

Fitter with Twitter: Understanding Personal Health and Fitness Activity in Social Media

Rannie Teodoro & Mor Naaman

School of Communication & Information, Rutgers University, 4 Huntington Street, New Brunswick, NJ 08901
{rteodoro, mor}@rutgers.edu

Abstract

With the growing interest in how online sedentary activity can mediate offline health practices, we present a study of social media activity related to personal health and fitness. We aim to identify the type of content and motivations for sharing health-related activity in social media outlets. To this end, we performed a qualitative analysis of Twitter posts, as well as an extensive set of interviews with experienced users who post messages on Twitter about exercise, diet, and weight loss activities. The qualitative analysis exposes varying levels of activity actualization and message sentiment. The interviews help us reason about the users practices and motivations for posting activity related to the pursuit and maintenance of volitional health behaviors. Our findings extend existing theoretical frameworks and can inform the design of technology that uses social media to help initiate and maintain challenging activities like exercise and diet.

Introduction

In the last 20 years, obesity has dramatically increased in the United States due to a range of causes, including poor eating habits and the prevalence of sedentary activity (CDC 2012). Numerous studies have considered various health and behavior maintenance issues such as motivational predictors, environmental considerations, and diet and exercise strategies (Hill and Peters 1998; Klem et al. 1997; Wilfley et al. 2007). Nevertheless, the maintenance (versus initiation) of healthy behavior remains a challenging problem. To address this problem, and increase the odds of weight and activity maintenance, individuals have been encouraged to monitor their behavior with food or exercise journals, and self-regulate their health-related activity (Wilfley et al. 2007).

Most recently, diet and exercise evidence, plans for exercise, general attitude, and general commentary about fitness activities have become popular topics within social media services (Kendall et al. 2011). These activities are especially prevalent in what systems we call “social awareness streams” (SAS), like those found in Facebook, Google+, or Twitter (Naaman et al. 2010). In SAS, users post short content items (such as “status messages,” links, or media items) instantly available publicly, or semi-publicly (e.g., restricted to the user’s designated contacts).

The technological affordances, like SAS, embedded within social media have implications for public health promotion efforts (Chou et al. 2009; Paul and Dredze 2011). Unique features like “mass customization, interactivity and convenience” are beneficial to “e-health communication” and health promotion efforts (Neuhauser and Kreps 2003), and enable what would have been “private” health entries in a food or exercise journal into interactive “public” disclosures and potential points of discussion among friends or “followers.” Although evidence links social support provision on Twitter to more weight loss (Turner-McGrievy and Tate 2013), the motivations for communicating these types of messages over social media, how it begins, and how it relates to weight loss maintenance are still under-examined.

For our purposes, we limit our scope of health behaviors to exercise and diet activities. We are interested in how and why users leverage outward facing social media to promote ongoing health behaviors. Our study reports on the everyday Twitter activity surrounding exercise/diet thoughts and behaviors, and draws comparisons with the reported and observable practices and intentions of expert users regularly performing health maintenance activities.

We consider the following research questions:

RQ1: What types of content are posted on Twitter about health related activities such as exercise, diet, and weight loss?

RQ2: What are the current practices and motivations of users posting fitness, weight, and/or diet activities?

RQ3: What type of feedback do users perceive as most beneficial within social media?

To pursue these research questions, we first performed a qualitative analysis of randomly selected diet and exercise Twitter messages (“tweets”) to provide insight into the type of content people posted. This resulted in the creation of a content taxonomy relevant to weight, diet, and exercise behaviors on Twitter. Next, we conducted semi-structured interviews with select Twitter users who post about health-related activities.

Background & Related Work

We first highlight the key Twitter features relevant to this work and then describe two theoretical frameworks related to our study. We then review the findings from recent weight maintenance studies.

Twitter

Twitter (and other SAS platforms) allows users to post short messages and content in public or semi-public settings, where messages are consumed, on Twitter, by other users who “follow” the posting user. When Person A follows Person B, Person B’s updates are included in A’s stream of updates (along with updates from other users that A follows) when A logs in. Twitter inherently is a “networked individualism” environment, where each user communicates and interacts with a set of individual contacts, and there are no well-defined, articulated communities (Wellman et al. 2003).

Instead, *ad-hoc* communities can form on Twitter, mostly via the conventional use of the hashtag (#) to signify a topic or type of message (e.g., #calories). Twitter “translates” hashtag terms into clickable links that allow users to see other messages with the same hashtag. Also, users can reference each other in messages by using the @ symbol followed by the user’s name (@username). Together, these communication conventions allow users to associate a message with a specific group, topic, or user (e.g., @lancearmstrong, #nikeplus), and follow such messages, thus creating loosely defined communities.

Twitter’s archive and access capabilities also play a role in this study. Messages are archived and displayed on the user’s page in reverse chronological order, allowing users (and their followers) to divulge, track, and refer back to posted content. Finally, users can access Twitter in multiple ways, both posting and retrieving messages via mobile phones, web, and other applications and devices, providing users with the ability to access and post to Twitter conveniently and on-the-go (Naaman et al. 2010).

Twitter (and other SAS) is thus different in their core features than other communication systems and, in particular, from other types of online communities. Key factors that differentiate SAS are the passive nature of content consumption (i.e., the fact that messages are usually not addressed at anyone in particular), coupled with the strong “network-driven” aspect of the activity (where each user interacts with their own set of contacts), and together with the opportunity for ad-hoc community formation and exchange based on interest. The presence of others in these “networked publics” (boyd 2008) facilitates the existence of an “imagined audience,” and guides the development of behavioral norms within the virtual environment (boyd & Ellison 2007). As such, the study of personal health activity shared via Twitter differentiates from existing research on different types of online communities (Grimes et al. 2010; Prochaska and Velicer 1997; Preece 2000; Sanford 2010).

Theoretical Frameworks

The Transtheoretical Model of Behavior Change (TTM) (Prochaska and Velicer 1997) and the hyperpersonal model (Walther 1996) help situate the behavior change process while recognizing the socio-technical affordances of Computer Mediated Communication (CMC) environments.

TTM describes the process of healthy behavior actualization through a series of stages: (1) Pre-contemplation, (2) Contemplation, (3) Preparation, (4) Action, and (5) Maintenance (Prochaska and Velicer 1997). Studies show community interaction can support effective action and prevent relapse (schraefel et al. 2009), but that people can progress cyclically through stages 1 through 4 before ever reaching maintenance (Wright et al. 2008). Rather than focusing on participants who initially or repeatedly seek health behavior change (e.g., workout beginners, “yo-yo dieters”), the present study sought to recruit users likely in the maintenance stage based on their consistent use of CMC to share health or fitness activities.

According to the hyperpersonal model, CMC affords individuals with certain communicative advantages over traditional face-to-face (FtF) interactions, including increased levels of affection and emotion (Walther 1996). Individuals who disclose in CMC can experience minimal feelings of pressure derived from peers or status. This suggests a sense of freedom afforded by technological constraints (i.e., selective self-presentation, limited sender/receiver cues, asynchronous message exchanges). The freedom of CMC environments enables distorted self-presentations by minimizing immediate accountability for deceptions (Ellison, Hancock, and Toma 2012) but also encourages honest disclosures and feedback as powerful accountability mechanisms (Hwang et al. 2010; Newman et al. 2011).

Findings from Previous Studies

Two recent studies offer significant overlap with our study. First, the work of Kendall et al. (2011) reports on content analysis of Twitter data about physical activity. The authors do not limit their analysis to personal activities and includes a significant amount of advertisement messages. Our analysis and taxonomy extend their results and focus on personal diet and exercise activities. Furthermore, our interviews shed light on the motivating factors prompting content creation. Second, Newman et al. (2011) conducted qualitative interviews with users of online health communities, who are also Facebook users, to study health activity and attitudes towards Facebook. The differences between Facebook and Twitter use are interesting to study in regards to their effects on health practices and adoption. Moreover, our user sample (and therefore practices) is significantly different due to the recruitment method used (users in Newman et al. were active in well-defined health online communities and diabetes forums) and the type of activity being studied (our focus is on the persistence of health behaviors). Nevertheless, some of our results are supported, and strengthened, by the findings in Newman et al., as we highlight in the discussion.

Previous studies suggest supportive friends can increase success in long-term weight maintenance (Wing and Jeffery 1999), but more careful design for weight management systems is needed (Maitland and Chalmers 2011). Wilfley et al. (2010) suggest behavior approaches are not enough to maintain healthy lifestyles, but a social component is typically more effective for long-term success. Compared to behavioral skills maintenance (BSM) approaches, which emphasize self-regulation behaviors like monitoring weight loss, social facilitation maintenance (SFM) groups experience less weight relapse than groups assigned cognitive behavioral approaches or no ongoing contact after an initial weight loss program (Wake et al. 2009; Wilfley et al. 2010). SFM techniques involve the facilitation of peer networks to support healthy eating and physical activity (Wilfley et al. 2010). Overall, more research is needed on what constitutes effective cooperative involvement and the processes for sustaining involvement.

Study: Qualitative Analysis of Tweets

In order to develop a qualitative understanding of the type of health maintenance behaviors occurring within social media, we conducted an inductive analysis of Twitter messages, and twelve semi-structured interviews with Twitter users who regularly post exercise, weight, and diet activity. The analysis of messages, reported in this section, helps identify distinct patterns and themes across users' posts about exercise, weight, and diet activities. The

interviews, as detailed in the next section, help us understand the intention and motivations behind such users' activity, and shed light on the themes and findings from conducting the qualitative analysis of messages.

Method

We analyzed a set of messages about health and wellness from Twitter and used affinity analysis to gather common themes. We first describe the properties of our dataset and the inclusion criteria for messages.

To perform the qualitative analysis, we first extracted a random sample of 1,000 Twitter posts from a larger dataset collected in 2010, which used the Twitter search API to limit the content to major U.S. cities such as New York City, Boston, Los Angeles, and Phoenix, which have large populations and obesity rates. Our sample included posts from November 2009 to February 2010 that included at least one of the following exercise, diet, and weight-related keywords: gym, workout, calories, diet, weight, and healthy. Purposefully, we chose a four-month period that accounts for critical points in weight loss, exercise maintenance, and health reflection, including Thanksgiving, Christmas, and New Year's resolutions.

Keywords were selected based on our ongoing, casual observations of Twitter users who post about health activities in various exercise and diet hashtag communities. We informally tested the keywords using Twitter's site search and examined the retrieved results for context and relevance to health activities. The selected terms were broad enough to retrieve many relevant messages, specific enough to minimize unrelated results, and easily interpretable as explicit health-related content.

We considered only the subset of the sampled messages relevant to personal health and wellness. The inclusion criteria only considered general commentary or posts related to personal health progress or goals, and messages that did not meet this context were removed and replaced with a different randomly selected post. For example, we removed and replaced posts like "Throw the whole *weight* of your anxieties upon Him" for irrelevancy and an advertisement like "...contact me about your free consult and *workout!*" which lacked personal health reflection/content.

Next, we used affinity analysis to gather common themes from the downloaded messages. Each of the authors independently grouped 100 different messages based on affinity, and then assigned "themes" to the resultant groupings. Themes from the two groupings were consolidated to create an initial set of "categories." A second set of 100 posts was used to match posts to the initial set of categories and refine them: we reflected on posts' appropriateness within the categorical confines and then modified the initial categories. Lastly, the remaining

700 Twitter messages were placed within the resultant categories to ensure comprehensiveness and relevance.

The main objective of our analysis was to obtain a descriptive evaluation of personal health content on Twitter. Naturally, users' intentions for posting the message were not available for the analysis, though the message content frequently suggested additional context and meaning.

Results

The analysis and affinity process resulted in a simple content taxonomy, capturing two key categories: activity actualization and sentiment.

First, the taxonomy reflects on what we call the *actualization* of the health-related statement: how the content of the post reflects on fulfillment and accomplishment of user activities. We split this dimension into three categories, according to the level of fulfillment captured in the message:

1. *Plans and goals* – Posts about future plans or goal-setting (e.g., “Trying to lose weight before my next photo shoot hehe”; “Attempting to begin a pageant diet. Nothing crazy just smaller portions less carbs and more lean protein. Let’s see how long this lasts”).
2. *Achieved* – Posts about actions performed or accomplished goals (e.g., “just did 33 min on the Wii Fit”; “according to weight watchers I have lost 26 pounds since I started... go me!”).
3. *Acts avoided* – Posts about actions not taken/avoided, missed goals (e.g., “Another missed workout this morning”; “Did not eat one healthy meal today... Wait does cheerios count?”).

Messages, of course, can sometimes include compound statements that fit into more than one category.

Second, the taxonomy captures the *sentiment* expressed by users as part of their post. Aside from goal or accomplishment disclosure, message content can convey positive sentiment (“starting the week off right with an early morning workout”) or detrimental qualities (“I broke my diet and had Barry’s lobster pizza, not good!”) for healthy lifestyle decisions. Positive, negative and neutral sentiment toward the activity reported are interpretable within the message content, since most users were clear about their satisfaction or dissatisfaction with the health activity. For example, the message “I... am about to go workout. Oh yes!!!! :)” reflects positive sentiment. The message “I spent 45 minutes on an elliptical machine. 542 calories burned. #LoseIt” is Neutral, not displaying a clear sentiment. Lastly, the message “I can’t stop eating :(there is no point in starting any sort of diet regime this time of year” reflects negative sentiment.

Note the activities, accomplishments and plans can be further placed on a “magnitude” scale ranging from small (“will not eat any sweets today!”) to large (e.g. “planning to lose 30 lbs by January”), which is another aspect of the

messages that can be highlighted. Another important attribute not addressed in the taxonomy is whether content is truly considered “healthy” or “unhealthy” activity, as a person’s desired and undesired health-related activities might conflict with what is actually healthy or unhealthy for that individual.

To answer RQ1, the two highlighted categories describe the main features of personal health-related content from our analysis. Although the taxonomy did not capture the content of every message, the majority of personal health activity messages fell within the categories’ confines. Again, since our RQs mainly concern content posted (“what/how users post”) and motivations (“why users post”), and not the frequency (“how often”) at which the phenomenon occurs, we do not report on the number of messages which fall into the main categories of posts. In fact, since messages often fit into more than one of the categories, the taxonomy is helpful for expansively classifying the health-related messages.

As we note below, this taxonomy can potentially aid in a future quantitative analysis of particular strategies correlated with success rates of health behavior maintenance within social media. More immediately, the taxonomy informed our follow-up in interviews, including the motivations for certain messages, as described next.

Study: Interviews

After analyzing the types of content posted, we sought to understand motivations for posting health-related content on a regular basis. We therefore conducted semi-structured interviews with experienced Twitter users who posted at least 20 different personal health-related messages or commentary throughout the last six months. In this section, we describe the method for recruitment, the characteristics of users interviewed, and the interview approach. The next section describes the themes that emerged through a grounded analysis of interview transcripts.

Method

We interviewed twelve participants that met a set of pre-defined requirements that aimed to verify familiarity with the Twitter environment and to identify behaviors relevant to this study. Participants were required to have at least ten Twitter followers and have posted at least 20 messages related to weight topics (pounds lost, gained, calories consumed) and fitness topics (miles ran, gym activities) in the last six months. Thus, our participants interacted with the Twitter community for a significant period of time, at least long enough to have and maintain some sort of following and community on Twitter. We also required that participants be at least 18 years old.

Intentionally, we sought long-time users engaged in popular Twitter “hashtag communities.” To diversify our sample to include exercise and diet-focused individuals, we

included hashtags like #LoseIt (exercise, diet, and weight tracking application), #TWYE (Tweetwhatyoueat.com), and #cardiotrainer (weight loss and fitness application). We approached users engaged in these hashtags communities, as well other users who we noticed interacting with “hashtag” users.

After we identified users that met the requirements, we sent 36 notices via Twitter replies and later direct messages, asking for voluntary, uncompensated participation in the study. Recruitment notices went out to users who posted exercise, diet, and weight-related Twitter messages, but the majority of users who followed through with interviews (n=12) posted mainly exercise and fitness-related messages compared to diet and weigh-in messages. Still, participants said they were conscious of their food intake even if they did not tweet about it. See Table 1 for characteristics of the interview participants. We ended recruitment well after reaching saturation of interview responses. Like other studies, sufficient saturation of responses occurred within the first twelve interviews, and as early as the sixth interview (Guest, Bunce, and Johnson 2006). Participants in our sample varied in hometown, age, and occupation, but identified similar types of content, motivations, and feedback of fitness and diet behaviors.

	Sex	Age	Joined Twitter	Focus of health messages and other comments
P1	F	21	2009	Fitness focus (gym, running), college student
P2	F	26	2009	Fitness focus (running), teacher
P3	F	28	2010	Fitness focus (yoga, running), diet focus (organic and natural foods), stay-at-home mom
P4	F	30	2010	Fitness focus (running), diet focus (calorie counting), weigh-in focus (pounds lost), accounting professional
P5	F	32	2009	Fitness focus (running), website founder
P6	F	36	2009	Fitness focus (running), diet focus (calorie counting, portion control), weigh-in (pounds lost, BMI tracking), business owner
P7	M	28	2007	Fitness focus (gym), higher education professional
P8	M	30	2010	Diet focus (calorie counting), weigh-in focus (pounds lost), blogger
P9	M	43	2009	Fitness focus (gym, sports, running), finance professional
P10	M	44	2008	Fitness focus (cycling), business owner
P11	M	45	2008	Fitness focus (running), writer and photographer
P12	M	45+	2011	Fitness focus (gym, running), diet focus (calorie counting, portion control), weigh-in (pounds lost), business professional

Table 1: Characteristics of Interview Participants

In summary, four out of the 12 participants described themselves as “overweight” or “obese.” Nine mentioned running as a regular health activity and seven had at least one explicit health-related user on their “following” list.

The qualitative analysis of tweets described earlier helped inform and guide the interview and analysis of the transcripts. Participants were interviewed regarding the details of their Twitter use (content, habits, and intentions)

and their personal experiences with exercise, weight, and diet. One of the researchers conducted the interviews and then created transcriptions from audio recordings of the interviews. Using the constant comparison method, axial coding, and selective coding (Glaser and Strauss 1967), we analyzed and compared participants’ responses to develop themes detailing the intricacies of weight maintenance behaviors and Twitter use. Within the interviews, we also asked participants to directly reflect on their health-related Twitter posts to ensure their content was consistent with our taxonomy. Depending on participants’ preferences, interviews were conducted via phone (9), video chat (2), or instant message (1).

Results

This section describes the key themes that emerged from the interviews about practices and motivations.

Lurking and Learning

All participants reported not actively seeking out the fitness community, but rather stumbling upon it on Twitter. Participants described a process of “coming across” the space and eventually learning about and exploring the health-related communities and activity through a process of “lurking,” or reading tweets without contributing their own content. Initial curiosity often developed into creating connections among people with shared interests in healthy behaviors and practices. For example, one participant originally sought to find an alternative route to work before coming across the cycling community:

I started finding commuter-related groups... and just came across [cycling hashtag] and thought this would be a fun challenge - set a goal to ride my bike every day, regardless of what else I got going on. (P10)

Similarly, participants expressed interest in learning about other people’s health activities and observed some hashtag communities before making their own contributions:

I'd have to say it was that lurking and learning mentality. Lurked and encouraged others [to shoot] for goals, then got the courage to throw some of my own [goals] out there. (P7)

I find the most interesting part is just learning about other people’s activities as far as getting out and running, and biking and being active. (P11)

Participants also commented that information obtained from users via SAS can feel more personable and “real” over other CMC, and thus potentially affect one’s actual health behaviors more so than automatically-generated information:

To me the best ones are like, “I just dropped a kettle bell on my toe but I’m still working out. My toe is bleeding but I’m still going.” To me, those are real life tweets and it paints a picture of what that person is going through in their day. (P4)

All participants reported similar appreciations for “real life” information sharing practices on Twitter, which allowed them to discover health-related information and people they would not have otherwise learned. This included links to bloggers, fitness videos, recipes, events, tips, and inspirational quotes.

In my real life, I probably would not associate with people who run marathons for a living... or in the very least who make that publicly known to their friends, which is something the Internet offers. At least this feel of anonymity... allows you to share more about yourself than you normally would with your personal friends. (P8)

The lurking and learning practices described by our participants allowed them to obtain CMC-facilitated health information and interaction with a personal and “real-life” feel, yet from a comfortable distance. These findings support Twitter as a social environment in which users can simply observe each other’s activity to influence or modify their own maintenance activities.

Need for lifestyle compatibility

Lifestyle compatibility emerged as a consistent theme among Twitter users who regularly posted health activity. Users insisted the need for technology compatible with their lifestyle, versus making their lifestyle compatible with a technology. Most participants admitted their everyday responsibilities (e.g., work, school, kids) made exercise and diet difficult to do consistently. Healthy choices meant more preparation and effort on their part. However, Twitter integrated well with participants’ busy, on-the-go lifestyles, especially given its mobile device compatibility, character limits, search structure, and novelty.

First, Twitter’s compatibility with multiple mobile phone health applications (e.g., Runkeeper, Nike+, Cardio Trainer, LoseIt) made health activities easy to track and share with others at a convenient time and place. All of our participants used mobile phone devices to connect with Twitter in some capacity (e.g., via third-party application or SMS text). Users could conveniently post brief, real-time information directly to their Twitter accounts while simultaneously tending to other offline tasks:

I don’t log in or out. It is ever present on my phone... And it’s kind of eternally logged in. (P1)

Participants mentioned the brief nature of tweets made Twitter an appealing tool for reporting and tracking health activity. The setup mimicked tracking logs, or “timelines” of health activity. Compared to other blog entries, gadgets, and chat rooms which some participants found tedious and time consuming, Twitter’s 140-character limit for messages required little preparation time to post content.

I do try to share my health progress from time to time. It’s a quicker and more convenient way than blogging... Twitter is probably one of the reasons

why I don’t blog as often as I should. It’s so quick – you don’t have to worry about publishing or posting pictures. (P8)

With continued use, the discovery of Twitter’s search features and public hashtags helped users identify pertinent communities based on similar interests, goals and even geographic location:

We (running group) actually met via Twitter... started running with them and then she started telling me to hashtag [#removed] which is trying to get people to be more active, to be runners, to enjoy running... I actually made a lot of real life friends via Twitter because they live in Louisiana and they run. (P4)

Because of the many lifestyle compatible features available through Twitter, user networks become less egocentric (user follows *individuals*) and more community-based (user joins and follows a *community*). Thus, users can join and participate in their preferred health “communities” in a way most compatible with their current lifestyle status, practices, and point in life.

Accountability to an audience

Accountability to an audience (or followers) emerged from the interviews as a strong consequence (and perhaps motivation) of posting content publicly on Twitter. Participants reported feeling a sense of responsibility to share their health progress reports – good or bad. While the participants’ health goals and progress are personal feats, the “perceived audience” encourages them to continuously enact desired activity. This phenomenon, shown also in Newman et al.’s (2011) research, confirms the impact of an individual’s “perceived audience” (boyd 2008): individuals understand the scope of their audience and consequently behave to “fit in” within the lines of acceptable behaviors and practices, or norms. Users navigate the online social environment carefully to maintain a “desired image.” In this case, maintaining this image meant maintaining fitness or diet activity regularly for most participants.

Regardless of the existence (or nonexistence) of an offline relationship with Twitter followers, respondents felt “accountable” to those within their follower community. They expressed feelings of embarrassment and disappointment in reporting missed goals:

If you don’t feel good and you don’t end up running and you can’t post it on Facebook or Twitter because you didn’t run, you feel like a schmuck. (P2)

Interestingly, eight participants explicitly mentioned “accountability” as a motivation to continually post health activity even though the interviewer never prompted the topic or the word:

Here’s a good way (Twitter) to have that accountability even though I don’t know who they (other users) are. But they’re doing the same thing as I am so it will be fun. (P10)

When I stopped food blogging, I stopped caring about everything else, where the food came from... I was caring less about that because I had less accountability to report that. (P8)

Participants felt a responsibility to accomplish health regimes *offline*, so they could share the progress *online*.

Navigating Feedback

In the previous section, we highlighted the ways the audience *implicitly* influenced participants' behaviors. In this next section, we describe the influence the audience provided through more *explicit* feedback (praise, criticism, or general commentary) on participants' weight maintenance behaviors.

Despite our taxonomy's ability to classify a large amount of tweets based on activity actualization and sentiment, the responses revealed that, in terms of feedback, positive versus negative sentiment was not enough to capture its effect on user maintenance behaviors. Positive feedback messages were always well received and words of encouragement often "inspired" users who then modeled behaviors for others. The act of providing and receiving feedback itself was a motivator for participants' own personal progress:

People coming back via my blog and via Twitter, [say] things like you're motivational, inspirational, or that's a great idea, or I want to do what you're doing. That gives me motivation because I'm out there helping people. (P4)

The reception of negative feedback messages was much more intricate. On one hand, some negative feedback were deemed helpful, as they indicated social presence and were genuine responses to keep participants motivated:

It keeps me accountable. I know there are people out there who read what I'm saying. I can scarcely believe I have almost 600 followers. But knowing there are others out there just like me that will support me or kick my ass - depending on what I need - really helps to motivate me. (P6)

People are going to tweet me or post on Facebook, "Oh, where's your running post today? Are you slacking?" You know, those types of things motivate me and keep me accountable. (P1)

On the other hand, negative feedback could be faultfinding and often discouraged users from posting activity altogether. For example, a participant received negative feedback on the "healthiness" of his meal:

What I tended to dislike was choosing to eat something and as soon as I tweeted it someone would criticize [me]. It had this feeling of my meal interrupted... I didn't need anyone ragging on me about a little honey. (P8)

Still, most participants said they did not let their followers affect how they posted:

Totally authentic. If you don't like it, don't follow. (P7)

Only three participants reported that they did not receive any negative feedback for posting health activity on Twitter, and their experiences with health activity on Twitter were all positive.

Users sought to obtain positive feedback and avoid criticisms, but admitted the usefulness of negative feedback. The results suggest tensions between maintaining user autonomy and managing accountability to the audience.

Discussion

The Twitter environment seems to naturally provide support for users engaged in weight maintenance activities. In Twitter, participants *discovered* health-related reporting activities and *matched* offline activities and lifestyle with beneficial CMC affordances; *accountability* to an audience encouraged maintenance behaviors; and finally, the *feedback* attained helped (in most cases, and at least reportedly) encourage health activities.

Weight Maintenance as a Process

Our findings help explicate the process of coming to share weight maintenance behaviors in social media. The findings revealed that most of our participants, considerably active themselves with personal health posts on Twitter, joined Twitter for other reasons, and adopted health-related Twitter behaviors via a process of social learning, or learning by observation ("lurking") (Bandura 1977). The easy, but still discrete, discovery of hashtag communities allowed participants to observe others and the norms of the community from a comfortable distance prior to interacting with the community.

As participants contributed weight maintenance content themselves, they found ways to integrate posting exercise or diet activities into their everyday lives. Multiple applications and devices support the ease and flexibility of access. In particular, mobile devices that enabled in-the-moment posting of messages were used by all our participants in various configurations — from exercise-specific apps that post to Twitter to posting self-crafted messages via a mobile device.

Health conscious users likely employ premeditated action when they post goal-oriented eating and fitness behaviors in Twitter. As a result, social media technologies can apply the same persuasion strategies humans use to influence others like positive feedback, modeling target behaviors or attitudes, social support, and influencing normative rules and social dynamics (Consolvo et al. 2009; Fogg 2003; Zajonc 1965). Because newcomers saw how others post about healthy lifestyles and decisions, they viewed this as a socially acceptable practice and became inspired to imitate those behaviors, uphold the community norms, and simultaneously decrease his or her own odds of

rebounded weight gain (a finding supportive of Wilfley et al. 2007).

As individuals transitioned out of novice roles and regularly contributed their own content, users became subject to the scrutiny of (what in the very least seems like) a captive audience in social media. Our study highlights the significant role of an audience, and how even the perception of an audience in social media encourages the maintenance of personal health behaviors.

Contributions to Previous Studies

The findings in our study extend the results of existing studies. For example, our qualitative analysis of messages confirmed and extended Kendall et al.'s (2011) findings that the users post evidence for and state plans for exercising. Additionally, Newman et al.'s (2007) findings are consistent with several of the key themes that emerged from our interviews (accountability, social support, and impression management). However, the different settings and types of individuals interviewed might inform different strategies based on users' particular health objectives (e.g. diabetic communities might employ different strategies than those needing to keep up with their physical therapy).

Indeed, the Online Health Communities (OHC) setup in Newman et al. (2007) provides different settings that expose both overlapping as well as different motivations and practices. In fact, Newman et al. (2007) reported that OHC participants were not comfortable sharing health-related posts on Facebook, with its strong identity and close personal contacts. Twitter, however, seems (at least for our participants) a natural place to publicly share such information. Our findings suggest this could be attributed to the different "following" norms associated with Facebook and Twitter. In Facebook, when friends connect, they default into reciprocated or semi-reciprocated information sharing features. In Twitter, however, individuals can elect to follow public users without getting followed in return. As such, the choice to follow public Twitter users and their health posts is left up to the follower. Still, it remains to be investigated if the root of this difference is participants' personal tendency, the properties of the systems themselves (e.g., hashtag retrieval properties), or both. As such, social learning and identity considerations might play out differently in Twitter than in Facebook and other online communities. These differences can contribute and inform future design of CMC-facilitated social behavior maintenance systems.

Implications

Our findings suggest a number of implications for theory, and for applications that build on Twitter and similar platforms to promote and support healthy lifestyle maintenance.

Theoretical Implications

The study has implications for the Transtheoretical Model of Behavior Change (TTM) and the hyperpersonal model.

For TTM, within the Action and the Maintenance stages, our findings suggest that individuals place less emphasis on behavior change goals themselves (e.g., lose 20 pounds), and focus more on *preserving motivations* to perform those goals (e.g., desire to exercise). Although all participants mentioned some overarching fitness goal (e.g., to run a marathon, to lose post-pregnancy pounds), their personal tweets showed little goal-setting content or explicit mentions of these goals; perhaps understandably so as weight maintenance goals are less related to a single behavior and more related to a series of behaviors requiring preparation, strategic planning, and sustained motivation over time (Strecher et al. 1995). This suggests that the theory should account for competing behavior change goals (e.g., trying to stick to a diet while exercising regularly) and how one can occupy a status in several stages depending on multiple behaviors or goals.

Relevant to the hyperpersonal model, our findings support CMC as advantageous to the message sender. Participants aspired to be motivational for *others* but, in doing so, achieved weight maintenance behaviors for *themselves*. This highlights the mutual benefits of hyperpersonal communication and that social facilitation maintenance techniques are indeed powerful ways to prevent weight relapse (Wilfley et al. 2007, 2010). Thus, we see from our study how the Twitter social settings can promote weight maintenance behaviors.

However, our interviews exposed tensions that are not necessarily predicted by the hyperpersonal model. In the Twitter environment, the autonomy of the individual is constrained by (1) the scrutiny of the audience and (2) the desire for helpful feedback. In this way, a person's attainment of hyperpersonal benefits like freedom to express and strategically self-censor are limited, as one cannot have personal autonomy, a scrutinizing audience, and helpful feedback all at once.

Individuals who share weight maintenance messages on Twitter are positioned to consider how the audience members not only receive but also *evaluate* those messages. For example, a primary reason individuals joined health hashtag communities was for the motivating role that social presence has on their weight maintenance activities. However, the audience can provide feedback that impinges on the individuals' behavior. As a result, participants (perhaps unknowingly) sacrificed part of their autonomy in pursuit of their weight maintenance goals.

Despite the desire for and benefits obtained from feedback, the audience controls how it is delivered. Although the hyperpersonal model considers the reciprocal influence between senders and receivers in CMC, our work suggests the reciprocal exchanges that occur in SAS are

not equitable, and should attribute significant value to the influential role of collective message recipients.

Implications for Social Media

Our findings suggest social media that leverages SAS features while providing more structured support for specific activities could prove effective. For example, applications can allow goal setting and progress tracking over time more effectively, alongside the SAS content. Such goal setting and tracking activities can be exposed to the user's set of contacts (or communities), and provide further motivation (for the user) and perhaps inspiration (for others). Applications can enhance social learning by exposing users to others with similar goals and interests.

The effects of sentiment and negative feedback can also be mitigated by technology. Users' posts could be moderated ("did you really mean to say this?") when a negative sentiment is detected. Similarly, applications can withhold, or at least delay feedback to avoid distraction. While SAS develop more subtle forms of favorable feedback ("like", "+1", or "favorite" on Facebook, Google+ and Twitter, respectively), specific types of feedback (support, inspiration, friendly competition) may be more in line with the motivations and practices described here for health information. For example, applications can have an "inspired" button or a "what you inspired me to do" feature that allows recipients to signal to senders their post had a positive effect on them beyond a superficial "liking" of the post.

Currently, weight-management interventions and applications lack support for mechanisms conducive to multiple participants, passive peer involvement (e.g., everyday diet/fitness conversations, relative comparisons with friends), and deliberate self-presentation. As we discuss in our study, such features could contribute to the construction of one's desired online identity and influence others' perceptions of that identity, in line with the acceptable norms of the community.

Finally, other users do not easily detect the absence of weight maintenance posts from a user. Can the same automated system that tracks users' progress provide feedback when posts are *not* made? Or, as our participants indicated a preference for a human "voice," (i.e., there's a "real" person behind the tweet) can such a system trigger effective action from other users who would encourage the dropping-out user to stay on track? Applications can help communicate goals, moderate feedback messages to increase perceived helpfulness, provide passive ways to interact with others, and activate encouragement.

Conclusion

Our study, combining qualitative analysis and interviews, shed light on content types, user practices, consideration and motivations for personal health (diet and exercise)

activity on Twitter. Such online activity seems to help users maintain actual health-related activities over time, and is indeed leveraged by observers to assist in their own weight maintenance activity. Considering the growing participation in social media sites like Twitter, Facebook and Google+, the potential of such sites as a tool for the promotion of healthy lifestyle and behavioral maintenance is increasingly important to explore.

Our study has a number of limitations. Of course, interview methods are limited in scope and biased by the recruiting methods and willingness to participate. In our case, participants leaned toward the exercise (rather than diet) side of the activity scale. In addition, the participants tended to be among those already fairly health-conscious on Twitter. Our recruitment strategy of starting with (but not limiting to) particular ad-hoc communities also could have resulted in bias in the chosen participants, not to mention that all the participants are those comfortable with sharing life and health information publicly on the Web. Additionally, most of our participants reflect a higher socio-economic background and do not represent the poor or underprivileged (a majority of who struggle with obesity and weight issues). Despite these privileges, however, participants still self-reported struggle with purchasing proper foods and arranging time to actualize health activity. Lastly, the selected keywords we chose to sample for the qualitative analysis was focused on certain types of health and wellness activities. Thus, we may have overlooked other activities not captured or underrepresented in the resultant content sample.

Nevertheless, our findings, including the taxonomy of content and user practices and motivations, could help inform studies that address the crafting of messages and feedback, as well as their outcome: a person's success in maintaining health-related activities over time. What type of Twitter (and other SAS) posts and feedback lead to better outcomes? Specifically, such research would look at fitness intention and progress in conjunction with actual evidence for productive and continuous progress. Further research can also explore the shifts in content production over time and as a result of social learning, and provide a more in-depth picture of the process of adoption of posting and health practices: how do users start, and under which conditions they *continue* to post health-related activities and whether this activity helps initiate, and maintain, fit and healthy behavior.

References

- boyd, d. 2008. Why youth (heart) social network sites: The role of networked publics in teenage social life. In Buckingham D (ed) *Youth, Identity, and Digital Media*, MIT Press, Cambridge, MA.
- boyd, d., and Ellison, N. 2007. Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication* 13(1): 210–230.

- Centers for Disease Control & Prevention. 2012. U.S. Obesity Trends. Retrieved from www.cdc.gov/obesity/data/trends.html.
- Chou, W.S.; Hunt, Y.M.; Beckjord, E.B.; Moser, R.P.; and Hesse, B.W. 2009. Social media use in the United States: Implications for health communication. *Journal of Medical Internet Research* 11(4): e48.
- Consolvo, S.; Klasnja, P.; McDonald, D.W.; and Landay, J.A. 2009. Goal-setting considerations for persuasive technologies that encourage physical activity. In *Proceedings of the 4th International Conference on Persuasive Technology*, Persuasive 2009. ACM.
- Ellison, N. B.; Hancock, J. T.; and Toma, C. L. 2012. Profile as promise: A framework for conceptualizing veracity in online dating self-presentations. *New Media & Society* 14: 45–62.
- Fogg, B.J. 2003. *Persuasive Technology: Using Computers to Change What We Think and Do*, San Francisco, CA, USA: Morgan Kaufmann Publishers.
- Glaser, B. G., and Strauss, A. L. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine Publishing Company.
- Grimes, A.; Landry, B.M.; and Grinter, R.E. 2010. Characteristics of shared health reflections in a local community. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work*, CSCW 2010. ACM.
- Guest, G.; Bunce, A.; and Johnson, L. 2006. How many interviews are enough?: An experiment with data saturation and variability. *Field Methods* 18: 59–82.
- Hill, J. O., and Peters, J. C. 1998. Environmental contributions to the obesity epidemic. *Science* 280:1371–1374.
- Hwang, K.O.; Ottenbacher, A.J.; Green, A.P.; Cannon-Diehl, M.R.; Richardson, O.; Bernstam, E.V.; and Thomas, E.J. 2010. Social support in an Internet weight loss community. *International Journal of Medical Informatics* 79: 5–13.
- Kendall, L.; Hartzler, A.; Klasnja, P.; and Pratt, W. 2011. Descriptive analysis of physical activity conversations on Twitter. In *Extended Abstracts of the ACM SIGCHI Conference on Human Factors in Computing Systems*, CHI 2011. ACM.
- Klem, M.L.; Wing, R.R.; McGuire, M.T.; Seagle, H.M.; and Hill, J.O. 1997. A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *American Journal of Clinical Nutrition* 66: 239–246.
- Maitland, J., and Chalmers, M. 2011. Designing for peer involvement in weight management. In *Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems*, CHI 2011. ACM.
- Naaman, M.; Boase, J.; and Lai, C.H. 2010. Is it really about me? Message content in social awareness streams. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work*, CSCW 2010. ACM.
- Neuhauser, L., and Kreps, G.L. 2003. Rethinking communication in the e-health era. *Journal of Health Psychology* 8(1): 7–23.
- Newman, M.W.; Lauterbach, D.; Munson, S.A.; Resnick, P.; and Morris, M.E. 2011. It's not that I don't have problems, I'm just not putting them on Facebook: Challenges and opportunities in using online social networks for health. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work*, CSCW 2011. ACM.
- Paul, M., and Dredze, M. 2011. You are what you tweet: Analyzing Twitter for public health. In *Proceedings of the AAAI Conference on Weblogs and Social Media*, ICWSM 2011. AAAI.
- Prochaska, J.O., and Velicer, W.F. 1997. Behavior change: The transtheoretical model of health behavior change. *American Journal of Health Promotion* 12(1): 38–48.
- Preece, J. 2000. *Online communities: Designing usability and supporting sociability*. John Wiley & Sons, Inc.
- Sanford, A.A. 2010. “I can air my feelings instead of eating them”: Blogging as social support for the morbidly obese. *Communication Studies* 61(5): 567–584.
- schraefel, m. c.; White, R. W.; André, P.; and Tan, D. 2009. Investigating web search strategies and forum use to support diet and weight loss. In *Extended Abstracts of the ACM SIGCHI Conference on Human Factors in Computing Systems*, CHI 2009. ACM.
- Strecher, V.J.; Seijts, G.H.; Kok, G.J.; Latham, G.P.; Glasgow, R.; DeVellis, B.; Meertens, R.M.; and Bulger, D.W. 1995. Goal setting as a strategy for health behavior change. *Health Education & Behavior* 22(2): 190–200.
- Turner-McGrievy, G.M., and Tate, D.F. 2013. Weight loss social support in 140 characters or less: Use of an online social network in a remotely delivered weight loss intervention. *Translational Behavioral Medicine*, 1–8.
- Wake, M. W.; Baur, L. A.; Gerner, B.; Gibbons, K.; Gold, L.; Gunn, J.; Levickis, P.; McCallum, Z.; Naughton, G.; Sanci, L.; and Ukoumunne, O.C. 2009. Outcomes and costs of primary care surveillance and intervention for overweight or obese children: The LEAP 2 randomised controlled trial. *British Medical Journal*, 339(b3308) 1–8.
- Walther, J. B. 1996. Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research* 23(1): 3–43.
- Wellman, B.; Quan-Haase, A.; Boase, J.; Chen, W.; Hampton, K.; Isla de Diaz, I.; and Miyata, K. 2003. The social affordances of the Internet for networked individualism. *Journal of Computer-Mediated Communication* 8(3).
- Wilfley, D.E.; Stein, R.I.; Saelens, B.E.; Mockus, D.S.; Matt, G.E.; Hayden-Wade, H.A.; Welch, R.; Schechtman, K.B.; Thompson, P.A.; and Epstein, L.H. 2007. Efficacy of maintenance treatment approaches for childhood overweight: A randomized controlled trial. *Journal of the American Medical Association* 298(14): 1661–1673.
- Wilfley, D. E.; Vannucci, A.; and White, E. K. 2010. Early intervention of eating- and weight-related problems. *Journal of Clinical Psychology in Medical Settings* 17(4): 285–300.
- Wing, R.R., and Jeffery, R.W. 1999. Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *Journal of Consulting and Clinical Psychology* 67(1): 132–138.
- Wright, J.A.; Velicer, W.F.; and Prochaska, J.O. 2008. Testing the predictive power of the transtheoretical model of behavior change applied to dietary fat intake. *Health Education Research* 24(2): 224–236.
- Zajonc, R. B. 1965. Social facilitation. *Science* 149: 269–274.