EVALUATING ACTIVITY AND SLEEP TRACKING TECHNOLOGIES FOR OLDER ADULTS

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EVALUATING ACTIVITY AND SLEEP TRACKING TECHNOLOGIES FOR OLDER ADULTS

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SUMMARY

There are currently over 99 million citizens in the United States who are age 50 and older. Many of these older adults are interested in independently maintaining their mental and physical well-being. There are various technologies such as activity and sleep tracking technologies that can help the growing population maintain their health independently. The purpose of this study was to understand user interactions and opinions from an older adult sample (age 50 and older) regarding the ease of use and personal value of seven different activity and sleep tracking technologies. Ninety-two participants used one of the following devices: Fitbit Charge, Misfit Flash, Withings Pulse O_2, Withings Activité Pop, Spire, Jawbone UP24, or LumoLift during the study. Over the course of six weeks, participants used the device and documented their use through diary entries. The study concluded with an interview to understand the overall experience as well as the users' specific likes and dislikes of the technology. Participants completed additional questionnaires to document their technology experience and opinions, exercise motivation, self-efficacy, and locus of control. Overall, 77% of the participants felt that activity and sleep tracking technologies they were assigned were useful or could be useful. Seventy-one percent became more aware of their activity and sleep patterns with 46% stating they actually became more active, slept better, or at more healthily because of the tracker. However, 55% of users found perceived inaccuracy of data to be the largest frustration with the technology and also faced challenges when it came to finding and reading the instructions and wearing the devices. The results of this study focus on several different features of activity and sleep tracking technologies and how they can be improved to help older adults independently monitor their health.

CHAPTER 1

INTRODUCTION

Technology that is suited for the aging population is becoming more relevant than ever (Ortman & Hogan, 2014). Activity and sleep tracking devices are some of these newly developing technologies that have many functions, including the ability to record and display the number of steps a user takes in a day, the hours of sleep a user gets at night, and even monitor a user's changing moods and emotions. These devices are quickly coming to market and can help older adults maintain a wide variety of their medical and health needs (Ghosh, et al., 2014).

There are currently more than 99 million citizens in the United States who are age 50 and older ("Statistics and Facts," n.d.) and studies show that many of these older adults have expressed interest in technologies and devices that can help them maintain their physical and mental well-being (Chen & Chan, 2011). There are a growing number of technological devices including activity and sleep tracking technologies that can help with self-management of their health. However, the effectiveness and user-friendliness of these products needs to be further investigated as these devices offer promise for improving health and fitness but have not been widely studied in older adults (Mercer, et al., 2016).

Previous research shows that older adults liked technologies with easy-to-use interfaces and components and typically only used or bought a technology when there was a clear value to the product (Chen & Chan, 2011). Older adults also expressed

interest in technology that showed personal benefits or was personalized for their lifestyles (Fausset, et al., 2013).

In a research study conducted by Fausset et al. (2013), eight participants were assigned one of four activity-tracking technologies: Striiv, Fitbit®, Nike+ FuelBand, and MyFitnessPal.com. The study ran over the course of two weeks and was designed to better understand the attitudes of older adults towards the devices. More than half of the participants (n =5) stated that they would not continue using the device because they did not provide personal benefits and were not personalized to their lifestyles. A study conducted with 30 participants supported the previous ideas including that the aging population more willingly adopts technology when it is useful and easy to use (Heinz, et al., 2013).

The goal of this study was to explore the ease of use and personal value that older adults find in seven different activity and sleep trackers currently on the market. This study examined the process of using an activity tracker from start to finish over the course of two weeks including the set-up, instructions, daily use, perceived data accuracy, sleep monitoring, and comfort. The collection of this data can help inform future device designs and make them more usable and valuable for older adults that wish to independently maintain their health.

CHAPTER 2

LITERATURE REVIEW

The United States' older adult population is growing, with an expected 20% increase in citizens age 65 or older in the next fifteen years (A Profile of Older Americans, 2012). Thus, technology that is suited for the aging population is becoming more relevant than ever (Ortman & Hogan, 2014). Studies show that many older adults have expressed interest in technologies and devices that would help them maintain their physical and mental well-being and provide additional safety and security (Heinz et al., 2013; Chen & Chan, 2011). Several emerging technologies, including activity tracking devices, have the potential to help the aging population in the maintenance of their mental and physical well-being as well as independence in their homes (Chen & Chan, 2011).

Technological devices, including activity-trackers, have been found to induce both positive and negative reactions from the aging population. Some of these positive reactions include that technology increases efficiency when completing tasks and makes communication with friends and family easier (Fausset, Harley, Farmer, & Fain, 2013). However, even though there are many positive attributes of technological devices, many older adults are skeptical about adopting new technologies as they were attributed to the loss of human contact and identity theft. Older adults liked technologies with easy interfaces and components (Chen & Chan, 2011) and typically only used or bought the technology when there was a clear value to the product and personal relevance in use (Chen & Chan, 2011). The current study looked at older adult's opinions on the assigned

activity trackers to find what is important and relevant to them and their lifestyles to help future designs improve upon or incorporate these features.

In a research study conducted by Fausset et al. (2013), eight participants were assigned one of four activity-tracking technologies: Striiv, Fitbit®, Nike+ FuelBand, and MyFitnessPal.com. The study ran over the course of two weeks and was designed to better understand the attitudes of older adults towards the devices. It was found that more than half of the participants (n=5) stated that they would not continue using the device. From this study, it was found that devices intended for use by older adults should provide personal benefits and be personalized to their lifestyles. Providing personal benefits is important in activity tracking technologies as many older adults are looking for accurate and reliable data so that they can help improve or maintain their health.

The results from a study conducted with 30 participants were consistent with previous studies' results the ideas in previous studies including that the aging population more willingly adopts technology when it is useful and easy to use (Heinz, et al., 2013). It also touched on the negative aspects of new technology such as a dependence on technology and a decline in human contact (Heinz, et al., 2013). This study suggests that making technologies such as activity trackers easy to use increases the likelihood of the older population using these technologies in their daily lives.

CHAPTER 3

METHODS

A total of 92 participants were enrolled in this study including 39 men and 53 women (Table 1). Participants in this study had to be over the age of 50, fluent in English, and have an Internet accessible computer, tablet, or smartphone. The participants in this study were recruited through the HomeLab database, a database of adults aged 50 and over from different counties in Georgia. Additional participants were recruited through email and word of mouth. Recruitment and appointment scheduling was done through phone calls and email.

Table 1
Number of Female and Male Users per Device

Device	Female	Male	Total
Fitbit Charge	7	6	13
Jawbone UP24	8	6	14
LumoLift	8	5	13
Misfit Flash	6	6	12
Spire	6	5	11
Withings Pulse O_2	12	6	18
Withings Activité Pop	6	5	11
Total	53	39	92

The average age of the participants was 65 years old (*SD* = 8.5; range = 50-89). Each participant was assigned one of the following activity tracking devices (Table 2): the Fitbit Charge, the Jawbone UP24, the LumoLift, the Misfit Flash, the Spire, the Withings Pulse O_2, or the Withings Activité Pop. The activity trackers provided feedback on daily activity and sleep patterns and some provided additional information such as

calories burned, posture reminders, and feedback to motivate the participants to reach their goals.

Table 2
Activity and Sleep Tracking Devices

Device	Wearing Method	Tracking Capabilities
 Fitbit Charge	Wrist	Steps, distance, calories burned, length and quality of sleep
 Jawbone UP24	Wrist	Steps, activity intensity, sleep
 LumoLift	Magnetic clip-on	Steps, posture, distance, calories burned
 Misfit Flash	Wrist, clip-on, pocket	Steps, distance, calories burned, quality of sleep
 Spire	Clip -on	Steps, calories burned
 Withings Pulse O_2	Wrist, clip-on, pocket	Steps, distance, calories burned, heart rate, sleep
 Withings Activité Pop	Wrist	Steps, calories burned, sleep

The study consisted of an initial interview, six weeks of individual activity tracker use, and a final interview. The interviews were conducted in the participant's homes and the initial and final interviews were filmed with the consent of the participant.

Before the initial interview, each participant completed a pre-evaluation questionnaire. The pre-evaluation questionnaire included Background and Health Information, Technology Experience Profile, Self-Efficacy for Health Management, Locus of Control, Exercise Motivation, and Technology Opinions questionnaires. These questionnaires were completed to understand the experiences participants previously had with technology, how well they believed they could maintain their health, and what motivated them to exercise.

During the initial interview, demographic information was collected and an arthritis assessment was completed. Before setting up the device, the participants responded to open-ended questions regarding their past experience with activity trackers. Then participants were asked to open the packaging and provide open-ended feedback on the process of opening the packaging and their initial thoughts on the device. Next, the participants walked through the set up of the assigned activity tracker. Participants went through the setup of the device, including opening the packaging and connecting the device to their personal technology, and completed a post-set up questionnaire in which they ranked six statements about the overall set up process and their feelings moving forward with the device. They were then asked additional questions about putting on, removing, charging, and using the instructions provided with the device.

The participants were asked to wear the devices for six weeks while completing their daily activities. During these six weeks, participants filled out a diary about their experiences. For the first week, they completed daily diary entries and for the last five weeks they completed weekly entries. These entries included overall experience ratings from very frustrating to very delightful and ease of use ratings from very difficult to very easy. There were also spaces to leave any additional comments they had about using the device.

The final session included an interview and a questionnaire packet that addressed topics such as the participant's satisfaction with the tracker, the desirability of the tracker, the aesthetics of the tracker, and the convenience of the tracker. The desirability questionnaire required the participants to rate how desirable certain characteristics of activity trackers are to them on a scale of not at all desirable to extremely desirable. The satisfaction questionnaire required the participants to rate how satisfied they were with each characteristic of the assigned tracker on a scale of not at all satisfied to extremely satisfied. The final interview consisted of questions related to the participant's general sentiment and value of the device, their behavioral changes due to the use of the device, the comfort and aesthetics of the device, and the convenience of the device. The participants were asked to recomplete the Self-Efficacy for Health Management, Locus of Control, Exercise Motivation, and Activity Tracking Technology Opinions questionnaires at the final session. Each participant was compensated $30 for the first appointment and $70 for the final appointment.

This research study was designed to be qualitative, so no statistical significance between participants was tested and no G-power test was conducted to determine the sample size. Originally the study was going to look at only 5 different activity trackers with 5 people from each age range for three age ranges, so a minimum of 75 participants was needed. However, due to incompatibility with some of the participant's devices and the addition of new devices during the study, there were groups that had more members than others.

Quantitative analysis was conducted on the completed questionnaires and the ranking scales. When participants were asked to rank their experiences on a scale, either the frequency of the selected rankings or the mean of the selected rankings was computed. Qualitative data analysis was conducted on the diary entries and the open-ended interview questions from both the initial and final visits by compiling, reviewing, and finding the frequency of participant's answers.

CHAPTER 4

RESULTS

At the end of this study, 77% of the participants stated in the interview that the assigned activity and sleep tracking technologies were useful or could be useful. Seventy-one percent were made more aware of their normal activity and sleep patterns as well as their activity levels at any time during the day. Forty-five percent of participants stated having increased motivation to live healthier lifestyles, while 46% stated that they actually became more active, slept better, or ate more healthily. At the final interview, 42% of the group said that they planned to continue using a similar device in the future.

Some of the features that participants enjoyed when using the devices included knowing more about their activity and sleep patterns on a daily basis, receiving motivating feedback regarding progress towards their goals from the device, and the ease of use of the devices. The four most common areas that participants experienced problems with the devices were the instructions, wearing the device, data inaccuracies, and improperly functioning devices.

Instructions and Set-Up

Set- up of the device included downloading the activity and sleep tracking technology app to the participants smartphone, tablet, or computer, creating a user profile, and syncing the device to the participant's personal technology. The participants were asked questions about the tasks of the set-up that they found to be difficult or confusing. They also ranked the ease of use of setting up the app from not at all easy to extremely easy and ranked the overall set up process from very difficult to very easy.

Eighty-nine percent of all participants ranked the set up process as being difficult and 81% of participants 70+ weren't able to set up the trackers without the help of a researcher. Figure 1 shows the set-up difficulty per age group.

The first thing that 29% of participants did was search for paper instructions. Thirty-nine percent had a hard time finding the instructions, especially when they were not in plain sight. People reported that the information in the instructions was incomplete and hard to follow making it difficult for participants to find and use all of the features of the technology.

Seventy – eight percent stated in their interviews that the font size used in the instruction booklet was too small. It was reported that some of the apps included unfamiliar words and symbols on a low contrast and small screen making the instructions difficult to follow.

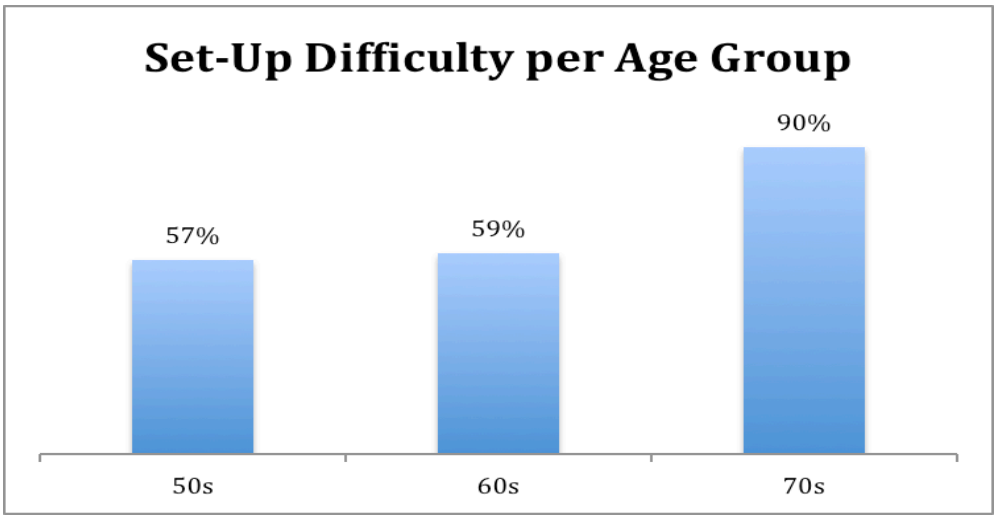

Figure 1. Set-Up difficulty per age group. Set-up difficulty was based on researcher observations during the user's set-up and the user's ability to complete set-up without the help of the researcher. It was found that users in their 70s were the most likely to have a difficult time initially setting up the devices while users in their 50s were the least likely to have a difficult time initially setting up the devices.

Some of the easy set up features were taking off the device, charging the device, and turning the device on and off. Figure 2 shows how participants rated different set-up functions of the devices.

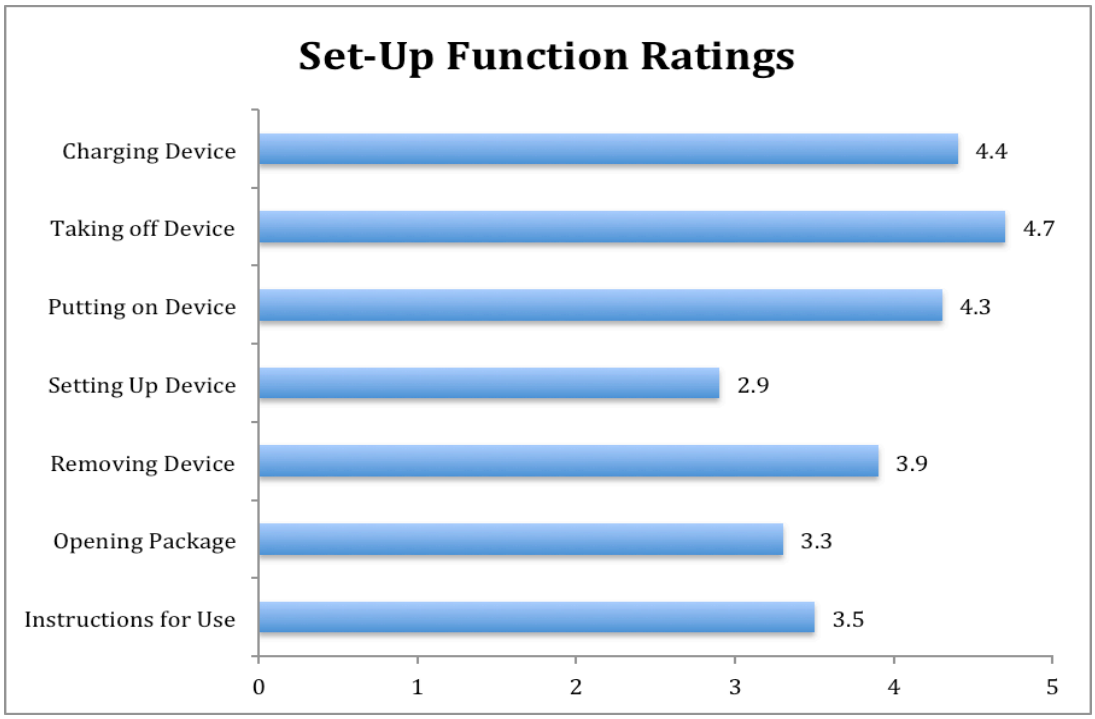

Figure 2. Set-Up Function Ratings. Participants in the study rated different set-up functions on a scale of 1 to 5 with 1 meaning not at all easy, 3 meaning moderately easy, and 5 meaning extremely easy. The top two easiest set-up functions included charging the device and taking off the device while the two most difficult set-up functions included opening the package and setting up the device.

Final Data Collection

The following data was collected after the participants used their device for 6 weeks.

Perceived Data Inaccuracy

The number one frustration of participants was the seeming inaccuracy of the data being supplied by the activity and sleep trackers. Fifty-five percent of the users didn't trust that the data was accurate and wanted to learn more about how the data was being collected. For many participants, the data did not reflect what was expected. There were

also activities that the trackers wouldn't account for including swimming and cycling. Some participants stated that the device would get different reports for the same activity or the device and app wouldn't have the same readings.

Another issue that participants faced was synchronizing the device with their personal electronic devices. Forty-seven percent of the group had times where they weren't sure if data was collecting because of unreliable connections between the device and their smartphones, tablets, and/or computer.

Sleep Tracking

Only 45 participants had trackers that were capable of monitoring sleep. Of those 45 people, 40% monitored their sleep for the entire study. There were 10 people that liked the sleep monitoring feature the most and 8 people reported positively changing their sleep habits during the study.

Comfort

Over 33% of the users found the devices to be uncomfortable for daily wear. Thirty-four stated that the discomfort came from the band's rigidity, fit, and pieces that would irritate the skin. Participants with trackers that clipped on to their clothing stated discomfort and also skin irritation. The participants also mentioned that they want trackers that fit their own styles and fashion senses.

Long Term Use

Over the course of the study, 13% of people age 50-59, 22% of people age 60-69, and 43% of people age 70+ quit using the devices earlier than six weeks. The average

time that participants continued to wear their devices was 32 of the 42 days that they were expected to wear the device. Most of the time the users that quit within 14 days were in the 70+ age group. Some of the reasons people quit early included discomfort when wearing the device or finding that the device didn't serve a purpose. Others quit using the device because they didn't believe they were receiving accurate information, they had issues using the app, or they couldn't sync the device.

The number of consistent users, users that used the device for the majority of the study, per age group is shown in Figure 3 and the number of early quitters, users that stopped using the device within 14 days, per age group is shown in Figure 4.

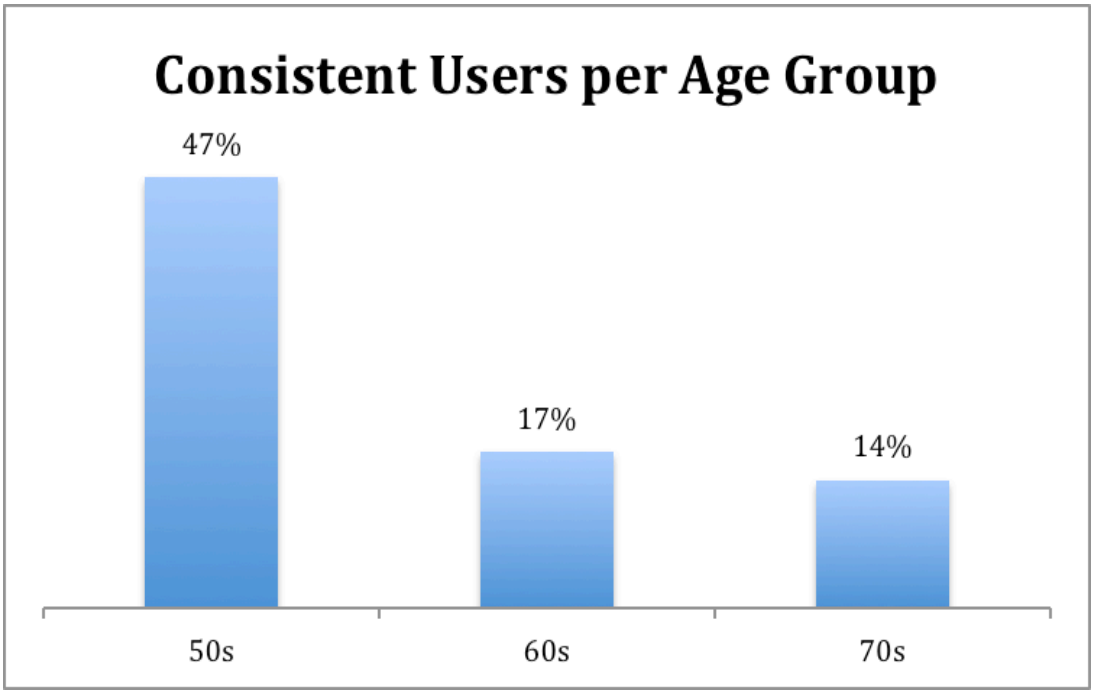

Figure 3. Consistent device users per age group. This study consisted of three different age ranges -50s, 60s, and 70s. Consistent device users were those that used the device for the majority of the study. It was found that the most consistent device users were in their 50s and the least consistent device users were in their 70s.

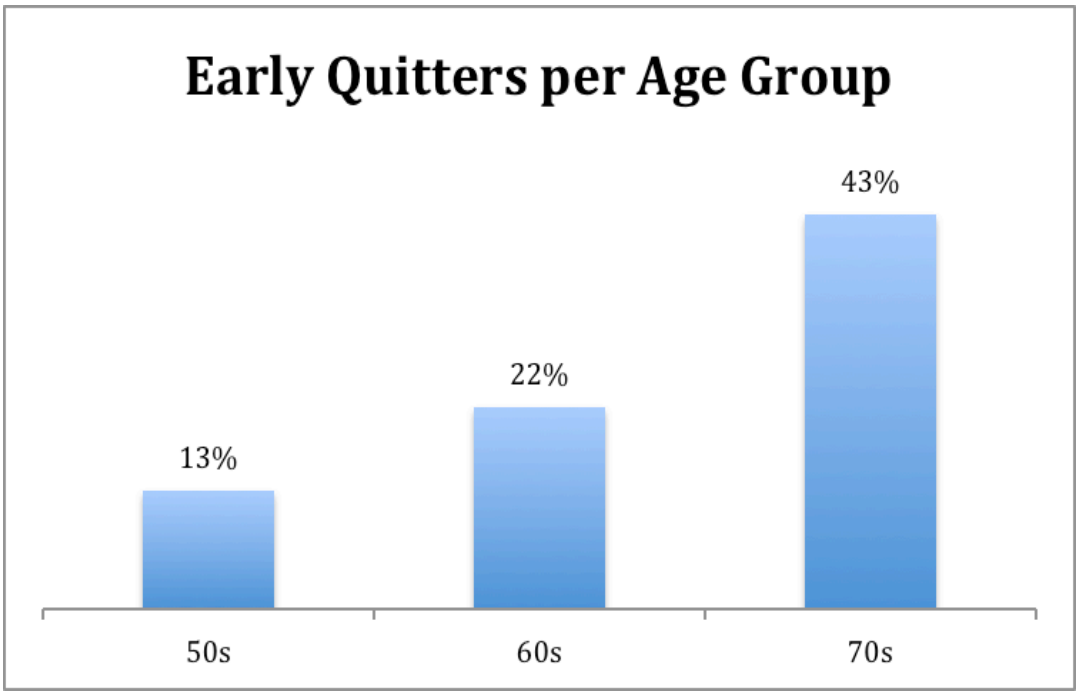

Figure 4. Early quitters per age group. Early quitters were users that stopped using the device within 14 days. It was found that users in their 70s were the most likely to quit using the device early while people in their 50s were less likely to quit using the device early.

CHAPTER 5

DISCUSSION

Seventy-seven percent of the participants in the study found the activity and sleep trackers to either be useful or have the potential to be useful and 46% of the participants altered their activity, sleeping, or eating habits based on the information from their trackers.

The results show that the population most likely to use the devices consistently are those in the 50-59 year age range, while those 70+ were the most likely to use the devices inconsistently and/or quit using the device altogether. Participants in the 70+ age group also had the most difficulty setting up the device: 81% were not able to complete set up without the help of the researcher. These results suggest that activity and sleep tracking technologies may not be user friendly for older adults age 70+.

The most common issue among the devices was perceived inaccuracy in the data; more than half of the participants claiming they had no trust in the accuracy of the data they received. Another common issue was the comfort of the device. Over 33% of the users reported that the devices were uncomfortable to wear stating issues such as the band's size and inflexibility. As devices continue to develop, companies should focus on making devices that are more accurate, reliable, and comfortable.

The results found from this study have pinpointed areas of activity and sleep tracking technology that need to be improved for users in the 50+ age range. Many changes to these devices including targeting them to health goals of the 50+ population, making them easier to set up, making them more comfortable, and including more

understandable instructions with larger font could increase the different tracker's ease of use in the older adult population. Using these devices can help older adults make informed, healthy decisions about their activity, sleep, and eating habits. Creating healthier lifestyles with the help of the activity and sleep trackers could help older adults manage or prevent chronic conditions.

Limitations of this study included device compatibility and the lack of geographically diverse participants. Participants without the correct technology were either not able to participate in the study or were limited to using specific devices. The users in the study were recruited only from counties in Atlanta. Thus, the lack of participants from other regions of the state and country in the study could present problems regarding the desires of the users.

Future work may want to investigate additional devices or look at the current activity tracking devices as they change over time. There are other activity tracking devices including the Garmin Vivoactive HR, Under Armour band, Microsoft Band, Moov Now, and many more that could be tested in future studies. Additionally, revisiting the activity trackers used in the current study as they improve may be a worthwhile future study.

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