93 (1.65)	4.87 (1.66)	.91
Commitment (1-10)	6.24 (2.50)	6.07 (2.43)	6.47 (2.43)	.53
PBC (1-10)	6.97 (1.95)	6.73 (2.11)	7.24 (1.90)	.22
Self-efficacy (1-10)	7.45 (1.69)	7.28 (1.75)	7.64 (1.74)	.36
Goal importance (1-5)	3.31 (1.25)	3.02 (1.16)	3.35 (1.15)	.14
Goal conflict (1-5)	3.08 (1.21)	2.78 (1.21)	2.79 (1.25)	.18
External motivation (0-4)	0.66 (0.84)	0.64 (0.82)	0.73 (0.80)	.76
Introjected motivation (0-4)	0.79 (0.97)	0.80 (1.01)	0.81 (0.92)	.99
Identified motivation (0-4)	2.11 (0.95)	2.12 (0.77)	2.09 (0.94)	.96
Intrinsic motivation (0-4)	1.73 (1.11)	1.74 (0.92)	1.58 (1.05)	.47
Amotivation (0-4)	0.87 (1.02)	0.70 (0.82)	0.88 (1.05)	.38

Table 2

Effect of manipulations on mean average daily pedometer steps (SD)

Condition	Phase 1 Steps (non-adj.)	Phase 2 Steps (non-adj.)	Phase 1 Steps (adjusted)	Phase 2 Steps (adjusted)	ANCOVA p-value (non-adj.)	ANCOVA p-value (adjusted)	Post-hoc
Competition	5169 (2606)	6420 (2587)	5365 (3776)	7005 (2783)	.03*	.002**	Com > Con
Self-monitoring	5768 (2924)	6169 (2534)	6483 (3779)	6683 (3412)			Com>SM (adj. only)
Control	5478 (2974)	5659 (3042)	5965 (3503)	5958 (3287)			SM=Con

Notes. *$p < .05$; **$p < .01$; Com = Competition; SM = Self-monitoring; Con = Control.

Table 3

Effect of manipulations on psychosocial measures: Means (and standard deviations)

Measures (Cronbach's T2,T3)	Competition T2	Competition T3	Self-monitor T2	Self-monitor T3	Control T2	Control T3	ANCOVA *F*	Post-hoc (effect size *g*; CI)
Intention (1-7) (.86, .93)	4.90 (1.48)	4.70 (1.41)	4.93 (1.46)	4.50 (1.51)	4.85 (1.53)	4.48 (1.46)	0.75	Com=SM (0.17; -0.13 – 0.48); Com=Con (0.15; -0.14 - 0.45); SM=Con (-0.02; -0.32 – 0.28)
Planning (1-7) (-,-)	4.80 (1.61)	4.48 (1.54)	4.60 (1.78)	4.18 (1.55)	4.55 (1.66)	4.15 (1.61)	0.59	Com=SM (0.14; -0.17 – 0.45); Com=Con (0.15; -0.15 - 0.44); SM=Con (0.01; -0.29 – 0.30)
Effort (1-7) (-,-)	5.07 (1.57)	4.82 (1.53)	4.91 (1.66)	4.43 (1.59)	4.81 (1.66)	4.28 (1.62)	2.07	Com>Control† (0.30; 0.00 - 0.59); Com=SM (0.23; -0.08 - 0.54); SM=Con (0.07; -0.23 – 0.36)
Commitment (1-10) (-,-)	6.37 (2.44)	6.00 (2.36)	6.10 (2.44)	5.32 (2.22)	6.39 (2.45)	5.42 (2.39)	2.42†	Com>SM† (0.28; - 0.03 – 0.59); Com > Con* (0.30; 0.01 – 0.60) SM=Con (0.03; -0.27 – 0.32)
PBC (1-10) (.74, .82)	6.95 (1.98)	6.45 (1.98)	6.74 (2.10)	6.29 (2.18)	7.23 (1.90)	6.63 (2.12)	0.03	Com=SM (0.02; -0.28 – 0.33); Com=Con (-0.02; -0.31 - 0.28); SM=Con (-0.04; -0.34 – 0.26)
Self-efficacy (1-10) (.86,.87)	7.51 (1.66)	7.21 (1.66)	7.29 (1.73)	7.13 (1.51)	7.63 (1.73)	7.04 (2.08)	0.98	Com=SM (-0.04; -0.34 – 0.27); Com=Con (0.16; -0.14 – 0.46); SM=Con (0.20; -0.10 – 0.49)
Goal importance (1-5) (-,-)	3.39 (1.20)	3.34 (1.11)	3.02 (1.18)	2.93 (1.13)	3.34 (1.16)	2.99 (1.21)	2.59†	Com>Control* (0.34; 0.04-0.64); Com=SM (0.22; -0.09 – 0.53); SM=Con (0.12; -0.18 – 0.42)

Goal conflict (1-5) (-,-)	3.11 (1.23)	2.89 (1.17)	2.72 (1.18)	2.96 (1.29)	2.78 (1.24)	3.04 (1.24)	1.61	Control>Com† (-0.26; -0.55-0.04); Com=SM (-0.21; -0.52 – 0.10); SM=Con (-0.05; -0.34 – 0.25)
External mot. (0-4) (.84, .82)	0.70 (0.85)	0.73 (0.75)	0.66 (.82)	0.77 (0.79)	0.70 (0.75)	0.67 (0.77)	0.69	Com=SM (-0.09; -0.39 – 0.22); Com=Con (0.09; -0.21 - 0.38); SM=Con (0.18; -0.12 – 0.47)
Introjected mot. (0-4) (.87, .86)	0.84 (0.98)	1.17 (0.99)	0.74 (0.95)	1.04 (1.01)	0.79 (0.88)	0.70 (0.86)	8.06***	Com>Con*** (0.55; 0.25-0.85); SM>Con** (0.47; 0.17-0.77) Com=SM (0.09; -0.22 – 0.39)
Identified mot. (0-4) (.80, .82)	2.18 (0.92)	2.35 (0.93)	2.10 (0.78)	2.20 (0.73)	2.07 (0.95)	1.95 (0.92)	5.37**	Com>Con** (0.47; 0.17- 0.77) SM>Con* (0.33; 0.03-0.63) Com=SM (0.14; -0.16 – 0.45)
Intrinsic mot. (0-4) (.92, .93)	1.79 (1.11)	2.05 (1.11)	1.75 (0.90)	2.16 (0.88)	1.56 (1.03)	1.47 (0.94)	13.58***	Com>Con*** (0.57; 0.27-0.87) SM>Con*** (0.74; 0.44-1.05) Com=SM (-0.17; -0.48 – 0.13)
Amotivation (0-4) (.92, .90)	0.80 (0.98)	0.81 (0.93)	0.71 (0.83)	0.78 (0.78)	0.86 (0.99)	0.82 (0.87)	0.04	Com=SM (-0.02; -0.33 – 0.28); Com=Con (0.02; -0.28 - 0.33); SM=Con (0.04; -0.25 – 0.34)

Notes. †$p < .10$; *$p < .05$; ** $p < .01$; *** $p < .001$; Com = Competition; SM = Self-monitoring; Con = Control.

Table 4

Summary of Mediation Analyses

Mediator	Competition vs. Control (adjusted steps) *Z*	95%CI	Competition vs. Control (non-adjusted steps)		Competition vs. Self-monitoring (adjusted steps)	
Intention	0.61	-108.60 – 253.01	0.67	-61.31 – 232.95	1.21	-64.15 – 482.18
Planning	0.19	-98.24 – 165.69	0.28	-121.21 – 167.68	0.55	-115.66 – 305.12
Effort	0.72	-57.61 – 194.54	0.71	-47.35 – 166.37	1.10	-49.97 – 366.16
Commitment	1.32	-35.62 – 417.64	1.37	-13.84 – 390.07	1.22	-39.33 – 445.93
PBC	0.33	-97.17 – 178.71	0.30	-98.35 – 156.19	0.00	-110.03 – 99.13
Self-efficacy	0.80	-47.30 – 276.74	0.92	-42.26 – 288.94	-0.37	-209.70 – 117.77
Goal Importance	1.47	3.58 – 431.99*	1.63	12.42 – 475.84*	0.49	-124.58 – 253.33
Goal Conflict	-0.17	-212.39 – 194.82	-0.92	-274.82 – 61.02	-0.97	-354.28 – 105.58
External	0.19	-56.49 – 98.24	0.30	-52.56 – 120.91	-0.22	-128.73 – 55.10
Introjected motivation	0.28	-164.16 – 248.09	0.32	-140.00 – 218.62	0.26	-128.11 – 162.13
Identified motivation	1.51	5.08 – 482.43*	1.66	9.16 – 493.09*	0.76	-90.42 – 314.05
Intrinsic motivation	1.48	0.96 – 450.76*	1.77	27.55 – 491.31*	-0.77	-279.54 – 73.73
Amotivation	-0.34	-217.92 – 113.29	-0.25	-140.30 – 81.89	0.09	-133.21 – 72.40

Notes. 95% CI reflects the 95% confidence interval of the bootstrap results of the indirect effect. Bootstrap estimates are based on 1,000 re-samples. * mediation significant at $p < .05$ (two-tailed).

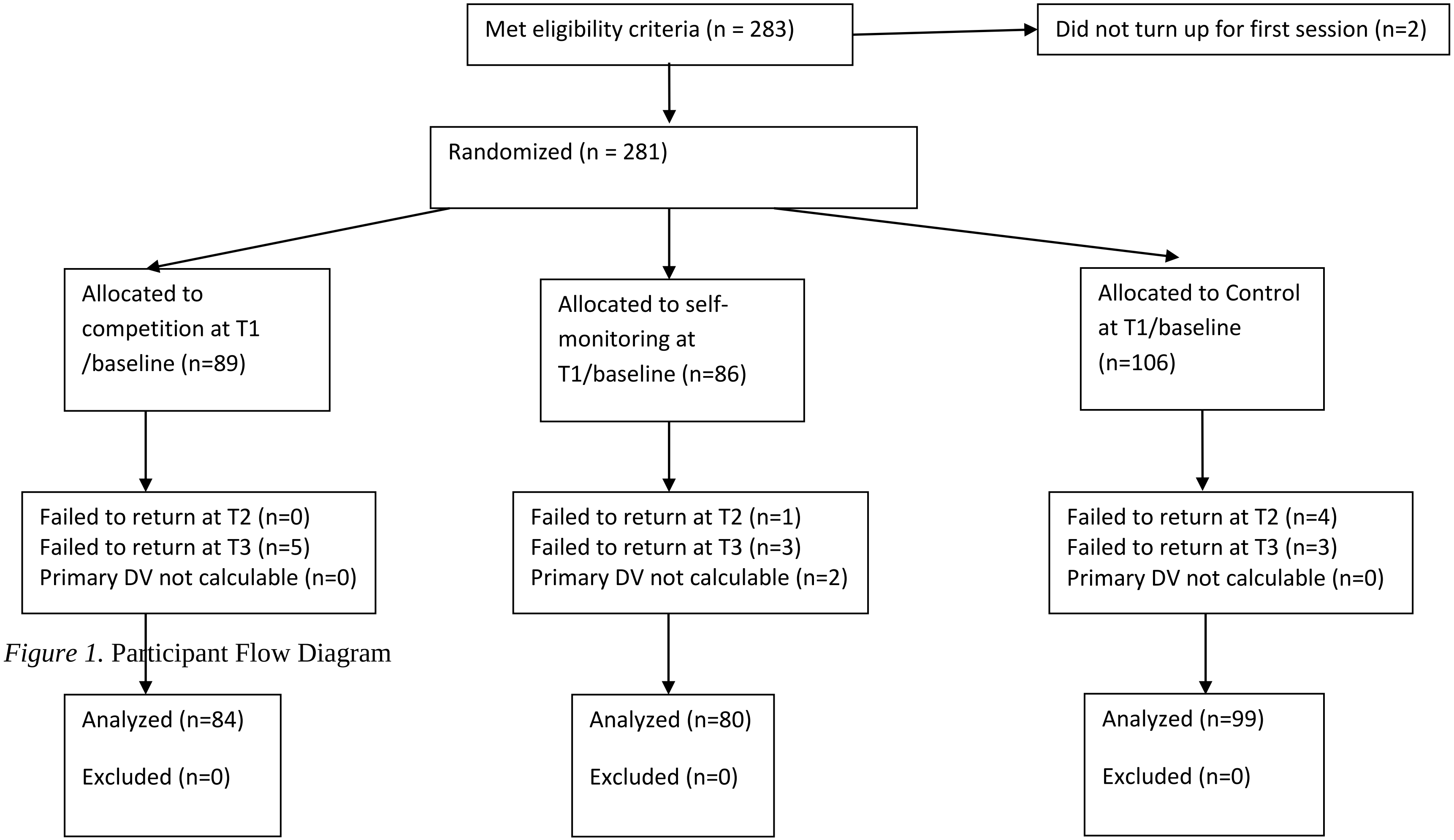

Figure 1. Participant Flow Diagram