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Older Adults' Acceptance of Activity Trackers

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Abstract

Objective—To assess the usability and acceptance of activity tracking technologies by older adults.

Method—First in our multi-method approach, we conducted heuristic evaluations of two activity trackers that revealed potential usability barriers to acceptance. Next, questionnaires and interviews were administered to 16 older adults ($M_{age}=70$, $SD_{age}=3.09$, $range_{age}=65-75$) before and after a 28-day field study to understand facilitators and additional barriers to acceptance. These measurements were supplemented with diary and usage data and assessed if and why users overcame usability issues.

Results—The heuristic evaluation revealed usability barriers in System Status Visibility; Error Prevention; and Consistency and Standards. The field study revealed additional barriers (e.g., accuracy, format), and acceptance-facilitators (e.g., goal-tracking, usefulness, encouragement).

Discussion—The acceptance of wellness management technologies, such as activity trackers, may be increased by addressing acceptance-barriers during deployment (e.g., providing tutorials on features that were challenging, communicating usefulness).

Given the growing aging population (United Nations, 2013), the health management of older adults (i.e., aged 65 or older) is becoming increasingly important. Moreover, healthcare is shifting towards a patient-professional partnership wherein individuals are taking greater charge in daily decisions about their wellness (Bodenheimer, Lorig, Holman, & Grumbach, 2002). Technologies, which can support management of one's own health (e.g., Holtz & Lauckner, 2012), may be particularly useful for older adults because (1) 80% of older adults have at least one chronic condition (Centers for Disease Control and Prevention, 2009) and (2) older adults can benefit cognitively, physically, and in quality of life from healthy habits (e.g., Colcombe & Kramer, 2003; Elward & Lawson, 1992; Rejeski & Mihalko, 2001).

Activity tracking technologies may benefit users by tracking daily health information such as exercise, caloric intake, and other, often customizable, measures (Figures 1 and 2). There are two types of activity trackers: non-wearable logs (e.g., myfitnesspal.com) and wearable activity trackers that also include logs (e.g., Fitbit One). These technologies allow users to capture more personal data than some other methods of tracking (e.g., pen and paper) and typically capture some data automatically. Additionally, fostering awareness of activities, which activity trackers do (e.g., by providing goal-relevant information), promotes healthy habits (Albania, 2008; Ananthanaryan & Siek, 2012; Tudor et al., 2011). Supporting health self-management behavior (e.g., planning or goal-setting) can increase self-efficacy (Marks,

Allegrante, & Lorig, 2005); higher self-efficacy in older adults is associated with healthier behaviors (e.g., Clark & Dodge, 1999; Grembowski et al., 1993) and better health outcomes compared to those with lower self-efficacy (e.g., Carroll, 1995). Activity trackers may also increase self-efficacy by creating supportive environments (e.g., providing encouraging statements).

The potential benefits of these technologies to support wellness are contingent upon older adults using them. In a recent survey of adults living in the United States, 71% of adults over 65 (n=830) reported tracking their weight, diet, or exercise, but only 2% used a computer program, only 1% used an app or mobile tool, and less than 1% used a website or other online tool to do so (Fox & Duggan, 2013). Rather, older adults reported keeping track in their heads or on paper. It remains unknown why older adults have not embraced using activity trackers despite their propensity to keep track of their wellness activities.

Technology acceptance models can provide insight into the facilitators and barriers to use. The technology acceptance model (TAM; Davis, Bagozzi, & Warshaw 1989), and its later iterations (e.g., TAM2; Venkatesh & Davis, 2000; UTAUT; Venkatesh, Morris, Davis, & Davis, 2003; UTAUT2; Venkatesh, Thong, & Xu, 2012), demonstrated that two important categories of facilitators and barriers are perceived ease of use (PEOU) and perceived usefulness (PU). According to these models, a favorable intent (i.e., a behavioral inclination) to use a technology results from high PEOU and high PU.

Although there have been several studies investigating older adults' technology acceptance (Chen & Chan, 2011 Although there have been several studies investigating older adults' technology acceptance (Chen & Chan, 2014), few have examined changes in acceptance over extended periods of time (e.g., Peek et al, 2014). Studies that have examined older adults' acceptance after usage have focused on technologies other than activity trackers (e.g., Son, Park, & Park, 2015). Moreover, only a few case studies have explored older adults' acceptance of activity trackers (Fausset et al., 2013). A better understanding of the barriers and facilitators that older adults face when using activity trackers could guide deployment strategies and promote use. Examining attitudes and intentions about activity trackers over-time may be a particularly useful method to elicit barriers and facilitators to acceptance because the user will have more time with the technology and may have the opportunity to use it in a variety of contexts.

Study Overview

We examined the potential barriers and facilitators to activity tracker acceptance for older adults in a multi-method, two-phase study. In Phase 1, we analyzed two activity trackers using Nielsen's (1994) heuristics for user interface design to assess overall usability that could elucidate barriers related to PEOU and PU. In Phase 2, to further understand barriers to acceptance and to determine facilitators to acceptance, we analyzed the attitudes of 16 older adults before, during, and after they were given an activity tracker to use. The field study included questionnaires and interviews that allowed for informed user feedback (both negative and positive) to emerge and provided insight into acceptance over time.

Phase 1. Heuristic Evaluation

Method

We conducted a comprehensive evaluation of the degree to which two popular activity trackers deviated from Nielsen's (1994) ten usability heuristics for interface design. One of the authors conducted the primary heuristic analyses and the analyses were reviewed by two of the other authors for clarity, approval, and revisions. The two technologies evaluated were [Myfitnesspal.com](https://myfitnesspal.com) and the Fitbit One. [Myfitnesspal.com](https://myfitnesspal.com) and the Fitbit One are representative of commonly available activity trackers.

[Myfitnesspal.com](https://myfitnesspal.com) is a free online website where users can manually enter foods consumed and exercises performed. Users can also keep track of other information on custom logs (e.g., cigarettes) and join online communities. [Myfitnesspal.com](https://myfitnesspal.com) is primarily marketed as a calorie-counting application.

The Fitbit One is commercially available and also offers food, exercise, and other logs. The Fitbit One has two elements: an online website and a wearable activity tracker. [Fitbit.com](https://fitbit.com) users can also manually enter data, such as food consumed, and join communities. However, the Fitbit One will also automatically input some data from its wearable device, such as steps walked and time slept. The Fitbit One is marketed as a wireless activity and sleep tracker.

Results

The most concerning violations of Nielsen's heuristics related to issues of: Consistency and Standards; Visibility of System Status; and Error Prevention. Violations of these heuristics, and the possible user difficulties created by them, are presented in Table 1. Some violations were unique to a particular activity tracker, such as the lack of labeling a delete function on [Myfitnesspal.com](https://myfitnesspal.com) or the lack of adequately communicating battery levels on the Fitbit One. However, analysis of the two trackers also revealed similar challenges, such as inconsistent navigation bars and advertisements in misleading colors (e.g., premium hyperlinks in the same color as free hyperlinks).

All the heuristic violations relate to ease of use barriers to acceptance. For example, the inconsistent navigation bars may make it difficult for users to know where to go on the website. The last three violations in Table 1 also relate to usefulness barriers. These violations could cause data to not be recorded, to be inaccurate, or to be deleted, all of which would decrease the accuracy of the information reported by the trackers. Inaccurate information is less useful than accurate information and is thus a barrier to acceptance. All PEOU and PU heuristic violations could possibly decrease acceptance.

Discussion

The heuristic evaluation provided an understanding of *potential* barriers that could decrease PEOU and PU. However, it remained unknown how influential these barriers were for acceptance, if these barriers were the only barriers older adults encounter, and what facilitators might aid acceptance despite such barriers. Phase 1 thus provided usability

barriers and a context to interpret older adult users' comments about their interactions with activity trackers in Phase 2. Participants in Phase 2 were not made aware of the usability testing results so as not to influence their experiences.

Phase 2. Field Study

Overview of Field Study

We conducted a longitudinal field study to understand the barriers and facilitators to the acceptance of activity trackers by older adults. In particular, we elicited dislikes and negative comments to understand additional barriers as well as likes, perceived benefits, and positive comments to understand facilitators from 16 novice users for activity trackers aged 65 to 75. Prior to being given either Myfitnesspal.com or the Fitbit One, participants completed questionnaires about their initial perceptions of activity trackers. Participants also communicated their initial attitudes about these trackers in a short interview. Participants received an activity tracker to use for 28 days, during which usage data and diaries of their experiences were documented. To assess acceptance at the end of the usage period, questionnaires were re-administered and final interviews were conducted.

Method

Participants—Sixteen older adults (8 females) between the ages of 65 and 75 ($M=70.06$, $SD=3.09$) were recruited from an at-home testing laboratory, Georgia Tech Homelab (<http://homelab.gtri.gatech.edu/>), and all participants completed the study (IRB protocol H13316). Participants had a working computer in their home but no previous experience using an activity tracker. Participants were compensated \$100. Thirteen participants identified themselves as Caucasian and three participants identified themselves as African American. Half of the sample reported having a formal education of a Bachelor's Degree or above.

Materials—All materials were pilot tested (Fausset et al., 2013) and revised where necessary.

Initial questionnaires: Participants completed six questionnaires prior to receiving their activity trackers. The Background and Health Information questionnaire requested general demographic and health information, and information about physical activities and eating habits (modified from Czaja et al., 2006). The Technology Experience Profile questionnaire (TEP; Barg-Walkow, Mitzner, & Rogers, 2014) assessed familiarity with a variety of technologies (e.g., mobile phone, automated teller machine) on a scale from 1 (not sure what it is) to 5 (used frequently). When scored, the TEP has general technology breadth score ranging from 0 to 36 and a technology use frequency score ranging from 0 to 3. The Activity Tracking Technology Opinions questionnaire began with a brief introductory description of activity trackers and contained three subscales of PEOU, PU, and Intention to Use, totaling 15 items. The anchors of these seven-point scales ranged from 1 (extremely unlikely) on the low PEOU, PU, and intention to use side, to 7 (extremely likely) on the high PEOU, PU, and intention to use side. The items of each of the subscales were averaged, resulting in ranges between 1 and 7. The neutral midpoint on these scales was 4. We modified these items from Davis (1989) and Venkatesh et al. (2003), such that “job” was replaced with “daily life,”

“system” was changed to “activity tracking technology,” and each of the seven points had its own label rather than only having anchors at the extreme ends of the scale.

The following questionnaires were also administered, but were not the focus on the current paper and therefore the data are not included: Self-Efficacy for Health Management, (Becker, Stuijbergen, Oh, & Hall, 1993), Locus of Control for Health (Wallston, Wallston, & DeVellis, 1978), and Exercise Motivation (Markland & Ingledew, 1997).

Initial interview: The initial interview included nine questions designed to elicit dislikes, likes, potential uses, and other opinions regarding activity trackers. Follow up questions were asked when needed. In this paper, we consider comments from the following three questions in the initial interview:

1. What don't you like? Why?
2. What did you like about it? Why?
3. Are there any ways you think this technology could benefit you? If so please explain.

Diary: The diary contained three prompts designed to capture factors that influence acceptance and that emerge over use:

1. Please describe any difficulties that you had with your technology today.
2. Please describe anything new that you learned about your technology today.
3. Please comment about any thoughts and/or experiences you had while using your technology today.

Usage Data: Usage data were obtained from the servers of manufacturers by using the unique identifier assigned to each participant. These data included the date and time participants synced information and the information entered by participants (e.g., the foods they logged).

Final questionnaires: The final set of questionnaires consisted of the Activity Tracking Technology Opinions questionnaire (modified from Davis, 1989; Venkatesh et al., 2003) and the following questionnaires not reported here: Self-Efficacy for Health Management, (Becker, et al., 1993), Locus of Control for Health (Wallston, et al., 1978) and Exercise Motivation (Markland & Ingledew, 1997).

Final interview: Twelve questions were asked after the 28-day field study to elicit opinions (e.g., dislikes, likes, perceived benefits) after usage. Follow up questions were asked when needed. This paper examines the four questions from the final interview that were related to PEOU and PU facilitators and barriers:

1. What did you dislike about this technology?
2. What did you like about this technology?
3. What were the benefits to you for using this technology over the past weeks?

4. How do you think other adults your age would benefit from using this technology?

Full scripts of the interviews and complete coding schemes are available from the authors.

Procedure—Questionnaires were mailed to participants prior to the initial home visit. At this first home visit, participants were interviewed about their opinion of activity trackers and knowledge of pedometers and calorie trackers. To ensure participants all had basic information on activity trackers, they were then given a short introduction to their assigned activity tracker that consisted of a less than 5-minute long promotional video, a user-account set-up, and a brief tour of the corresponding website. Then participants were asked the initial interview questions, which lasted about 5 minutes.

In the first two weeks of use, participants were emailed the diary to complete daily. Participants were called briefly at the midway point of the study for a check-in. During the second two weeks of the study, participants were emailed the diary twice a week. Data on the online websites, either manually entered or automatically uploaded data, were recorded throughout the field study.

The final questionnaires were mailed to participants prior to the final interview. In this interview, participants were also asked a series of questions about if their activity tracker met their expectations, if additional help or instruction was desired, what they would change about their tracker, if they would use the tracker in the future, and how much they would pay for the tracker. Interviews were conducted by trained research assistants who had explained to participants that the purpose of this project was to investigate people's usage of and attitudes about an activity tracking technology. Final interviews lasted about 10 minutes. The Fitbit One devices were collected at the final home visit interviews. Both the initial and final interviews were recorded and transcribed.

Design—Eight participants were given [Myfitnesspal.com](https://myfitnesspal.com) and eight participants were given the Fitbit One to use for 28 days. If two spouses were recruited for the study, both participants were assigned the same tracker to avoid influences from observing different features on a spouse's different tracker. With this exception, activity tracking technology assignment was random. Independent variables included tracker assignment ([Myfitnesspal.com](https://myfitnesspal.com) or the Fitbit One) and usage (pre or post). Dependent variables reported here include (1) scale measures of intention to use, PEOU, and PU; (2) statements of dislikes and negative comments of the trackers as barriers; and (3) statements of likes, benefits, and positive comments of the trackers.

Results

All participants recorded data on their tracker's website for at least 18 days, with three recording data between 23 and 27 days and 12 recording data all 28 days. χ^2 and *t*-tests indicated that the [Myfitnesspal.com](https://myfitnesspal.com) and Fitbit One groups did not differ in age, gender, education, race, self-reported general health, technology experience, initial intentions to use, or final intentions to use, $p > .05$. Therefore, when possible, we collapsed the data across activity trackers.

Subjective Health and Exercise Activities—On average, participants reported their health as good or very good, $M_{\text{self-ratings of health}}=3.47$ (1 = poor and 5 = excellent; $SD = .54$, range: 2.5–4). None of our participants were wheel-chair users. When describing their weekly physical activities, 11 participants walked, 6 completed housework, 4 engaged in yard work, and 4 took part in water exercises. All other physical activities were reported by only 2 or fewer participants (e.g., golf, tai-chi, shopping, volunteer work, socializing). Half of the participants stated they were not on any diet. Of the other 8 participants who reported a particular diet, 4 watched their carbohydrate intake. Other diet concerns were mentioned only by individual participants (e.g., cholesterol, meat type, salt, alcohol).

Questionnaires—Participants were moderately experienced with technology (Table 2). On intention to use, PEOU, and PU, most participants had favorable attitudes towards their activity trackers with scores above the neutral midpoint of 4 both before and after usage. The means for intention to use, PEOU, and PU did not change considerably over usage. However, the change in range over the study for intention of use was notable. Four participants, all of whom were initially at or above the midpoint of 4 on the 1–7 scale, fell below 4 in their intention to use after usage. Additionally, no participants initially scored a 7 in their intention to use. However, after usage, three participants scored a 7 on intention to use. Therefore, most participants initially perceived activity trackers moderately favorably, but after trying the trackers, participants became more polarized in their acceptance of activity trackers. To investigate the reasons behind intention to use, and the roles of PEOU and PU barriers and facilitators to acceptance, we examined the interview and diary data.

Coding schemes—Because the nature and depth of comments varied across the methods employed, data analysis and codes differed among the initial interview, diaries, and final interview. Coding schemes were developed based on the findings from the heuristic evaluation, and the pilot study (Fausset et al., 2013). The initial interview and diaries also influenced the coding scheme for the final interview. Thus, some codes were identified in advance. However, additional codes were also derived from the data to complete the coding schemes.

Initial interview—The interview questions relating to dislikes, likes, and perceived benefits were examined by one coder for emerging themes. As expected for users with limited experience, participants often expressed having yet to form an attitude, with statements such as “*I won’t know until I use it.*” In particular, they appeared to have unformed attitudes about potential barriers to acceptance. Indeed, fifteen participants responded to, “What don’t you like? Why?” with an answer of “*no {nothing}*,” “*I’m not sure yet*,” or a positive comment about the tracker. The one participant who provided a dislike gave a general answer of “*probably doing it.*”

Where initial attitudes had formed, they tended to be positive. Positive attitudes emerged as responses of likes and potential benefits, both of which could act as facilitators to acceptance. Across questions, most participants made positive comments about either the calorie tracker or the activity tracker features, as illustrated by this Fitbit One user, “*It appears that there are several things you can do. Given your activity level, your calorie level... And you actually put in what you eat? That’s cool.*” These comments revolved

around the categories of PEOU and PU. For PEOU, participants liked the trackers' presentations (e.g., simplicity, format), as this [Myfitnesspal.com](#) participant explained, "*The program was easy to read.*" With regard to PU, the majority of participants stated they believed the activity tracker would benefit them by encouraging healthier habits, often through setting and tracking goals: "*I think it will encourage me to continue exercising. Probably inform me of what I need to eliminate more of out of my diet*" - [Myfitnesspal.com User](#).

In sum, after only a brief introduction to activity trackers, participants mentioned several facilitators, such as easy to use formats and potential uses, including meeting diet or exercise goals. Participants did not initially name potential barriers or usability challenges, such as those identified in the heuristic evaluation. However, diary data and final interview data revealed that some challenges emerged over time.

Diary—Most participants adhered to completing the diaries: 8 participants completed all 18 entries, 4 participants completed between 75% and 100% of entries, 1 participant completed between 50 and 75% of entries, and 3 participants completed 25% to 50% of entries. Diary comments were coded as positive, negative, or neutral, and were excluded if unrelated to activity trackers. This coding scheme was developed to determine the participants' overall affect towards the trackers and the reasons underlying those affects. Each tracker-related noun and verb combination was considered an idea unit, regardless of the occurrence of multiple units in the same response to a question (e.g., "*I like the fact that my Fitbit keeps track of my steps and converts the steps into miles*" counted as two positive tracker-related comments). Responses to "Please describe any difficulties that you had with your technology today" were coded as negative, unless participants explained that the difficulty was somehow not negative. Percent agreements by two independent raters were greater than 90% for each code. Therefore, coding results from Rater 1 are presented here. Over the course of the study, participants made 125 negative comments, 128 positive comments, and 80 neutral comments. Table 3 provides examples of participants' comments.

In examining underlying themes, the negative comments revealed potential barriers of accuracy and time. Related to PEOU, users raised concerns about the amount of time involved in using their trackers, especially when entering data. For example, adding foods to the calorie trackers, particularly homemade foods, was described as difficult. In the negative comments related to PU, some participants found their calorie logs or exercise trackers inaccurate (although other participants felt the opposite). Inaccurate information decreases PU.

The positive idea units contained some broad comments on liking the activity tracker, but the more detailed comments revolved around PEOU and PU. For PEOU facilitators, participants thought that the activity tracker was easy to use and that the help sections supported use. For example, [Myfitnesspal.com](#) users found the website very complete, frequently discussing the extensive food database. The extensive databases often had one-click nutrients auto-fill, which requires less time and effort than manually entering nutrition information. Necessary time and effort was also low in the case of Fitbit One's automatic logging, as demonstrated by this participant's comment "*Keystrokes were saved by activating the sleep mode instead*

of having to key the time.” Fitbit One users also liked the help section, which explained how to use various features (e.g., the sleep function).

The value of viewing progress over time was a theme in the positive comments that related to PU. Additionally, some of the above PEOU trends also related to PU, as illustrated by this [Myfitnesspal.com](https://www.myfitnesspal.com) user's comment “*I was able to look up foods by the name of their manufacture* [PEOU of the extensive food database]. *This makes tracking foods and drinks more accurate.* [PU].” Fitbit One users tended to explain additional benefits of the clip-on logging device (e.g., accuracy, sleep tracker, silent alarm features). For example, one participant stated “*Maybe I could show my doctor my sleep data if my problem's with returning to sleep after a bathroom visit.*”

Indeed, when looking at the barriers and the facilitators together under the categories of PEOU and PU, it is clear that the patterns in the comments, not the sheer number of comments, drove favorable intentions to use. In a PEOU example, participants described using the help sections when navigating usability challenges. This suggests that by mitigating the barriers that emerged in the negative comments (i.e., usability challenges) the facilitators that emerged in the positive comments (i.e., usefulness) can dominate acceptance.

With regard to PU, many users desired to bring the automated device of the Fitbit One into the pool to track water exercises, but it was not waterproof. Here, participants wanted to use the activity tracker more to get what they perceived as greater benefits. That is, they wanted to track *more*, thereby increasing the automatic tracking (decreasing manual entry time, increasing ease of data entry), increasing the accuracy of daily totals, and increasing the potential benefits. Thus, it is only because the automatic logging of data tends to be a facilitator that not being able to automatically log a particular type of exercise may be commented on negatively.

Final interview

Data segmentation and general coding scheme development: Four questions from the final interview were coded to further explore barriers to acceptance and the facilitators that can influence users to overcome those barriers. Data were segmented by questions that included dislikes, likes, benefits to the participants, and benefits to other users. Two of the lengthiest interview transcripts were used to develop and revise all four coding schemes. Two raters independently coded these two transcripts, with coding scheme revisions occurring between the two transcripts. Codes were applied once for each non-repetitive statement such that the frequency of each code is the number of participants that expressed that like, dislike, or perceived benefit. After reaching inter-rater agreement above 80% for all revised coding schemes and coming to consensus on disagreements, one rater coded six of the transcripts and the other rater coded the remaining eight of the transcripts. The data from all 16 transcripts are described below.

Barriers—The Dislikes coding scheme was developed to capture which features or functions were disliked and why (Figure 3). Overall, inaccuracies coupled with difficult

formats (e.g., layout, how information is added), particularly in entering data on food logs, were the main barriers to acceptance.

PEOU: Many of the dislikes revolved around usability issues, including participants finding the format difficult, especially for the food tracker. This was from design issues that left participants not knowing how to add foods to the database, not understanding how the tracker worked, and not knowing how to optimally customize it:

- “Yeah, when you can't delete when you made a mistake, because a couple times I entered an item twice. Because I would go to the database to look it up, and then sometimes it would be in the database but it would not move to that next icon where you could add it. So I would go back to the database and I don't know what would happen, but I would look up and it would be on there twice.” – [Myfitnesspal.com](#) User, Format
- “I didn't utilize that calorie counting thing at all. Because I know nothing about calorie counts on food. That would have been a major job to keep up with all of that because you have so many calories per serving. It would take so much research to figure all that stuff out - I didn't even attempt that.” – Fitbit One User, Food Tracker
- “Sometimes I had difficulty considering the amount of food I ate, finding it in the search. Because sometimes I would eat half that; it took me a little while to figure out how to compensate for that.” – [Myfitnesspal.com](#) User, Difficult to Use.

PU: The most frequently mentioned dislike was perceived inaccuracy, as demonstrated by the statement “*One day it wasn't registering what it should have registered. It had to do with the sleep...*” – Fitbit One User, Accuracy Code. Other PU barriers were rare.

Facilitators—The Likes coding scheme was developed to capture which features or functions were liked and why they were liked (Figure 4). The identical Benefits to You and Benefits to Others coding schemes were designed to capture perceived benefits and potential uses (Figure 5).

PEOU: Facilitators related to PEOU mainly emerged in the likes question, for which users most frequently mentioned liking features of individual trackers, namely the exercise logs and food logs. For the exercise log, Fitbit One users tended to discuss the automatic logging of data, as illustrated here: “*Well I liked the way it [the automatic tracking device] keeps up with your physical activity.*” When talking about liking the food log, many users mentioned that it became easier to log with experience: “*Once I learned the technology it became easier and fun to track my intake of food*” – [Myfitnesspal.com](#) User, Food Tracker.

Based on usage data, the physical activity and food trackers were most frequently used by the older adults in our study, instead of sleep, blood pressure, mood, or other customizable measures (e.g., cigarettes). However, it is not clear if these other trackers were not used

because: (1) participants simply had no desire to use them despite being easy to use or (2) they were not used because of PEOU barriers.

PU: In answering likability questions, participants clearly recognized potential uses for activity trackers. For instance, one user described how [Myfitnesspal.com](https://myfitnesspal.com) could help with goal tracking: “I liked being kept aware of the calories per day because I didn’t always stay under the goal. And 1200 calories is what mine was and that’s difficult. It really lets you know. I like the line where it had your goal and then it had the bar. I could see how many days I went over.” Related to setting and meeting goals, other participants explained that the activity trackers encouraged them and made them more aware of their exercise and their food consumption, as observed in this excerpt: “I liked the fact that it goads you” [Interviewer: “Like cons you into exercising?”] “Yeah, and that’s not a negative thing.” – Fitbit One User, Encouragement. Also related to PU, participants stated that they liked that their health information could be viewed and liked that the activity tracker was useful in general.

When answering how the activity trackers could benefit themselves, participants tended to give specific benefits. In congruence with the likes, the most frequently reported benefits to participants were that the activity trackers provided encouragement, awareness about food intake, and awareness about exercise. The following examples illustrate some benefits participants found for themselves in using their activity trackers:

- “Keeping me in tune to my walking. There’s a couple of times I went over the 10,000. I think even when you got to five it was nice. So it just lets me know okay if I’m feeling okay, you can do a little bit more today. So it encouraged me to go out and walk a little bit more.” –Fitbit One User, Encouragement
- “It really gave me an overview of my eating. Is it really balanced? Maybe you don’t need that candy...” –[Myfitnesspal.com](https://myfitnesspal.com) User, Helped With Diet

These quotes demonstrate that older adults felt they could personally benefit from activity trackers after using them.

Participants mostly spoke in general terms when asked about benefits to others (e.g., “In looking at my sister and her husband, I think they would benefit from it.” - Fitbit One User, Meets Needs or General Usefulness). Nonetheless, when specific uses were mentioned they were generally relevant to how the trackers could help with dieting, increase the level of awareness of food intake, and provide encouragement. However, one unique theme that was discussed as a benefit to others was being able to track diseases, as explained by this [Myfitnesspal.com](https://myfitnesspal.com) user: “I think, particularly, [for] those with specific diseases or conditions that require their food to be closely monitored both by content and balance, [this] would be really helpful. I think if you had someone with an eating disorder and you needed to monitor their intake. I think those are the primary benefits that I see in it.”

Results from the final interview question about dislikes of the activity trackers showed usability barriers. However, despite these challenges, participants used their trackers and described many facilitators related to PEOU and PU. Results from the final interview were consistent with those of the questionnaires, initial interview, and diary. Overall, the results

suggest that older adults think activity trackers could be very useful for promoting healthy habits. However, the older adults valued the ability to accurately log information in an easy format.

Discussion

The goal of this study was to examine the acceptance of activity trackers by older adults. This emerging technology has the potential to help older adults with health self-management, self-efficacy, and healthy habits. Despite this potential, most older adults do not use activity trackers for their health-tracking needs and instead rely on pen and paper documentation or no documentation at all (Fox & Duggan, 2013).

It is possible that older adults may not use activity trackers because of usability barriers. Heuristic evaluations revealed potential PEOU and PU barriers to acceptance in the areas of: Consistency and Standards; Visibility of System Status; and Error Prevention. As a PEOU Consistency example, Myfitnesspal.com allowed exercises to be entered with a drop-down menu on some, but not all, of the exercise entry pages, which could make it difficult for users to know how to enter data. As a PU Visibility of System Status example, it was difficult for users to easily know the sensitivity setting of the Fitbit One device, which could cause inaccurate automatic data logging. A PEOU Error Prevention violation left the delete function for the food log of Myfitnesspal.com unlabeled and made the format for adding/deleting foods challenging. The PEOU and PU heuristic violations revealed in our evaluations provided background into potential user experiences.

To assess how older adults experienced the potential usability barriers identified in the heuristic analyses, we conducted a longitudinal field study in which 16 older adults used fitness trackers. We also examined whether additional barriers existed for older users beyond those identified in the heuristic analyses, and investigated facilitators of acceptance. Consistent with our heuristic analyses, the field study results were also related to PEOU and PU. For PEOU, some participants found the format for adding, deleting, or editing logs difficult, especially on the food log. For PU barriers, participants sometimes perceived the automatic tracking device of the Fitbit One and the database information online (e.g., nutrients per portion) as inaccurate. PEOU facilitators included automation (e.g., the Fitbit One device, auto-fill food logs), the completeness of the websites, and the help sections. PU facilitators frequently revolved around the purposes of activity trackers, which is to help meet health goals by promoting awareness of health habits. Participants reported PEOU and PU facilitators initially, during, and at the end of the study.

TAM (Davis et al., 1989) predicted that PEOU and PU would emerge as categories of barriers and facilitators that drive acceptance across time. The results from PEOU and PU categories suggested that to minimize barriers and increase facilitators for older adults through design, activity trackers should (1) automatically log exercise data; (2) have simpler, clutter free logs, especially for food; and (3) maintain their easy-to-view summary information that allows for goal setting, goal monitoring, habit awareness, and encouragement. Decreasing barriers and increasing facilitators through design may promote the acceptance of activity trackers.

A second pattern that emerged over time was that many of the older adults in our study had favorable intentions to use activity trackers. This may have been because our participants were given the opportunity to try out their trackers without financial cost or permanent obligations to use, thereby lowering their perceived costs (Rogers, 2003). Low-risk or low-cost trial periods may be one way to encourage the use of activity trackers. Indeed, any strategy that decreases the amount of costs relative to the amount of benefits may promote acceptance.

The value-based adoption model (VAM; Kim, Chan, & Gupta, 2007) captures a cost-benefit tradeoff that may help explain why participants had high acceptances of activity trackers despite barriers to acceptance. According to VAM, a consumer's decision to accept is based on their perceived value of the technology. Perceived value is calculated by weighing the perceived sacrifices and the perceived benefits. Examining perceived sacrifices and perceived benefits helps explain the results of our study.

The barriers to acceptance revealed in the heuristic evaluation, dislikes, and negative comments are perceived sacrifices because they pose costs to users. For example, slower learning of the system from inconsistent links or inconsistent navigation bars may cause a time-cost. Time and effort costs were also evident in adding homemade food to the logs. Inaccuracies in data logging could make trackers insufficiently reliable which decreases perceived value in VAM (Kim et al., 2007). By decreasing perceived value, barriers decrease acceptance.

Perceived benefits are facilitators to acceptance. They were revealed in likes, benefits, and positive commentary of the field study findings. For example, the final interview revealed the PEOU benefit of the Fitbit One's automatic logging of physical activity. Participants also discussed encouragement and awareness of their food intake, exercise, or habits in general as PU benefits. This awareness would help with daily decisions (e.g., food selection). These potential uses were commonly reported and appear to be why older adults would overcome potential usability issues, in accordance with the cost-benefit tradeoff of VAM.

Perhaps older adults outside of this study are not tracking healthy behaviors using activity trackers because of an unwillingness to risk the initially unknown PEOU difficulties without the clear benefits of PU. This study revealed what these usability difficulties and benefits are; the VAM framework suggests that minimizing the associated costs and maximizing benefits will likely increase acceptance. Aside from design considerations, deployment and training strategies that target older adults may help minimize costs and maximize benefits.

Based on the barriers and facilitators to acceptance revealed in this study, possible deployment and training strategies are provided in Table 4. Interventions could be directly implemented by activity tracking companies. For example, an advertisement by an activity tracker company could show older adults using the food tracker to watch sodium intake. Indeed, advertisements like the short promotional videos used in our study, may influence initial attitudes. Additionally, other stakeholders in older adult healthcare, especially in preventative healthy habits and in chronic condition management, can also provide these implementations. For instance, an insurance company could send out pamphlets to

individuals over the age of 65 that lists monitoring nutritional intake as a benefit of activity trackers. Instead of solely through design, human factors interventions in deployment could increase perceived value and promote the acceptance of activity trackers by older adults. Furthermore, these interventions may be modified for other consumer health information technologies that help users *maintain* health and focus on wellness (i.e., not urgent disease management). The term “wellness management technology” may best encompass this class of health technologies that includes activity trackers. Other wellness management technologies should be included in future research.

Limitations and Future Research

In developing interventions that could increase activity tracker acceptance by older adults, the limitations of this study should be considered. First, due to the nature of the interview method, observer effects and demand characteristics might have resulted in more positive than negative comments (although the participants certainly had negative comments). Second, participants were not provided training on how to use corresponding smart phone apps. As only one participant mentioned using an app or phone during the study, it is unlikely that many of participants used these apps. However, future research should examine the usability of app platforms for older adults using activity trackers. Third, the participants in this study reported generally being in good health. Because health is a predictor in some technology acceptance models (e.g., STAM; Chen & Chan, 2014), future studies should consider the role health has in wellness management technology acceptance by assessing attitudes of less-healthy individuals. Finally, participants were selected from a database of older adults who agreed to test out products in their homes and were required to have a computer in their homes. It is possible that our participants may have been more experienced and interested in technology in general than other groups of older adults. Consequently, the recruitment strategy used in this study may have favored early adopters of new technologies (Rogers, 2003). Additionally, although we did not directly measure social influence processes (e.g., subjective norm, image), nor did participants mention them, these constructs may impact the perceived usefulness of wellness management technologies for older adults (Venkatesh & Davis, 2000) and should be investigated further. Depending on their health, technology experience, and social influences, older adults may require different training and deployment strategies to alleviate unique difficulties that were not revealed in this study.

Strengths of Study

The many strengths of this study contribute to an under-explored area of research. Using multiple assessment methods, this study revealed the different barriers and facilitators that have a role in the acceptance of one type of wellness management technologies by older adults. Participants used their activity trackers frequently, which allowed for the elicitation of rich, well-informed opinions. Moreover, this study collected older adults' acceptance measures after a 28-day field study with their technology, which many studies have not done (Peek et al., 2014). Longitudinal designs are important in acceptance research because they demonstrate changes over time, such as polarization after usage or other relevant trends.

Conclusion

Although using activity trackers could be beneficial for older adults, usage of these technologies by this population has been limited. The present results suggest that this may not necessarily be because older adults are not willing to use them. Rather, it could, in part, be due to their lack of awareness about activity trackers and concerns about potential costs (financial, time, effort). Training and deployment strategies that can explain benefits and minimize cost could help increase usage. Potential strategies include:

- Communicating personal benefits to the older adult population specifically
- Creating tutorial videos that ease users into learning difficult or new features
- Adding navigation and accuracy hints to initial start-up guides
- Allowing for trial-use periods

Implementation of these acceptance-promoting strategies could help activity trackers reach the older adult population. The acceptance of wellness management technologies by older adults will become increasingly important as the population continues to age and as healthcare self-management continues to increase.

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References

- Albaina, IM. Master's Thesis. Delft University of Technology; The Netherlands: 2008. Persuasive technology to motivate elderly individuals to walk: A case study.
- Ananthanarayan, S., Siek, KA. the 6th International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth). IEEE; 2012. Persuasive wearable technology design for health and wellness; p. 236-240.
- Barg-Walkow, LH., Mitzner, TL., Rogers, WA. Technology Experience Profile (HFA-TR-1402). Atlanta, GA: Georgia Institute of Technology, School of Psychology, Human Factors and Aging Laboratory; 2014.
- Becker H, Stuifbergen A, Oh HS, Hall S. Self-rated abilities for health practices: A health self-efficacy measure. *Health Values: The Journal of Health Behavior, Education & Promotion*. 1993; 17(5):42–50.
- Bodenheimer T, Lorig K, Holman H, Grumbach K. Patient self-management of chronic disease in primary care. *JAMA: The Journal of the American Medical Association*. 2002; 288(19):2469–2475. [PubMed: 12435261]
- Carroll DL. The importance of self-efficacy expectations in elderly patients recovering from coronary artery bypass surgery. *Heart & Lung: The Journal of Acute and Critical Care*. 1995; 24(1):50–59. [PubMed: 7706100]

- Center for Disease Control and Prevention. Healthy aging: Improving and extending quality of life among older Americans. 2009. Retrieved April 15, 2014 from http://www.cdc.gov/nccdphp/publications/aag/pdf/healthy_aging.pdf
- Chen K, Chan AHS. A review of technology acceptance by older adults. *Gerontechnology*. 2011; 10(1):1–12.
- Chen K, Chan AHS. Gerontechnology acceptance by elderly Hong Kong Chinese: A senior technology acceptance model (STAM). *Ergonomics*. 2014; 57(5):635–652. [PubMed: 24655221]
- Colcombe S, Kramer AF. Fitness effects on the cognitive function of older adults A meta-analytic study. *Psychological Science*. 2003; 14(2):125–130. [PubMed: 12661673]
- Czaja SJ, Charness N, Fisk AD, Hertzog C, Nair SN, Rogers WA, Sharit J. Factors predicting the use of technology: Findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and Aging*. 2006; 21:333–352. [PubMed: 16768579]
- Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*. 1989; 13(3):319–340.
- Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: a comparison of two theoretical models. *Management Science*. 1989; 35(8):982–1003.
- Elward K, Larson E. Benefits of exercise for older adults. A review of existing evidence and current recommendations for the general population. *Clinics in Geriatric Medicine*. 1992; 8(1):35–50. [PubMed: 1576579]
- Fausset, CB., Mitzner, TL., Price, CE., Jones, BD., Fain, BW., Rogers, WA. Older adults' use of and attitudes toward activity monitoring technologies Proceedings of the 2013 Human Factors and Ergonomics Society Annual Meeting. Santa Monica, CA: Human Factors and Ergonomics Society; 2013. p. 1683-1687.
- Fox, S., Duggan, M. Tracking for Health. Pew Internet & American Life Project. 2013. Retrieved April 15, 2014 from <http://pewinternet.org/Reports/2013/Tracking-for-Health>
- Grembowski D, Patrick D, Diehr P, Durham M, Beresford S, Kay E, Hecht J. Self-efficacy and health behavior among older adults. *Journal of Health and Social Behavior*. 1993; 34(2):89–104. [PubMed: 8277130]
- Holtz B, Lauckner C. Diabetes management via mobile phones: A systematic review. *Telemedicine and e-Health*. 2012; 18(3):175–184. [PubMed: 22356525]
- Kim HW, Chan HC, Gupta S. Value-based adoption of mobile internet: An empirical investigation. *Decision Support Systems*. 2007; 43(1):111–126.
- Markland D, Ingledew DK. The measurement of exercise motives: Factorial validity and invariance across gender of a revised Exercise Motivations Inventory. *British Journal of Health Psychology*. 1997; 2(4):361–376.
- Marks R, Allegrante JP, Iorig. A review and synthesis of research evidence for self-efficacy-enhancing interventions for reducing chronic disability: Implications for health education practice (part II). *Health Promotion Practice*. 2005; 6(2):148–156. [PubMed: 15855284]
- National Council on Aging. Chronic Disease Self-Management Fact Sheet. 2014. Retrieved July 15, 2014 from <http://www.ncoa.org/assets/files/pdf/NCOA-Chronic-Disease.pdf>
- Nielsen, J. Heuristic Evaluation. In: Nielsen, J., Mack, RL., editors. *Usability Inspection Methods*. New York, NY: John Wiley & Sons, Inc; 1994. p. 25-62.
- Peek S, Wouters EJ, van Hoof J, Luijkx KG, Boeije HR, Vrijhoef HJ. Factors influencing acceptance of technology for aging in place: A systematic review. *International Journal of Medical Informatics*. 2014; 83(4):235–248. [PubMed: 24529817]
- Preusse, KC., Mitzner, TM., Fausset, CB., Rogers, WA. Proceedings of the 2014 Symposium on Human Factors and Ergonomics in Health Care: Leading the Way. Santa Monica, California: Human Factors and Ergonomics Society; 2014. Activity monitoring technologies and older adult users: Heuristic analysis and usability assessment; p. 23-27.
- Preusse, KC., Mitzner, TM., Fausset, CB., Rogers, WA. Proceedings of the Human Factors and Ergonomics Society 58th Annual Meeting. Santa Monica, California: Human Factors and Ergonomics Society; 2014. Older adults' changes in intent to adopt wellness management technologies; p. 200-204.

- Rejeski WJ, Mihalko SL. Physical activity and quality of life in older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*. 2001; 56(suppl 2):23–35.
- Rogers, EM. *Diffusion of innovations*. 5th. New York, NY: Free Press; 2003.
- Son J, Park M, Park BB. The effect of age, gender and roadway environment on the acceptance and effectiveness of Advanced Driver Assistance Systems. *Transportation Research Part F: Traffic Psychology and Behaviour*. 2015; 31:12–24.
- Tudor-Locke C, Craig CL, Aoyagi Y, Bell RC, Croteau KA, De Bourdeaudhuij I, et al. Lutes LD. How many steps/day are enough? For older adults and special populations. *International Journal of Behavioral Nutrition and Physical Activity*. 2011; 8(1):80. [PubMed: 21798044]
- United Nations: The Population Division of the Department of Economic and Social Affairs. *World Population Ageing 2013*. 2013. Retrieved June 15, 2014 from <http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf>
- Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*. 2000; 46(2):186–204.
- Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. *MIS Quarterly*. 2003; 27(3):425–478.
- Venkatesh V, Thong JY, Xu X. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly*. 2012; 36(1):157–178.
- Wallston KA, Wallston BS, DeVellis R. Development of the multidimensional health locus of control (MHLC) scales. *Health Education & Behavior*. 1978; 6(1):160–170.

Figure 1.
[Myfitnesspal.com](https://www.myfitnesspal.com) is an example of a free activity tracker.

2a Fitbit One (<http://www.pcmag.com/article2/0,2817,2411271,00.asp>)

2b. www.Fitbit.com

Figure 2.

The Fitbit One is an example of an activity tracker that includes both a wearable device and a website.

Figure 3.

Dislikes codes used twice or more during the final interview. Seventy dislikes were coded over 22 responses - some dislikes were mentioned answering "What did you like about this technology?" Dislike codes that were only used once included: Does not Support Wellness Management, Doesn't Support Daily Life, Doing It, Inconvenience, Internet or Computer Based, Other, Something to Do, and Broken System.

Figure 4.

Likes reported by participants in the final interviews. Fifty-eight likes were coded over 15 responses. One participant only stated "I just don't know" for the likes question. Only codes with at least two responses are presented here. Like codes that only received one response were Accuracy, Graphs, Helpful, Other, Puzzle-like, Supports Wellness Management, and Website.

Figure 5.

Benefits mentioned at least twice in the final interviews. Twenty-nine benefits were mentioned across 14 segments in response to “What were the benefits to you for using this technology over the past weeks?” and 34 benefits were mentioned in 15 participant responses to “How do you think other adults your age would benefit from using this technology?” because some participants stated the activity trackers had not benefited them or were unsure how it could benefit others. The following codes had one response to the benefits to yourself question: Helped With Sleep, Helped With Exercise, Graphs, Memory Aid, Convenience, and Awareness About Sleep. The following codes had one response to the benefits to other questions: Awareness About Exercise, Helped Meet Goals, Learned About Wellness.

Table 1
Results of Heuristic Evaluations of Myfitnesspal.com and the Fitbit One

Heuristic	Violation	Activity Tracker	Example	Potential User Difficulties
Consistency and Standards	Used the same coloring of the website's features for advertisements or premium service links	Fitbit.com	--Some small blue links for logging additional measurements (e.g., weight) opened up additional free boxes for users to type in data. --Other small blue links for adding a new measurement (e.g., glucose) did not allow the user to enter in more boxes, and rather prompted the user to purchase a premium service.	--May make it difficult for users to discriminate services that are part of the activity tracker and those that are not. --May cause users to end up on pages they did not want to be on.
		Myfitnesspal.com	--Some advertisements along the banners of the website were in similar colors to those of Myfitnesspal.com (orange and blue). --Links to "Related Ads" were in the themed colors of orange and blue.	
	Color meaning changed across graphs	Fitbit.com	--Progress graphs on the dashboard did not use the same colors consistently on all graphs.	--Having to learn new associations may make reading multiple graphs more challenging.
	Dropdown data entry menus were inconsistently available	Myfitnesspal.com	--On some log pages such as EXERCISE \database a dropdown menu was provided to add exercise. --On other log pages, such as EXERCISE \ExerciseDiary \AddExercise, the user's only option was to start typing in an exercise to search.	--May make it difficult for users to know how to enter data, as they must learn different methods for each page.
Consistency and Standards and Visibility of System Status	Inconsistent navigation bars	Myfitnesspal.com	--The typical navigation bar used throughout the rest of the user's account was replaced by a novel and unique navigation bar upon clicking on the "MyBlog" page.	--Novel navigation bars are an unnecessary, second navigation system that the user must learn to use efficiently, and may be confused with the primary navigation system.
		Fitbit.com	--On Fitbit.com , when the user went to the help page, the navigation bar completely disappears.	--The elimination of a consistent navigation can make it difficult to know where a user is on the website, if a user is still logged in, and how to get back to the user's logs.
Visibility of System Status	Battery life of device was not visible of the device	Fitbit One (device)	--The user could only view battery life of the device when it was either plugged into the	--Could make it difficult for new users to know when to recharge.

Heuristic	Violation	Activity Tracker	Example	Potential User Difficulties
			computer or when the user was on the website. --The user could not view battery life levels on the technology otherwise (e.g., when on-person).	
Visibility of System Status and Error Prevention	Device sensitivity setting, which impacts log accuracy, was not obviously communicated	Fitbit.com and Fitbit One (device)	--Inaccuracies of the device's automatic step and sleep logging could have been improved by adjusting sensitivity settings. Sensitivity settings were not prominent because they were not viewable on device or across the website (e.g., the heading). --Sensitive settings were only viewable online under Settings/Device. --Users were not introduced to the sensitivity setting to check accuracy during their first few steps.	--Users may not be aware if the device is in a certain sensitive state and that adjusting that state could prevent errors in automatic step and sleep tracking.
Error Prevention	Unlabeled delete icons	Myfitnesspal.com	--On several logs, to remove an entry a user could hit the delete key, which was a small red circle with a horizontal white line. Although multiple delete symbols may exist in the user's knowledge (for example x's and trash cans), the small red circle was not labeled. --No confirmation message appeared upon clicking the icon to ask the user if he or she was certain that the entry should be deleted.	--Users may accidentally delete logs by not knowing what the icon does, especially when learning how to use the technology.

Table 2
Technology Experience Profile and Technology Opinions Questionnaire Data Collapsed Across Activity Trackers (n=16)

		<i>M</i>	<i>SD</i>	range	<i>t</i> -test
Technology Experience Profile	General technology breadth	23.06	4.92	12-32	
	Technology use frequency	1.57	0.42	.83-2.47	
Intention to Use	Pre	5.65	0.80	4.00-6.70	ns
	Post	5.23	1.75	2.00-7.00	
Perceived Ease Of Use	Pre	5.68	0.81	3.50-4.67	ns
	Post	5.61	1.03	3.50-7.00	
Perceived Usefulness	Pre	5.41	0.95	3.50-6.67	ns
	Post	4.96	1.08	2.00-6.33	

Table 3
Examples of Activity Tracker Related Comments From Diaries

Activity Tracker	Question	Representative Comments	Code	Classification
Fitbit One	Thoughts and experiences	"I really think the Fitbit should be waterproof! That way it could be used during water aerobics to measure movements and the heart rate."	Negative	PU
Fitbit One	Difficulties	"Since I do cook (somewhat) at home, it takes a while to enter the new food and its calories, etc. into the new foods log..."	Negative	PEOU
Myfitnesspal.com	Difficulties	"Having a difficult time adding food and exercise without going out of the program and reentering information."	Negative	PEOU
Fitbit One	New things learned	"I found that there are many questions that can be answered in the program "help" (how to) section."	Positive	PEOU
Myfitnesspal.com	Thoughts and experiences	"I can see progress on choosing better types of food, also amounts. This has resulted in less snacking."	Positive	PU

Table 4
Possible Training and Deployment Interventions For Older Adults To Increase Their
Perceived Value of Activity Tracking Wellness Management Technologies

Perceived Value Element	Intervention
Decrease reliability costs by improving accuracy on the automatic tracking devices	The first few times a user views a sleep or step log, inform the users on that log page that if the numbers look wrong, sensitivity setting adjustments can help improve accuracy, and direct the user to those settings.
Decrease time and effort costs by improving navigation	In an initial start-up video, show users that the navigation bar changes in certain contexts and where they can always click to return to their homepage.
Decrease time and effort costs when adding to the food tracker log	An introductory video should guide users step-by-step, through adding a food, deleting accidental errors without restarting the log anew, entering a unique food, and reusing frequently consumed foods. This video could be available for reference when users add their first entries for users to follow along with in real time.
Decrease learning costs and increase potential uses by gradually easing users into the format and into less commonly explored features	Ease users into learning the many different trackers and settings. For example, for the first few days of logging in, new videos or pop-up labels could explain features, starting with the most important on the first days and continuing with less critical features on later days (e.g., first activities and foods, then custom trackers, then greeting changes).
Increase personal benefits by improving communication of usefulness with older adults	Include older adults in advertisements and market on media streams older adults frequently encounter. Explain how older adults can personally benefit. For example, for older adults monitoring diet intake (e.g., sodium or sugar), explain that the calorie tracker also records nutritional values.
Decrease financial costs and make benefits more tangible	Allow free trial-use periods, enabling older adults to know that they will like the technology prior to buying and enabling older adults to experience the benefits for themselves.