# "…is it normal to be this sore?": Using an Online Forum to Investigate Barriers to Physical Activity

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## ABSTRACT
The importance of regular physical activity to overall health has been well established, yet U.S. adults are leading increasingly sedentary lives. Research suggests that lowering perceived barriers to physical activity is a critical part of interventions that encourage physical activity. In this paper, we describe the top five barriers—two of which have not been reported as principle barriers in the literature—that emerged from our systematic qualitative coding of an online forum used to support a three-month healthy lifestyle intervention. Based on our analysis, we identify design considerations for technologies that encourage and support physical activity. Understanding the needs of a population is a critical step in the design process, and this paper offers unique insights for those working in this growing domain.

## Categories and Subject Descriptors
H.5.3 [**Group and Organization Interfaces**]: Collaborative Computing; H.5.0 [**General**]; H.5.m [**Miscellaneous**].

## General Terms
Design

## Keywords
Physical activity, fitness, health, barriers, message boards, bulletin boards, web forums, virtual community.

## 1. INTRODUCTION
Constance has a plan. After work she will pick up the kids from daycare and head home. Her mother is going to meet her at 5:30pm to watch the kids for 90 minutes while Constance goes to the gym. By the time 5:30pm rolls around, Constance is dressed and ready to go to the gym, but her mother has not arrived. In fact, her mother does not arrive for another 20 minutes. While waiting for her mother, Constance receives an email about a work-related emergency that must be handled immediately—by the time she is ready to leave for the gym, she has already lost 45 minutes of her workout time. Given that it takes Constance 10 minutes to commute to the gym and another 10 minutes to return home, she only has 25 minutes of actual workout time remaining. Constance is so frustrated that she is no longer motivated to go to the gym tonight. She feels that the whole world is conspiring to defeat her efforts to stay healthy.



Among adults in the U.S. who begin an exercise program, approximately 50% drop out after the first three to six months [12]. Research suggests that an individual's perceived barriers to physical activity are an important determinant of activity level [38][44]. Large-scale surveys have shown that people have many barriers to being physically active such as *lack of time*, *lack of motivation* and *lack of energy* (e.g., [4][7][27][48]). Several investigations have reported that helping people overcome their perceived barriers has more influence on encouraging people to be physically active than does enhancing perceived benefits of exercise [26][36][38]. In fact, knowledge of health benefits is not correlated with activity levels [38]. Barriers may affect those who are trying to make a change *and* cause those who are regularly physically active to break their routine.

The study described in this paper is part of a requirements gathering effort to inform the design of technologies to encourage and support people who are beginning or maintaining a physical activity routine. Understanding the needs of a population is a critical step in the design process, and this paper offers unique insights for those working in this domain, an area of growing popularity (e.g., [3][9][11][21][22][30][32][31][32][42]). We examined the content of message board traffic during a three-month healthy lifestyle intervention that promoted physical activity and healthy eating. We employed a grounded approach to our analysis [41] and found natural categories of barriers for which message board posters sought advice. The principle barriers and ranking we identified differ from those reported in the literature. Our findings identify opportunities for technologies to help individuals overcome or mitigate barriers, as well as help designers and evaluators of the technologies understand potential issues that may arise during long-term use of the technologies which may adversely affect the technologies' effectiveness.

In the following, we provide an overview of the principle barriers suggested by prior work. The method we employed to analyze the message board traffic is described next, followed by our findings related to the message board posters' top barriers. Finally, we discuss the limitations of our method, then propose design considerations for technologies that encourage and support physical activity.

## 2. BARRIERS TO PHYSICAL ACTIVITY

People who strive to initiate and maintain a physically active lifestyle are constantly challenged—busy schedules, family responsibilities, inclement weather, job demand, and so on—these barriers can overwhelm even the most devout fitness addict. In addition to these "personal barriers," other factors including environmental constraints such as the limited availability of safe trails and parks have been identified that influence an adult's choice to begin and continue a physical activity routine. These factors or "determinants" of physical activity have been studied extensively to help design interventions that promote physical activity. In our work, we focus on *personal barriers* to physical activity because it has emerged as one of the most consistent and strong correlates of physical activity behavior [44].

Table 1 provides a summary of the principle barriers reported in the 13 studies of barriers that we reviewed [4][5][6][7][15][16][19][1][24][27][36][37][48][49][50]. Most of the studies used survey instruments to collect data, while a couple employed focus groups or interviews [15][49]. In 11 of the studies, the top reported barrier for not being physically active was a *lack of time* [5][6][7][15][19][24][27][36][48][49][50]. *Care-giving duties*, including caring for children, elderly parents, or other family members, was a prevalent barrier in studies that focused on women [4][24][27][48]. *Lack of motivation* [6][7][15][19] and *lack of energy* [5][27][48] were also frequently ranked as principle barriers[2].

Two studies in our review assessed barriers for participants in physical activity interventions. In Williams et al.'s study of postmenopausal women [49], the top reported barrier at the end of a seven-week walking program was *lack of time*. Ransdell et al. studied 20 mother-daughter pairs who were participating in a 12-week intervention that included group fitness activities and educational sessions [36]. *Lack of time* (or "time expenditure") was also the top barrier for that study. Ransdell et al. concluded that *decreasing perceived barriers* plays a bigger role in the uptake of physical activity than increasing perceived benefits [36]. To determine barriers, both studies administered the *Exercise Benefits/Barriers Scale (EBBS)* [39] pre- and post-intervention, but not *during* the intervention when barriers naturally occurred. Williams et al. also interviewed participants.

The majority of studies that report about barriers select subjects randomly from specific segments of the general population. Data is usually collected from surveys dispensed during phone and/or face-to-face interviews from instruments such as the EBBS and *Behavioral Risk Factor Surveillance Survey (BRFSS)*[3]. The questions used to prompt subjects about their barriers are therefore very structured.

Another tool that has emerged from the research on barriers is the *Barriers to Being Active* quiz [45]. Similar to the EBBS and BRFSS, it can help intervention developers understand their target population and thus where to focus efforts. This quiz helped to inform the coding of message board traffic that is the focus of this paper.

**Table 1. Principle Barriers to Physical Activity. *Italicized references* indicate the top barrier for the study.**

| Principle Barrier | Study |
|---|---|
| Lack of time | *[5][6][7][15]**[19]**[24][27][36]**[48]**[49]*[50]* |
| Care-giving duties | [4][24][27]***[48]**** |
| Lack of motivation | [6][7][15][19] |
| Lack of energy | [5][27][48] |
| Physical exertion | [24][36] |
| Exercise is tiring | *[16]*[49] |
| Exercise is fatiguing | [16][49] |
| Exercise is hard work | [16]***[49]**** |
| Too tired | [6][27] |
| Injury or poor health | ***[19]**** |
| Health concerns | [15] |
| Lack of interest | *[37]* |
| Lack of enjoyment | [37] |
| Social interaction | [24] |
| Lack of social support | [15] |
| Get physical activity on the job | [6] |
| Not the sporty type | [50] |

* In [19], *lack of time* was the top reported barrier overall, but *injury or poor health* was the top barrier for those aged 60-75. In [48], *lack of time* was the top barrier for urban women, and *care-giving duties* for rural women. In [49], *Exercise is hard work* was the top barrier pre-intervention, and *lack of time* post-intervention.

## 3. METHOD

We wanted to understand the barriers that naturally occur as people attempt to change their behavior to lead healthier lifestyles. Many of the prior studies rely on retrospective surveys of people randomly selected from a specific segment of the general population. While that well-established approach may yield statistically significant and generalizable results, it may miss barriers that are not part of the formalized prompts or which respondents simply do not recall. That approach may also fail to uncover the nuances of and interplay between the barriers.

In contrast, the method that we employed focused on the open-ended, natural discussions that occur in online communities such as Usenet and other web-based forums. Briefly, our method was to **(1)** identify and archive message board traffic, **(2)** develop a set of codes to apply to the messages, **(3)** systematically code the content of the messages, and then **(4)** analyze the coded messages.

We archived web forum messages from *GetFit!*, an annual three-month healthy lifestyle intervention created and promoted by

[1] [4] and [19] report on the same study.

[2] Barriers from the various studies may overlap in some cases due to an inconsistency in their naming (e.g., *care-giving duties* is often related to a *lack of time*; *lack of energy* in one study may be synonymous with *too tired* in another).

[3] http://www.cdc.gov/brfss {link verified 24 Aug 2010}

BeFit[4]—a U.S. magazine that covers women's fitness, nutrition, health, beauty, and style topics. BeFit has roughly 5 million readers, almost 75% of whom are college educated with a median age in their late 30's and household income of around $72,000 USD. Each month during *GetFit!*, BeFit publishes articles about incorporating physical activity (cardio, strength, and flexibility training) and proper nutrition practices into daily life.

During the *GetFit!* intervention that we studied, BeFit offered web forums to support intervention participants. Forums were arranged topically including one where experts[5] responded to posts, as did other forum posters. No registration or membership was required to read or post messages. We collected 13,262 posts (from 3,223 threads) over a 3.5 month period, which spanned the duration of *GetFit!* and contained all messages from the "expert" forum. Threads contained from 1 to 74 messages each (mean: 4.1, median: 3). Ten experts and 2,649 registered posters (i.e., unique poster IDs) contributed posts. There were an additional 945 contributions by the undifferentiated "guest" poster name.

In this section, we describe how we developed our codebook, how we coded and analyzed the message traffic, and some general demographics that we were able to collect by reading and analyzing the 13,262 messages.

## 3.1 Data Coding & Analysis

We developed an initial set of codes based on a review of the related literature including the *Barriers to Being Active Quiz* [45], other barrier-related literature (including [13]) and two social-psychological theories—*Presentation of Self in Everyday Life* [23], which addresses impression management, the pervasiveness of social interaction, and how social interactions impact behavior, and the *Theory of Cognitive Dissonance* [18], which addresses the distinction between attitudes and behaviors and the justifications that people use to explain inconsistencies between them. Given the initial set of codes, a sample of messages was read to identify (code) omissions. When a message included a topic related to, but not accounted for by a code, we either clarified or expanded the code, or added a new code to cover the topic (e.g., for discussions related to goals or use of media). During coding, we specified whether the segment of text being coded regarded physical activity and/or nutrition. The codebook was validated through pairwise pre- and post-discussion Kappa values among four coders. Prior to any discussion, Kappa values ranged from 'slight agreement' to 'fair agreement' while post-discussion, all coders were in 'almost perfect agreement' according to the "Interpretation of Kappa" values [28][47].

Two of the four coders systematically coded the data using the validated codebook. This method for analyzing message data has been used by others, for example, by Arguello et al. to identify the qualities of a post in Usenet groups that led to a successful thread [2], by Preece et al. to investigate the empathetic qualities of posts on a message board support group for individuals with knee injuries [34], and by Farnham et al. in HutchWorld, to investigate the impact of social support offered via the internet on the quality of life of cancer patients and their caregivers [17].

## 3.2 Observed *GetFit!* Demographics

We do not have complete demographics for the forum as we had no direct interaction with the posters. However, the content of many posts included demographic information, from which we were able to collect the following: age range of 13 to 62 years old, weight range from 70 to 267 pounds, height range of 4'10" to 6'4", and body mass index[6] (BMI) range of 13.1 to 41.1 kg/m$^2$. Though BeFit magazine targets women in the U.S., at least a few males (self-identified) and international posters (identified by use of culturally specific terminology such as references to "stones" as a unit of measure for weight) posted to the forum.

Although our analysis of the *GetFit!* message traffic covers a broad range of topics related to physical activity and nutrition, our focus here is on results related to barriers to physical activity. We have selected this topic because lowering perceived barriers has been shown to be more effective at encouraging people to be physically active than has educating people about the benefits of physical activity [26][36][38], therefore focusing on reducing barriers presents opportunities for those developing technologies to encourage and support physical activity.

# 4. NATURALLY OCCURRING BARRIERS

In this section, we present the barriers to physical activity that arose naturally as *GetFit!* message board posters asked questions on the forum. We identified 1,426 quotations about barriers to physical activity and coded them into three major categories: **(1)** a request for advice about a barrier, **(2)** an offer of advice about a barrier, and **(3)** a simple mention of a barrier. In 394 (28%) of the messages, posters *requested advice* about a barrier. Advice requests were often posted as questions. In 638 quotations (45%), posters *offered advice* about a barrier. The offering of advice was not always in response to a request; it was sometimes provided in a "for your information" type of message. Finally, 394 quotations (28%) *simply mentioned* a barrier.

This analysis focuses on quotations where advice was requested about a barrier. These quotations offer a rich source of insight into the natural struggle that posters experienced as they attempted to be physically active. Table 2 provides the frequency of mention for all of the physical activity-related barriers in our dataset where posters sought advice. The top five barriers, *injury or illness, lack of willpower, lack of time, actual or anticipated body change, and lack of resources* are discussed next; they account for 80% of the quotations in which posters sought advice about overcoming a barrier. For each, we **(1)** provide excerpts from the posts that characterize the barrier and **(2)** propose design considerations for technologies that seek to encourage and support physical activity.

## 4.1 Illness or Injury

*Illness or injury* was the most frequently mentioned barrier, comprising 188 (48%) unique quotations. Posters asked about how to start or continue physical activity routines when confronted with an illness or injury. A range of illness and injury-

[4] Pseudonyms are used for the magazine and health intervention names to protect the identities of message board posters, expert contributors, and the magazine.

[5] Experts, who were arranged by BeFit, included two psychologists, an Obstetrician/Gynecologist, a Registered Dietitian, two personal trainers, two gym owners, a personal finance columnist, and a spa chef.

[6] BMI, which has been shown to strongly correlate with body fatness, is calculated based on an individual's height and weight. It is used to classify people as being underweight (BMI < 18.5 kg/m$^2$), normal weight (18.5 to 24.9), overweight (25.0 to 29.9), or obese (BMI ≥ 30.0).

related barriers were discussed including broken bones and recovery from surgical procedures, as well as common illnesses such as colds and flu. Chronic problems were also reported and ranged from permanent back and knee injuries to chronic diseases such as fibromyalgia and arthritis. However, the top complaint was *muscle pain* from exercise (e.g., sore muscles, shin splints), with *common illnesses* and *general knee pain* tied for second. Interestingly, this barrier is often not mentioned as a principle barrier in the literature, and when it is, minor illnesses and injuries such as sore muscles and common colds are not described.

### *4.1.1 Overdoing It*

Muscle soreness, sometimes caused by overdoing it, was a common barrier for which posters sought advice. The following quotation illustrates how soreness from a new workout may negatively influence an individual's choice to continue.

> "On Monday night I did the strength workout for month 1 down to the letter...when I stood and walked after doing the squats my hamstrings were very tight. When I woke up on Tuesday, I was incredibly sore, and it was almost painful to walk downhill or downstairs...and I could feel my hamstrings with every step. So, I skipped my plan cardio (walking/running) b/c I couldn't bear the thought of moving my legs that much. Today they are the same, possibly even worse. I hadn't worked out at all for months before I started [GetFit!]...is it normal to be this sore? I can't imagine I could hurt myself from doing squats without weights, but...??? I've been trying to stretch my hamstrings out, but they don't seem to be feeling any better. I'm probably just freaking out over nothing, but I have to travel internationally on Saturday and I don't want to not be able to walk through the airports!" <Poster 1, or "P1">

P1 is frustrated by muscle soreness from a new workout regimen and wonders if she has done something wrong. She is uncertain if the soreness is "normal" or an injury, when perhaps it is simply a case of attempting a program that was too ambitious for her starting activity level or not knowing what to expect from a new strength-training routine. While muscle soreness related to a new workout regimen is a common and usually temporary condition, it can be discouraging and may be difficult to distinguish from a potentially serious injury, especially for someone new to exercise.

### *4.1.2 Getting Back on Track*

Common illnesses, such as a cold or flu, can also interfere with routines. Getting motivated to resume physical activity during or after an illness was another common theme from our analysis. The following quotation illustrates an individual's experience with an illness that interrupted her progress in the *GetFit!* intervention.

> "I had made a lot of progress in the first 4 weeks and was really feeling great. However, this week, week five, both my baby and I were sick. The day I was sick I barely had the energy to take care of my baby's and my needs. On the two days my baby was sick I could not leave the house and spent much of my time holding her so I wasn't able to get my workouts in. Now it seems I've lost my momentum. I went out walking this morning for only 22 minutes. Any suggestions on how to get back into the swing of things. I don't want to fall backwards on my progress". <P2>

This quotation exposes the rich complexity of barriers and daily life. Both the poster *and* her baby were ill, illustrating how *care-giving duties* can also present a barrier. She is disappointed at the setback and concerned about losing the momentum she gained in the first month of the program. Everyone is eventually affected by a cold or flu, not only parents with young children. In fact, adults average two-to-four colds per year [33].

**Table 2. Barriers to physical activity from the forum posts about which advice was requested, listed in order of frequency.**

| Barrier | # of Unique Quotes |
|---|---|
| Illness or injury | 188 (48%) |
| Lack of willpower | 34 (9%) |
| Lack of time | 33 (8%) |
| Actual or anticipated change in body | 30 (8%) |
| Lack of resources | 27 (7%) |
| Lack of energy | 15 (4%) |
| Other barriers – generic | 12 (3%) |
| Lack of progress | 11 (3%) |
| Weather related barriers | 10 (3%) |
| Psychological barriers | 6 (2%) |
| Social Influence | 6 (2%) |
| Too boring | 5 (2%) |
| Change in physical environment | 4 (1%) |
| Occupation | 4 (1%) |
| Fear of injury | 3 (1%) |
| Temporary change in environment | 3 (1%) |
| Physical barriers | 2 (0.5%) |
| Lack of enjoyment/ fun | 1 (0.25%) |

### *4.1.3 Seeking Alternative Exercises*

*GetFit!* posters often requested alternative exercises from the published routines that would be safe and effective given a particular illness, disease, or injury. In the following, a poster with a knee injury exacerbated by arthritis asks for help.

> "I want to get back in shape before my reunion this summer. I have trouble with my knees - actually I have arthritis. I normally love aerobics, softball, volleyball, doing weights, etc. but now I'm trying to figure out what I can do aerobically and I want to get my muscle tone back. I had a knee injury a year and a half ago and had to quit working out until I could get it checked. Before that my legs were defined and muscular. I want to get the lean but toned look. Any ideas? I love working out…." <P3>

P3 expresses motivation and enjoys being physically active but is in need of alternative exercises to the *GetFit!* intervention's routine that will make workouts safe for her particular conditions and not contribute additional pain.

Another quotation offered a glimpse into the experience of people who suffer from chronic debilitating diseases such as fibromyalgia, chronic fatigue syndrome, or arthritis.

> "I hope someone can help me. I have a chronic illness that has recently gotten worse. I feel lost as I'm unable to work out at all right now. Exercise is my way of feeling normal with my illness. But because of things beyond my control I can't even walk on my treadmill. If anyone can help me get through this untill *[sic]* my illness is less active I would be greatfull *[sic]*. I love this message board and read it, any advise *[sic]* would be appreciated." <P21>

This post generated a large number of responses with suggestions and support from others who suffer from chronic disease but still want and need to be active. Some research has identified injury as the number one reason people stop *vigorous* activity [37], and in our analysis, it was also a principle barrier to *moderate* activity.

### *4.1.4 Design Considerations for Illness or Injury*

When designing technology to encourage and support physical activity, it is important to address the barriers that may arise from illness or injury, even when the illnesses or injuries may seem minor. This was by far the most commonly discussed barrier on the forum, indicating that it can be a serious issue for people who are actively pursuing a healthy lifestyle change. Design considerations to help people overcome this type of barrier include: **(1)** Anticipate muscle pain from starting or adding to an exercise regimen and build in mechanisms to assist people in getting around the discomfort. This includes keeping people interested in exercise while taking it easy during recovery, and helping them understand what to expect and when they should rest or work through the soreness/pain. **(2)** Provide suggestions for safe alternative exercises. In many cases, people with illnesses or injuries wanted to be physically active, they just did not know what was appropriate to do given their current condition. **(3)** Expect temporary disengagements with physical activity due to illness or injury, and use persuasive techniques [20] to help people get back to focusing on their fitness.

## 4.2 Lack of Willpower

Many people have trouble starting or restarting a physical activity routine, despite knowing that they should and even wanting to do so. Thirty-four quotations (9%) sought advice about how to find the willpower to become or continue to be physically active.

### *4.2.1 Can't seem to get started*

The following quotation is a representative example of someone who wants to but cannot seem to start exercising.

> "I'm having a problem motivating myself to diet and exercise. I can wake up in the morning and tell myself "today is going to be a healthy day. I'm going to eat right and work out after classes." But by the time noon rolls around all I want to do is eat a bag of chips and call it a day. It's coming to the point where I'm almost trying to convince myself that 200 lbs. at 20 years of age is OK. I mean, after all, my friends say that I look good and my boyfriend isn't complaining and can't understand why I would want to diet. But I know I'm not on a healthy track. What can I do? I have tried so many things and now I'm frustrated! " <P4>

P4 wants to live a healthy lifestyle, starting her day with good intentions. However, she lacks willpower to follow through as the day goes on, falling back to unhealthy habits. Further, her friends and boyfriend actually support her unhealthy lifestyle. Social support is another correlate of physical activity that has a consistently positive association, particularly in women [44]. Similar to findings by Christakis and Fowler that suggest that *"obesity appears to spread through social ties"* [8], this quotation highlights how social influences can exacerbate barriers to physical activity—in this case, a lack of willpower.

### *4.2.2 Falling off the wagon*

A break from a particular behavior due to a lapse in willpower is sometimes called "falling off the wagon." Experiencing a lapse in willpower to continue physical activity by people who had already found the willpower to get started was a common concern on the forum as the following quotation reveals.

> "I really fell off the wagon this past week and it's a really hard recovery process. I still worked out, but only half as much and I ate really bad and didn't record a darn thing (probably out of shame). I'm confused as to why, when I lost 4 lbs already. I was really tired this week, but that's no excuse. And I am having a hard exercise motivation time. What can I tell myself to help me stop with the slacking, because the things I'm thinking right now, like you've come so far, and how can you do this to yourself when you were doing so well and not having a hard time doing it? I'm scared that I'll backslide again or continue this pattern and I could really use some pearls of wisdom." <P6>

This quotation illustrates a conflict between attitude (the desire to lead a healthy life) and behavior (a decrease in activity). Occasional lapses are normal and do not need to lead to a "*backslide,"* however, 50% of people who start a new exercise regimen stop it within the first three to six months [39]. P6 is concerned about losing the ground that she gained in prior weeks and is having difficulty motivating herself to get back on track.

### *4.2.3 Design Considerations for Lack of Willpower*

Willpower was often elusive for posters; sometimes they had it and other times, they did not. It can prevent people from getting started as well as disrupt healthy routines that are being established. We offer the following considerations for technology that encourages and supports physical activity. **(1)** There are critical decision making moments throughout the day when willpower may be low and where technology could have influence. **(2)** At times of low willpower, encourage at least some physical activity, even if it is not as comprehensive as the prescribed routine—some physical activity is usually healthier than no physical activity. **(3)** Recognize that social influence can affect willpower positively *and* negatively, potentially impacting the effectiveness of the technology. **(4)** As with the *illness and injury* barrier, expect disengagements with physical activity that will inevitably occur, and find ways to help the individual get back on track rather than develop a pattern of inactivity.

## 4.3 Lack of Time

*Lack of time* is the most frequently reported barrier to physical activity across gender, race, culture and socioeconomic status in prior research [4][7][27][48]. In our data, it was only the third most common barrier for which *GetFit!* forum posters sought advice with 33 (8%) unique quotations. The principle time constraints were work commitments (13 quotations), school commitments (10), caring for children (5) and housework (3). In many cases, physically active people do not *have* more time than those who are inactive, but rather *make* time for activity.

### *4.3.1 Need to 'make' the time*

The following quotation is an example of how people get trapped in hectic lives and put off fitness goals.

> "I signed up for [GetFit!] toward the end of the first week. That weekend I had planned to get the things I needed to do workouts but other things came up and I wasn't able to. Then in week two, I had no time due to long work hours, church commitments and my two-hour commute. I was getting home late, going to sleep even later and was very tired in the morning. I feel guilty about not being able to squeeze any workouts in. I plan to make up the missed time at the end but I still don't feel good about last week. I also noticed the my *[sic]* lack of time had me eating on the run and late in the evening. I've gotten a few DVD's to help with workouts in the house and I'm not sure if I'll get any outdoor workouts in this week. I'm also determined to do better with my eating this week. Is squeezing in workouts (as opposed to having sufficient time) going to help

me? Is it o.k. for me to make up missed time at the end or should I approach the problem a different way? I have a few commitments that are going to take up a lot of my time until mid-{month}." <P22>

This litany of responsibilities and commitments reflects personal choices about how time is spent. In such situations a 'perceived' time barrier must be overcome. P22 needs help finding ways to fit physical activity into her busy daily life.

The next quotation exemplifies the challenge imposed by a new daily schedule brought about by a change in stage of life.

"I am an avid exerciser.....always been involved with sports in school, and now being in college, I workout *[sic]* at a local gym regularly. Lately I have been so busy and overwhelmed with my classes and schedule that I have went *[sic]* a whole week, sometimes a week and a half w/out working out! since I am so used to working out at least 4 days a week, I feel like a complete blob! Some people may say that I'm being ridiculous but when your *[sic]* used to something and for some reason or the other circumstances change, you are bound to feel awkward. Is this huge break of no exercise going to effect *[sic]* my weight maintenance? Is there a place to start to get back on track?" <P9>

For P9, her new school schedule is competing with her established workout routine. What used to work for her no longer does, and she does not know what to do about it. Transition periods such as starting college, changing jobs, and moving homes require reconstructing workout schedules and habits. Stressful life events can create pressure to complete ordinary tasks, restricting time for physical activity [38].

Seasonal fluxes in family or work commitments may also create barriers, as explained in the following quotation.

"[Addressed to those with a certain career]: how do you fit in exercise during busy season *[sic]*? I have been pretty good with getting my workouts in, but it seems that during this time of year, work takes over and I stop exercising. Just when [busy work season] is over, [next season] is begining *[sic]* and I'm still so flabby! Any tips? My only option right now is to get up at 530-6am...." <P10>

In this quotation, a stressful, but predictable period at work interrupts P10's workout routine. P10 is seeking help for how to structure her daily routine for exercise when she is confronted with an overwhelming work schedule.

### *4.3.2 Design Considerations for Lack of Time*

We offer the following considerations for technologies that encourage and support physical activity to help people overcome a *lack of time* barrier. **(1)** People often need help finding opportunities for physical activity in what they perceive as being already over-packed daily schedules. Even 10-minute increments of activity can provide health benefits [46]. **(2)** Workout routines may need to be restructured following life transitions and during stressful events. Technology could be leveraged to detect these periods and offer support. **(3)** Account for fluxes in schedules, for example, unusually long work hours related to impending paper deadlines. In our work, we have found that helping people reflect on their recent physical activity can often help them reprioritize what is going on in their lives so that they find time to be active when they otherwise would not have [9][11].

## 4.4 Actual or Anticipated Body Change

Thirty (8%) unique quotations were characterized by concern over actual or anticipated changes in body shape or size brought on by physical activity (and in some cases, the resulting weight loss). The types of posts in this category have not been previously addressed by studies that report on barriers to physical activity. Half of the participants who sought advice about this barrier were concerned with increasing the size of their lower body (15 quotations). Of those 15 quotations, seven posters experienced an actual change in their thighs, calves and/or buttocks and eight were afraid of such changes.

### *4.4.1 Bulking up on the bottom*

The following quotation expresses a fear of an anticipated, undesirable change in body size due to physical activity.

"I used to do the elliptical everyday but one of my friends said if I wanted to loose *[sic]* weight off my butt and thighs the most productive machine to use would be the stepper, but then one of my other friends said she bulked up from using the stepper… and believe me my butt needs no more bulking—even if it is muscle." <P12>

In this case, P12 is concerned about using the stair stepper because of a preexisting body image concern that she believes will be exacerbated. Her fears have been substantiated by a friend's experience with the equipment. Another poster experienced an actual, undesirable change in her muscle mass complaining that, "*some of my pants don't fit my legs anymore!*" <P11>.

### *4.4.2 Bulking up on top*

For some, increased muscle mass from strength training can be an undesirable outcome of this healthy behavior.

"My arms are very defined and toned. A few weeks ago, I once again increased the weights I use for my arms - except now I'm noticing my arms are looking bigger. I really don't want my arms bigger, I'm very happy with how they look right now. The problem is, if I drop down in the amount of wt. I'm lifting its no longer challenging for me. So, how can I maintain but yet still challenge myself?" <P13>

P13 has experienced an actual body change after trying a more challenging strength-training workout. Her desire to challenge herself physically is competing with her notion of her ideal body image. She is motivated and actively engaged in a healthy behavior that may be deterred by the need to project a particular image. Dworkin describes the dilemma in her sociological perspective on the ideologies of women's fitness: *"Despite the message that women should 'just do it,' ideals of emphasized femininity lead many women in the weight room to 'just hold back'"* [[14], p. 346].

### *4.4.3 Losing weight in the wrong places*

Targeting weight loss to specific areas of the body is not possible and thus when weight is lost, it can be lost in places where the loss is not necessarily desired, as explained in the following.

"Since I've started working out I've gone from 175lbs to 132lbs which makes me extremely happy but I have also gone from a C cup to an A cup. Any suggestions on how to continue to lose weight without ending up with a compeltely *[sic]* flat chest?" <P14>

The poster is "*extremely happy"* with her 43 pound weight loss which may greatly contribute to her health, but she is struggling with a competing concern to maintain a particular body image. It is not clear if the change in breast size will definitely deter future efforts to continue physical activity but it was enough of a concern that she asked for advice about how to continue to lose weight without losing more of her breast size.

### 4.4.4 Design Considerations for Actual or Anticipated Body Change

The concerns over body changes resulting from exercise were a very real fear or experience for many *GetFit!* forum posters. Its rank as the fourth most frequently occurring barrier in our analysis is important considering that it has not been identified in the related barriers literature. Though it may be difficult for technology to address the larger issue at hand—that is, cultural definitions of body image—we have identified some considerations for technical approaches to this barrier. **(1)** Help people focus on their fitness accomplishments and how physical activity is benefiting their long-term health. **(2)** Identify concerns about body change and encourage alternative exercises where appropriate. **(3)** Let people know what to expect in the way of likely body changes and debunk common myths (e.g., the *Fact or Fiction* video feature of Bedsider.org [25]). In addition, we note that the *actual or anticipated body change* barrier may impact the effectiveness of an otherwise well-designed technology to encourage and support physical activity.

## 4.5 Lack of Resources

Twenty-seven (7%) unique quotations sought advice about how to overcome a lack of resources. Twenty quotations specifically requested advice about how to do an equivalent strength-training workout *without* using the equipment prescribed by *GetFit!*. Each month, BeFit published a set of strength training exercises that participants were to incorporate into their routine, for example, doing abdominal crunches or bicep curls on an exercise ball.

### 4.5.1 Additional equipment cost

This quotation illustrates the need for alternative exercise recommendations that can be done without special equipment.

> "I belong to a gym, own a treadmill, freeweights *[sic]*, and just bought a stability ball for month one. I can't justify any more expenditures on fitness at this point. Is there any alternative to the tubes or bands for this month's workout? I really want to know if there are any alternatives. [Expert 5]? I don't want to spend more money right now!!!!! I think it is a stinker for them not to have any alternate exercises. I know I can do my own routine, but it doesn't register the "right" amount of calories in the log..." <P16>

P16 is motivated to work out and has access to many resources (a gym membership as well as a treadmill, free weights, and stability ball at home) but is still having trouble performing the *GetFit!* routine. The lack of alternatives provided by the intervention upset her. When she came up with her own alternative, she did not get proper credit for the exercise in the intervention's calorie expenditure log. In our work, we have found that providing proper credit for one's efforts is critical, and not providing proper credit can lead to disengagement with the technology that is intended to support physical activity as well as with the physical activities themselves [9].

### 4.5.2 Space

Similarly, this poster seeks a substitute strength-training workout.

> "I don't own a stability ball because I live in a small apartment that does not afford me the room. Are there any modifications to the exercises that do not require a stability ball?" <P20>

P20's barrier is not necessarily associated with financial difficulty, but rather a result of her living environment. The small size of her living space limits her ability to strength train with the intervention's prescribed stability ball.

### 4.5.3 Childcare

Care-giving duties, often related to a *lack of time*, have been identified as a common barrier in prior work [4][24][27][48]. The following quotation reveals how care-giving duties can also be related to a *lack of resources* barrier.

> "I wanted to know if having kids and running after them and taking care of them is considered any type of workout? I have 3 children of my own, ages 5,3, and 8 months - and my husband are fostering (with hopes of adoption) my 2 nephews ages 2 and 9 months. I never stop I am always on the move … We have a gym membership that "he" goes to, but for me to go is like trying to move a mountain, because of the Daycare fees, and we are not among the "high society" or even "middle class" income level (hehe) - and you try finding someone to watch all the lil' monkeys it is almost impossible. So i am coming to a crossroad- I want to lose weight and gain my muscle tone and look great but will I have to put it aside until the children get older?" <P17>

Although this family has a gym membership, P17 is the primary caregiver for five children under the age of six, and the daycare fees are simply not affordable. Finding adequate childcare for that number of small children is difficult and expensive. Care-giving duties, a common barrier for women, have previously been shown to contribute to a decline in physical activity [4][24][27][48].

### 4.5.4 Design Considerations for Lack of Resources

The posts on the forum have revealed that *lack of resources* barriers are not *always* about socioeconomics or access to exercise equipment or fitness facilities as one may assume when reading results from large-population surveys. Even for people who are able to spend money on fitness equipment, they may reach a point where adding *more* equipment is simply not "worth it." There may be physical constraints of the home that prohibit use of certain types of equipment, independent of financial resources. And even people with gym memberships may not be able to take advantage of those memberships due to competing responsibilities that they cannot afford to outsource, such as childcare. Designers of technologies to motivate physical activity should be aware that this barrier can have a particularly negative impact on user acceptance, as it did with *GetFit!* forum posters. The principle considerations that we have identified for design are to **(1)** provide alternative exercises so the individual can effectively make substitutions to the exercise regimen, and **(2)** help the individual find opportunities to incorporate physical activity into competing responsibilities such as care-giving.

# 5. DISCUSSION

There are two primary contributions from this work. First, from the results of our qualitative analysis, we have produced a set of design considerations for those developing technologies to encourage and support physical activity. The richness of the posts on the forum convey the nuances of the barriers as well as the emotions—frustration, despair, desperation, amusement—that posters experienced as they encountered barriers, offering insight into how technology may be able to better support physical activity. Second, the method that we used to investigate the advice that posters naturally sought on the forum to overcome their barriers has offered an alternative perspective to the problems faced as people attempt to make healthy lifestyle changes. Our findings are complementary to those presented in the barriers literature and have shed light on two categories that have not been previously reported as principle barriers to physical activity.

## 5.1 Under-represented Barriers

*Illness and injury* was by far the most common barrier for which people sought advice on the *GetFit!* forum, with muscle pain, common illnesses, and general knee pain being the top complaints. Although the survey instruments used in most of the studies from the barriers literature included questions posing ill health and injury as potential barriers, the impact of those barriers when compared with our findings is under-represented.

We note that *injury* has been cited as the number one cause for relapsing from *vigorous* activity [38] (though not from *moderate* activity, as we observed on the forum). Similarly in Eyler et al.'s qualitative study of minority women 40 years of age or older, participants cited *health concerns* due to fatigue, injury, and specific conditions such as arthritis as significant barriers [15]. While Eyler et al.'s finding may differ from the findings of the survey-based studies due to the specific population of the participants, it may also be associated with the qualitative data collection method employed (i.e., focus groups). Finally, Finch, Owen, and Price found *injury or disability* to be among the barriers to physical activity in their survey study of 2,298 people living in Australia (it was the top barrier for subjects aged 60-75) [19]. The researchers suggest that this barrier be further explored, and our findings represent such an exploration, illustrating how seemingly minor illnesses and injuries can represent important barriers to older as well as younger adults.

*Anticipated or actual body change* does not appear to be represented in the barriers literature, although some research suggests that an individual's self-presentation concerns may impact her willingness to exercise [29]. In an overview of factors affecting levels of physical activity, Seefeldt et al. note that *"self-presentation is a neglected but important determinant in the exercise behavior of adults"* [40]. In our findings, this barrier had nearly the same number of quotations as *lack of time*—the number one barrier reported in most of the prior work we reviewed. Thus, our approach to understanding this population has uncovered two important issues that may have gone un- or at least under-considered in a general review of the barriers literature.

## 5.2 Study Limitations

The message board posters chose to participate in the *GetFit!* intervention as well as on the *GetFit!* forum. This population is a group of self-selected individuals who are unlikely to be representative of the general population. Their needs may be different from individuals who do not have Internet access or chose not to participate in online forums. Without complete demographic and medical history information from the message board posters, we cannot say if the findings from this study address the needs of older adults (our oldest known participant was 62) or those with chronic disease. However, they represent a group of people who were actively attempting to change their behavior to live a healthier lifestyle and were seeking advice from others who were going through a similar experience.

We also note that our analysis focuses specifically on barriers. People naturally talk about many topics on open-ended forums and the *GetFit!* forum was no exception. As mentioned earlier, we coded for a wide range of topics related to physical activity and nutrition. The fact that two of the top five barriers to physical activity for which posters sought advice have little representation in the literature makes our focus on barriers novel and valuable.

Finally, we note that our findings may be different from the prior literature that used survey-based methods because they come from a fundamentally different perspective—the free-form opinions of people who were in the midst of participating in a healthy lifestyle intervention. As such, our method did not attempt to elicit all posters' experiences with all possible barriers. Instead, our analysis focused on the barriers about which posters chose to solicit advice from the online community. The approach that we employed captured the naturally occurring barriers about which people chose to seek advice online as they attempted to follow a healthy lifestyle intervention, and as such, complements the studies from the barriers-related literature.

## 5.3 Opportunities for Design

The opportunities for design that emerged from our analysis are based on the commonly reported barriers on the *GetFit!* forum. The rationale for constructing design considerations that address barriers is grounded in literature that suggests that helping people overcome perceived barriers is one of the most important elements of effectively encouraging physical activity [44]. It was not our intent to identify technological solutions for each barrier as much as to characterize the prevalent barriers in an effort to inform future work. Some of our findings are not implementable design suggestions but rather offer insight into why otherwise good designs may fail to motivate the target behavior.

We propose four general categories of opportunities for technology to help people overcome or mitigate the top barriers identified in our study.

***(1) Set expectations, not just goals.*** People need to know what to expect from the activity or they may abandon their workout routines for fear of injury or an undesirable body change. For example, *injury* barriers may be reduced if people know what type of soreness or discomfort is normal versus what should be cause for concern. When should they take a break from working out, try a different activity, or work through the discomfort? What can they do to help their recovery? When is it time to see a doctor? *Actual or anticipated body change* barriers may be reduced by being clear about the benefits that the physical activity offers and what types of changes in their bodies they should expect from performing the physical activity.

***(2) Provide alternatives.*** Technology provides a unique ability to immediately offer a vast array of alternative exercises, including live expert opinions. *Illness & injury* barriers may be reduced if safe and effective exercise alternatives are offered. Providing disease-specific alternative exercise recommendations may motivate an individual incapacitated with a debilitating disease. Suggestions for alternative workout regimens may lower the obstacles presented by life transitions, helping individuals deal with a perceived *lack of time* or *lack of resources*. Offering substitute cardio and strength training routines may mitigate fears of undesirable *body changes.*

***(3) Encourage a little now, for a lot later.*** People are unlikely to consistently perform the recommended physical activity routine all of the time due to a variety of reasons, for example, illness, injury, lack of willpower, time, resources, an actual or anticipated body change, a temporary change in priorities, stress, and so on. Technology can be used to identify these lapses as well as encourage people to continue to do at least some form of physical activity. For example, in our work with UbiFit, we provided people with the option to set a primary as well as a secondary goal [11]. The secondary goal was intended to help people stay active

during difficult times, such as a work deadline or mild illness. Of course, the technology should also encourage people to get back on track as soon as is reasonable. The goal should be to prevent a pattern of low or inactivity from developing [35].

***(4) Accommodate lapses in routine.*** It will not always be possible or even appropriate to encourage people to do at least some form of activity during lapses; therefore the technology should be designed to keep people thinking about physical activity goals even during periods of inactivity. Providing feedback that is not guilt-producing but rather an encouraging reminder of past accomplishments or how minor lapses can have minor impact in the big picture may help people overcome set backs resulting from illness, injury, stressful life events or periods of low motivation. Additionally, it might be helpful to include alternative incentives for being physically active, perhaps by making physical activity entertaining, such as Fitster's "Race Across Michigan" [1] or the approach being used by Nintendo's Wii Fit. However, care should be taken when using non-health related incentives to motivate health, and as with opportunity #3 above, the technology should encourage people to get back on track as soon as is reasonable. Technology can be used to reduce the burden of re-entry into an exercise routine by breaking down the larger goal into smaller steps and offering cues for problem solving—for example, bolstering self-efficacy and self-control [43]. Again, the goal is to prevent a pattern of low or inactivity from developing [35], not to make people feel guilty about taking a reasonable break.

# 6. CONCLUSION

The conversations that took place in the virtual community of the *GetFit!* forum have illustrated the struggle that people encounter when trying to start or continue an exercise routine. Helping individuals overcome or mitigate barriers has emerged as one of the most consistent and strong correlates of physical activity behavior [44], and our findings have outlined several opportunities where technologies that are intended to encourage and support physical activity can help. Our findings also uncovered some of the nuances of and interplay between the barriers, and can be used to help designers and evaluators understand potential issues that may arise during long-term use of their technology, which may adversely impact the effectiveness of an otherwise well-designed technology.

Discretionary-use technologies that are intended to encourage and support physical activity need to be used over long periods of time to be effective. Therefore it is important to understand the barriers that people are likely to face in order to help them overcome those barriers and lead healthy lives.

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