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

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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.



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, 2015), 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

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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 1000 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 1000 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, pp. 261–278). 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 minimize 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, Conner, Hurling, Ayres, & Morris, 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