



Support or competition? How online social networks increase physical activity: A randomized controlled trial[☆]

Jingwen Zhang PhD, Devon Brackbill PhD, Sijia Yang MA, Joshua Becker MA, Natalie Herbert MA, Damon Centola PhD^{*}

Annenberg School for Communication, University of Pennsylvania, 3620 Walnut Street, Philadelphia, PA 19104, United States

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ABSTRACT

To identify what features of online social networks can increase physical activity, we conducted a 4-arm randomized controlled trial in 2014 in Philadelphia, PA. Students ($n = 790$, mean age = 25.2) at an university were randomly assigned to one of four conditions composed of either supportive or competitive relationships and either with individual or team incentives for attending exercise classes. The social comparison condition placed participants into 6-person competitive networks with individual incentives. The social support condition placed participants into 6-person teams with team incentives. The combined condition with both supportive and competitive relationships placed participants into 6-person teams, where participants could compare their team's performance to 5 other teams' performances. The control condition only allowed participants to attend classes with individual incentives. Rewards were based on the total number of classes attended by an individual, or the average number of classes attended by the members of a team. The outcome was the number of classes that participants attended. Data were analyzed using multilevel models in 2014. The mean attendance numbers per week were 35.7, 38.5, 20.3, and 16.8 in the social comparison, the combined, the control, and the social support conditions. Attendance numbers were 90% higher in the social comparison and the combined conditions (mean = 1.9, SE = 0.2) in contrast to the two conditions without comparison (mean = 1.0, SE = 0.2) ($p = 0.003$). Social comparison was more effective for increasing physical activity than social support and its effects did not depend on individual or team incentives.

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1. Introduction

Physical inactivity significantly increases the risk of chronic disease (Lee et al., 2001; Sattelmair et al., 2011) and mortality (Nocon et al., 2008; Wen et al., 2011). Low levels of physical activity among young adults remains a serious nationwide problem, with 69% of Americans 18 to 24 years of age failing to meet the federal guidelines for physical activity in 2014 (National Center for Health Statistics, 2015). Among all the social and environmental factors affecting physical activity (Addy et al., 2004; Martin and Savla, 2011), interpersonal social networks are one of the most prominent targets for cost-effective interventions (Maher et al., 2015). Online social networks, in particular, have become a highly attractive target for large scale health initiatives (Centola, 2013; Cobb and Graham, 2012); however, there is insufficient knowledge about why online networks might be effective sources of social influence for improving physical activity levels. One prominent argument in the literature on networks and health suggests that online

relationships improve physical activity through supportive interactions that encourage healthy behaviors (Centola, 2010, 2011). An alternative approach stresses peer competition within online networks, emphasizing the value of social comparison as a mechanism for increasing individuals' receptiveness to positive behavioral influences (Foster et al., 2010). We evaluate the effects of each of these approaches independently, and in combination, to determine how social motivations for behavior change directly impact people's exercise activity.

Social support is one of the most widely used and studied strategies for encouraging behavior change in social networks (Berkman et al., 2000). When people with similar interests interact to achieve a shared goal, social support can reduce the perceived costs of adopting a new exercise routine by providing companionship in the activity (Cavallo et al., 2014; Uchino, 2004). Further, social support reduces the uncertainty of exploring new exercises by providing access to relevant sources of peer information (Wing and Jeffery, 1999). Thus, cooperative online relationships, where people work towards the same health goals, can foster collective efficacy for improving everyone's levels of physical activity (Cohen et al., 2006).

While social support via cooperative relationships may promote physical activity, an alternative approach utilizes social comparison via

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^{*} Corresponding author.

E-mail address: dcentola@asc.upenn.edu (D. Centola).

competitive social relations (Foster et al., 2010; Zhang et al., 2015). Social comparison strategies are implicit in fitness and exercise programs that use rankings, leader boards, and social status markers to increase physical activity (Festinger, 1954). In these competitive environments, people work towards their goals individually, and differences in goal attainment motivate individuals to adjust their aspirations upward. The dynamic process of comparing oneself to others increases everyone's expectation for goal attainment and eventually improves overall levels of physical activity (Leahey et al., 2012; Shakya et al., 2015).

The number of online social network health interventions has increased dramatically in recent years (Laranjo et al., 2015; Maher et al., 2014; Williams et al., 2014). However, the independent causal effects as well as the interaction effects of these two contrasting approaches have not been identified (Cavallo et al., 2012; Napolitano et al., 2013; Neiger et al., 2012). As a result, there is very little guidance as to how these approaches might be used in applied settings to maximize social resources for increased fitness. This is particularly striking in light of recent meta-analyses of online social network health interventions, which have been inconclusive both on identifying which approaches are most effective, and regarding whether there are any systematic network strategies that can reliably be used to promote physical activity (Maher et al., 2014).

These problems of identification are compounded by the fact that the vast majority of research on online social networks and behavior change supplements social motivations with non-social incentives, such as health education and behavior tracking (Korda and Itani, 2013; Williams et al., 2014). This introduces interaction effects that prevent the identification of how, or whether, social factors can directly motivate behavior change. These shortcomings raise serious theoretical difficulties for developing consistent and replicable theories of how online social networks impact physical activity. They also limit the ability to apply online social network interventions to specific behavioral settings, where clear guidelines are required in order to implement effective interventions. We addressed these problems by conducting a double-blind four-arm randomized controlled study that compared the effects of social support and social comparison on increasing physical activity.

2. Methods

2.1. Study design

An 11-week online social network-based exercise program called SHAPE-UP was conducted at a Northeastern university. The program offered 90 exercise classes. On average, eight classes were offered per week on the University's campus, and each class lasted for an hour. Class content covered both aerobic and muscle-strengthening physical activities, including running, spinning, yoga, Pilates, weight lifting, high intensity interval training, and group exercising. All classes were led by instructors from the Department of Recreation and Health Services (DRHS) at the University. Participation in all classes was restricted to the program participants. At the conclusion of the program, participants were rewarded with gift cards for their participation based on the cumulative number of exercise classes they attended.

All participants in the program received access to the SHAPE-UP website, which was the only way for participants to enroll in classes and to interact with the program. Each participant created an online profile including username, gender, age, and their University affiliation. All participants had continuous and equal access to the website. To register for an exercise class, participants selected available classes from an interactive calendar that provided a brief class description and a registration tool. Upon registering, participants immediately received a confirmation email, and a reminder email was sent 12 h before each class started. An online tracking tool provided all participants with a daily journal of their exercise classes.

Upon logging into the website for the first time, participants were randomly assigned to one of four experimental conditions. Fig. 1 illustrates the four experimental conditions and Table 1 summarizes the different intervention components of the four conditions. Participants in the control condition were given the basic website for registering for classes. The control participants were provided with no social motivations, and were rewarded at the end of the program based on their individual record of attendance at exercise classes. The top 10% of participants in the condition were rewarded \$20 gift cards at the end of the program. Three different experimental manipulations supplemented the control condition by providing online peer networks with different social incentives that might increase participation.

The *social comparison* condition supplemented the basic class registration website by giving participants access to 6-person peer networks. Each participant in this condition was randomly assigned 5 peers, which comprised 5 members of the study who were connected to the participant in a program-generated social network. Participants in this condition were able to compare their performance in the program with their peers via a competitive ranking based on their peers' activity levels. As in the control condition, at the conclusion of the program, the rewards for participants were based on each participant's individual record of class attendance. The top 10% of participants in the condition were rewarded \$20 gift cards at the end of the program. All peers' information was anonymous, and there was almost no possibility for direct communication between participants in this condition online or offline.

By contrast, the *social support* condition was designed to provide participants with direct peer support from other members of the program who could encourage each other to improve their levels of regular exercise. Participants in this condition were randomly assigned to 6-person teams. At the completion of the program, rewards were based on the team's collective activity levels, incentivizing team members to actively support each other's attendance at exercise classes. All members in the top 10% of teams in the condition were rewarded \$20 gift cards at the end of the program. To facilitate supportive social interaction, participants in the social support condition were provided with a chatting tool that they could use to directly communicate with each other in real-time. Team members could see both each other's individual records of class attendance as well as the collective record of the team. Participants in this condition were able to register for classes individually, but they could also coordinate to register for classes collectively.

Finally, to understand if there was an interaction effect of combining the motivations of social support and social comparison, the *combined* condition randomly placed individuals on 6-person teams and provided the same team incentives and technologies as the social support condition; however this condition was supplemented with a competitive feature, in the form of an interface that allowed participants to compare their team's performance against the performances of 5 other teams. All members in the top 5% of teams in the condition were rewarded \$20 gift cards at the end of the program.

In these three conditions with online networks, participants in the same network also received real-time web and email notifications about their peers' registration and attendance of classes. For instance, when a network member attended a class, all of her peers would receive a notification about her class attendance. This signaling system was identical for all online networks across conditions.

2.2. Study participants

The SHAPE-UP program was open to all graduate and professional students at the University who were 18 years or older. Participants were recruited through advertisements on the University's website, through the student email list, via advertisements from the graduate student association, and with paper flyers placed on billboards around campus. The recruitment materials specified that the purpose of the project was to improve participants' quality of life through better fitness. Eligibility for enrollment in the study was determined by a physical assessment

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