

A Study on Twitter Usage for Fitness Self-Reporting via Mobile Apps

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Abstract

The purpose of this study was to research the new emerging technology of mobile health, the use of mobile fitness apps to share one's workout with their Twitter social network, the workout tweets and the individualities of the Tweeters. 70,748 tweets from mobile fitness application Endomondo were processed using an online tweet collection application and a customized JavaScript to determine aspects of the shared workouts and the demographics of those that share. The data shows that by tracking mobile fitness app hashtags, a wealth of information can be gathered to include but not limited to exercise frequency, daily use patterns, location based workouts and language characteristics. While a majority of these tweets are to share a specific workout with their Twitter social networking, the data would suggest other reasons for sharing as well.

Introduction

There is a substantial body of research regarding social networking and increased physical activity, but little regarding the effective usage of advanced web technologies to address exercise adherence, a topic that is very important since many people drop out of exercise programs within six months. Studies have indicated that "lack of motivation" is a key factor in why a person does not exercise. While various mobile fitness apps (MFA) monitor and track a person's exercise behaviors, the effectiveness of online sharing via social networks of one's physical activity has yet to be fully understood. This research looks at the sharing habits of a workout via Twitter using a mobile fitness application. This was accomplished by reviewing the technology of one mobile fitness app (Endomondo), the integration of a person's workout sharing using Endomondo via Twitter and an analysis of user information and group dynamics as gathered via Twitter.

Koop (1995) suggested that "...cutting-edge technology, especially in communication and information transfer, will enable the greatest advances yet in public health.

Eventually, we will have access to health information 24 hours a day, 7 days a week, encouraging personal wellness and prevention, and leading to better informed decisions about health care". The concept of "electronic health" or eHealth has been defined in a number of different ways (Oh et al. 2005). One generally accepted definition proposed by (Eng 2001) focuses on the use of emerging interactive technologies to enable disease prevention and disease management. eHealth uses technologies such as miniaturized health sensors, broadband networks and mobile devices are enhancing and creating new health care capabilities such as remote monitoring and online care (Accenture 2009).

Mobile telephone advancements allow eHealth to occur from a person's smart phone. The first wave of mobile health (mHealth) apps focused in wellness areas such as fitness, nutrition and general wellbeing. These apps can be important preventative tools since the majority of contributing factors to diseases like heart disease, cancer, diabetes and obesity are lifestyle-related and therefore modifiable (Byrne 2011).

It is through the technological advancements in mHealth that the foundation for this research is based.

Research Questions

The goal in conducting this research and in the presentation of the research findings is to address two overarching questions. With respect to the first research question, general research exists that presents research findings suggesting what type of person uses Twitter. Part of this research will evaluate if the same "type" of person uses Twitter to share their physical activity through a mobile fitness application.

Regarding the second research question, to understand the type of person that uses mobile fitness applications as a means of self and public motivation to partake in physical activity, an understanding of the demographics of such a user are important not only for the designers of such applications, but also to the person themselves and any related health provider engaged with the person in a health

behavior modification, to include but not limited to a personal trainer, a nutritionist, physician, coach or “workout buddy”.

At a higher level, the goals are two-fold. First, the research aims to articulate findings that can improve the utility of information retrieval systems within the context of mobile fitness applications, Twitter and the user’s online social network. Secondly, the research can enrich both developers’ and scholars’ understanding of how this relatively new medium figures into the exercise motivation of users.

Literature Review

Over three quarters of US health care spending goes to the care of people with chronic conditions, including heart disease, diabetes and asthma whilst in 2004, nearly half of Americans were diagnosed with one or more chronic conditions, this number is expected to increase dramatically as the baby boomer generation rapidly approaches their retirement age (Accenture 2009). The new reality, dubbed “Connected Health”, incorporates a broad range of health and fitness applications that are always on, always active and always aware (Accenture 2009).

Health and Social Networking

One aspect of “Connected Health” is via the power of a person’s social network. Research suggests that people interact with their social network with regards to their health. Christakis and Fowler (2009) concluded that “... a person with more friends and social contacts generally has better health than a person with fewer friends, and a person at the center of a network is more susceptible to both the benefits and risks of social connection than those at the periphery of a network”. This would suggest that not only is a person affected by their location in a social network, but also are influenced by the behaviors of those who are “close” to them in the network. Perceived social support and physical activity are directly associated with a person’s perceived health status (Almeida 2008).

Technology and Health Behavior Modification

By using mHealth technology, health providers can practice a more “personalized medicine” and potentially reach more individuals with effective health-related advice and information at a very low cost (Streicher 2007). (Griffiths et al. 2006) suggest a number of reasons for delivering web based health, wellness and fitness interventions including reduced delivery costs, convenience to users, timeliness, reduction of stigma and reduction of time based isolation barriers.

Technologies can play three roles with regards to behavior modification: as tools, as media, and as social actors. As a tool, interactive technologies can be persuasive by making target behavior easier, leading people through a process, or performing calculations/measurements that motivate. As a medium, interactive technologies can be persuasive by allowing people to explore cause-and effect relationships, providing people with experiences that motivate, or helping people to rehearse a behavior. As a social actor, interactive technologies can be persuasive by rewarding people with positive feedback, modeling a target behavior or attitude, and providing a social network of support (Fogg 2002). Within the health care field, interactive technologies can be effectively deployed to take on multiple roles at the same time. For example, a simple persuasive tool can measure calories while at the same time giving a reward upon attainment of a personal goal. This type of self-monitoring is a key ingredient in successful behavioral modification. In addition, if several people are connected through the internet, then social support can be leveraged, which has been shown to impact motivation and behavior change (Chatterjee and Price 2009).

Mobile Fitness Applications

One category of physical activity measurement is through various technological devices used to monitor and record physical activity behavior. A significant benefit of these devices is that many provide direct measures of intensity and duration (exercise heart rate, distance walked) as well as indirect estimates of energy expenditure (calories burned, metabolic units). Devices include heart rate monitors, pedometers, accelerometers, global positioning units (GPS) and mobile fitness applications (Lox et al. 2010). In 2009, management and technology consultant Accenture released a report on how technology will transform the future of chronic care. Cited in the report is the anticipated crisis in care that will be further challenged as the baby boomer generation begins to retire.

“According to the US Census Bureau, the world’s population of people age 65 and older is projected to triple by mid-century, from 516 million in 2009 to 1.53 billion in 2050. This growing trend places a tremendous economic burden on governments, private employers and individual consumers alike. It also puts strain on the capacity of skilled care professionals and nursing homes.” (Accenture 2009)

In addition to the inexpensive cost of computers and internet connectivity, the report identifies three technological advancements that are paramount to the future of chronic care:

- Seamless capture and sharing of patient information in real-world settings;

- Improvements in ways to combine and interpret data about an individual's health and wellness so that appropriate interventions can be made before an acute situation occurs;
- Innovative tools including user modeling, advanced visualization, decision support and collaboration.

Advancements in Connected Health have eliminated the need for precise measurements to be administered in a doctor's office or laboratory setting. Patients can now measure health from home, their place of work, even while on the road using wireless collection devices such as blood pressure cuffs, weight scales, sensor embedded clothing and mobile phones. These small and inexpensive tools can in real time transmit health data from patient to health provider including but not limited to respiration, posture, cardiac function, body movements, health flux, skin temperature, heart rate, body weight and body mass index. These advancements will enable providers and consumers to better use the information for more effective and healthy decision making and actions so that they can stay focused on what is truly important, their own health (Accenture 2009).

mHealth and Twitter

mHealth not only allows for the sharing of information between user and health care provider, but also with a user's friends. One way to share this health data is through a microblogging service such as Twitter. Twitter is a form of communication in which users can describe their current status in short posts distributed by instant messages, mobile phones, email or the Web (Java et al. 2007). Founded by Jack Dorsey and Biz Stone in a San Francisco podcasting company called Odeo in 2006, Twitter became mainstream after winning the South By Southwest (SXSW) web award in 2007 (Twitter 2011).

The structure of Twitter is simple - users send messages (a.k.a., tweets) to a network of people (a.k.a., followers) from a variety of devices (desktop computers, mobile phones, etc.). Tweets are text-based messages of up to 140 characters in length. The default setting for tweets is public, which permits other Twitter users to follow others and read each other's tweets. Each user has a Twitter page where all their tweets are aggregated into a single list (hence the name microblogging) (Jansen and Zhang 2009).

Unlike other online social networking sites, the relationship of following and being followed requires no reciprocation. A user can follow any other user, and the user being followed need not follow back. Being a follower on Twitter means that the user receives all the messages from those the user follows (Kwak et al. 2010). This unusual simplicity of Twitter – the users and their content - continues to warp perception of how the

relationship between user and platform operates. Many of the popularized studies examining influence on Twitter fail to identify the nuances of social interaction in the system (Leavitt et al. 2009).

Research design

To effectively gather and analyze the vast amount of Twitter related information, collection and analytical tools were needed including a tweet collection tool and a Twitter interface to build a database of publicly available data.

The cloud based application called TwapperKeeper was used for Tweet data collection specific to mobile fitness app (MFA) hashtags, while the Wang/Vickey Tweet Crawler API was used to gather information that linked MFA tweeters and their publicly available demographic data.

TwapperKeeper

TwapperKeeper is a web application designed to archive social media data via Twitter to allow for long term archival and analysis. The application uses a Twitter enabled API that acts as an interface between the Twitter search function and a cloud database for tweet storage. The application allows users to monitor and archive specific hashtags and to provide additional metadata to describe an archive that can later be viewed in multiple. The Wang/Vickey Fitness Tweet Crawler API is a Javascript that takes Twitter information collected from the TwapperKeeper database and requests specific information about the publicly available Twitter user account. After limiting the process to unique users, the script sends Twitter user information to websites such as Twitter, Klout and other Twitter information websites to collect general information about the Twitter users such as their start date on Twitter, number of total sent Tweets, their Klout score and frequency of Tweets. For more information on this process see (Vickey, Breslin and Tsai 2011).

Mobile Fitness App - Endomondo

For the purposes of this research, the mobile fitness application Endomondo was used. Described as a personal athletics tracker, Endomondo is a free mobile/GPS-powered Sports Tracker app which runs on multiple platforms, including iPhone, Android and Garmin watches (Endomondo, 2011).

As of October 2010, the mobile fitness app has had more than one million downloads with 500,000 registered users. The application has had growth from 40,000 registered users in January 2010 to 100,000 in April 2010, a doubling of its user base every 10 weeks over the past year (O'Hear 2010). The alpha version of the application was released in September 2008 in connection with the world's largest

running race, the DHL race with 100,000 participants in Copenhagen, Denmark. Enhancements to the application from the feedback provided by the initial users allowed for a beta version of Endomondo.com launch in July 2009 (Endomondo, 2011).

The Endomondo app, with competitors such as RunKeeper and MapMyFitness in the United States and MapMyTracks in Europe, allows a user to track their fitness activities via GPS from their mobile phone, and to then share the workout with the community via the application website, Facebook or Twitter.

In addition to the basic tracking of a workout route, split times, calorie consumption and challenges, Endomondo provides the user with an audio coach. For each mile or kilometer, a voice will inform the user about distance and speed. In addition, the app enables friends to follow the user's run in real-time from their PC, from which they can send messages of encouragement that are converted to audio and played during the workout (Endomondo, 2011).

Data Results

The Tweets

Data collection using TwapperKeeper began on Friday March 11, 2011 at 20:10 Greenwich Mean Time and continued until May 10, 2011 at 23:59 for a total collection of Twitter data of 55 days. Due to a technical problem between TwapperKeeper and Twitter, one week of data was lost or deemed unusable and thus not included in the analysis.

After review of the collected Twitter data specific to the #endomondo hashtag, it was determined that 70,748 tweets were collected in 23 different languages.

However, for the purposes of this research only the English tweets were used, thus the total number of processed tweets in English was 65,450. Of these English Only tweets, there were 8,538 unique users (see Figure 1).

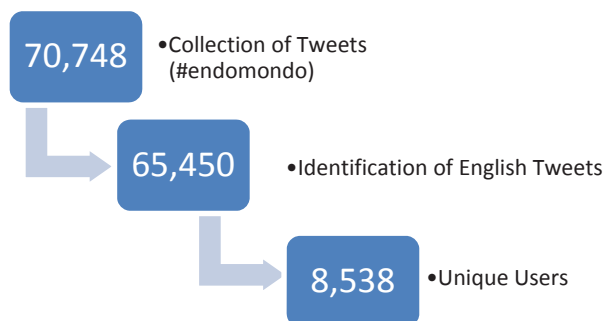


Figure 1 – Flow diagram for Tweet selection process

Through the analysis of the Twitter stream, it was established that the most popular day to exercise while using the sharing-to-Twitter option of the Endomondo mobile fitness application was on Sundays.

The most popular day for the 55 days of data analysis was the last day of data collection on May 10, 2011.

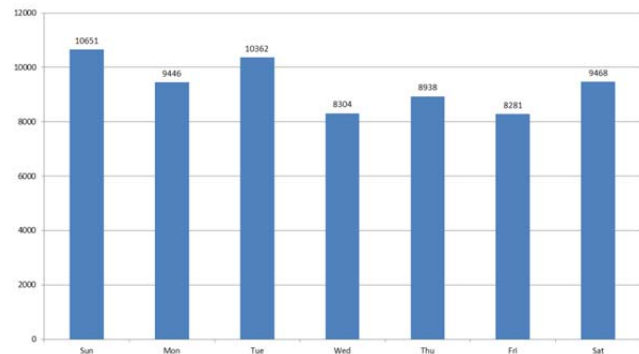
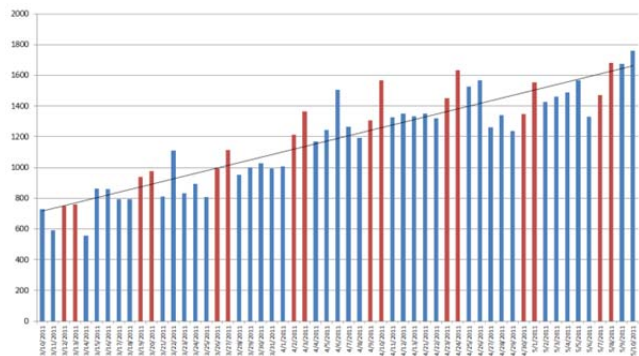


Figure 2 - Workout day popularity



The researcher believes that this “last day” popularity is

Figure 3 - Workout date popularity

due to the continuous marketing of the mobile fitness application and thus the increased usage. The trend analysis would suggest that Endomondo usage and sharing of one's workout via Twitter has continued to increase over the course of the research timeframe. The red bars in Figure 3 indicate Saturday and Sunday measurements.

Of the 65,450 total tweets that contained #endomondo, 47,429 (72%) were classified as a fitness tweet. This classification used the Vickey/Breslin Fitness Tweet classification model of a fitness related tweet being activity, blarney or conversation (Vickey and Breslin 2011).

The Tweeter

With regards to who sent the Tweets (the Tweeter), the collected data from the constructed Twitter database was

sent via the Wang/Vickey Fitness Tweet API to two websites that provide Tweet user information; twitter.com and klout.com.

When observing the English only information gathered from the #endomondo hashtag, the following statistics were calculated:

- N=65450
- Range of Count = 318
- Median of Count = 3

A histogram (see Figure 4) of the collected data also indicates in addition to a few outliers, there were also 3990

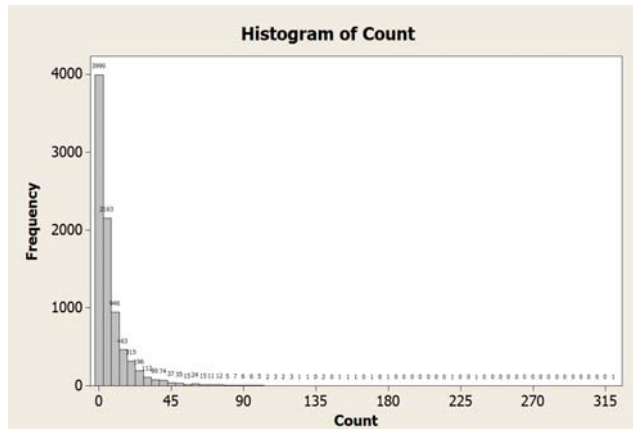


Figure 4 – Histogram of Tweeters using #endomondo hashtag over study period

users (46% of total users) that used the sharing of their workout from the Endomondo fitness app via Twitter just one time.

Users participate in Twitter for not just the sharing of their workouts. An analysis of the overall Twitter demographics of the #endomondo mobile fitness app users who share their workouts on Twitter indicates the following:

	Total Tweets	Following	Followers
Average	4,768	317	555
Mode	63	18	8
Median	846	108	82
Standard Deviation	12,022	1,171	6,225

Figure 5 - Overall Twitter statistics of #endomondo users

Note: These tweets are the total number of all of a user's tweets, not just #endomondo related tweets.

Conclusions

The objectives for this research were to determine who shares online workouts from a mobile fitness app and what the overall Twitter demographics of those users are. These objectives were reached, yet have identified additional areas of research.

The data shows that by tracking mobile fitness app hashtags, a wealth of information can be gathered to include but not limited to exercise frequency, daily use patterns, location based workouts and language characteristics. While a majority of these tweets are to share a specific workout with their Twitter social networking, the data would suggest other reasons for sharing as well.

Understanding a person's social network may be one key to better health, as technology continues to impact humanity. It is the hypothesis of the researcher statistics (the increase in global obesity) and research (the decline in overall physical activity) would suggest that the lack of habit forming exercise and the deficiency of structured exercise programs continues to be a challenge for those that wish to adopt a more healthy lifestyle. Whilst there are a wide range of mobile fitness applications currently available, until these technologies incorporate a more persuasive approach to behavior change, minimal results directly related to the sharing of workouts using these applications will occur.

Research indicates that there is a potential for technologies to be used as a means for generating positive behavior change. Simple mobile devices can function as an inexpensive, accessible and powerful trigger towards behavior change without the need of overly complex and expensive applications or devices (Foster et al. 2010). This research has shown that there is a tremendous amount of data is available to monitor physical activity. In a short study duration of 55 days, over 70,000 tweets specific to just one mobile fitness app (Endomondo) were collected. Trend analysis of the use of mobile fitness apps has shown an increase week after week. Over the course of one year, over half of one million data points will have been collected for Endomondo alone.

Future work will include a more robust mobile fitness app tweet classification system, an in-depth analysis of a mobile fitness app user's social network, comparison studies of multiple mobile fitness apps and the integration of such research into the behavioral changed needed to impact the overall health and fitness of these users.

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