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PHYSICAL ACTIVITY

Perceptions of Physical Activity Tracking Devices: A Survey Analysis

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Abstract

Most adults fail to meet recommended physical activity (PA) guidelines. PA tracking technologies may help increase activity because they facilitate self-monitoring and self-regulation. In response to recent calls for testing the effectiveness of these technologies, this study surveyed opinions of Fitbit users within a university setting. Participants ($N = 371$, $M_{age} = 31.3$, $SD = 14.4$) responded to an online survey that gauged perceived usefulness and adoption of Fitbit. Analyses revealed that 97.3% of the respondents used Fitbit to track PA, while others did it to track heart rate or to compete against others. The majority of respondents (80.9%) reported increased PA levels as a result of Fitbit use, and 63.5% reported Fitbit had a very positive impact on their health. Most respondents (88.1%) also reported they liked using Fitbit. With regard to continued use, a portion of respondents (67.7%) reported intentions for continued use to increase PA in the future. Respondents' reported satisfaction with Fitbit use was significantly associated with the perceived usefulness of Fitbit's mobile application, perceived impact of Fitbit on health, and intentions for future use ($p < .001$). Qualitative analysis revealed three major themes: (1) criticism related to use,

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(2) positive comments related to use, and (3) comments related to mobile application. Results suggest that novel advances, such as Fitbit, could hold unique potentials to improve PA behaviors.

Despite the well-known health benefits of physical activity, over half of the adults in the United States fail to meet the recommended 150 min/week of moderate- to vigorous-intensity physical activity (Bassuk & Manson, 2005; Centers for Disease Control and Prevention, 1996, 2008; Dunlop et al., 2015; Moreau et al., 2001; Owens, Matthews, Raikkonen, & Kuller, 2003; Pleis & Lucas, 2009; Troiano et al., 2008; Vagetti et al., 2014; Vallance et al., 2011). The most commonly cited barriers to physical activity include lack of time, lack of motivation, and perceived adverse effects associated with physical activity (Netz, Zeev, Arnon, & Tenenbaum, 2008). One public health priority is to develop and test the effectiveness of low-cost interventions targeted toward increasing physical activity levels (Wang et al., 2015). Over the years, interventions to increase physical activity have included approaches ranging from individual- to group-based, phone- and/or Web-based, and counseling to coaching modalities (Irwin et al., 2009; Jakicic, Marcus, Lang, & Janney, 2008; Pierce et al., 2007; Rock et al., 2010). Recently, there has been growing interest in wearable physical activity tracking devices that help individuals self-monitor and increase physical activity behaviors (Lee, Kim, & Welk, 2014; Patel, Asch, & Volpp, 2015; Wang et al., 2015).

Commercially available wearable physical activity tracking devices offer a practical tool for improved self-monitoring of physical activity (Wang et al., 2015). These trackers gather objective measures of physical activity levels, upload the collected physical activity data onto a personal website or mobile application account, and provide real-time and daily summary data for detailed feedback on users' physical activity performance. Additionally, they allow users to set goals and obtain real-time feedback on progress toward meeting these goals. From a behavioral standpoint, these products facilitate self-monitoring and self-regulation, which frequently assist health behavior change (Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Michie et al., 2011).

Despite the growing popularity of these devices, researchers have noted that most mobile health applications draw too little from principles of behavioral economics and theories of health behavior

(Conroy, Yang, & Maher, 2014; Loewenstein, Asch, & Volpp, 2013). Therefore, the potential of these devices and their mobile applications to address the major challenge of long-term behavior change remains unknown. Furthermore, over half of individuals who purchase a wearable device discontinue its use, and one third of them do so within the first six months (Ledger & McCaffrey, 2014). For long-term behavior change, consumer research has emphasized that these technologies should meet the psychological principles of (a) habit formation to enhance wellness, (b) social motivation to connect in a community and goal sharing and competitions toward the achievement of these goals, and (c) goal reinforcement to lead to positive momentum for progress (Boyd & Ellison, 2007; Fogg, Cuellar, & Danielson, 2009; Ledger & McCaffrey, 2014; Lieberman, 2013; Seger & Spiering, 2011).

Consequently, researchers have noted a paucity of published literature on the usability of these devices and their potential to get users to increase their physical activity (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015; Feehan, Clayton, Carruthers, & Li, 2014; Wang et al., 2015; Wanless et al., 2014). Researchers also contended that potential health benefits are contingent upon the design of interventions and engagement strategies rather than the technological features of the device (Patel et al., 2015). Ultimately, it was suggested that the monitoring of physical activity data does not always lead to behavior change. Hence, more research is needed so that we can better understand the effectiveness of these devices for true behavior change (Krebs & Duncan, 2015; Lazar, Koehler, Tanenbaum, & Nguyen, 2015; Wang et al., 2015).

Of interest to this study, Fitbit activity trackers make up the majority of physical activity trackers purchased by consumers (Agomuoh, 2014). Given the lack of data into users' opinions and attitudes on perceived usefulness and intentional adoption of these technologies (Ledger & McCaffrey, 2014; Shin, Cheon, & Jarrahi, 2015), this study surveyed the attitudes, beliefs, preferences, and physical activity levels of Fitbit users in a university setting in the United States.

Method

Study Design and Sample

A survey of 451 Fitbit users affiliated with a university in the Midwestern United States was conducted. Potential respondents were recruited via a university-wide recruitment e-mail, which requested Fitbit users complete the survey between July 2015 and August 2015. After clicking on a Qualtrics (Qualtrics Labs, Provo, UT) survey link, respondents were screened for the following eligibility criteria: aged 18 to 80 years and owned a Fitbit activity monitor. Individuals who met these criteria completed an online informed consent document. Respondents were provided all questions at once via two successive web pages. Respondents were permitted to review and change previous answers. As an incentive, respondents were entered into a random drawing for one $20 gift card to a major local retailer. The researchers' university institutional review board approved all study procedures.

Survey Items

The survey consisted of 15 items (Figure 1). All items were presented to each respondent in the same order. The survey took approximately 10 min for the participants to complete.

Data Processing and Analysis

Data analysis was completed with SPSS 21 (IBM Corp., Armonk, NY). It consisted of three groups of respondents: main group (every respondent), physical activity subgroup (respondents who provided access to step count data from their Fitbit device), and qualitative subgroup (respondents who completed Item 15, additional thoughts and comments about Fitbit). Descriptive statistics were calculated for the data of all groups. Frequencies were computed on select attitudes and opinions by means of Likert scales (1 = *really dislike* to 5 = *really like*; 1 = *less often* to 3 = *more often*; 1 = *much less active* to 5 = *much more active*; 1= *very negatively* to 5 = *very positively*; 1 = *less often* to 3 = *more often*; Figure 1).

1. Please select one that applies: I am a
   a. University student
   b. University staff
   c. University faculty
   d. Other
2. Please select one that applies: I am
   a. Male
   b. Female
   c. Prefer not to reply
3. My current age is ___ years.
4. Did you purchase your Fitbit physical activity monitor through the University's wellness program?
   a. Yes
   b. No
5. In months, how long have you owned your Fitbit device?
   a. < 1 month
   b. 1–2 months
   c. 3–4 months
   d. 5–6 months
   e. 7–9 months
   f. 10–12 months
   g. 13–18 months
   h. 19–24 months
   i. > 24 months
6. Please select one that applies: What model of Fitbit do you own?
   a. Flex
   b. One
   c. Zip
   d. Ultra
   e. Surge
   f. Charge
7. Why do you use your Fitbit? (select all that apply)
   a. To track your physical activity levels
   b. To track your nutrition
   c. To track your sleep
   d. For fashion
   e. Other (Please type additional usage answer(s) in blank)
8. How do you feel about your Fitbit?
   a. Really dislike
   b. Dislike
   c. Neutral
   d. Like
   e. Really like
9. Do you use the Fitbit app for smartphones?
   a. Yes
   b. No
10. If answering yes to question 9, how do you feel about the app? (Only available if yes was selected on #9)
    a. Really dislike
    b. Dislike
    c. Neutral
    d. Like
    e. Really like
11. How has your Fitbit influenced your activity levels?
    a. Much less active
    b. Less active
    c. Same amount of physical activity
    d. More active
    e. Much more active
12. How has your Fitbit affected your overall health?
    a. Very negatively
    b. Negatively
    c. No change in health
    d. Positively
    e. Very positively
13. In comparison to your current usage, how often do you plan to use your Fitbit in the future?
    a. Less often
    b. Same amount
    c. More often
14. In comparison to your current amount of exercising, how often do you plan to exercise in the next 6 months?
    a. Less often
    b. Same amount
    c. More often
15. Do you have any additional thoughts or comments about your experience with your Fitbit that you would like to share? (Blank space provided)

If you would like to be included in the drawing for one of three $20 Meijer gift cards, please provide an email address at which we may contact your if you win. (Blank space provided)

Are you a member of the University's wellness group on the Fitbit website? Being a member of this group allows you to see how your physical activity level ranks with others within the group. If interested in joining, simply go to fitbit.com, log in, click on the "Community" tab at the top of the site and then proceed to the "Activity Groups" page. From there, you can search for and join the group.

Additionally, for the purposes of obtaining a greater understanding of how opinions regarding Fitbit trackers may influence physical activity levels, we would greatly appreciate your voluntary willingness to share your username. (Blank space provided)

Figure 1. Survey distributed via Qualtrics.

For the physical activity subgroup, average weekly step counts were calculated for participants. Daily step totals were tracked and recorded from September 2015 through November 2015. For a week of data to be considered valid and included in the analysis, the respondent needed at least 4 days of 1,000+ steps. Additionally, respondents needed at least 5 weeks of valid data for their step data to be included for analysis. Based on these data, respondents were split into one of two groups based on established suggestions: the "more active" group (average steps/day ≥ 10,000) and the "less active" group (average steps/day < 10,000; Tudor-Locke & Bassett, 2004).

Likelihood ratio chi-square analyses were performed to test for potential associations between variables ($p < .05$). For the respondents completing the qualitative item (Question 15; qualitative subgroup), an inductive thematic analytical approach was used (Fereday & Muir-Cochrane, 2006).

Results

A final sample of 371 respondents were included in the data analysis. The data were divided into the three aforementioned groups (i.e., main group, physical activity subgroup, qualitative subgroup).

Main Group Analysis

Demographics and Fitbit ownership. Table 1 provides information related to demographics and Fitbit ownership. For the main group, respondents' mean age was 31.3 years ($SD = 14.4$) and ranged from 18 to 72 years. The majority of respondents were female (> 80%) and students (> 60%). Of the Fitbit models owned, the Fitbit Flex was owned by over 55% of the respondents. Length of ownership was most commonly reported to be 3 to 4 months (18.2% of respondents). Regarding the Fitbit mobile application, most respondents (> 85%) reported having used the application, and most users of the app regarded it positively (> 92%).

Opinions, future plans, and usage of Fitbit. Nearly all respondents (> 97%) reported using their Fitbit to track physical activity. Few (< 7%) reported using it for tracking heart rate and time of day or competing against others. The majority of respondents reported liking their Fitbit to some degree (> 88%). Most respondents reported that their Fitbit positively affected their health (73.6%) and physical activity levels (83.1%). Finally, although most respondents

(> 60%) planned to use their Fitbit the same amount in the future, most (> 65%) revealed planning to exercise more often in coming months (see Table 1).

Table 1
Demographic Characteristics and Opinions of the Main Group (n = 371), Physical Activity Subgroup (n = 32), and Qualitative Subgroup (n = 112)

Item	Characteristic/ opinion rating	Main group *n* (%)	Physical activity subgroup *n* (%)	Qualitative subgroup *n* (%)
Sex	Female	301 (81.1)	23 (71.9)	93 (83.0)
	Male	70 (18.8)	9 (28.1)	19 (17.0)
Role	Student	241 (65.0)	14 (43.8)	61 (54.5)
	Staff	75 (20.2)	14 (43.8)	29 (25.9)
	Faculty	44 (11.9)	4 (12.5)	17 (15.2)
	Other (undisclosed)	11 (3.0)	–	5 (4.5)
Fitbit Model Owned	Flex	207 (55.8)	17 (53.1)	60 (53.6)
	Charge	102 (27.5)	9 (28.1)	35 (31.3)
	One	34 (9.2)	2 (6.3)	11 (9.8)
	Zip	16 (4.3)	2 (6.3)	3 (2.7)
	Surge	11 (3.0)	2 (6.3)	2 (2.7)
	Ultra	1 (0.3)	-	-
Use of Fitbit Mobile Application[a]	Yes	332 (89.5)	29 (90.6)	101 (90.2)
Appreciation of Fitbit Mobile Application[b]	Dislike	4 (1.2)	–	3 (3.0)
	Neutral	20 (6.1)	–	5 (5.0)
	Like	168 (51.7)	18 (62.1)	50 (49.5)
	Really Like	133 (40.9)	11 (37.9)	43 (42.6)

Table 1 (cont.)

Item	Characteristic/ opinion rating	Main group *n* (%)	Physical activity subgroup *n* (%)	Qualitative subgroup *n* (%)
Reasons for Owning Fitbit[a, c]	Track Physical Activity	361 (97.3)	31 (96.9)	109 (97.3)
	Track Sleep	178 (48.0)	17 (53.1)	60 (53.6)
	Track Nutrition	71 (19.1)	7 (21.9)	19 (17.0)
	For Fashion	10 (2.7)	1 (3.1)	1 (0.9)
	Other (e.g. heart rate, time)	24 (6.5)	1 (3.1)	9 (8.0)
Feel About Fitbit[a]	Dislike	10 (2.7)	–	7 (6.3)
	Neutral	34 (9.2)	2 (6.5)	11 (9.9)
	Like	134 (36.2)	9 (29.0)	25 (22.5)
	Really Like	193 (51.9)	20 (64.5)	68 (61.3)
How Has Fitbit Affected Health[a]	Negatively	1 (0.3)	-	-
	No Change in Health	96 (26.5)	8 (25.0)	29 (25.9)
	Positively	35 (9.7)	5 (15.6)	14 (12.5)
	Very Positively	230 (63.5)	19 (59.4)	69 (61.6)
Future Fitbit Usage[a]	Less Often	20 (5.5)	–	9 (8.0)
	Same Amount	228 (63.0)	23 (71.9)	73 (65.2)
	More Often	114 (31.5)	9 (28.1)	30 (26.8)
Future Plan to Exercise[a]	Less Often	2 (0.6)	–	1 (0.9)
	Same Amount	115 (31.8)	11 (34.4)	30 (26.8)
	More Often	245 (67.7)	21 (65.6)	81 (72.3)

[a]Only respondents who answered each item were included in the analyses. [b]Only respondents who answered Yes to "Use of Fitbit Mobile Application" were provided access to this question. [c]Respondents were permitted to select multiple reasons.

Likelihood ratio chi-square tests. Significant associations ($p < .05$) with at least moderate strength (Cramer's V ≥ .30) were highlighted (Table 2; Cohen, 1977). For the main group, the strongest associations emerged between how respondents felt about their Fitbit and other variables. Feelings about Fitbit strongly associated with feelings about the mobile application, perceptions of influence on health and physical activity, and anticipation for future use (all $p < .001$; see Table 2).

Physical Activity Subgroup Analysis

Demographics and Fitbit ownership. The subgroup respondents' mean age and age range were similar to that of the main group. The proportion of females was slightly less in this subgroup (~72%), while the majority of respondents were either students or staff (~44% each). Fitbit model owned, length of ownership, and feelings regarding the Fitbit application were also consistent with that of the main group (see Table 1).

Opinions, future plans, and usage of Fitbit. The responses of the subgroup were similar to the main group's regarding using the Fitbit mainly to track physical activity (> 96%), in maintaining a positive regard for their Fitbit (> 93%), in perceiving that their Fitbit positively affects their health (75.0%) and physical activity levels (74.6%), as well as expected future use (same amount: > 70%) and increased exercise plans (100%).

Step count comparison *t* tests. Regarding step averages, 16 (50.0%) of the respondents averaged meeting the daily recommended step count of ≥ 10,000 steps/day. Independent samples *t* tests revealed no significant difference in age, sex, or role of those who met and did not meet the recommendation of 10,000 steps/day. Paired samples *t* tests comparing users' Week 1 step count averages to Week 4 ($p = .29$) and then to Week 9 ($p = .95$) step count averages showed no significant differences, regardless of if respondents planned to exercise more in the future.

Likelihood ratio chi-square tests. For the physical activity subgroup, dissimilar from the main group, feelings about Fitbit did not

strongly associate with most variables, except for sex ($p = .03$) and future exercise plans ($p < .001$). Unique to this subgroup, strong associations existed between multiple variables and future exercise plans. Specifically, in addition to sex and feelings about their Fitbit, future exercise plans strongly associated with perceived influence on activity ($p = .01$), effect on health ($p = .006$), and future desired use of their Fitbit ($p = .002$; Table 2).

Qualitative Subgroup Analysis

Demographics and Fitbit ownership. For this subgroup, all demographic and Fitbit ownership variables were similar to that observed in the main group (see Table 1).

Opinions, future plans, and usage of Fitbit. The responses of the qualitative subgroup were similar to those of the main group and physical activity subgroup regarding their opinions (> 80% like device and > 90% of those who use app like it), future exercise plans (> 98% plan to exercise more), and usage of their Fitbit (> 65% plan to use it the same amount).

Likelihood ratio chi-square tests. For the qualitative subgroup, consistent with the main group, feelings about Fitbit strongly associated with feelings about the mobile application, perceived influence on health and physical activity, as well as future use plans (all $p < .001$). Unique to this subgroup, strong associations existed also between the perceived influence their Fitbit had on activity and health ($p < .001$), as well as future use desires ($p = .001$; Table 2). Analyses were also conducted comparing comment type with each of the previously tested variables. For these analyses, respondents who provided both positive and negative comments were removed from analyses and comparisons with only positive or negative comments ($n = 99$) were made. Strong associations existed between the type of comment respondents made and the way they felt about their Fitbit ($p < .001$), the Fitbit mobile application ($p = .001$), as well as how they perceived the Fitbit to affect their health and activity levels (both $p < .001$; Table 2).

Table 2

Chi-Square Likelihood Test Results for Main Group, Physical Activity Subgroup, and Qualitative Data Subgroup

Variable	Sex	Length owned	Model	Feel about Fitbit	Use app	Feel about app[a]	Influence activity	Affect health	Future use	Future exercise
Sex		.44 (.15)	.56 (.11)	**.04** **(.16)**	.88 (.01)	**.04** **(.16)**	**.03** **(.17)**	.33 (.11)	.66 (.05)	**.02** **(.15)**
Length Owned	**.02** **(.67)** *.52* *(.23)*		**< .001** **(.22)**	.13 (.17)	.48 (.13)	.16 (.17)	.29 (.16)	.66 (.15)	**.004** **(.21)**	.52 (.15)
Model	.10 (.46) *.06* *(.28)*	.49 (.55) *.06* *(.32)*		**.01** **(.16)**	**.03** **(.21)**	.403 (.11)	.13 (.21)	**.02** **(.23)**	.07 (.14)	.08 (.15)
Feel About Fitbit	**.03** **(.49)** *.26* *(.17)*	.75 (.45) *.06* *(.32)*	.33 (.36) *.20* *(.19)*		**< .001** **(.23)**	**<** **.001** **(.36)**	**< .001** **(.31)**	**< .001** **(.30)**	**< .001** **(.33)**	**.01** **(.15)**
Use App	.15 (.20) *.32* *(.10)*	.26 (.66) *.25* *(.25)*	**.002** **(.90)** *.56* *(.14)*	.33 (.27) *.31* *(.17)*		[b]	**.001** **(.22)**	.06 (.15)	.33 (.08)	**.05** **(.14)**
Feel About App[a]	**.03** **(.37)** *.61* *(.12)*	**02** **(.68)** *.46* *(.26)*	.14 (.40) *.36* *(.20)*	.06 (.40) ***<.001*** ***(.39)***	[b]		**.002** **(.16)**	**.001** **(.18)**	**.001** **(.27)**	.40 (.10)
Influence Activity	.78 (.13) *.65* *(.09)*	.32 (.52) *.55* *(.24)*	.57 (.28) *.78* *(.15)*	.07 (.35) ***<.001*** ***(.40)***	.30 (.21) *.27* *(.16)*	**.05** **(.38)** ***.01*** ***(.26)***		**< .001** **(.69)**	**.001** **(.24)**	**.04** **(.14)**
Affect Health	.25 (.31) *.87* *(.05)*	.76 (.40) *.75* *(.26)*	.07 (.50) *.12* *(.26)*	.10 (.35) ***<.001*** ***(.36)***	.58 (.14) *.69* *(.08)*	.84 (.11) ***.004*** ***(.29)***	**.004** **(.53)** ***<.001*** ***(.54)***		**< .001** **(.22)**	.21 (.10)
Future Use	.16 (.24) *.41* *(.12)*	.43 (.43) *.18* *(.28)*	.46 (.29) *.10* *(.23)*	.13 (.33) ***<.001*** ***(.44)***	.84 (.04) *.52* *(.11)*	.98 (.01) ***.005*** ***(.33)***	.06 (.37) ***.001*** ***(.32)***	**.02** **(.42)** ***.001*** ***(.31)***		**< .001** **(.25)**
Future Exercise	**.02** **(.43)** *.22* *(.17)*	.23 (.52) *.38* *(.28)*	.25 (.36) ***.01*** ***(.29)***	**< .001** **(.79)** *.54* *(.15)*	.97 (.01) *.73* *(.07)*	.14 (.27) *.94* *(.08)*	**.01** **(.48)** *.17* *(.17)*	**.006** **(.53)** *.49* *(.11)*	**.002** **(.45)** *.06* *(.20)*	
Step Goal	.24 (.21)	.21 (.51)	.99 (.07)	.24 (.26)	.54 (.11)	.31 (.19)	.82 (.11)	.88 (.09)	.69 (.07)	.71 (.07)
Pos./Neg. Comment	*.19* *(.14)*	*.06* *(.35)*	*.54* *(.15)*	***<.001*** ***(.54)***	*.09* *(.17)*	***.001*** ***(.40)***	***<.001*** ***(.46)***	***<.001*** ***(.40)***	*.13* *(.21)*	*.23* *(.17)*

Note. Main group (top right), physical activity subgroup (bottom left, regular font), and qualitative subgroup (bottom left, italicized font). *P* values with Cramer's V results included in parentheses. Significant results ($p < .05$) bolded. Variable analyses included for those who met or did not meet 10,000-step/day goal (gray boxes, regular font) and positive/negative comments (grey boxes, italicized font).

[a]Only respondents who answered Yes to "Use of Fitbit Mobile Application" were provided access to this question. [b]Variables are constants (not independent).

Thematic content analysis

A thematic content analysis revealed three major themes, along with two subthemes for each major theme.

Complaints and suggestions regarding Fitbit use and device technology. One major theme included complaints and suggestions regarding participants' experiences with their Fitbit device. Two subthemes that developed were general complaints about the Fitbit device and technology-related critics and suggestions. These are presented in this section.

Subtheme 1: Participants indicated general complaints about the device. Participants indicated difficulties related to Fitbit use. Some of these pertained to challenges associated with use. These participants stated difficulties related to the overuse of Fitbit, its potential to be tedious and hard to charge, and finally how its regular use can increase one's stress levels.

> "I feel that, depending on one's lifestyle, using a Fitbit device can be tedious to use daily."

> "Wish mine warned me when it was dying . . . vibrate or something like that to indicate I need to charge it."

> "Using the Fitbit has made me obsessive, at times, about my level of physical activity. It has caused emotional distress when I don't reach the goals set by the Fitbit, as I feel upset about my failure."

> "Wearing the Fitbit would occasionally increase my stress level. I tended to feel guilty if I was working or doing homework and my Fitbit would indicate that I had not been active enough that day. I also think I would feel more tired if I woke up and saw on my Fitbit tracker app that my sleep had been restless. I think knowing that I had slept restlessly made me more aware of my exhaustion."

Others similarly discussed how wearing a Fibit device can be challenging within different settings. Throughout the participants' statements, it was evident that not all participants conceived Fitbit suitable for specific lifestyles and/or professions.

"Fitbit too sensitive for a working man."

"I can't track my steps at a restaurant because of health code and getting the Fitbit wet when helping with dishes."

"It is not ideal for athletes."

Subtheme 2: Participants indicated criticism and suggestions to improve the Fitbit technology. Throughout their responses, some of the participants reported technical difficulties associated with Fitbit use. A few of these also suggested potential strategies to improve upon these.

"Small technical issues become annoying."

"I also wish it included heart rate information."

"It would be much better if Fitbits were waterproof."

"I wish there was a better way to track sleep. I wear my Fitbit one in my bra so it is difficult to wear it when I sleep to track."

"I wish the battery lasted longer."

"Sometimes it doesn't hold a charge."

"So, needs improvement to rotate in iPhone or iPad. Need to be able to download date to Excel."

Supportive statements in relation to Fitbit experience. A second major theme created was supportive statements in relation to participants' Fitbit experience. Subthemes that were generated corresponded to supportive statements for general use and supportive statements with regard to device-related features.

Subtheme 1: Participants indicated supportive statements for general use. Participants indicated their satisfaction related to Fitbit use in general. Some of these directly related to the participants' positive feelings and opinions about Fitbit.

"I really enjoy Fitbit."

"I'm still in the 'slightly obsessed with my Fitbit' stage."

"I like it overall."

"I love my Fitbit."

"I couldn't be happier with the product."

"I absolutely love mine and feel lost without it on me."

Others indicated satisfaction from specific causes. As such, some emphasized the motivational gains associated with regular self-monitoring, while others reported enjoying its feedback and accountability aspects.

"It is very useful and has made me more conscious of how active I really am."

"I like the feedback and accountability."

"I liked it a lot more than I anticipated! It motivates me to exercise."

"I definitely recommend a Fitbit! It's a great way to track steps, heart rate, sleep, and etc. Makes me work harder to reach my goal."

"I really enjoy having data that will enable me to track activity."

Subtheme 2: Participants indicated support for device-related features. Throughout their supportive comments, rather than relating to their Fitbit experience in general some of the participants discussed their positive opinions related to the Fitbit device and its properties. These participants reported their contentment about specific features and accompanying motivational gains.

"I will continue to wear it because I like the sleep tracking feature."

"Fitbit has a been a great way for me to have a functional watch, but to also know the level I am at in fitness with heart rate and steps."

"Fitbit is highly 'addictive' and provides motivational feedback including comparison to friends."

"Activity level monitoring has been very motivating."

Statements with regard to Fitbit mobile app. The final and third major theme pertained to the Fitbit mobile application. Subthemes included complaints and supportive statements regarding the application.

Subtheme 1: Participants indicated complaints with regards to the app. Some of the participants indicated difficulties related to Fitbit mobile app use. They discussed an unease to use the app in general, mostly due to freezing, malfunction, and/or lack of synchronization and connection issues.

"The app frequently freezes and has to be shut down."

"Malfunctioned after having it for only four months and it hasn't functioned correctly with the app since."

"My flex would no longer connect to the app."

"Loved my Fitbit until it stopped syncing with my app. Now it's not as useful. Disappointing."

Others elaborated on app-related issues pertaining to specific Fitbit features. As such, app features including nutrition tracking, goal setting, and sleep monitoring seemed to pose challenges to some of the respondents.

"I find the food tracking difficult if you use your own recipes."

"It doesn't give you any goals to lose the weight based upon your nutrition."

"The app changed dramatically making the sleep monitoring more challenging."

Subtheme 2: Participants indicated support with regard to the app. As opposed to the participants who reported issues related to app use geared toward specific features, others reported satisfaction with the app and its features. Some of these participants commented on their positive experience with select features, self-monitoring guidance, and overall happiness with the app's design and structure.

"Like the way you can track nutrition."

"I like that the app gives badges based on meeting certain milestones such as a total distance walked or a new record for steps walked in a single day."

"Very well-designed device and app."

Discussion

Based upon the present results, tracking physical activity, sleep, and nutrition behaviors were the most common reasons for using the Fitbit mobile application. The majority of users liked their Fitbit and associated Fitbit with higher activity and positive health effects; hence, they reported intentions for continued use in the future. Persons with more positive attitudes toward the product (i.e., liking or very much liking it) also tended to perceive it more beneficial for health and had greater intentions for continued use in the future.

Of the individuals with step count averages, half met the daily recommended step count of ≥ 10,000 steps/day. However, in this subgroup, females tended to report increased positive attitudes toward Fitbit. They also tended to perceive it as more beneficial and had greater intentions for continued use in the future. Physical nuisance in the form of skin irritation and misfit (of the product) into one's lifestyle was a concern among respondents. Respondents also indicated that tracking and monitoring reminded them of failure to meet goals and hence led to disappointment and guilt. Others requested additional watch features, higher quality wristband, improved sleep and nutritional tracking, enhanced synchronization, and fewer episodes of freezing. Among those with positive comments, satisfaction

with the product and its mobile application, as well as the belief in its perceived effect on increased activity and health, was high. In contrast to those with criticizing comments, among those with positive comments, enjoyment of the monitoring features for physical activity, sleep, and nutrition, as well as appreciation of peer challenging, was also present.

Given limited previous work that investigated attitudes, beliefs, preferences, and physical activity levels among Fitbit users, this study offers a unique contribution (Ledger & McCaffrey, 2014; Shin et al., 2015). While not survey based, previous studies reveal that physical activity tracking devices, such as pedometers, can help individuals increase physical activity through increased monitoring and self-regulation (Lee et al., 2014; Michie et al., 2009; Michie et al., 2011; Patel et al., 2015; Wang et al., 2015; Wanless et al., 2014). Some researchers also suggested that significant changes in physical activity behavior occur when self-monitoring is combined with either goal setting and/or performance feedback (Michie et al., 2009). The data in this study also indicated that respondents reporting higher perceived impact of Fitbit on their activity behaviors were more likely to value the tracking and monitoring properties of the product. In contrast to the previous findings, however, the results indicated that some respondents discontinued use of their Fitbit because they felt discouraged by its tracking and monitoring.

Consistent with extant consumer research (Ledger & McCaffrey, 2014), the results of this study suggested that respondents who reported their Fitbit helped increase physical activity levels also enjoyed the social connection and competition allowed by the product. Consistent with previous findings (Boyd & Ellison, 2007; Fogg et al., 2009; Lieberman, 2013), these results indicated that features of goal setting, goal sharing, and goal reinforcement produced feelings of discouragement and guilt in some individuals and caused them to discontinue use.

In terms of the most common reasons for Fitbit mobile application use, the findings of this study confirmed other studies indicating that self-monitoring of physical activity presents unique benefits for behavior change, which is arguably its most common use (Michie et al., 2009; Michie et al., 2011). While this study did not ask specific questions to measure whether the mobile application supports

behavioral economics and theories of health, the data indicated a high regard for the mobile application, with some respondents noting they commonly used their application; found it helpful for self-monitoring and self-regulating physical activity, sleeping, and nutritional behaviors; and wanted to increase and optimize its features (Conroy et al., 2014; Loewenstein et al., 2013).

The data in this study indicated that some participants perceived competition as confrontational. Competition features may need to further consider users' motivation to prevent frustration (Middelweerd et al., 2015). A 3-month follow-up of the physical activity subgroup indicated that many respondents' desire to increase physical activity did not translate into real changes, as determined by no change in average daily step counts. Therefore, while this small subgroup relied on their Fitbit to maintain physical activity, Fitbit did not appear to help them increase physical activity despite their stated intention to increase physical activity. To that end, the state of evidence for wearable technologies and applications including Fitbit to increase physical activity is somewhat lacking (Middelweerd, Mollee, van der Wal, Brug, & TeVelde, 2014). This finding may be attributed to a critically limited use of possible behavior change techniques by these technologies (Conroy et al., 2014; Direito et al., 2014; Middelweerd et al., 2014).

For true promotion of change, a foundational requirement could be further aligning these products with theories of health behavior change (Foster et al., 2013; Michie et al., 2009; Noar, Harrington, Van Stee, & Aldrich, 2011; Webb, Joseph, Yardley, & Michie, 2010). Beyond self-monitoring, generic feedback on performance and goal settings may likely be required (Golley, Hendrie, Slater, & Corsini, 2011; Hermsen, Frost, Renes, & Kerkhof, 2016; Michie et al., 2009; Webb et al., 2010). For instance, inclusion of role models, positive self-talk scripts, prompted barrier identifications and possible strategies to overcome these, and the delivery of more individually tailored feedback could enhance the effectiveness of Fitbit and thus further disrupt inactivity and allow long-term behavior change (Hermsen et al., 2016; Kaptein & van Halteren, 2013; Middelweerd et al., 2015; Noar, Benac, & Harris, 2007; Noar et al., 2011).

In contrast to many online surveys, this survey was designed to examine psychological determinants of adoption with the actual

step counts among Fitbit users. To the extent that there is a need to investigate both the subjective opinions of the adopter and the objective data provided by these wearable technologies, these all-inclusive methods of data collection are important (Kim & Shin, 2015; Paul et al., 2015). Also, this survey evaluated key information, especially in regard to reasons for use and disuse of Fitbit, and analyzed demographic and attitude-based correlates of Fitbit and Fitbit mobile application use. Nevertheless, although this study analyzed the step counts of a small subgroup of the total sample, responses to survey items were based on self-report, and the survey included only persons from a college in the Midwestern United States. In addition, although the step counts were observed at various points in time, the survey responses are cross-sectional in nature. While the cross-sectional data can allow attitudes, beliefs, and preferences to be examined at one point in time, these patterns likely may vary over time.

Based upon the open-ended responses, some participants indicated a desire for tracking and monitoring features not to be as prominent. Consumers may find being reminded of goals and viewing information about achievement of their goals burdensome and invasive. These responses also indicated a strong desire in the ability of mobile applications to track and synchronize more efficiently and without frequent freezing. Current findings showed that these technologies could be improved regarding their features and the number of behavioral strategies for increasing activity. Based upon previous recommendations (Middelweerd et al., 2015), Fitbit can further motivate users with a coaching-like function that integrates a personalized and customized behavior change system. While refining these technologies, researchers and practitioners should consider the potential utility and the obstacles these emerging tools may face when reaching broader populations and disrupting deep-rooted habitual patterns.

Application of Findings for Future Research in Physical Education

National guidelines indicate that adults should obtain at least 150 min/week of moderate- to vigorous-intensity physical activity (Centers for Disease Control and Prevention, 2015). Policy and

legislative changes pertaining to physical education classes have been suggested among effective approaches for promoting physical activity (Story, Nanney, & Schwartz, 2009.) Researchers have also suggested that increasing physical education and activity within schools and after school (Wanless et al., 2014) may have the greatest impact on improving physical activity behaviors into adulthood. Therefore, physical education professionals who can use technology appropriately play an important role in helping students become physically educated individuals (National Association for Sport and Physical Education, 2009). Accordingly, early use of personal self-monitoring devices such as Fitbit may help instill long-standing physical activity habits in youth. Researchers have already recommended use of self-monitoring devices for integrating high levels of activity in physical education. Specifically, some have suggested that within physical education settings, personal gadgets can help students meet learning objectives such as the number of steps to achieve by the end of the class (Lynch et al., 2017).

This study offered an initial overview of adults' perceptions and opinions toward physical activity tracking devices. Drawing upon the need for increasing activity in the general population, physical activity leaders who work in the university or adult settings can consider this technology-based intervention to increase physical activity. To the extent that self-monitoring and behavior change are closely associated (Carels et al., 2005; Gleeson-Kreig, 2006), using Fitbit may allow increases in physical activity levels in college students and adults, and this is important to consider. This said, sustained physical activity increase requires adequate behavioral intention and attitude for behavior change (Kim, 2014). Consequently, physical activity leaders can benefit from using these technologies in conjunction with other behavioral and motivational approaches for optimizing self-efficacy and self-regulation (Shieh, Weaver, Hanna, Newsome, & Mogos, 2015). Some of these strategies include goal setting, feedback and rewards, social support, and assisting individuals in identifying common obstacles and barriers to activity (Sullivan & Lachman, 2016). On a final note then, future work should prioritize that these technologies are supported by evidence-based behavior change advances that are specifically geared toward targeted populations.

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