# "*I shy away from them because they are very identifiable*": A qualitative study exploring user and non-user's perceptions of wearable activity trackers

Katie Burford[1] (iD), Natalie M Golaszewski[2] and John Bartholomew[3]

## Abstract

**Objective:** Wearable activity trackers hold potential as a research tool to increase physical activity. However, long-term wearable adherence is low among users, which may be due to the limited understanding of the factors related to use and relation to health behavior theory. The purpose of this study was to qualitatively explore the perceptions of wearables among active adult users and non-users. Findings will inform potential barriers and facilitators for the adherence and adoption of wearables through the application of the Self-Determination Theory.

**Methods:** Six focus groups were conducted and equally stratified to wearable users ($n = 10$) and non-users ($n = 10$). Data were audio recorded, transcribed, and analyzed using an iterative approach creating first-level codes. This was followed by developing second-level codes that allowed for generating themes.

**Results:** For users, the wearables' feedback provided them with validation, a sense of achievement, and other-determined motivation. Users appreciated the functionality of wearables, particularly with simpler and newer models. They also reported improvements in health behaviors. While both users and non-users had a general positive feeling towards wearables, they held similar concerns about cost, guilt, dependency, and accuracy. Non-users were unique in their concerns for materialism and functionality (i.e. ease of use and charge) associated with wearables. They also seemed to be more intrinsically motivated to be physically active by relying less on external sources of motivation as potentially provided by wearables.

**Conclusions:** Findings show that while both adult users and non-users held positive perceptions of wearables and concerns for feelings of guilt and dependency, widespread adoption and adherence may be prevented by differences in motivation for physical activity and concerns for cost, materialism, and functionality.

## Keywords

Digital health, wearables, physical activity, qualitative, exercise, device

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## Introduction

Physical inactivity is the fourth leading cause of death worldwide.[1] This can be attributed to physical inactivity being a strong risk factor for prevalent non-communicable conditions including cardiovascular disease, type 2 diabetes, and breast and colon cancers.[2] In addition to these health consequences, physical inactivity has led to a costly $67.5 billion international dollars to the health care

[1]Michael Susan Dell Center for Healthy Living, The University of Texas Health Science Center at Houston School of Public Health in Austin, Austin, TX, United States
[2]Herbert Wertheim School of Public Health and Human Longevity Science, University of California, San Diego, CA, United States
[3]Department of Kinesiology and Health Education, The University of Texas at Austin, Austin, TX, United States

**Corresponding author:**
Katie Burford, Michael Susan Dell Center for Healthy Living, The University of Texas Health Science Center at Houston School of Public Health in Austin, 1616 Guadalupe St, Suite 6.300, Austin, TX 78701, USA.
Email: Kathryn.Burford@uth.tmc.edu

system.[3] While more countries have implemented physical activity policies to address these pressing concerns, physical activity has yet to improve worldwide.[4] There is a need for scalable, cost-effective, and population-level strategies to promote physical activity.[5] The wearable activity tracker technology has the potential to support physical activity among a wide audience.

Wearable activity trackers have become an increasingly popular market force in the United States. As of 2019, an estimated 34% of Americans reported they had worn a wearable, with an estimated 19% of Americans actively using a wearable and 15% formerly using a device.[6] The wearable industry was valued at $32.63 billion U.S. dollars in 2019 and this valuation is projected to continue growing, particularly among wrist-worn products.[7,8] The popularity of wearables lies in allowing consumers to track real time physical activity typically assessed using accelerometers, energy expenditure, heart rate, and other activity-related measures using sensors.[9,10] Evidence confirming the validity and reliability of these outcomes is growing, although the level of validity tends to depend on the product type and metric.[11–13] In addition to providing objective feedback, wearables employ a wide range of evidence-based behavior change techniques and constructs to encourage use that tend to vary across devices.[14] Most wearable trackers allow users to self-monitor and self-regulate activity-related behaviors, obtain objective feedback, and support goal setting.[15,16]

Despite their promise, there is limited long-term adherence among users.[17,18] In a recent survey, authors found that among 6223 individuals who purchased a wearable, more than half stopped using their wearable and one-third stopped after just 6 months.[18] One review of 5 studies confirmed similar adherence issues in health interventions to monitor and manage participants' weight, with only three studies reporting long-term (18 months or more) retention to using wearable trackers.[19] Furthermore, there were no significant differences in physical activity and weight loss outcomes between the wearable technology intervention groups and control groups, which was likely attributable to the low retention in wearable device use overtime.[19]

The decline in wearable use overtime among the general population and within behavior change interventions might stem from the limited number of studies that have sought to determine through which mechanisms wearables might facilitate lasting behavior change.[20] To address this gap, components of the Self-Determination Theory (SDT) could be used to understand differences in type of motivation for physical activity that may influence device adoption and adherence.[21] The SDT has been used as a framework to understand and influence sustained physical activity participation.[22] SDT proposes that a person's motivational state falls along a continuum of motivation from amotivation to intrinsic motivation, which is dependent on three psychological needs autonomy, relatedness, and competence.[22,23]

Autonomy is the need to have choice over one's behaviors. Relatedness is the need for connection with others. Competence is the need to improve and master a skill or ability in a behavior domain such as physical activity.[21] Intrinsically motivated behavior depends on all three needs being met and is thought to occur when an individual engages in an activity because they enjoy it. The next level on the continuum is self-determined extrinsic motivation, which exists when a behavior is freely chosen to obtain a valued outcome such as for fitness or to lose weight. Other-determined extrinsic motivation exists when the behavior occurs due to guilt, fear, or reward. And lastly, amotivation exists when an individual lacks any motivation for the behavior at all.[22] Thus it may be that wearable device adoption and maintenance is dependent on how effectively it satisfies autonomy, relatedness, and competence to motivate physical activity and the existing motivational state of the user towards engaging in physical activity. Quantitative research has shown that incorporating features into wearables that encourage autonomy, competence, and relatedness was related to greater device use and desire for continued use.[24,25] To our knowledge, only one existing study applied SDT within a qualitative study design to understand adult's perceptions of wearable technology, which was limited to current and former users. The inclusion of active adults and non-users may provide unique insights into the maintenance of using a wearable and the influence of varying motivational states on device use.

The few existing qualitative studies to understand wearable use have focused primarily on select groups including clinical populations, truck drivers, older adults, and wearable users with only two of these studies tying participant responses to health behavior theory.[26–34] Findings from these studies revealed that wearable users endorsed a number of aspects of the wearable experience including: accountability, awareness, self-monitoring, the option to set goals, social interaction through sharing data, and competition.[19–22] Furthermore, Kononova and colleagues were the only researchers who considered the opinions of non-users and why they might forsake wearables through the application of the transtheoretical model of behavior change.[28] The researchers found that functionality, lack of knowledge, and skepticism regarding accuracy of wearables were barriers to adoption and use for older adult non-users and former wearable users.[28] Interestingly, similar barriers were found for both older adult short-term users and long-term users of wearable activity monitors. We know of no study that considered the perceptions of active adults who have not chosen to use wearables or considered their barriers to wearable use. As the application of any intervention component requires understanding of potential facilitators and barriers, this is a critical gap in the literature.

It is likely that wearable-based intervention research would benefit from foundational work that pursues the

application of the SDT to participant responses and the general perceptions of trackers from physically active users and non-users. This would inform the implementation of wearables as a component of digital behavior change interventions. Given the low sustainability of wearable use, a successful intervention will need to address potentially negative perceptions that serve as barriers to continued use of these wearables.[18] On the other hand, understanding potential factors that facilitate the use of wearables will also inform success of interventions.[19] As this kind of preliminary data benefits from participant-driven responses, the purpose of this study was to qualitatively explore perceptions towards wearable activity trackers among active adult users and non-users.

## Methods

### Participants and recruitment

Upon approval from The University of Texas at Austin Institutional Review Board, participants (ages 18–60 years) were recruited with flyers, recruiting emails, and listservs at The University of Texas at Austin. A total of 27 participants were initially recruited and screened. Within the screening questionnaire, participants were asked if they were wearable users or non-users, their age, race/ethnicity, sex, type of physical activity tracker they currently used, and the number of days per week they were physically active. Participants were only eligible to participate in this study if they were between 24–60 years old and able to participate in the focus group at locations in Austin, Texas. There were no other study inclusion requirements. Participants who did not provide written informed consent were also excluded from the study. There was no compensation provided to participants however, they were provided with light refreshments.

### Procedure

We conducted a total of 6 focus groups between October 2016 and February 2017 at a university campus and local gym. Two moderators (KG and NG) were present and led all focus groups. Upon arrival at the sessions, each participant was required to provide written informed consent and completed a short personal information survey (Table 1). Participants were given a randomly assigned number to maintain confidentiality of their transcript statements. The researchers used a semi-structured interview approach such that the questions asked were flexible, open-ended, and allowed for probes during conversation.[35] Each session was audio recorded and transcribed. The focus groups sessions lasted between 30–60 min in duration (see Appendix A for the list of questions).

### Data coding and analysis

Each focus group was audio recorded using Microsoft OneNote (2016). All audio files were de-identified and transcribed using NVivo (released in 2015).[36] Data were analyzed using an iterative approach.[35] The iterative approach allowed the two coders (KB and NG) to alternate between considering existing explanations and theories—used to develop our research questions—and emerging data to determine common themes. During the initial coding process, the two coders individually and independently looked for words and phrases to establish first-level codes. Then the two coders met to discuss findings, reach

**Table 1.** Participant characteristics ($n = 20$).

| Characteristic | Total sample ($n = 20$) | Non-users ($n = 10$) | Users ($n = 10$) |
|---|---|---|---|
| Age (years), M (SD) | 33.0 (9.2) | 32.5 (8.1) | 35.0 (10.4) |
| Female, n (%) | 11 (55) | 3 (30) | 8 (80) |
| Race/ethnicity, n (%) | | | |
| White | 17 (85) | 9 (90) | 8 (80) |
| African-American | 0 (0) | 0 (0) | 0 (0) |
| Asian/Pacific Islander | 3 (15) | 1 (10) | 2 (20) |
| Hispanic | 1 (5) | 0 (0) | 1 (10) |
| Physical activity per week, n (%) | | | |
| 0 days | 0 (0) | 0 (0) | 0 (0) |
| 1–2 days | 0 (0) | 0 (0) | 0 (0) |
| 3–4 days | 6 (30) | 4 (40) | 2 (20) |
| 5–6 days | 9 (45) | 3 (30) | 6 (60) |
| 7 days | 5 (25) | 3 (30) | 2 (20) |
| Wearable activity tracker, n (%) | | | |
| Fitbit | 4 (40) | 0 (0) | 4 (40) |
| Apple watch | 3 (30) | 0 (0) | 3 (30) |
| Garmin | 2 (20) | 0 (0) | 2 (20) |
| Fitbit and Garmin[1] | 1 (10) | 0 (0) | 1 (10) |

[1]One participant wore Fitbit for lifestyle and Garmin for exercise.
SD: standard deviation.

agreement, and confirm 125 first-level codes. When there was disagreement between a code, the coders discussed and re-coded the transcript data. This discussion and revision of codes ensured intercoder agreement throughout the data analysis process. After examining and organizing the first-level codes, an average of 14 second-level codes were created by identifying patterns and hierarchically coding the data to form more distinct themes. We established 12 themes, which are presented in the results section.

## Results

### Participants characteristics

The characteristics of the participants are presented in Table 1. Participants were 20 adults (24–59 years old) who were primarily female (80%) and White (80%) living in Austin, Texas. All participants were physically active, with the majority (45%) reporting activity on 5–6 days weekly. Focus groups were equally stratified by wearable activity tracker users (n = 10) or non-users (n = 10). There were three focus groups for user group (n1 = 2, n2 = 3, n3 = 5) and three focus groups for the non-user group (n4 = 3, n5 = 4, n6 = 5). Several participants reported former usage of a tracker but were assigned to the non-user group due to their current report of non-usage. Of wearable users, four used a Fitbit, two used a Garmin, three used an Apple Watch, and one used a Fitbit and Garmin (Table 1).

### General perceptions: validating, costly, inaccurate, materialistic

Wearable users typically held positive perceptions towards their wearables by discussing the accountability and validation provided by the devices. More specifically, the objective feedback (e.g. steps, heart rate, distance, calories, sleep) seemed to motivate participants to maintain consistency in their activity. Users also mentioned that they purchased their wearables for these performance indicators. The objective data made many users feel confident about their physical activity experience because they could see the results and progress:

> For anyone I think it helps them stay accountable and increase their step rate throughout the day because you have that data there.

> This gave me feedback, motivation, goals, and some tangible data about what I am really doing.

> I feel stronger. So you know not having it you can guess that you are, you think you are but then I guess it is showing wow I feel stronger. It confirms, validates.

Despite these positive feelings, several wearable users expressed a cyclical relationship between using their monitors to help achieve goals and reducing use after goals were met. Users suggested that perhaps the goal setting features are not enough to encourage long-term usage of these devices. The abandonment of devices overtime was recognized by one user who mentioned:

> At work there was that whole early adopters' disillusionment. Pretty much everyone on my team bought a watch and you kinda saw after 5 months you saw people making fun of their watches, and you saw people stop wearing their watches on the weekend, and then they stopped.

Both users and non-users were asked to describe aspects of the devices they would like to change or that prevented them from purchasing a device. Participants in both groups mentioned the cost may not be worth the benefits. Interestingly, five of the users reported that they were gifted or received their device on discount, which may have prevented cost from posing as a barrier to adoption in comparison to non-users. In addition, some wearable users were concerned that the devices were not accurate based upon their own experiences. Improving the audience's understanding of the validity of these devices and price of these trackers might encourage more use. These concerns are first stated by wearable users:

> They are pretty expensive for how much value they actually bring your life on an everyday basis

> I just want fitness to be more accurate and I don't feel like it is accurate at all.

Similarly, most non-users described wearable monitors to be costly. For example, one participant said:

> I think for the cost I don't know how much it would motivate me.

Non-wearable users held perceptions that wearables were overly responsive to popular trends, materialistic, and even inequitable as the paramount reason for resisting adoption of the technology:

> People with disposable income. People that buy things.

They even mentioned that people who wear a device might not necessarily be physically active, but want to identify as someone who uses this type of product:

> I shy away from them because they are very identifiable.

## Psychological constructs: sense of achievement, dependency, guilt, differences in motivation

Both wearable users and non-users discussed their attitudes and emotions surrounding physical activity trackers. The majority of users expressed positive emotional reactions towards their devices. Most users felt like the devices created a sense of achievement in their lives by adding to their performance, routines, and overall wellness:

> I can't right now imagine not having a tool like this

> This is really a legitimate tool helping me feel better and be able to do that and be happier and healthier to do the thing I want to do.

Wearable users did mention feelings of codependence as their device elicited added stress and a sense of guilt. The wearable became so profound in some participants' daily routines that their entire day would revolve around meeting their exercise goals. The wearables seemed to create an addictive behavior and sense of pressure in several of the participants:

> I only use it Monday through Friday because I am super concerned that on Saturday and Sunday I am not getting those steps in and I can't handle it. So it rests.

> It made or broke my day.

Non-users expressed several positive feelings toward wearables as they provide a sense of achievement and accountability. The non-users were asked to discuss their opinions of those wearing the devices. Even though participants did not see the devices directly improving their physical activity routines, they often discussed people in their lives who were more physically active and aware of their sedentary time. They also enjoyed discussing the general goal of the devices to improve movement in our population as one participant said:

> I have a positive feeling towards them because it does get people who might not otherwise have a goal. Five years ago the number 10,000 meant nothing to people so I feel like it is worth more than a fad.

On the other hand, non-users described these devices as bringing added dependency and reflecting attention seeking behaviors. Several mentioned that exercise habits cannot be sustained by technology. They did not perceive the devices as promoting a lasting, beneficial relationship with health behaviors. In addition, non-users discussed differences in motivation as a major reason for owning or not owning a device. Many of these participants were avid exercisers who were intrinsically motivated to be active each day as reflected in their reported physical activity. They did not perceive a need for an outside source of motivation because of their long-lasting relationship and existing goals with physical activity:

> I just feel like I have to workout every couple of days, it is just engraved.

## User friendliness: functionality, annoyance, inaccuracy

Wearable users seemed to find the devices easier and more enjoyable to use than non-users. However, users wore different brands of devices, leading to discrepancy in responses. Some found their models to be frustrating to use. Those with the simplest and newest devices tended to express more positive experiences with their watches.

Interestingly, there were three non-users that reported former usage of a wearable. For these non-users, there were certain flaws, such as charging the device, ease of use, and even skin irritation that that led non-users to stop using a device:

> The charge part is probably a barrier, my wife tried to start getting me to wear it again and I don't know where my charger is so it is like whatever.

Further, both users and non-users expressed skepticism towards the accuracy of the tracking features based upon their own experience. There was a particular concern with the devices overestimating the amount of activity:

> I feel like Fitbits for example you can stand there and wash the dishes and be like yay I got 10,000 steps.

Non-users thought that the data needs to be more user-friendly and suggestive of their exercise performance. In addition, more insightful information about their effort during exercise might increase motivation for activity than just step count, distance, and pace:

> Maybe if they incorporated a user-friendly step count or user-friendly graphs, something with strict training that would be influential. That would change my behavior because I would go in and push myself.

## Health benefits: health behavior change

Overall, wearable users described behavior change following use of the device. Specifically, in terms of health behavior change and sedentary change. Much of this seemed to derive from the notifications and data that led to a new

awareness for users' sleep patterns, physical activity, and sedentary time:

> Whenever I don't wear it, I am still cognizant of my activity because I have been checking it so long, I still have a general picture of what I have been doing. Definitely I am more aware.

> It was even sort of the final push to buy a new bed because I noticed that my sleep pattern, I had a really old bed, and I noticed my sleep wasn't very good and I ruled out some other things and I thought you know I really want it.

Likewise, non-users recognized the potential of the devices to encourage physical activity and prevent disease:

> It is a good healthy benefit to remember to get up and move. So anything that encourages that seems like a health benefit.

Both users and non-users supported the use of devices in the medical field as they would be helpful for providers and patients—if certain aspects were changed, including: cost, appearance, accuracy. This might be the solution to the sustainability for users:

> This is literally like a diagnostic tool who is so much nicer than seeing a doctor. I would much rather have this telling me you need to keep moving rather than having somebody go take a pill. So this is really a tool that is nagging me but helping me be more fit because my environment is changed, my body is changed and neither one of those is helping me.

## Discussion

### Principal findings

To the best of our knowledge, this is the first study to explore wearable users and non-users' experiences with wearable devices among a sample of active adults. The findings of this study revealed that wearable users felt they had improved experiences with physical activity and support for maintaining their activity by using a wearable tracker. These devices encouraged behaviors that may be due to perceptions of increased validation, feelings of achievement, awareness, and changes in motivation and behavior. Non-users also expressed positive perceptions of wearables as they were interested in the sense of achievement and potential of devices to change behavior. These benefits were outweighed by concerns, some of which were shared with users and some that were distinct. Both users and non-users expressed concerns regarding their perceptions of wearable inaccuracy, feelings of dependency and guilt, and their cost. However, non-users were unique in their perceptions of wearable monitors reflecting

materialism, issues of functionality (e.g. ease of use and charge), and motivation towards physical activity. While both groups would appreciate greater accuracy and less feelings of dependency and guilt, these concerns do not appear to be the preliminary factors in forgoing a wearable. Instead, it may be the unique factors surrounding materialism, functionality, and differences in motivation that do distinguish active non-users. As such, each of these provide a potential point of intervention to increase acceptance and adoption of wearables.

Non-users in this study were particularly concerned with the general perceptions of materialism reflected by using a wearable. Non-users viewed the devices as reflection of image and status rather than a technology that could add value to their health. Materialism is thought to be a value orientation that influences consumer behavior such as increased brand importance and consumption of products.[37] Individuals that hold strong material values may seek to impress others and achieve happiness through possessions.[37] Additionally, consumers use products, brands, and possessions to express their personalities and establish a group membership through status.[37] However, less materialistic consumers are more likely to avoid status seeking through products.[37] Thus, there may be differences in the material values held by users and non-users that influenced their adoption of wearable products. For example, as pointed out by non-users in this study, users may wear a device to identify as tech-savvy or even an "exerciser." Perhaps if wearable companies made devices more affordable, while also focusing on the purpose and utility behind using the devices, non-users might be more influenced to wear a device.[18] While this finding is unique among the qualitative literature, Chuah and colleagues also identified the materialistic image as an influence for the adoption of smartwatches among non-users.[38] Specifically, the researchers found that when participants perceived the devices as a fashion accessory, the watch's visibility was more salient to adoption intention than the ease of use of the device. However, participants who perceived the devices as a technology were more likely to adopt the devices for usefulness.[38] Future studies could further expand upon these results by measuring characteristics of consumers that may be related to their perceptions of materialism and explore how various brands of wearables influence adoption.

Functionality, a second major theme tied to non-users' responses in our study, is also a consistent barrier to wearable use in the literature. Non-users were particularly frustrated by the charging aspect of devices. Similarly, one cross-sectional study found that 70% of adult users in the sample reported functionality issues related to battery life and technical difficulties with their devices.[39] Kononova and colleagues also found that battery capacity was one of the main reasons for former older adult users to abandon their devices.[28] According to Ledger and

McCaffery, the more times a user is required to charge or take off their device, the more likely they are to abandon it.[18] Non-users also mentioned that data provided by the devices on the market at the time of the study (e.g. distance, step count, pace) were not motivating and needed to include the tracking of other activities such as rock climbing and weightlifting, especially at the cost of the devices. While users also recognized these devices were costly, this was not a barrier to adoption. However, this may be because half of the users received their wearable as a gift or at discount. In contrast, skepticism for the accuracy and validity arose as a theme from both non-users and users in our study. This also seems to be a concern for users in the existing qualitative research.[31] Improving skepticism around the accuracy of the feedback and data provided by the devices could improve utility, and in return increase the likelihood of adoption. To date, there are consistent findings that support the high validity and reliability of a few wearable measures such as step count and heart rate among some of the mainstream wearables.[11,12,40,41] However, there is lower validity for energy expenditure and discrepancies for measures persist across various products.[11,12,40,41] Without improvements to the validity and reliability of these measures, widespread adoption may be limited by consumers' desire for more functional and accurate feedback at an affordable price.

In examining responses through the lens of SDT, users and non-users expressed differences in motivational states. In our study, it seemed as though the active non-users experienced intrinsic motivation for physical activity because they tended to express genuine enjoyment for the activities that they engaged in.[21] As such, active non-users may have had no motivational use for the existing wearables, which was reflected in the unsuccessful adherence by former users in this sample. In contrast, users may have relied upon the wearables' feedback and features to provide them with a sense of achievement, validation, and awareness to be physically active. This led users to exist in a other-determined extrinsically motivated state with physical activity because their motives were tied to outcomes associated with physical activity and fostered by their device not the physical activity itself.[22] Furthermore, it may be that these extrinsic motives from the devices are facilitating a health behavior change for users into a more intrinsically motivated state with physical activity and ultimately prove to be useful as a motivator. The only qualitative study to explore motivational states of users and former users of wearables did not align with our findings.[32] The researchers found that current device users expressed no motivation to engage in physical activity from their devices but rather used them solely for visualizing data.[32] Given these differences, future studies could clarify how an individual's motivational state changes with stage of device adoption and duration of use.

Lastly, the feelings of guilt and dependency arose as themes derived from both users and non-users' responses related to psychological constructs. The feeling of guilt can be tied to the SDT, which states that when individuals participate in activity to avoid guilt, obtain a reward, or even avoid punishment this is considered other-determined extrinsic motivation.[42] This form of controlled motivation undermines maintenance of behaviors, which may lead to low adherence in behavior change interventions.[42] Thus, features of wearables that may foster feelings of guilt (e.g. notifications, quantified feedback, social comparison) may not only be limiting the long-term utility of these devices but also hinder the health benefits that these devices were intended to provide. Nuss and Li similarly found that among former users, feelings of guilt and failure arose when they did not meet their goals.[32] Additionally, Kerner and Goodyear found that adolescents who wore Fitbits for 8 weeks experienced feelings of guilt, which likely contributed to a significant increase in amotivation at the end of the intervention.[43] Likewise, the feeling of dependency may also be facilitated by wearable features that are perceived as externally rewarding (e.g. quantified feedback, gamification), which may lead to the reduction of physical activity when a tracker is not available.[44] This is known as the dependency effect, which researchers found to be strongest among participants with high extrinsic motivation for physical activity and tracker usage.[44] In contrast, individuals with high intrinsic motivation for physical activity—like the non-users in our study—showed a weak dependency on wearable device feedback for maintaining physical activity.[44] Thus, feelings of dependency are related to partcipants' motivational states for physical activity.

The principals of goal setting theory can further help to interpret participants' responses.[45] While wearables may help to encourage short-term, easily achievable goals such as increased daily step count, they may not support self-regulation to achieve long-term goals. According to Locke and Latham's goal setting theory (1990), when specific goals are too easy accomplish, they are less effective at motivating behavior than more difficult goals, such as improving fitness or weight loss.[46] Ultimately choosing easy goals, such as reaching a daily step count, may lead to device abandonment. These same constructs can be tied to SDT principals as more difficult goals reflect valued outcomes such as improved fitness and socialization that are associated with existing in the self-determined extrinsic motivation state. However, simple goals that reflect external feedback such as rewards and guilt, indicate existing in the state of other-determined extrinsic motivation. This suggests that the feedback provided by these wearables might need to be paired with a broader behavioral theory, such as SDT or goal setting theory, to support long-term physical activity, especially for use in physical activity interventions.

## Limitations

Although this study provides new conclusions about perceptions of wearables, it is not without limitations. Participants were recruited from similar contexts including the academic setting and gyms. While generalizability is not an expectation in qualitative research, this homogeneous sample may have limited the range of responses captured. While we did not capture the specific models of wearable devices, we did find that the brands of wearables varied across users (Table 1), which may impact user experience and responses. Further, duration of wear and former use of wearables, as reported by three non-users, might have influenced responses. These attributes would be important to consider in follow-up studies to better understand differences in determinants of adherence. Several wearable users mentioned changing brands overtime, which could have created different experiences. The length of wear and model type should be addressed as potential questions of interest in future qualitative studies. Furthermore, the findings of this study were limited to active adults. Thus, future studies should capture inactive participants' responses to wearable technology, as there may be differences related to the use of the devices for supporting physical activity rather than exercise and these individuals would likely be the target for behavior change interventions.

## Conclusions

Our findings are helpful for understanding those attributes that resonate most acutely with users of wearable activity trackers, and which are barriers to non-users. Wearable users and non-wearable users recognized benefits for providing a sense of achievement and supporting behavior change, but also held similar concerns for accuracy, cost, and feelings of dependency and guilt. Of particular interest were the perspectives shared by non-users. These individuals expressed concerns surrounding functionality, materialism, and differences in motivation compared to users. Addressing these barriers, while considering behavior change theory such as the SDT, might support adoption and long-term use of wearables. The perceptions of active users and non-users towards wearables informs future digital behavior change interventions and physical activity research that are built around or supplemented with wearable activity trackers.

**ORCID iD:** Katie Burford (iD) https://orcid.org/0000-0001-5500-9609

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## Appendix A

Focus group questions to explore the specific themes that include user friendliness, psychological constructs, and health benefits of physical activity trackers for both wearable and non-wearable samples.

### User friendliness

Wearable users

1. Why did you purchase your wearable?
2. How often do you use your wearable? Would you consider it to be apart of your daily routine?
3. Is your wearable easy to use?
4. Would you recommend your device to a friend? If so, what advice would you provide on how to use a wearable?
5. Are there any aspects of your wearable that you would like to change?

Non-wearable users

1. Why have you not invested in a wearable?

2. Are there certain aspects of wearables that have kept you from purchasing a device?

### Psychological constructs

Wearable users

1. How does wearing your wearable make you feel?
   1.1. Do you set goals associated with it? Do you ever have social goals or individual goals? If you achieve it, what do you do? If you fall short, what do you do?
2. When you don't wear it for a period of time, how do you feel?
3. What kind of feedback do you like that your wearable provides? What do you not like?
4. How does your wearable motivate you to exercise?
5. Do you find that your wearable makes you more physically active?

Non-wearable users

1. What kind of feelings do you associate with wearables?
2. Could you see a wearable providing you with motivation to increase your physical activity? Why don't you have one?
3. What is your perception of people wearing wearables?

### Health benefits

Wearable users

1. What are the perceived health benefits (if any) for wearing a wearable physical activity tracker?
   1.1. Probe Question: Since you've had your wearable, have you experienced any of these health benefits?
2. How has your wearable improved your daily life?
3. Has it caused a behavior change in your life?
   3.1. Probe Question: Are you happy with this behavior change?

Non-wearable users

1. What are the perceived health benefits (if any) for wearing a wearable physical activity tracker?
   1.1. Probe Question: Do you believe that these perceptions are true?
2. How would these health benefits impact your physical activity levels?
3. Are you happy with your physical fitness level?