Chapter 17. How Social Networks Shape Social Comparison

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Abstract: While social comparison research has focused on the processes and consequences of how the comparer gleans information from the comparison other (individual or group), recent research on social networks demonstrates how information and influence is distributed across persons in a network. This chapter reviews social influence processes in social networks. We first review recent research on social comparison and its negative consequences in online social networks. Then we delve into discussing the social network causes of biased social perceptions online and how this can be remedied by building more accurate perceptions through constructed online networks. Lastly, we discuss findings from recent experimental studies that illustrate how constructed online networks can harness social comparison to induce significant changes in health behavior.

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Connections between people lead to connections between their behaviors. Social psychologists have long demonstrated that our decisions can be influenced by other people even without our being aware of it (Bargh et al., 1996). Although our immediate social influences (e.g., family and friends) are known to us, the broader scope of social reference points that we use for evaluating our own attractiveness, our level of healthiness, our weight, and our expectations for ourselves often reside within the extended social networks that we are only implicitly aware of.

Over the past decade there have been growing theoretical discussions and empirical tests of the impact of social networks in shaping people's behaviors. The relations between social networks and health have received perhaps the most research attention (Berkman et al., 2000; Smith & Christakis, 2008). Large observational studies have consistently shown that health behaviors (e.g., smoking, obesity, latrine ownership) tend to be clustered in people's offline social networks (Christakis and Fowler, 2007, 2008; Christakis and Fowler, 2013; Shakya et al., 2015). While evidence for the existence of behavioral clustering in social networks is overwhelming, what remains poorly understood are the causes. Are people in some parts of the social network more susceptible to advertising or informational signals? Is there clustering by race or socio-economic-status, which translates into differential patterns of health behavior? Is there clustering by health behaviors simply due to the homophily principle (McPherson et al., 2011), that social connections between people who share similar behavior patterns occur at a higher rate than among people who are dissimilar in behavioral choices? Or, as some suspect, do people actively influence one another within their social networks to change their health behaviors?

To answer these questions, innovative designs using online social network experiments have demonstrated the causal impact of network structures on behavior diffusion. The results show that not only do people influence the behavior patterns of those who are connected to them socially, but also the underlying structures of people's social networks can directly shape their behavior patterns (Centola, 2010, 2011, 2013). In this chapter, we focus on discussing health behaviors as examples, although other domains of behaviors are just as relevant. In one study, Centola (2010) compared the effects of two different network structures on determining the diffusion of a behavior (i.e., signing up for an online health forum). In the random networks people were randomly connected with a low frequency of sharing mutual contacts, whereas in the clustered networks people were put into clusters with a high frequency of sharing multiple mutual contacts (see Figure 1 for an illustration of the two network structures). The results showed that the frequency of people having multiple shared friends, or overlapping network contacts between them within an online social network, directly predicted the speed at which the health behavior would spread through the population.

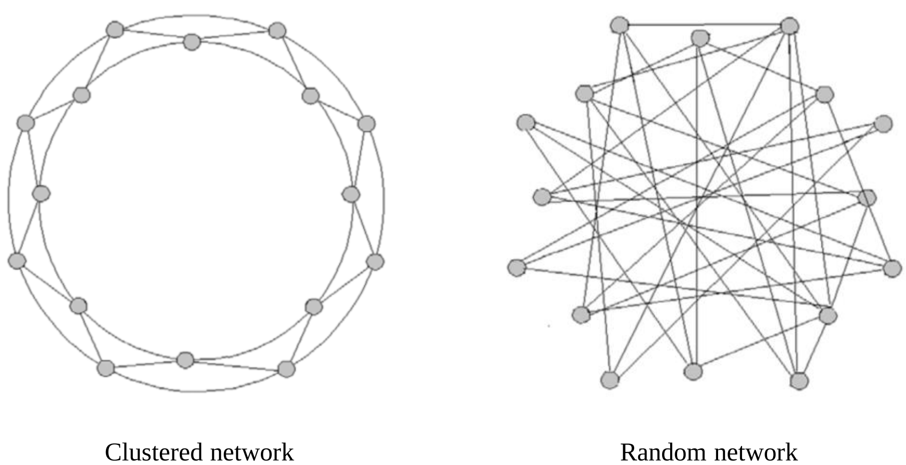

Figure 1. Structures of clustered network and random network

In another study, to test whether homophily further facilitated behavior diffusion, Centola (2011) compared the effects of homophilous networks where people who shared similar characters (i.e., gender, age, and body-mass-index [BMI]) were connected with each other online with non-homophilous networks where people were not connected to similar others (see Figure 2 for an illustration of the network conditions). The results showed when people were connected with others who shared similar health traits, they were significantly more likely to adopt the health behavior under the influence of similar others. Thus, not only do people influence each other's health behavior, but surprisingly simple structural features of a social network, including the frequency of sharing mutual friends in a network and the extent of having friends who share similar health traits, can directly affect whether health behaviors will be adopted.

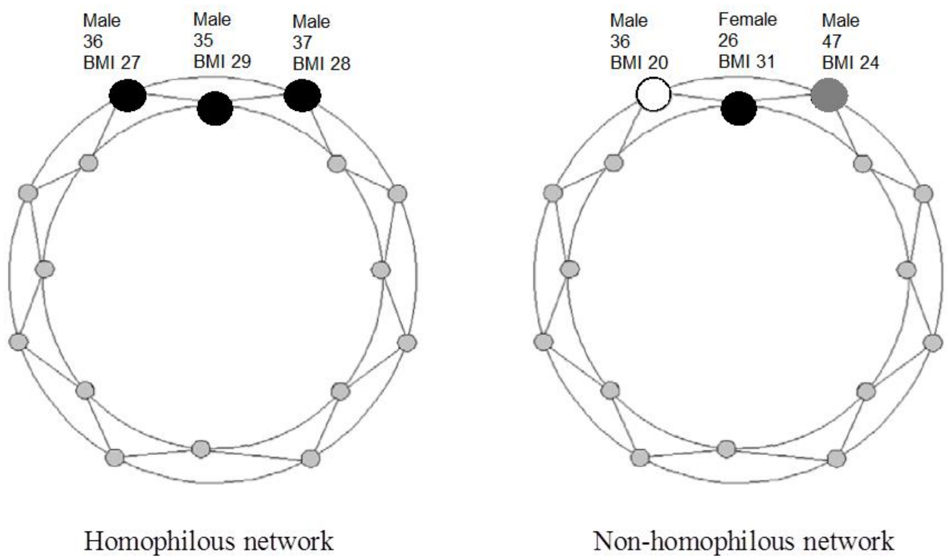

Figure 2. Structures of homophilous network and non-homophilous network

There are several mechanisms that can explain why social networks may influence people's health behaviors –such as social reinforcement, social comparison, companionship, and social support (Berkman et al., 2000). Here we explore one of these mechanisms in detail –i.e., social comparison among network contacts –and show how it can be used for designing network-based behavioral interventions. While social comparison has been given only modest attention in the networks literature, it is a ubiquitous feature of social life as this volume shows, with wide-reaching implications for decision making and behavior change. This chapter reveals the important connections between social networks and social comparison, highlighting how research on social networks can be used to understand when and how social comparison operates. We begin with a review of recent research on social comparison in online social networks, paying special attention to recent work on the negative effects of social comparison online. Then we delve into discussing the underlying social network causes of biased social perceptions online, and how this can be remedied by building more accurate social perceptions through constructed online social networks. Lastly we provide a case study that illustrates how constructed online networks can harness social comparison to induce significant changes in health behavior.

Social Comparison and Depression in Online Social Networking Sites

A recent upsurge in interest in social influence online has been accelerated by research attention to social networking sites (SNSs; e.g., Facebook, LinkedIn, and Twitter) that allow individuals to construct their own profiles and build a network of connections with other users within the system (Boyd and Ellison, 2007). There is often overlap between people's online and offline networks (Reich et al., 2012; Subrahmanyam et al., 2008). For instance, people regularly use SNSs to connect and reconnect with friends and family members. Yet, despite early research showing that SNSs use was positively associated with social capital (Ellison et al., 2007), recent studies suggest that SNSs use is significantly associated with the onset of depression (Feinstein et al., 2013; Sidani et al., 2016; Tandoc et al., 2015). In using SNSs, people tend to selectively present flattering photos, achievements, and interesting activities, and those without such impressive updates often choose not to use or don't participate in SNSs (Krämer and Winter, 2008; Siibak, 2009). One explanation for the association between SNS use and depression is that passive exposure to highly idealized representations of peers on SNSs elicits feelings of envy and the belief that peers are living better and more successful lives (Tandoc et al., 2015). Further, upward social comparison with one's peers on SNSs places individuals at risk for experiencing lowered self-esteem (Vogel et al., 2014) and negative rumination, which in turn leads to depressive symptoms (Feinstein et al., 2013).

This line of research drew a great deal of popular attention, with news articles warning about "Facebook depression," especially in children and teens. Although "Facebook depression" seems like a new phenomenon, the underlying social comparison process has been studied for a long time. People compare themselves with others to obtain self-evaluation, self-enhancement, or self-improvement. Depending on different goals, people engage in different types of comparisons. Lateral comparison serves self- evaluation, downward comparison serves self-enhancement, and upward comparison serves self- improvement (Corcoran et al., 2011). Social comparisons can happen strategically or implicitly and they affect people's mood and self-perception (Mussweiler et al., 2006; Wood, 1989). Although upward comparison can sometimes create a more positive perception of one's personal reality and facilitate self-improvement (Collins,1995), when people engage in upward comparisons with others who are similar on other dimensions than the comparison area, they are also likely to experience lowered self-regard, which has been shown to associate with poor health, depression, and suicide even in affluent communities (Cacioppo et al., 2009; Rosenquist et al., 2011). In general, people tend to seek out others who share similar attributes (e.g., demographic background, general worldview) for comparisons (Suls et al., 2002). Similar others provide a useful reference point for self-assessment in all three of these directions and similarity on performance and related attributes especially serves the goal of self-assessment of ability (Wheeler et al., 1997). Comparisons with people whose opinion or ability are too different from one's own may often be disregarded as irrelevant (Festinger, 1954).

Consequently, SNSs tend to adhere to the "homophily principle" – people are connected to people who are like themselves. For instance, Facebook networks among college students tended to connect people with similar demographic traits, as well as similar cultural preferences on movies, music, and books (Lewis et al., 2008). One consequence of this homophily principle is that people's personal networks are homogeneous with regard to many sociodemographic, behavioral, and intrapersonal characteristics (McPherson et al., 2011).

While this same principle is also true of offline networks, the difference online is that people now can have an ambient awareness of the behaviors and activities of many other people in their extended social circles. Offline, the targets for social comparison are limited to just a few friends, colleagues, or neighbors due to time and space constraints. With the capability of SNSs to create a readily accessible large web of social connections, each status and picture update by every friend of a friend reveals details of others' lives for social comparison. One explanation for "Facebook depression" is that, while each individual update seems meaningless on its own, the collection of them forms a powerful impression about others' life, in contrast to one's own life. People may then compare themselves with a simplified "other" constructed by a collective of others' status updates, pictures, and shared information. Consistent with impression management theory (Leary and Kowalski, 1990), people can be expected to optimize their self-presentations on SNSs (Chou and Edge, 2012), creating a social presentation of the generalized "other" that inaccurately represents their happiness, engagement and success. Continuous passive exposure to these kinds of signals can elicit negative outcomes of social comparison, such as feelings of envy, relative deprivation, and depression.

Social comparison often happens implicitly rather than strategically, engaging automatic cognitive triggers of self-evaluation (Mussweiler et al., 2006). As Mussweiler et al. (2006) put it, “[w]henever people are confronted with information about how others are, what others can and cannot do, or what others have achieved and have failed to achieve, people relate this information to themselves.” Experimental studies show that being continuously and passively exposed to social information can effectively generate new self-assessments. For instance, in an experimental study where images of Michael Jordan were subliminally presented to subjects, participants were significantly more likely to rate themselves as less athletic, even though Michael Jordan was not an obvious reference point for athletic achievement (Mussweiler et al., 2004). Building on these results, a recent survey study found a positive correlation between social comparison frequency on Facebook and the frequency of having a negative feeling from comparison (i.e., think others are having a better life and doing better than the comparer) (Lee, 2014). And, an examination of the mediation mechanisms linking Facebook use and self-esteem indeed found that upward comparison was more frequent is SNS use and mediated the association between SNS use of lower self-esteem (Vogel et al., 2014). In other words, increased awareness of a high volume of peers’ SNS activity was linked to a higher level of upward comparison and a greater likelihood of feeling worse about oneself.

The Majority Illusion and Biased Perceptions in Social Networks

Beyond the content of social comparison, social network structures can also contribute to systematic biases in social perceptions, leading to negative forms of self-assessment. In social network theory, the "degree" of an individual, or "node," in the network refers to the number of connections the person has. In a large, connected network, each individual is embedded in a complex web of social interactions that could impact on wellbeing. Social networks have emergent properties not explained by the individuals' attributes. It is often misleading to generalize from individual preferences and behaviors to the aggregate preferences and behaviors of the interconnected group (Granovetter, 1978; Schelling, 1978). As Hall and Wellman (1985) summarized, network analysis "focuses on the characteristic patterns of ties between actors in a social system rather than on characteristics of the individual actors themselves. Analysts search for the structure of ties underlying what often appears to be incoherent surface appearances and use their descriptions to study how these social structures constrain network member's behavior" (p.26). To map a complete or global network for the structure of ties underlying certain social patterns, researchers need to survey or observe all or nearly all members of a community or group and their connections to each other. Such global network structures where individuals are embedded in are beyond each individual's comprehension, and have been shown to explain health disparities (e.g., sexually transmitted diseases including HIV) on the population level (Laumann & Youm, 1999; Schneider et al., 2013).

Biases in social perceptions are created by the fact that individuals sample "locally," from their immediate peer group in the network, rather than "globally," from the population as a whole. An individual's local network is represented by the tie structures among the individual and his or her direct social contacts whereas a global network is represented by the tie structures among all members of the network. The biases thus are a result of the fact that the network has different local properties for different people, creating an uneven picture of what people think, and how they behave. The information that people get from their network is thus based more on the complex structure of how people are arranged in the social web, than on their individual characteristics. For instance, in most complex social networks there are some individuals who are more highly connected than others. These “social stars” or “hubs” may have several times more contacts than most other people. Because the hubs are more connected, their personal opinions and behaviors are also more represented in the network. The hubs appear in a lot of people’s social networks, so the hubs have more exposure to the population than most people. This can give rise to what is known as the “majority illusion.”

The “majority illusion” suggests that under some conditions, individuals will overestimate the prevalence of some behaviors (e.g., binge drinking) in their local networks based on behaviors of their known social contacts, even though the behaviors are relatively rare in the global network. This is because the high- degree nodes, or hubs of a social network, present such behaviors to a lot of different people, creating a skewed perception of the behavior’s popularity in the network. Lerman et al. (2016) showed that the paradox is much stronger in networks where low-degree nodes are connected with high-degree nodes, and in conditions where the degree-attribute correlation is high. In other words, if hubs tend not to interact with other hubs, and hubs also tend to exhibit the same behaviors, then just a few hubs can make everyone think that an unusual behavior is actually quite popular. In fact, any attribute that is correlated with degree will produce a “majority illusion,” and empirically high-degree nodes do share certain attributes that make them the network hubs. For instance, research has shown people with extraversion personality play a pivotal role in the tie formation process (Wehrli, 2008), putting them into the hub positions. Extraversion has been linked to problematic drinking and heavy drinking patterns (Fairbairn et al., 2015). This particular degree-attribute correlation explains a common observation that people often overestimate heavy drinking behaviors among their peers. More broadly, high-degrees can also correlate with attractiveness and wealth. Recent analyses on SNSs show that this can happen quite easily, for instance, on Twitter, where the celebrities (high-degree nodes) attract their fans (low-degree nodes) to connect to them (Li et al., 2014). As a result, social comparisons in social networks are biased upward due to the overrepresentations of such "successful" characters.

These network insights provide an important structural explanation for people's biased social perceptions about their peers, social comparison effects that can emerge from that. Particularly in online social networks, people are not only exposed to others' curated "better life," but are also subject to structurally biased reference groups of high degree individuals for social comparison.

Constructed Online Social Networks

Social comparison with online peers is an unavoidable feature of the SNS landscape. However, one solution to the concerns about the potential for negative effects has been to harness these networks to create positive forms of social comparison to improve health. Recent research has begun to pioneer the use of constructed online social networks to investigate the effects of different social network design on promoting healthy behavior. Instead of allowing users to freely select their social contacts and edit contents, researcher-designed online networks can (1) control network structure to make social influences more representative of the true population behavior and (2) encourage positive forms of social comparison.

Recent innovations in conducting online social network experiments have provided causal evidence that constructed online networks can directly affect health behaviors (Centola, 2010, 2011, 2013; Zhang et al., 2015, 2016). These studies focus on comparing network-based social mechanisms that affect behavioral change. In these studies, social network structure was created before individual participants enrolled in the study. Participants were then randomly assigned into pre-existing network topologies, and their social contacts in the online networks were determined by which participants of the study populated the adjacent positions in the network. Unlike evolving SNSs such as Facebook, the experimental social networks did not evolve endogenously, but were constrained by the study design. In one study, Centola (2010) created an online health community and embedded participants into anonymous online networks. On the study website, participants could view their own and their neighbors' profiles. Participants were randomized into one of two network conditions – one condition was designed with tightly clustered, "strong tie" networks, and one was designed with randomly structured "weak tie" or "small world" networks. In the clustered networks, participants shared common neighbors, therefore individual participants received social reinforcement on the behavior from the closely connected neighborhood (Centola and Macy, 2007). In contrast, in the small world networks, participants had random connections and did not share common neighbors (see Figure 1). Diffusion dynamics were initiated by sending an email signal from a randomly chosen seed participant to its neighbors in the online network, inviting them to register for a health forum that offered access and rating tools for online health resources. If any of these participants adopted the forum, their network neighbors would, in turn, also receive email invitation notifications about the forum. All email notifications were automatically sent by the system from the participant who adopted the tool to his or her network neighbors. Results showed more participants in the clustered network condition registered for the health forum website than those in the random network condition, indicating the clustered social networks were more effective than the small world networks in promoting health behavior adoption. In a subsequent study, using a similar study design for studying the diffusion dynamics, Centola (2011) further tested whether homophilous clustered networks were more effective in improving health behavior adoption than non-homophilous clustered networks. Participants were randomized into either the homophilous networks or the non-homophilous control networks. In the homophilous networks, participants who shared the same gender, similar age, and similar BMI were neighbors of each other. In the control networks, participants were connected randomly (See Figure 2). The results showed that more participants in the homophilous network condition registered for the online health tool than those in the non-homophilous control condition, and the effects was stronger among obese participants, indicating homophily on health characteristics significantly improved health behavior adoption and social reinforcement is stronger when people share common neighbors who have similar characteristics.

In both of these network experiments, participants were exposed to social influence from peers who were endorsing positive behaviors. Specifically, participants received notifications about their peers registering for the new online health tool. Multiple notifications from multiple peers encouraged participants to learn from their online peers, and use them as reference points for discovering new opportunities and behaviors. The online community was designed to help participants to improve their health, therefore upward social comparison was engaged by encouraging participants to pay attention to others' behaviors for self-improvement. In other words, because these constructed networks controlled the kinds of signals people could receive, they also influenced the way that social comparison was used to engage behavior change. One useful contrast between uncontrolled SNSs and constructed health networking sites is that constructed networks can be designed to limit biased signals in the network. The majority illusion can be prevented, and people's estimation of other people's activity reflects a more accurate representation of the real social behaviors of other people in the online community.

A Case Study: Harnessing Social Comparison to Promote Physical Activity in Online Social Networks

Building upon the abovementioned studies, Zhang et al. (2016) conducted a large field experiment to directly test whether and how social comparison in constructed online networks would be as an effective mechanism for promoting physical activity. This study evaluated the effects of social comparison in contrast with the effects of social support. Social support has long been thought a beneficial factor associated with long-term adherence to exercise (Wing and Jeffery, 1999). People with shared goals can support each other by providing informational, instrumental, emotional, and appraisal support (Berkman et al., 2000; House et al., 1988). If individuals are incentivized to work towards a common goal, positive feedback loops can arise where self-reinforcing social support bolsters the performance of all individuals in a network. In contrast, social comparison, is thought to influence behavior by providing relevant reference points (Festinger, 1954). Such reference points allow individuals to adjust their effort to achieve desirable relative positions (Priebe and Spink, 2014; Wing et al., 2009). If individuals are incentivized to perform better than their peers, positive feedback loops in the social network can arise as an individual's increased performance motivates her peers to perform better, which in turn motivates the original individual to exert more effort. In this case study, researchers compared the causal effects of both social support and social comparison within constructed online networks on increasing participants' physical activity levels.

Collaborating with a fitness program at a northeastern university, the study was run as an 11-week fitness program, which offered 90 weekly exercise classes. Approximately 800 participants were randomized across four experimental conditions: Control, Social Comparison, Social Support, and Group Comparison. Participants in the control condition were given a basic website interface, which could be used to look at the class schedule and register for classes. They were provided with no social incentives for participation and were rewarded at the end of the program based on their individual record of attendance at exercise classes. Three different experimental manipulations supplemented the control condition by providing social incentives hypothesized to increase physical activity participation.

The social comparison condition supplemented the basic class registration website by giving participants access to 6-person online networks, comprised of participants who were drawn from members of the study, and who were connected to each other in a program-generated online 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' exercise class attendance 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. All peers were anonymous, and there was no possibility for direct communication between participants in this condition.

By contrast, the social support condition consisted of 6-person online social networks 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, and rewards at the completion of the program were based on each team's collective activity levels. Thus, team members were incentivized to actively support each other's attendance at exercise classes. To facilitate supportive social interaction, participants in the social support condition were provided with an online chat tool that they could use to directly communicate with other team members in real-time within the program website. Team members could see each other's individual records of class attendance but the focus was on the collective record of the team. There was no competitive ranking board and all teams in this condition did not know other teams' performances. Team members were able to register for classes individually, but could also coordinate to register for classes collectively.

The final condition of this study examined whether there were interaction effects of combining the motivations of social support and social comparison. The group comparison condition randomly placed individuals on 6-person teams and provided the same team incentives and technologies as the social support condition, but also added 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. In all three social conditions, individuals received automated real-time emails informing them of their peers' class registration and attendance activities.

The outcome of interest was the total number of exercise classes that participants attended throughout the 11-week program. Complete attendance data for all classes were provided by class instructors. In total, 790 students were qualified and enrolled in the program and were randomly assigned to a condition. There were no significant differences in gender, age, race, or BMI between participants across conditions. Participants ranged in age from 20 to 59 years (mean = 25.2, SD = 3.4), and ranged in BMI from 16.1 to 45.0 (mean = 23.0, SD = 3.8). Among all, 15.7% were overweight and 5.3% were obese. Data from 790 participants were used for the analyses. The outcome was the number of exercise classes that participants attended, which ranged from 0 to 39 classes. Figure 3 shows the number of cumulative exercise classes attended over 11 weeks across the experimental conditions. Both the social comparison and the group comparison condition showed significant increases in exercise class attendance compared with the social support condition and the control condition. Participants in the social support condition, on the other hand, performed significantly worse than participants in the control condition.

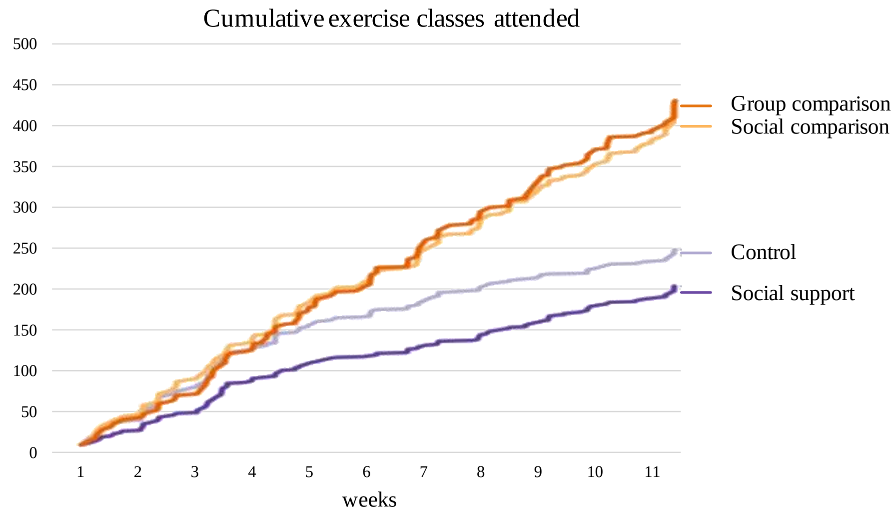

Figure 3. Cumulative exercise classes attended over 11 weeks.

On average, social comparison and group comparison conditions both increased attendance rates by 99% compared to the control condition, with high significance ($p<0.01$). There were no significant differences between the social comparison and group comparison conditions. Interestingly, this suggests that peer incentives that came from social comparison effects were just as powerful at the individual level as they were at the group level. Team-based group comparison with other groups provided an equally strong motivation for increasing physical activity as individual comparison with other individuals. Perhaps most surprisingly, these influences were not affected by the differences between individual and group incentives across conditions –team rewards were just as effective as individual ones. By contrast, in the social support condition, participation levels dropped significantly compared to the control condition. Thus, not only was social comparison a strong motivator for increased activity, but providing social support networks without any features of social comparison acted as a significant disincentive for participation, despite participants in this condition having the same individual incentives to exercise.

These results from this case study suggest that networks that emphasize social comparison among members can be surprisingly effective for motivating desirable behaviors. Exposing individuals to relevant reference points, whether those reference points were other individuals or other teams, increased social responsiveness to the physical activity of their peers. The results from the group comparison condition, where adding team performances to a supportive environment significantly increased exercise levels, suggest that the introduction of a minimal competitive reference point into an otherwise support-based environment can change ineffective health networks into highly motivating social resources. Importantly, in the successful online networks, individuals received real-time automated emails about their peers' physical activities. This created a feedback effect of social comparison whereby each person's activity helped to create additional incentives for others to keep up. Thus, networks of social comparison created a "social ratchet" effect, where everyone adjusted effort based on the best performer in the previous day so everyone increased everyone else's activity levels. When participants were influenced by their peers to exercise more, it created a social reinforcing loop, keeping the entire group moving forward toward improved fitness.

Summary, Implications, and Next Steps

The purpose of this chapter has been to invite researchers to think about social comparison in the context of social networks, in particular within emerging online social networks. Our review suggests that SNSs can create biased social perceptions and distorted comparison reference points. When people compare themselves with their social contacts' self-presentations online, the effects of the majority illusion may draw their attention to popular people, who often possess better resources and higher statuses. Frequent comparisons to highly curated signals can create perceptions of relative deprivation and social inadequacy, leading deleterious implications for both physical and mental health.

To address these biases in social comparison that can be created by online social networks, researchers have begun exploring ways of constructing online social networks to optimize network structures and shared contents for improved health. The case study presented here shows that social comparison effects can be harnessed in constructed online social networks to effectively promote desirable health behaviors. Importantly, the findings show that social comparison can create a positive social reinforcing loop, which can become a self-sustaining mechanism for improving everyone's health in the group (Zhang et al., 2016).

More broadly, research on social networks and health has explored a variety of different network compositions, including randomly assigned peers, networks composed of existing friends, and family networks (Aharony et al., 2011; Foster et al., 2010; Leahey et al., 2012; Wing and Jeffery, 1999). The relative advantages of each of these approaches is still a topic for future explorations. For instance, there may be some behaviors where subjects' sense of shame, or fear of social sanctions, may prevent subjects from being convinced to adopt new behaviors within close-tie family networks; in these situations, it may be easier to activate social comparison effects in anonymous peer networks. Conversely, there are other behaviors that may be more easily influenced when people are embedded in a network of close relations. Future research on social comparison would benefit from explorations of these effects of network composition, and how they interact with the role of social comparison in behavior change.

A related, and very interesting future direction of research is also to examine network formation, and whether social comparison can lead to the creation of particular patterns of network ties. For instance, Centola and van de Rijt (2014) show that members of an online fitness community voluntarily chose to form network ties to other community members based exclusively on similarity on age, gender and BMI. Interestingly, these same traits were also found to be significant factors for establishing relevant sources of social comparison (Centola 2011). Future research might explore how particular features of an online environment can systematically alter people's choices for establishing connections to other members, and how these choices may then influence the ways that people use each other as sources of social comparison, and thereby as reference points for behavior change.

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