Redefining Activity Tracking Through Older Adults' Reflections on Meaningful Activities

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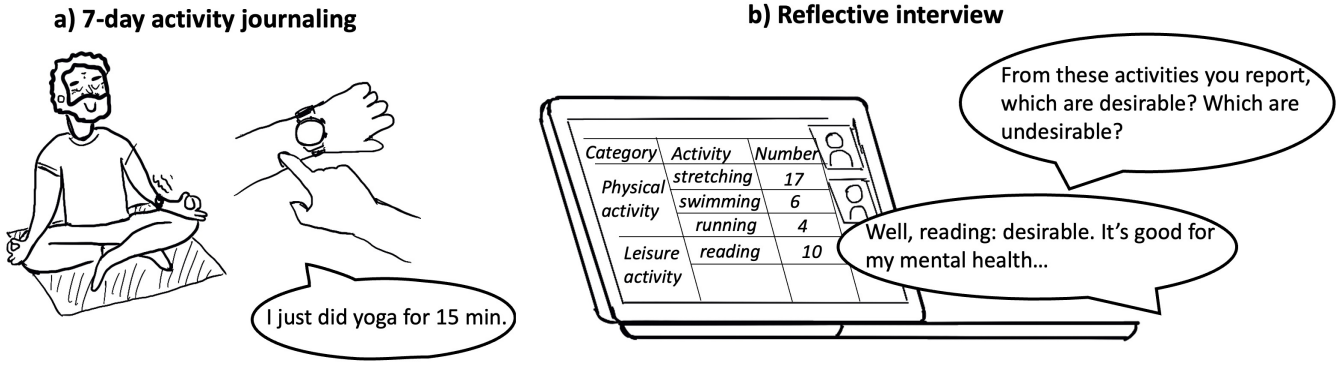

Figure 1: Our study consists of two parts: (a) 7-day activity journaling: we deployed a smartwatch-based app for participants to verbally report their everyday activities in situ and (b) Reflective interview: a semi-structured interview to elicit participants' reflection on meaningfulness and desirability of their daily activities. During the interview, researchers screen-shared the reported data organized in a spreadsheet with participants to prompt reflection.

ABSTRACT

Activity tracking has the potential to promote active lifestyles among older adults. However, current activity tracking technologies may inadvertently perpetuate ageism by focusing on age-related health risks. Advocating for a personalized approach in activity tracking technology, we sought to understand what activities older adults find meaningful to track and the underlying values of those activities. We conducted a reflective interview study following a 7-day activity journaling with 13 participants. We identified various underlying values motivating participants to track activities they deemed meaningful. These values, whether competing or aligned, shape the desirability of activities. Older adults appreciate low-exertion activities, but they are difficult to track. We discuss how these activities can become central in designing activity tracking systems. Our research offers insights for creating value-driven, personalized activity trackers that resonate more fully with the meaningful activities of older adults.

*Young-Ho Kim conducted this work while at the University of Maryland.

CHI '24, May 11–16, 2024, Honolulu, HI, USA

ACM ISBN 979-8-4007-0330-0/24/05
https://doi.org/10.1145/3613904.3642170

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

KEYWORDS

activity tracking, older adults, meaningful activity, interview study

ACM Reference Format:
Yiwen Wang, Mengying Li, Young-Ho Kim, Bongshin Lee, Margaret Danilovich, Amanda Lazar, David E. Conroy, Hernisa Kacorri, and Eun Kyoung Choe. 2024. Redefining Activity Tracking Through Older Adults' Reflections on Meaningful Activities. In *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '24), May 11–16, 2024, Honolulu, HI, USA.* ACM, New York, NY, USA, 15 pages. https://doi.org/10.1145/3613904.3642170

1 INTRODUCTION

As the global population ages, we are witnessing an increase in technologies specifically designed to cater to older adults. While older adults constitute a diverse and heterogeneous group, common stereotypes highlighting age-related deficits heavily shape the design of these technologies. Consider, for example, the numerous activity tracking systems for older adults, such as fall detection devices [42, 84]. In these technologies, older adults are viewed as "chronologically aged people with declined abilities" [47, 91]. This form of ageism may not only inflict harm on this demographic but also affect their propensity towards adopting active lifestyles, posing a significant risk to sustaining active lifestyles [22, 27].

We suspect that current activity tracking technologies are not well-suited to older adults' needs and contexts. Despite the array of activities in which older adults participate [61], existing systems track rather a limited set of activities, with approximately 77.4% being walking, exercising, and fall detection [90]. Furthermore, meaningful physical activity goals can change over time and vary significantly among older adults. Current technologies do not accommodate these individual differences; while mainly facilitating goals related to step count or vigorous activity (e.g., at least 150 minutes of moderate-to-vigorous physical activity per week [74]), they offer neither sufficient guidance nor structure for setting personalized goals that are appropriate for aging individuals or those with certain conditions that may limit their involvement in moderate-to-vigorous physical activities.

Recognizing these issues, we envision new activity tracking systems that incorporate older adults' preferences and needs from the outset of the design process. What activities do older adults find meaningful, and which ones are they interested in tracking? What factors do older adults consider when prioritizing various activities, and what values and the interplay among different values influence these decisions? By examining these questions, we aim to inform the design of personalized activity tracking systems that encourage older adults to participate in meaningful activities and disengage from those deemed undesirable. To this end, we conducted semi-structured interviews with 13 older adults after they completed a 7-day activity journaling. During the interview, we presented each participant with a summary of the activities they had logged to facilitate their reflections on the meaningfulness and desirability of these activities, in general and for tracking, respectively.

Through a reflexive thematic analysis of the interview data, we discerned various values, each vying for precedence, that influence how activities are perceived as meaningful by the participants. Specifically, we found that physical health often competes with other values, such as mental well-being and social connectedness, as priorities in later life. Low-exertion activities, like household chores and walking around the house, were deemed important. Not only are they considered essential activities, but they are also regarded as ambulating time due to the exertion levels involved for older adults, making them important to track. We also present how we can design value-driven activity tracking technologies based on our findings.

In summary, we make the following contributions:

- We present underlying values of the activities that older adults deem meaningful, and the interplay of these values in situations where they compete or align.
- We discuss what constitutes an activity worth tracking. Low-exertion activities are meaningful but often go untracked due to tracking difficulties.
- We discuss design considerations for activity trackers that encourage older adults to partake in activities that they find personally meaningful.

2 RELATED WORK

In this section, we review previous work on technologies to promote activities among older adults. We also discuss research examining older adults' meaningful activities.

2.1 Contrasting Perspectives on Promoting Healthy Aging

Since Rowe and Kahn introduced the concept of "successful aging" in 1997 [80], many scholars in the fields of gerontology, psychology, and sports science have explored ways to promote active aging, aiming to prevent disease and disability, enhance physical and cognitive performance, and foster life engagement [86]. For example, the prevailing view in sports science is to design intervention programs that address age-related declines and to promote physical activity among older adults. This is achieved by encouraging individuals to adopt active and healthy lifestyles through activity consultation [10, 40], with a commitment to regular physical activities such as walking [66], running [34], and swimming [23].

One particular focus in promoting older adults' health is reducing sedentary time [46]. This emphasis is grounded in evidence suggesting that prolonged sedentary behavior is linked to adverse health outcomes and a heightened risk of chronic diseases in later life [2, 71]. Intervention strategies include tracking sedentary time [79], sending alerts [9], goal setting [5, 56, 57], and promoting peer collaboration and competition [1, 41]. However, according to a systematic review article, many systems showed positive effects on reducing sedentary behavior by the end of the study, but their long-term efficacy on older adults' physical activity was limited [85]. Furthermore, the precise reason behind the limited long-term effect remains unknown. We suspect that there is potential to further tailor interventions to better align with the physiological functional status and unique preferences of older adults. For example, compared to moderate-to-vigorous physical activities, interventions focusing on increasing light physical activity (e.g., standing or light ambulation) are believed to be more sustainable and effective for older adults [18, 31, 60]. However, Fan et al. highlighted that many activity monitors overlook these milder activities and provide inaccurate feedback to older adults [24]. On another note, Maher and Conroy found variations in how older adults perceive the value of different sedentary activities [58]. This perception affects how successfully these sedentary activities can be reduced or displaced

by physical activities through intervention [58]. Some sedentary activities (e.g., playing puzzles, reading, watching TV) benefit the health and well-being of older adults [59, 72]. These activities can also provide much-needed rest and social interaction following demanding tasks like gardening [75]. However, current tracking systems cannot distinguish between sedentary activities with different purposes, thus failing to address the unique activity preferences and individual needs of older adults.

Much of the earlier research on Aging in HCI has drawn from gerontology and sports science's theoretical lens, primarily adopting a deficit-focused approach when designing systems for technological interventions [91]. The primary issue with the deficit-focused approach is its negative portrayal of aging. This perspective often depicts older adults as societal burdens, emphasizing their economic implications and functional limitations. Instead of highlighting the positive aspects of later life, it leans heavily on perceived weaknesses [47]. Moreover, this approach frequently sidelines the perspectives and voices of older adults, often leading to technical solutions that may not fully empower them [27]. We argue that not all age-related interventions and medical interventions are bad; in fact, we believe that it is essential to strike a balance between addressing genuine medical issues associated with aging and respecting and understanding the natural, non-pathological aspects of growing older. Our goal is to examine this notion within the realm of activity tracking technology. We seek to explore the potential of designing such technologies that not only contribute to older adults' health (in a medical context) but also reinforce their empowerment, extending the tracking beyond physical health to encompass broader mental and social values in later life to foster a positive perspective on aging [65].

2.2 Meaningful Activities of Older Adults

Numerous interpretations of "meaningful activity" exist in psychology and social sciences, notably within the field of occupational therapy [20]. Generally, it refers to an activity deemed important, worthwhile, and purposeful by an individual [43, 73], allowing them to realize their life's potential [28]. In turn, life experiences, personal values, and beliefs shape how individuals perceive meaningfulness in activities [6, 30]. For older adults, leisure activities play a central role in this concept, fulfilling their psychological needs [95] and enhancing life satisfaction [12, 44, 81, 93] and happiness [14, 53]. It is also worth noting that there are individual differences in the leisure activities preferred by older adults and the benefits they derive from these activities [89], indicating a strong need for personalized tracking. Older adults, due to differing life experiences and societal expectations, often have distinct perspectives on what activities hold meaning for them [15, 47]. Investigating these perspectives can enhance our understanding of how to foster healthy, engaged, and fulfilling lives as people age [69].

Typically, a medicalized view of meaningful activities of older adults extends beyond leisure to include ADLs (Activities of Daily Living, i.e., activities oriented toward taking care of one's own body, such as eating, bathing, and dressing) [39] and IADLs (Instrumental Activities of Daily Living, i.e., activities that are considered important for maintaining an individual's independence and overall quality of life; these involve more complex cognitive and social skills, such as managing finances, grocery shopping, and cooking) [48], and other physical, social, and cognitive activities [33, 63]. Prior work within this literature shows that these activities reflect older adults' personal needs and life meaning. Various assessment methods have been employed to study the meaningfulness of these activities and their relationship to psychological well-being and physical health (e.g., MAPA [21]). Lazar and Nguyen's study of older adults in independent living communities discussed how participants' choices of leisure activities are shaped by physical and cognitive health motivations [49]. More recently, Zhao et al. explored opportunities and challenges involved in older adults' use of technology for meaningful activities during the COVID-19 lockdowns [95]. They found that while technology met older adults' psychological needs, it also undermined their autonomy with limited access to various choices of activities, negatively impacting the development of their personal interests.

As previously highlighted, current activity tracking systems show limitations in tracking the full range of activities. The majority of activity tracking technologies primarily focus on tracking physical health [27], while having a notable shortfall in capturing the leisure activities that older adults prefer [90]. This functional approach often overlooks the importance of encouraging older adults to engage in a wide array of activities, not just for health but also for enjoyment and skill development in leisure contexts. Counter to this, recent work by Caldeira et al. underscored the significance of capturing and leveraging data that aligns with older adults' values and aspects of their self-identity and personal significance, such as their time dedicated to active lifestyles, hobbies, and crafts [8]. This finding highlights the need for personalized tracking solutions that cover a wide range of activities that older adults value, including a variety of physical activities (e.g., moderate-to-vigorous activities such as running and swimming, and less strenuous activities such as ambulation and stretching) and other leisure and social activities (e.g., reading, knitting, online meetings).

In our paper, we extend the understanding of meaningful activities among older adults in the self-tracking context, including and beyond the health lens [17]. We also build upon Lazar and Nguyen's work, which examined the underlying motivations of older adults' leisure activities [49]. Our extension not only encompasses activities beyond leisure but also specifically tailors the discourse to the domain of activity tracking. We analyze older adults' reflections on meaningful activities and derive various facets of activities that are meaningful and worth tracking, and address the diverse needs of older adults in self-tracking technologies. Our findings provide design implications that consider older adults' agency, promoting their involvement in self-management and supporting their long-term engagement with technology, by leveraging these tracking tools for enhanced quality of life.

3 METHOD

We carried out a reflective interview [64] with 13 participants after a 7-day activity journaling via speech input with a smartwatch (Figure 1). This interview study was part of a larger project, which aimed to understand older adults' activities through collecting a variety of data including a thigh-worn sensor [87], smartwatch sensors, and voice journaling. The journaling was conducted both

to collect older adults' activities in situ and to situate participants to reflect on their own activities during the interview. We implemented a speech-based activity journaling app on a smartwatch, allowing participants to capture everyday activities *in situ*. Participants could respond to time-based prompts or provide voluntary verbal reports at any time. We presented the details of the smartwatch reporting app, journaling data, and sensor data in [45]. In this paper, we report the findings from the reflective interview following the journaling phase, wherein we showcased the recorded activities as a way to foster participants' reflections (Figure 1b). During the interview, we first asked questions based on activity reports displayed on a shared screen. Second, we posed questions focused on activities that were omitted in the report. Last, we discussed new thoughts and concerns towards personalized activity tracking systems.

3.1 Study Procedure

The study was conducted between May and July 2021 amidst the COVID-19 pandemic in the U.S. Thus, the introduction session, tutorial, and interview were held remotely via Zoom. Following the safety protocols, study devices (e.g., smartwatches) were sanitized and delivered by our research team. A pilot study involving two older adults—one with an HCI expertise and one without—helped us revise the interaction flow of the reporting app and refine the tutorial material for clarity. Our university's institutional review board approved the study, and participants received compensation for their involvement ($50 for the interview portion).

3.1.1 7-day activity journaling. Upon receiving their devices, participants engaged in a 45-minute remote setup and introduction session, during which we assisted with device setup, WiFi connection, and familiarizing with the activity reporting app. To ensure that participants are comfortable with interacting with the smartwatch, we incorporated a 3-day adaptation phase prior to the 7-day activity journaling phase. For the initial 3 days, participants were encouraged to wear the devices during active daytime hours to acclimate themselves to the smartwatch. Towards the end of the adaption phase, we held a 1-hour tutorial session to demonstrate the process of reporting activities through the smartwatch app. We showcased five activity type examples: moving and aerobic exercises, strength exercises, stretching and balancing exercises, housekeeping, and stationary activities. We emphasized that while these examples cover common activity types, individual variations are expected. We explained that, ideally, we are looking to collect activity details, time and duration, and level of exertion. However, flexibility was encouraged, allowing participants to omit certain details and phrase information freely using voice input. In addition, guidance on app features, such as responding to reminders and voluntary reporting, was provided. During the 7-day activity journaling period, participants received nightly text reminders for device charging.

3.1.2 Reflective interview. In the semi-structured interview, we began by asking about their educational, occupational, and skill backgrounds, and if their jobs involve data work. For those who are retired, we probed differences in activities pre- and post-retirement, enabling insights into the impact of major life events on routines. We also asked about their technical proficiency, use of various technology devices, familiarity with tracking technology and speech-based systems, and general screen time.

Next, we guided the participants through a shared-screen review of their reported activities on a Google Sheet (Figure 1b). A researcher summarized the data, highlighting the total number of reports and initial activity categorizations. These activity categories were formulated through affinity analysis (Table 1 in Appendix). Participants were then asked to comment on the activity categorizations and anything they found intriguing in the report. We also discussed any variance in their activity patterns during the data collection period versus other times, and identified any significant activities omitted in the report. We sought reflections on the meaningfulness, desirability, and frequency of their activities.

In the final interview segment, we examined participants' desired activities to track and reasons. We discussed their prior self-tracking experiences and the tools they used. For experienced trackers, we asked about the challenges or benefits of their methods. We then presented our vision of creating a personalized activity tracking system and inquired about the meaningful activities they would like to track, assuming no limitations.

3.2 Participants

We advertised through local senior community mailing lists in the Northeast region of the U.S. Our inclusion criteria required participants to be aged 60 or older, and to have an interest in monitoring their physical/sedentary activity levels. They also needed a stable Wi-Fi connection, devices to join video calls, and proficiency in English. Due to hardware button constraints on the smartwatch, only right-handed individuals were recruited. Additionally, we recruited participants capable of using a speech-based activity reporting app (i.e., no self-identified speech, hearing, or cognitive impairments).

We recruited 13 participants (10 females, 3 males; Table 1), ranging in age from 61 to 90 (*Mean* = 71.1, *SD* = 8.7). While demonstrating high age variance within the older adults group and diverse professional backgrounds (8 retired, 3 self-employed, 2 full-time), our sample reflects a medium to high level of technical proficiency and a varied range of tracking experiences. For example, participants reported using different tracking tools throughout their lifespan; P9 journaled until her 40s and later used a Fitbit, and P4 wore a Casio databank, a memo-recording digital watch, throughout his adult life. All participants were smartphone users, with seven using iPhones and six using Android phones. We also note that our sample is skewed toward highly educated older adults, with an overrepresentation of women and limitations in terms of disability status. While participants did not disclose any self-identified disabilities during the screening process, they shared various health conditions during the interviews, including atrial fibrillation (P3), pre-diabetic (P4), arrhythmia (P5), macular degeneration and hand arthritis (P8), diabetes (P11), non-diabetic neuropathy and spinal stenosis (P12), and problems of back, knees and shoulders (P2, P3, P6, P7, P9, P12). Some mentioned recent and ongoing treatments, including eye injection (P8), shoulder surgery (P9), tooth surgery (P10), insulin (P11), and doxycycline (P13).

Table 1: Participants' demographics, tech proficiency, and tracking experience.

ID	Age (Gender)	Employment	Latest Occupation	Education	Tech Proficiency	Tracking Items (Tools)
P1	61 (M)	Retired	Senior manager	Bachelor's	Very confident	Steps (Android app), Exercise (Manually)
P2	67 (F)	Self-employed	Visual artist	Bachelor's	Enjoy the challenge	Steps (Pedometer), Book reading (Manually)
P3	77 (F)	Retired	Qualitative researcher	Ph.D./M.D.	Very confident	Heart conditions (Kardia), Finance (Excel sheets)
P4	70 (M)	Self-employed	Landlord	Bachelor's	Enjoy the challenge	Blood sugar (Monitor), Events (Manually & Casio databank), Finance, Walking & Biking (Strava)
P5	81 (F)	Retired	Disability consultant	Master's	A little apprehensive	Heart conditions (Monitor), Steps (Phone app), Finance, Medical records (Spreadsheet)
P6	79 (F)	Retired	Policy analyst	Master's	Very confident	None
P7	69 (F)	Full-time	Business manager	Master's	Enjoy the challenge	Steps (Fitbit)
P8	90 (F)	Self-employed	Piano tutor	Master-level	Enjoy the challenge	None
P9	62 (F)	Full-time	Communications director	Master-level	Very confident	Steps (Fitbit)
P10	62 (F)	Retired	Human resource specialist	Bachelor's	Very confident	Steps (Fitbit), Exercise & Eating (Phone apps)
P11	67 (F)	Retired	Technical training manager	Master-level	Enjoy the challenge	Blood sugar (Monitor & Manually)
P12	75 (F)	Retired	Rehabilitation counselor	Master's	Very apprehensive	None
P13	64 (M)	Retired	Regulatory specialist	Master's	Enjoy the challenge	None

3.3 Data Analysis

We employed reflexive thematic analysis following a six-phase approach [3, 4] to identify patterns of the meaningful activities reported by participants and their underlying values. Among various perspectives on value, we adopt the notion of Schwartz [82]: values are individual beliefs and principles that describe what is important in one's life; they refer to desirable goals that motivate action. While others have investigated ethical and moral values (e.g., [26]), our emphasis lies in understanding personal values. While activities can show what people are doing, the underlying values reveal the reason behind those actions, providing a richer, more nuanced understanding that can inform the design of sustainable interventions grounded in deep-seated values. We collected 12 hours and 37 minutes of interview recordings, which were transcribed and analyzed in NVivo, supplemented with observational notes. Two researchers began by familiarizing themselves with the transcripts and individually coded data from P1–P3 using open coding. They shared the coded outcomes, with discrepancies noted. A third researcher assisted in resolving these discrepancies in weekly meetings. We repeated this process by adding more data from P4–P7, and the new codes were applied to P1–P7 data. For P8–P13, two researchers independently coded the data, reconciled confusions, and merged the codes. The three researchers met often to generate, review, and iterate on themes.

4 FINDINGS

We identified themes that shed light on the types of activities older adults find meaningful and the underlying values of those activities. We emphasize that the interplay of values, stemming from various facets of meaningfulness, influences older adults' preferences regarding activity tracking. Moreover, we sometimes observed a discrepancy between the significance of an activity and our participants' interest in tracking it, a situation made worse by the limited support in existing tracking technology.

4.1 Multi-dimensionality of Older Adults' Activities

The definition of 'meaningful' can vary among individuals. To examine this concept further, we phrased our inquiries in various ways—asking participants about activities they deem desirable and important, and activities they wished to engage in more or less frequently. Note that what we report here in Section 4.1, focuses on the activities themselves, devoid of tracking context, unless explicitly stated otherwise. Details about their tracking preferences are discussed in Section 4.2.

4.1.1 Core Values and Their Manifestation in Activities. Through the data analysis, we noted multiple underlying values that motivate older adults to pursue activities. These values included: (1) physical health, (2) mental well-being, (3) cognitive health, (4) social connectedness, and (5) basic needs. In this section, we present a conceptualization of each of these values derived from both existing literature and our analysis. Following this, we offer detailed accounts and examples illustrating how these values manifest in various activities.

(1) **Physical health**, which refers to the medical definition associated with the state of illness [52], was a strong value that motivated our participants to either engage in or disengage from various activities. These include engaging in activities to prevent injuries, managing chronic conditions, or avoiding certain activities that might exacerbate their existing health issues. For example, P13 conducts core strength training that could help prevent running injuries, and P3 takes more naps due to the fatigue caused by atrial fibrillation. To alleviate body pain and muscle stiffness, P9 exercises and receives massages to aid in arm and shoulder recovery, while P3 performs stretching exercises to address back pain. However, the significance of these activities may or may not translate to enjoyment, as illustrated by P9, *"I think the pool time exercise is very desirable. I'm a water person so I really enjoy being in the pool,"* and P3, *"Lately I've been going to physical therapy because I have a problem with my back. And so, when I say I've been stretching and*

doing some strength exercises, that's all because of being in physical therapy the last month. But I don't like it. It's, it's not as much fun."

Some activities that once benefited our participants' health no longer do so. As participants experience shifts in their health, they come to recognize and respect their boundaries, taking care not to overexert themselves or avoid specific activities when necessary. For example, P12 described how she went from being a physically active person to one who preferred to be sedentary because of various health problems:

> *"I have become a floor potato, I love sitting on the floor... So I'm a floor potato. I'm a desk potato. I'm a bed potato. I don't engage in a lot of exercise because I have a lot of physical problems. I have, for example, non-diabetic neuropathy and my feet. I can barely feel them... I have spinal stenosis... and at the moment I need a knee replacement... But it's really impeding my ability to walk. So, all of that put together kind of interferes with my ability to exercise and I used to do a lot of it. A lot of walking and bicycling and all of that, but I can't do that anymore."*

Our participants (P1, P4, P5) viewed going up and down the stairs as a form of brief exercise. Yet, with age, actions like navigating the stairs or carrying a vacuum cleaner upstairs have become safety risks, intensified by factors like diminishing eyesight (P8) and knee conditions (P7). As such, they found living in a home with a staircase problematic. P7 commented, *"...I can't do stairs very often anymore, so that, that's a little difficult."*

(2) **Mental well-being** is a state in which people can manage their stresses, and realize and develop their abilities in learning and working [68]. This comprehensive concept was a significant value for our participants' engagement in various activities. They were drawn to activities that boost positive emotions and pleasure, spark creativity, curiosity, and learning, or provide spiritual fulfillment. Watching movies/TV or reading books was mentioned as a source of pleasure and joy, as noted by P2: *"Reading I love, so I mean I've always been that way and I just would never give that up, that's one of my favorite things to do."* Creating art, for P3, serves as a cathartic outlet, allowing her to express her frustration about the opposing political party. P4 finds pleasure in *"building things, looking at the workbench,"* a reason for being a landlord, which enables him to pursue his woodworking passion at home. P5 finds solace in activities with an aesthetic appeal, such as gardening: *"... we have a large house, and it's surrounded by gardens. The aesthetic appeal to my spirit is real. You look out any window, and you're looking into trees and bushes and flowers, getting out every day and checking what's blooming and what's coming and planning and organizing and bending and still being in watering. All of those, I think they all contribute massively to feeling well."* P5's reflection implies an individuality of activity that the satisfaction she derives from gardening is inherently personal and might not resonate with everyone: *"So for me, it's a joy. For someone else, it's a chore; they wouldn't do it in a minute."* P3 and P10 both take online and offline classes for fun. While mental well-being was not the only motivation, P3 and P10 were particularly driven by the sheer joy of learning. P10 emphasized this sentiment, appreciating the pure joy of learning without the pressure of formal academic assessments and the pursuit of degrees:

> *"I'm taking two classes online. One is the history of the 20th century, and that's a two-hour class via Zoom. And then I'm taking another class 19th century British authors, and that's a one-hour class also on Zoom... These are enrichment classes for fun. They don't have exams, they don't have papers, the usual academic stuff."*

(3) **Cognitive health** involves the mental processes of *"thinking, learning, and remembering"* [67]. Some participants described intentionally partaking in activities that stimulate their cognitive health. These encompass reading and tuning into the news (P2), learning new things (P2, P4), and playing crossword puzzles and games (P5, P7, P11) as ways to stimulate their mind. Learning for the sake of cognitive health as a primary motivation looks a little different from the joy-driven learning we discussed earlier. For P2, taking an art class was part of *"mental stimulation and a little bit of social connection."* Likewise, P4 attended many Zoom webinars because *"you are seeing other people and you're getting some mental stimulation, so it is a form of... it serves a kind of a social or intellectually stimulating purpose."* Some participants played crossword puzzles and quiz games as a cognitive activity. P7 noted the benefits of such activities as *"keeping mentally alerted"* and *"stimulated."* P5 elaborated that engaging in games requires a substantial commitment of time and effort to memorize words, an activity that would prove advantageous for older adults experiencing cognitive decline. She mentioned:

> *"I would say that it [crossword puzzle] is a brain building, spatial intelligence challenge, absolutely. Um, so in a way, yes, you could say it was a hobby or relaxation. But I know when we're doing it, that it's good for us... it's certainly, if we continue to do puzzles, I think we will benefit from it. We are aware of losing cognitive capability."*

(4) **Social connectedness** was valued by our participants as it fosters a sense of belonging within a specific community or group. This involves a deep sense of interpersonal connection that extends beyond simple social interactions [16, 70]. This value manifested in our participants' efforts to connect with their family and friends in various ways and to serve communities in diverse roles, significantly influencing their preferences for desirable activities such as engaging in computer-mediated communication (P1, P3), interacting with their family and friends (P10, P11), and volunteering (P5, P6, P11, P12). Among these social activities, participants noted that computers play a critical role in staying connected with close friends and facilitating work-related email exchanges and video conferencing. P1 talked about using computers for *"social and business communication,"* whereas P3 highlighted their use for *"connecting with people."* As opposed to online communication, some participants stressed the importance of making efforts to arrange in-person meetings. P10 highlighted the importance of regular in-person meetings with her friends, especially for retirees. She mentioned that *"when you're retired, you have to make an effort to do that because we don't have a built-in social network like you do when you're working or going to school. So it's something that you have to actually sort of organize and make an effort to do. It doesn't just, you know, organically come to you."* However, another retiree, P11, has a different view. Surrounded by a large family, she

describes herself as follows: *"I'm socially active all the time because I have six people living with me and then I have a certain area that I visit quite frequent so just with my family and interacting socially a lot."*

Apart from their closest personal connections, most participants demonstrated an eagerness to participate and actively engage in the wider community or society. This engagement takes the form of volunteer efforts in neighborhood, community, city, or statewide programs, and encompasses a range of tasks such as coordinating, arranging, organizing, communicating, and fundraising (P3, P4, P5, P11, P12) as well as driving and grocery shopping for shelters (P6). In addition to pursuing social interactions, P11 commented that engaging in volunteer work provided her with a deep feeling of being valued and cherished by others: *"In my situation where I'm retired, I'm kind of looking for outlets to engage with people. I would say they are social... But I kind of like the personal pride I take in the organizational work, it is very, you know, professional life. It's very structured, you know, there's a lot of gratification in it."* Further, P12 emphasized that her commitment to volunteering was deeply ingrained in her family heritage. She saw it as a way to both nurture her family bonds and carry forward the tradition of making meaningful contributions to society: *"I spent my whole life from the time I came out of the womb in social service. I was a candy striper at Children's Hospital in [city's name] and a Girl Scout from the time I was a brownie and then a Girl Scout through high school and I was always volunteering for things. So, social services [is] in my blood and I inherited it so to speak from my parents."*

(5) **Basic needs** refer to the minimum necessities that would be required to meet the standard of living [11]. Activities that address basic needs are essential for independence and quality of living, including but not limited to personal care and household chores. In detail, participants mentioned cleaning and organizing—both digital and real world—(P1, P2, P3, P6, P9, P10), picking up phones (P2), driving (P1, P2), preparing food and grocery shopping (P3, P5), taking care of pets (P3, P6), and saving money and managing finances (P12). While participants recognized the importance of these activities, we noticed that most of these activities are perceived as undesirable if they require more time than expected. For example, P5 expressed a strong apprehension about spending an excessive amount of time to keep her digital space clean: *"I'm probably on my computer, all day, and if you include the phone, you know, clearing messages, checking messages and stuff, probably three or four hours a day. I don't want to. I don't like that I do that, I find that there's just so much intrusive information that I'm constantly cleaning out, cleaning out."* Similarly, P2 discussed how to keep the necessities minimal when allocating time for driving: *"...driving is something I do as a, you know, on a need-be basis. I don't find it particularly fun or, but it gets me to places that I need to go."*

The way basic needs are met can differ among participants' households. While some share the workload, others manage tasks on their own. P3 noted, *"I live alone at the moment. And so there are many activities that I must do and I don't share or the other person or persons do them."* Further, P3 wanted to hire someone to assist with her household chores if her financial situation allows: *"...like fixing dinner, like shopping, fixing, washing the dishes, housecleaning, if I had the money that would be the place I would put my money, housekeeper."* P12 engages in activities that incur financial gains, such as accumulating points for obtaining free items, often involving extensive paperwork and meticulous tracking.

4.1.2 Navigating Value Conflicts. The values drawn from our participants' diverse activities sometimes compete, resulting in dilemmas, discontent, and intricate decision-making. In this section, we unveil the competing values within a single activity by examining participants' perceptions of the trade-offs involved. Further, we unpack how our participants prioritize competing activities wherein they assess the values and costs associated with various activities, a process complicated by sociopolitical and environmental impact due to COVID-19.

Competing Values Embedded in a Single Activity. Participants expressed interest in certain activities that involved potentially harmful postures like prolonged sitting or bending (e.g., watching a movie, using a computer, gardening, vacuuming). Worries about physical health were sometimes overshadowed by the benefits associated with other values like mental well-being, social connectedness, and basic needs. Oftentimes, discerning the desirability of such activities was not always clear-cut.

P6 is aware of the trade-off between computer usage and its impact on his physical health. While prolonged sitting during computer use is detrimental to her physical health, she attends online meetings for volunteer work, an important activity for her social and mental well-being. She mentioned, *"I think when I attend some of these meetings they can be relaxing for me... I'm trying to not sit in front of the computer for long, because if it bothers my back and I know it's not good for me."* Similarly, activities supporting basic needs, such as driving (sitting for too long) and vacuuming (having to bend back), were noted as activities with value conflicts.

Seemingly innocuous activities like gardening could be harmful if done excessively. Eleven out of 13 participants frequently gardened, a notably high proportion for such a distinct activity. The seasonality of our study (late spring to early summer) and the participants' living environment may account for this, but it also highlights gardening's positive impact on participants' physical and mental well-being. However, certain gardening tasks, as P3 described (*"lifting, moving, you know, whether it be dirt or pushing a wheelbarrow, digging..."*) could aggravate health issues like back pain and arthritis. As such, some participants wanted to be aware of their specific limits and goals through tracking, ensuring they do not overextend themselves while immersed in the activities that they enjoy. Similarly, P2 considers tracking her computer usage to ensure moderation: *"it might be an interesting thing if I could keep track of the time to spend, that I spend on the computer, just to make sure that I don't go overboard with that."*

Lastly, a single activity can simultaneously uphold and compromise the same value—in P8's case, it's physical health—leading to dilemmas and discontent. Although swimming is P8's favorite form of exercise, her recent macular degeneration diagnosis, necessitating monthly protein shots, has halted her swimming routine. She diligently tends to her eye health with frequent doctor visits and regular shots, but she deeply misses her time in the water.

Prioritizing Activities Amidst COVID-19 Pandemic. Our research was undertaken during the lockdown of the COVID-19 pandemic, and its sociopolitical implications heightened the complexity of value conflicts, significantly influencing and constraining our

participants' activity choices. Value conflicts were pervasive, ranging from public health concerns conflicting with personal health priorities to challenges in social connectedness, mental well-being, and even basic needs. Participants were directly affected by the lockdown measures on public spaces like swimming pools, museums, and grocery stores (P9, P10, P11), as well as the shift of in-person events, church sheltering services (P6), community art and crafting classes (P11, P12), and exercise programs (P3, P13), which either stopped entirely or shifted to online formats. Taking an example of physical exercise, P9 prefers swimming; however, due to policy restrictions, she had to proactively plan and make reservations for pool access, requiring additional coordination effort. P2 likes to socialize with others, but during the pandemic, she developed the new habit of watching movies in the evenings, while missing the social connection and feeling lonely: *"you know during regular times, non-pandemic, I would probably be out of the house more with errands and meeting people."*

In response to the absence of face-to-face activities during COVID-19, many (P2, P4, P6, P9, P11, P12) turned to remote meetings through videoconferencing tools like Zoom as substitutes. However, the online format did not provide the same level of satisfaction as the in-person experience. P11, comparing her pre-pandemic crafting class experience to the online art class, finds it fell short of expectations, and its continued high tuition added to her disappointment. She expresses reduced interest in online classes, opting for a different group that allows for social interactions. The decision was based on evaluating the cost and benefit, considering the value gained, temporal commitments, and financial costs. Despite many activities for fulfilling basic needs, such as grocery shopping and running errands (P9), transitioning to online formats during the pandemic, P5 remained committed to visiting grocery stores in person because *"My release was to go to the grocery store. We have a little [store's name] now and so there's always something fun and cheap there. And so, it's just easier just make my little list and go run and get some more stuff."* P6 also kept going to the grocery store during the pandemic but adopted a strategy to reduce time roaming in the store by making a shopping list in response to the pandemic time restrictions on the store. However, not everyone could easily find alternatives, as expressed by P7, who voiced frustration about the interruption in activities due to the pandemic and the challenges of finding replacements. In the end, P7 remarked, *"I spend too much time at home alone, without activities to do."*

4.1.3 Activities Underscored by Multiple Values Leading to Enhanced Motivation. A single activity can be driven by multiple values and could serve diverse purposes. For example, P9 views walking the dog primarily as a form of physical exercise, but it also is a social activity *"because you always run into somebody that you know."* Moreover, pet caring inherently fulfills the basic needs (for the pet). For P9, who places a high value on social interactions, especially coming out of the pandemic, the act of walking the dog becomes important and desirable.

Likewise, P13's volunteering at the plant nursery involves significant physical activities, promoting both social connection and physical health. In both instances, while the initial motivation for the activities was not primarily physical health, they inadvertently benefited their physical health. Additionally, these experiences provided increased motivation, creating a virtuous cycle.

Sometimes, a simple activity such as preparing food, may carry several layers of meaning, touching on multiple values. Consider P5, who enjoys cooking: *"I do spend quite a bit of time preparing meals because I like to cook. And we, I like to eat healthy food and I don't particularly like to eat out."* She explains the values inherent in preparing food—connecting with her family roots and sharing positive emotions with others: *"And one of my favorite things to do is to go grocery shopping and buy food. My dad was a grocer I lived above a grocery store. So food is an important part of our life. And I spend a lot of time in the kitchen. And that's okay, you know, that works out for everyone; makes my husband happy, makes my friends happy, and makes me happy."* However, in the absence of these multiple values enriching their meaningfulness, activities for basic needs such as the mundane task of meal preparation were perceived as mere obligations or burdens, as we reported earlier.

4.2 Activities Perceived to Be Tracking Worthy

We observed that meaningful activities our participants mentioned in Section 4.1 do not always align with what they consider *worthy of tracking*. Some activities might be meaningful, but they might not be worthy of tracking. Other activities might be tracking worthy, but they may impose too much burden on the participants, thus not feasible to track with the current technology. In this section, we highlight a variety of activities that are perceived as worthy of tracking and discuss their merits and rationale.

4.2.1 Tracking for Physical Health. Most of our participants recognized the importance of tracking activities related to physical health to stay active. Participants also viewed activity tracking as a means to be aware of changes in their physical health or specific limits, ensuring they do not overextend themselves or abstain from certain activities.

Participants indicated that tracking physical activities could help them stay active, including exercises like walking and running (P2, P5, P7, P13) and some non-exercise activities like gardening (P1, P13). P7 desires to track typical exercises for the purpose of monitoring activity progress. Similarly, P13 thinks gardening would be *"a useful thing to be able to capture,"* because *"it is active"* although not categorized as exercise.

Activity tracking can guide participants in their decision-making. P5 has a heart condition called arrhythmia and is recommended to follow a prescriptive exercise of walking. However, she does not want to follow the exercise prescription because she does not like walking. Instead, she is curious about the amount of physical activity she achieves through daily household tasks. She is interested in understanding whether her daily routine provides enough exercise to meet general health recommendations without having to walk several times a week. P11, who lives in a three-story house with the laundry situated in the basement, pondered how activity tracking might help her decide whether to transition to a safer, single-level residence. She recognized such a decision would be difficult: *"...if I could track what I'm doing in this house and how I'm moving and how I conduct my daily activities, particularly laundry, with the laundry being down the basement. It might help you make some decisions*

about when and if you were to downsize and what would be the more ideal locations and layouts for you."

We observed that many participants desired to track screen time activities that involve prolonged sitting. Many participants (P1, P2, P4, P6, P7, P8) wanted to track their screen time, such as *"watching TV"* or *"time spent on the computer."* While sitting duration and screen time are two different things, many of our participants closely associated the two. Their primary goal for tracking was to reduce the sitting time for health benefits, exemplified in P4 who wanted to reduce his screen time for health purposes: *"They say the screen time is bad for you. I think it's probably true. I try not to do too much television time, but my wife has the television on, so if I'm in the living room I'm watching TV too... You could have a, you know, you could have it set so that they could set it to X amount of time of relative inactivity. They get a, they get a suggestion or a reminder or, you know, a vibration or whatever it might be."*

4.2.2 Recognizing the Importance of Low-Exertion Activities. We highlight a specific form of physical activity that many participants reported during the interview: *low-exertion activities*. Examples of these activities include stretching and strengthening (P1, P2), indoor ambulation such as going up and down stairs (P1, P4, P5, P6, P8, P12), household chores such as vacuuming (P1) and laundry (P11). These activities are typically short and in slow gaits, they consume low energy, and are not considered as an exercise in the traditional sense. At the beginning of the interview, despite our emphasis on the flexibility of journaling and encouraging a broad spectrum of activities beyond typical physical activities, participants' comments did not touch on the meaningfulness of these activities. P11 noted that one reason for this trend may be the tendency toward reporting *"discrete activities."* However, as the interview progressed, we encouraged participants to reflect on the omitted activities in the report and to explore the difference in the activity patterns by recalling the time outside of the data collection period. Participants began to recognize the value of low-exertion activities and expressed a desire to track them.

Some participants thought that such low-exertion activities could contribute to their physical health and considered them as exercises. P4 explained that walking around the house while carrying a bike is worthy of tracking. This is because the perceived exertion level is high due to the bike's weight and distance covered. P5 recognized that tracking the time spent ambulating around the house could substantially contribute to her goal of increasing activity level: *"We have a large house. So I can walk from the garden room out to the garage and back to the garden room and it's really quite a bit of walking. So, I do get [exercise], I think, within the house."*

However, it's worth noting that not all participants regarded low-exertion activities as important. For example, P13 found it *pointless* to track these low-exertion activities, especially when compared to typical physical activities like *"running or swimming."* Likewise, P9 thought that low-exertion activities, such as indoor ambulation, were not worth tracking primarily because they do not significantly impact her Fitbit's step counts. However, given that devices like Fitbit tend to underreport steps at the typical walking speed of older adults (0.9 m/s) [92], P9's perception of the low-exertion activity's significance might be undervalued.

Due to their sporadic and fleeting nature, participants admitted that these low-exertion activities were often overlooked and underreported during the 7-day journaling. Moreover, pinpointing the exact start and end times of such activities becomes particularly challenging when individuals multitask or engage in sequential activities. As P9 aptly put it, *"I'm always doing about two or three things at once."* Likewise, P6 recalled a scenario of going up and downstairs that occurred with a series of low-exertion activities in the basement like *"lifting the humidifier, dehumidifier, the water, and draining, and opening the cellar door, and then it is nice and I would walk outside, and do something with a plant,"* which place her in a natural flow of performance. This blurring of activity boundaries presents significant challenges in capturing and dissecting them for activity tracking. Nonetheless, these activities hold significant potential for enhancing the health and well-being of older adults.

5 DISCUSSION

This research aimed to understand what activities older adults consider meaningful within the self-tracking context through their reflection. We presented the underlying values of the activities that older adults deem meaningful, and how these values conflict or align across various activities. While older adults' values and valued activities were studied in the past [8, 37, 49, 51], we contribute to this line of research by examining the multidimensional values within the self-tracking domain, discussing what constitutes an activity worth tracking and why tracking these activities holds significance. In this section, we discuss opportunities and challenges in designing activity tracking systems for older adults based on our findings.

5.1 Meaningful Activities versus Activities Meaningful to Track

We noticed both overlaps and differences between activities that participants found meaningful (Section 4.1) and those deemed worthy of tracking (Section 4.2). A notable overlap existed in activities that directly impacted participants' physical health. These included both activities individuals desired to increase, decrease, and maintain at a balance. The primary motivation behind wanting to track these activities was the desire to manage their health and physical well-being on their own. Some participants wanted to set explicit goals, not necessarily to exceed these goals (like the well-known 10,000 steps goal), but not to exceed them and avoid overexertion. There were also notable differences between our findings and those of prior work, particularly Caldeira et al.'s study [7], in terms of the physical activities to track. Unlike our participants who exhibited a willingness to monitor all range of activities—from positive to negative health behaviors, Caldeira et al.'s findings placed a primary emphasis on capturing an active lifestyle approximated by time spent outside—positive health behaviors. While differences in study design, tracking methods, and associated burdens could account for these disparities, we believe that a more crucial focus should be on examining older adults' deep-seated values and motivations rather than confining the analysis to surface-level activities. In our study, the motivation beyond capturing undesirable behaviors such as sedentary time is also to aim for an active lifestyle, confirming Caldeira et al.'s finding.

It became evident that not all meaningful activities need to be tracked. Activities that participants do for their mental well-being, cognitive health, and social connectedness (e.g., spending quality time with their family) were areas where participants preferred immersion over tracking. The primary sentiment was the desire to fully relish these experiences without the interference or distraction of tracking. However, it is important to contextualize this finding in light of our study setup. In our study, participants assumed they would be required to manually or semi-automatically contribute to data collection about their activities, likely due to their activity journaling experience. Consequently, our participants might have displayed a somewhat conservative approach to selecting activities for tracking. Therefore, it warrants further investigation to explore how the mode of tracking and its associated burden might affect individuals' preferences on what activities they choose to track.

As the interview progressed, activities originally perceived as trivial emerged as important in the participants' view. These activities, often of low exertion, include slow-paced, brief walks inside the home, or short stretching breaks. We discovered through interviews that the speech-based journaling tool we employed might not have been adequate in capturing low-exertion activities due to their brief and sporadic nature. Consequently, there is a likelihood that participants underreported these activities. We believe that tracking these activities is especially important for older adults. The current activity tracking technologies predominantly track what may be considered as 'typical exercises'—those that involve moderate-to-vigorous exertion, such as running, biking, and swimming. However, a recent study found that all activities count [94]; even a short duration (i.e., 10 minutes/week) of leisure time physical activities, like gardening, can significantly affect one's health. This is also an area that existing tracking technologies often overlook [27]. Thus, we call for creators of activity tracking technologies to invest in mechanisms that effectively capture these activities deemed meaningful to track, as derived from our study's findings.

5.2 Toward Richer Understanding of an Activity

During the interview, when participants detailed a specific activity, they often used various attributes to provide a fuller picture. These attributes included *semantics* (the inherent meaning of the activity), *posture* (sitting, standing, lying down, etc.), and other *contextual details*, such as with whom they do the activity or where the activity takes place. Knowing such details could significantly enrich an understanding of the underlying values of an activity. At times, these details can clarify or complicate an activity's desirability, as in the case of "reading while lying down on a couch"—is this desirable for someone with back pain who loves to read?

However, capturing this breadth of information fully manually is demanding and may not always be feasible. On the other hand, capturing all of them fully automatically may not be feasible either. One way to mitigate this challenge is by the semi-automated tracking approach, leveraging both automated and manual data capture methods [13]. Wearable sensors, such as accelerometers and gyroscopes, can detect postures, while external applications can provide insights into activities, for example, revealing if someone is using a computer for communication, writing, or watching Netflix. Yet, some nuances are best captured directly from individuals, as human input can sometimes be more accurate or contextually relevant than automated sensing data. The semi-automated tracking approach aims to balance information needs, data capture feasibility, and data capture burden. Using this approach, we may achieve richer and more accurate personal data tracking, while ensuring an engaging experience for people.

We also suggest that future activity labeling or tracking systems support collecting diverse contexts by supporting a range of input mechanisms and in a multi-device environment. For instance, the ExtraSensory system relies on the integration of mobile phone and smartwatch to capture the activity labels in situ and report past and imminent events [88]. In particular, we call attention to accommodating older adults' abilities and willingness to contribute to data collection. Although speech-based methods show promise in reducing the data capture burden, they also introduce the cognitive burden as individuals formulate ideas while speaking [54]. Thus, instead of relying on a free-form input mechanism, offering multiple-choice options based on likely answers (e.g., Is your activity an Option 1, Option 2, Option 3...?)—either through speech or touch—could reduce both input and cognitive burdens for older adults while efficiently collecting richer information about a given activity. Additionally, other data capture mechanisms that older adults are comfortable to use may be integrated, such as text messages and phone calls.

5.3 Personalizing Activity Trackers

There is a substantial body of literature highlighting the advantages of customization in tracking tools. Recent work has delved into people's customization needs and practices concerning smartwatches, exploring aspects such as the information displayed on the smartwatches or fitness trackers—ranging from sensor data and aesthetics to personal modifications of watchfaces [29, 38]. Building upon this work, our results underscore the importance of tracking customization at the level of underlying machine learning models, facilitating the recognition of meaningful activities among older adults. This involves not only adapting to their idiosyncratic movement patterns but also recognizing personally meaningful activities that may go beyond conventional ones in tracking applications like walking and running. Consequently, our work emphasizes the importance of developing machine teaching [83, 96] tools to enable older adults to integrate their activity data and labels into personal activity recognizers. This parallels existing examples of such tools designed to support end users without expertise in machine learning, including applications in gesture recognition for musicians [25], object recognition for blind individuals [36, 62], and AI education for youth [19, 32, 97].

Our study offers insights into the distinctive challenges inherent in designing machine teaching tools that call upon older adults to contribute training data for personalizing an activity tracker. Specifically, we demonstrate that the meaningfulness of tracked activities is influenced by the discrete nature of the activity and older adults' perception of what the sensors capture, as well as the potential disruption caused by the tracking process itself. These intertwined insights underscore the necessity of adopting a participatory approach with older adults when developing such tools. For example, the feasibility of tracking depends on the sensors

employed in wearable and mobile devices, such as smartwatches and smartphones, or those integrated into the environment, such as in kitchens and gardens, which older adults may or may not adopt. Similarly, the level of disruption during the activity is contingent on the user's preferred balance between machine-initiated and user-initiated tracking, frequency and overall duration for machine teaching, as well as the modality of machine teaching (e.g., verbal reports, gestures indicating start and end, or activity naming) and preferences for later editing of the training examples. Furthermore, the discreteness of activities poses challenges related to both activity labeling and time granularity, particularly in the case of low-exertion activities that participants in our study expressed a desire to track. The sporadic and fleeting nature of these activities makes it especially challenging to precisely identify their start and end times, particularly when individuals multitask or engage in sequential activities. This blurring of activity boundaries presents significant hurdles in capturing and dissecting them for training an activity tracker calling for creative solutions.

5.4 Supporting Activities with Multidimensional Values

We found that a single activity may hold multiple values and give different meanings to individuals. These values, whether competing or aligned, shape the desirability of activities. When an activity is underscored by multiple values, a virtuous cycle of continued engagement is created, as seen in P9's dog walking and P13's volunteering activity. In prior work, the multidimensional values of older adults' activities were studied, focusing on leisure activities [49], and more specifically on the making and crafting activities of older adults [37]. Prior research reported that older adults' leisure activities are intertwined with their motivation to maintain health and wellness, encompassing aspects of physical, mental, and cognitive health, as well as social connectedness [49]. Making and crafting activities hold particular significance to older adults, providing a sense of belonging, quality, and creativity [37]. As these activities often align with individuals' intrinsic motivation, they may necessitate less technological support to encourage engagement, respecting the preference for immersion during the activity, as shown in our result. However, if these activities can be automatically captured, as exemplified by the motion sensor in [7], the activity data feedback may highlight people's joyful moments, achievements, and level of engagement for later reflection.

On the other hand, we observed many accounts where activities possessing conflicting values posed dilemmas. The conflict was especially evident when participants' activities involved screen time on computers and tablets, typically leading to prolonged sedentary periods. Many participants expressed a desire to track their computer usage to enjoy valued activities in moderation (refer to Section 4.2.1). In fact, many screen time tracking applications exist (e.g., RescueTime, ManicTime, TimeCamp). But, they are primarily framed as productivity tools, tailored to a specific demographic: the information worker. For example, RescueTime produces a 'Productivity Score' and emphasizes 'Focus Work,' defined by *"high-impact, mentally demanding work that typically requires long stretches of uninterrupted focus to complete"* [76]. Such platforms tend to overlook users' physical conditions or postures, inadvertently promoting extended sedentary behaviors. Furthermore, these tools categorize the semantics of an activity rather mechanically, defaulting to label entertainment and social networking as 'unproductive.' Should we design a screen time tracking tool for older adults, it might look very different from current models. Such a system would send notifications encouraging regular, preferably longer, breaks from screen time (a design suggested in Time for Break [55], although this was for information workers). Moreover, it would respect users' preferences, ensuring they are not interrupted during activities like watching their favorite TV show. It would also recognize and positively reinforce activities that older adults cherish, whether it's connecting with others, attending webinars, or watching movies.

Extending beyond the productivity context, it calls for future research to assist individuals in navigating conflicting values as they arise, help them explore options, and attain a balanced lifestyle. In behavioral medicine literature, the concept of *time displacement* [77] elucidates how one might make health-related decisions amid other commitments and goals. Time displacement refers to the phenomenon where the allocation of time to pursue one goal or activity takes away the time available for another goal or activity, potentially creating goal conflicts [78]. Understanding people's preferred activities and willingness to consider time displacement is essential for designing interventions that address goal conflicts. A goal-setting intervention could, for instance, suggest concurrent activities with different underlying values (e.g., watching Netflix on a treadmill) or help individuals assemble sequential activities that could satisfy various values, thus minimizing goal conflicts and promoting a more integrated approach to achieving diverse goals.

5.5 Value-Driven Activity Tracking Systems

We started off by challenging the deficit-focused approach, an approach that often emphasizes the setbacks, declines, and losses associated with aging rather than its possibilities. However, when analyzing our data, we encountered numerous accounts interspersed with the health concerns, constraints, and perceived deficits among our participants, as shown in Section 4.1. So how does our study deviate from the very deficit-focused perspectives?

At the heart of our research is the perspectives coming directly from older adult participants. We sought to understand values from their standpoint. In HCI, there exists a rich tradition of accounting for human values in creating computing systems. Two prominent approaches are 'Value-Sensitive Design' (VSD) by Friedman et al. [26] and Values-led Participatory Design (PD) proposed by Iversen et al. [35]. VSD integrates human values systematically throughout the design process. One of the principles of VSD is the awareness of various stakeholders—both direct and indirect. Sometimes, the voices of key stakeholders, in our case, older adults, get overshadowed. Our work attempts to remedy that oversight. By listening to our participants, we gained insights into how they prioritize conflicting values and navigate the associated trade-offs. While VSD centers on moral values, Values-led PD explores personal values [37] and emphasizes active stakeholder engagement during the design process, guiding participants to be able to explicitly work with values during the design session. Acknowledging the difficulty participants face in discussing values in abstraction [50], we chose to focus on what they *do*. We facilitated this by having

our participants journal their activities and reflect on them at the end of the 7-day journaling.

From our analysis, it was evident that physical health stood out as the primary value of our participants, but it is equally important to note that it wasn't the only important value. Activities that cater to mental well-being, social connectedness, cognitive health, and even basic needs were meaningful. And they warrant a holistic understanding, a perspective shared by other researchers [49, 65]. Likewise, we also argue the need to broaden the scope of tracking to encapsulate health and non-health-related activities, recognizing the intricate relationships between them, especially in how they affect motivation and tracking desirability. We suggest designing value-driven activity tracking systems that emphasize the integration of broader lifestyle values beyond health metrics. It involves engaging older adults in identifying their values and preferences and developing design concepts that reflect the integration of health and lifestyle values. This approach aims to create systems that are not only functional but deeply resonate with users' lifestyles and underlying values, which may lead to more effective and sustainable design outcomes.

5.6 Study limitations

As noted in Section 3.2, our participant group presented limited diversity. While our participants had diverse expertise and technical backgrounds, none of them had severe disabilities that would hinder interaction with a speech-based activity journaling smartwatch app, in line with our exclusion criteria. Thus, the findings we discussed may be limited to those who are relatively technologically proficient and may not be readily generalized to other marginalized groups, such as older adults with disabilities. We acknowledge that values are culturally shaped; we observed different values emerged from people living in different environments, such as living alone, with spouses, or in an intergenerational family. However, we did not collect data regarding people's household settings or income status, and our participants were mainly residents of urban communities. Lastly, our study was conducted in the summer of 2021 when the COVID-19 pandemic made a significant impact on participants' lifestyles and routines. Policies such as the stay-at-home order required minimizing unnecessary social contacts, potentially limiting the activities that participants engaged in. The majority of participants discussed the lockdown's impact on their daily activities, for example, shifting in-person activities like swimming to online social events, as reported in Section 4.1.2. However, during the interview, we probed about potential variations in activity patterns by contrasting the data collection period with other times.

6 CONCLUSION

In this study, we conducted a reflective interview following a 7-day activity journaling with 13 participants to understand what activities older adults find meaningful and perceive as worthy of tracking. Activities related to physical health were considered meaningful, but in some cases, activities possessing conflicting values posed dilemmas. The interplay of the underlying values affected the desirability of activity tracking. We highlighted the importance of considering some low-exertion activities in tracking, yet future work should address the potential challenges older adults face. Our discussion presented design suggestions for future activity tracking systems that support older adults in tracking personally meaningful activities.

ACKNOWLEDGMENTS

We thank our participants for their time and dedication. We also thank Diana Chou for helping with data collection. We are grateful to Bonnie McClellan and Explorations On Aging for helping us recruit participants. This work was supported by the National Science Foundation awards #1955568 and #1955590.

REFERENCES

[1] Maureen C Ashe, Meghan Winters, Christiane A Hoppmann, Martin G Dawes, Paul A Gardiner, Lora M Giangregorio, Kenneth M Madden, Megan M McAllister, Gillian Wong, Joseph H Puyat, et al. 2015. "Not just another walking program": Everyday Activity Supports You (EASY) model—a randomized pilot study for a parallel randomized controlled trial. *Pilot and feasibility studies* 1, 1 (2015), 1–12.

[2] Aviroop Biswas, Paul I Oh, Guy E Faulkner, Ravi R Bajaj, Michael A Silver, Marc S Mitchell, and David A Alter. 2015. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Annals of internal medicine* 162, 2 (2015), 123–132.

[3] Virginia Braun and Victoria Clarke. 2012. *Thematic analysis.* American Psychological Association.

[4] Virginia Braun and Victoria Clarke. 2019. Reflecting on reflexive thematic analysis. *Qualitative research in sport, exercise and health* 11, 4 (2019), 589–597.

[5] Karen Broekhuizen, Jelle de Gelder, Carolien A Wijsman, Liselotte W Wijsman, Rudi GJ Westendorp, Evert Verhagen, Pieternella E Slagboom, Anton J de Craen, Willem van Mechelen, Diana van Heemst, et al. 2016. An internet-based physical activity intervention to improve quality of life of inactive older adults: a randomized controlled trial. *Journal of medical Internet research* 18, 4 (2016), e4335.

[6] Karen Marie Bundgaard. 2005. The meaning of everyday meals in living units for older people. *Journal of Occupational Science* 12, 2 (2005), 91–101.

[7] Clara Caldeira and Yunan Chen. 2019. Seniors and self-tracking technology. *Perspectives on human-computer interaction research with older people* (2019), 67–79.

[8] Clara Caldeira, Novia Nurain, Anna A Heintzman, Haley Molchan, Kelly Caine, George Demiris, Katie A Siek, Blaine Reeder, and Kay Connelly. 2023. How do I compare to the other people?": Older Adults' Perspectives on Personal Smart Home Data for Self-Management". *Proceedings of the ACM on Human-Computer Interaction* 7, CSCW2 (2023), 1–32.

[9] Jessica R Cauchard, Jeremy Frey, Octavia Zahrt, Krister Johnson, Alia Crum, and James A Landay. 2019. The positive impact of push vs pull progress feedback: a 6-week activity tracking study in the wild. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 3, 3 (2019), 1–23.

[10] Jo-Ana D Chase, Lorraine J Phillips, and Marybeth Brown. 2017. Physical activity intervention effects on physical function among community-dwelling older adults: a systematic review and meta-analysis. *Journal of aging and physical activity* 25, 1 (2017), 149–170.

[11] Enrica Chiappero et al. 2014. Basic needs. In *Encyclopedia of quality of life and well-being research.* Springer, 329–335.

[12] Dongwook Cho, Jay Post, and Sung Kyeom Kim. 2018. Comparison of passive and active leisure activities and life satisfaction with aging. *Geriatrics & gerontology international* 18, 3 (2018), 380–386.

[13] Eun Kyoung Choe, Saeed Abdullah, Mashfiqui Rabbi, Edison Thomaz, Daniel A Epstein, Felicia Cordeiro, Matthew Kay, Gregory D Abowd, Tanzeem Choudhury, James Fogarty, et al. 2017. Semi-automated tracking: a balanced approach for self-monitoring applications. *IEEE Pervasive Computing* 16, 1 (2017), 74–84.

[14] BUM Chul-Ho, John Arthur Johnson, and CHOI Chulhwan. 2020. Healthy aging and happiness in the Korean elderly based upon leisure activity type. *Iranian Journal of Public Health* 49, 3 (2020), 454–462.

[15] Lynne Corner, Katie Brittain, and John Bond. 2007. Social aspects of ageing. *Psychiatry* 6, 12 (2007), 480–483.

[16] Benjamin Cornwell, Edward O Laumann, and L Philip Schumm. 2008. The social connectedness of older adults: A national profile. *American sociological review* 73, 2 (2008), 185–203.

[17] Jennifer L Davidson and Carlos Jensen. 2013. What health topics older adults want to track: a participatory design study. In *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility.* 1–8.

[18] David W Dunstan, Bronwyn A Kingwell, Robyn Larsen, Genevieve N Healy, Ester Cerin, Marc T Hamilton, Jonathan E Shaw, David A Bertovic, Paul Z Zimmet, Jo Salmon, et al. 2012. Breaking up prolonged sitting reduces postprandial glucose and insulin responses. *Diabetes care* 35, 5 (2012), 976–983.

[19] Utkarsh Dwivedi, Jaina Gandhi, Raj Parikh, Merijke Coenraad, Elizabeth Bonsignore, and Hernisa Kacorri. 2021. Exploring Machine Teaching with Children. In *2021 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC)*. 1–11. https://doi.org/10.1109/VL/HCC51201.2021.9576171

[20] Aaron M Eakman. 2013. Relationships between meaningful activity, basic psychological needs, and meaning in life: Test of the meaningful activity and life meaning model. *OTJR: Occupation, Participation and Health* 33, 2 (2013), 100–109.

[21] Aaron M Eakman, Mike E Carlson, and Florence A Clark. 2010. The meaningful activity participation assessment: A measure of engagement in personally valued activities. *The International Journal of Aging and Human Development* 70, 4 (2010), 299–317.

[22] Mélanie Emile, Aina Chalabaev, Yannick Stephan, Karine Corrion, and Fabienne d'Arripe Longueville. 2014. Aging stereotypes and active lifestyle: Personal correlates of stereotype internalization and relationships with level of physical activity among older adults. *Psychology of Sport and Exercise* 15, 2 (2014), 198–204.

[23] AB Evans, A Nistrup, and J Allen-Collinson. 2018. Socio-cultural approaches to ageing: Changing our understanding of the life-course. *The Palgrave Handbook of Ageing and Physical Activity Promotion. London: Palgrave* (2018).

[24] Chloe Fan, Jodi Forlizzi, and Anind Dey. 2012. Considerations for technology that support physical activity by older adults. In *Proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility*. 33–40.

[25] Rebecca Fiebrink, Perry R. Cook, and Dan Trueman. 2011. Human Model Evaluation in Interactive Supervised Learning. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Vancouver, BC, Canada) *(CHI '11)*. Association for Computing Machinery, New York, NY, USA, 147–156. https://doi.org/10.1145/1978942.1978965

[26] Batya Friedman, Peter Kahn, and Alan Borning. 2002. Value sensitive design: Theory and methods. *University of Washington technical report* 2, 8 (2002).

[27] Kathrin Gerling, Mo Ray, Vero Vanden Abeele, and Adam B Evans. 2020. Critical reflections on technology to support physical activity among older adults: An exploration of leading HCI venues. *ACM Transactions on Accessible Computing (TACCESS)* 13, 1 (2020), 1–23.

[28] Bluma Goldberg, E Sharon Brintnell, and Jack Goldberg. 2002. The relationship between engagement in meaningful activities and quality of life in persons disabled by mental illness. *Occupational Therapy in Mental Health* 18, 2 (2002), 17–44.

[29] Rúben Gouveia and Daniel A Epstein. 2023. This Watchface Fits with my Tattoos: Investigating Customisation Needs and Preferences in Personal Tracking. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–15.

[30] Deborah Hannam. 1997. More than a cup of tea: Meaning construction in an everyday occupation. *Journal of Occupational Science* 4, 2 (1997), 69–73.

[31] Genevieve N Healy, Katrien Wijndaele, David W Dunstan, Jonathan E Shaw, Jo Salmon, Paul Z Zimmet, and Neville Owen. 2008. Objectively measured sedentary time, physical activity, and metabolic risk: the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Diabetes care* 31, 2 (2008), 369–371.

[32] Tom Hitron, Yoav Orlev, Iddo Wald, Ariel Shamir, Hadas Erel, and Oren Zuckerman. 2019. Can Children Understand Machine Learning Concepts? The Effect of Uncovering Black Boxes. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, Article 415, 11 pages. https://doi.org/10.1145/3290605.3300645

[33] Ann L Horgas, Hans-Ulrich Wilms, and Margret M Baltes. 1998. Daily life in very old age: Everyday activities as expression of successful living. *The Gerontologist* 38, 5 (1998), 556–568.

[34] Chun Liang Hsu, John R Best, Jennifer C Davis, Lindsay S Nagamatsu, Shirley Wang, Lara A Boyd, GY Robin Hsiung, Michelle W Voss, Janice Jennifer Eng, and Teresa Liu-Ambrose. 2018. Aerobic exercise promotes executive functions and impacts functional neural activity among older adults with vascular cognitive impairment. *British journal of sports medicine* 52, 3 (2018), 184–191.

[35] Ole Sejer Iversen, Kim Halskov, and Tuck W Leong. 2012. Values-led participatory design. *CoDesign* 8, 2-3 (2012), 87–103.

[36] Hernisa Kacorri, Kris M. Kitani, Jeffrey P. Bigham, and Chieko Asakawa. 2017. People with Visual Impairment Training Personal Object Recognizers: Feasibility and Challenges. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. ACM, New York, NY, USA, 5839–5849. https://doi.org/10.1145/3025453.3025899

[37] Anna Kalma, Bernd Ploderer, Laurianne Sitbon, and Margot Brereton. 2020. Understanding Older Adult Values through Technologies Used for Crafting. In *Proceedings of the 32nd Australian Conference on Human-Computer Interaction*. 602–613.

[38] Jin Kang, Jomara Binda, Pratik Agarwal, Bruno Saconi, and Eun Kyoung Choe. 2017. Fostering user engagement: Improving sense of identity through cosmetic customization in wearable trackers. In *Proceedings of the 11th EAI international conference on pervasive computing technologies for healthcare*. 11–20.

[39] Sidney Katz, Amasa B Ford, Roland W Moskowitz, Beverly A Jackson, and Marjorie W Jaffe. 1963. Studies of illness in the aged: the index of ADL: a standardized measure of biological and psychosocial function. *jama* 185, 12 (1963), 914–919.

[40] Michael P Kelly and Mary Barker. 2016. Why is changing health-related behaviour so difficult? *Public health* 136 (2016), 109–116.

[41] Justin WL Keogh, Nicola Power, Leslie Wooller, Patricia Lucas, and Chris Whatman. 2014. Physical and psychosocial function in residential aged-care elders: effect of Nintendo Wii Sports games. *Journal of aging and physical activity* 22, 2 (2014), 235–244.

[42] Hamed Ketabdar and Tim Polzehl. 2009. Fall and emergency detection with mobile phones. In *Proceedings of the 11th international ACM SIGACCESS conference on Computers and accessibility*. 241–242.

[43] Gary Kielhofner. 2002. *A model of human occupation: Theory and application*. Lippincott Williams & Wilkins.

[44] Junhyoung Kim, Sunwoo Lee, Sanghee Chun, Areum Han, and Jinmoo Heo. 2017. The effects of leisure-time physical activity for optimism, life satisfaction, psychological well-being, and positive affect among older adults with loneliness. *Annals of leisure research* 20, 4 (2017), 406–415.

[45] Young-Ho Kim, Diana Chou, Bongshin Lee, Margaret Danilovich, Amanda Lazar, David E Conroy, Hernisa Kacorri, and Eun Kyoung Choe. 2022. Mymove: Facilitating older adults to collect in-situ activity labels on a smartwatch with speech. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. 1–21.

[46] Abby C King, Eric B Hekler, Lauren A Grieco, Sandra J Winter, Jylana L Sheats, Matthew P Buman, Banny Banerjee, Thomas N Robinson, and Jesse Cirimele. 2013. Harnessing different motivational frames via mobile phones to promote daily physical activity and reduce sedentary behavior in aging adults. *PloS one* 8, 4 (2013), e62613.

[47] Bran Knowles, Vicki L Hanson, Yvonne Rogers, Anne Marie Piper, Jenny Waycott, Nigel Davies, Aloha Hufana Ambe, Robin N Brewer, Debaleena Chattopadhyay, Marianne Dee, et al. 2021. The harm in conflating aging with accessibility. *Commun. ACM* 64, 7 (2021), 66–71.

[48] M Powell Lawton and Elaine M Brody. 1969. Assessment of older people: self-maintaining and instrumental activities of daily living. *The gerontologist* 9, 3_Part_1 (1969), 179–186.

[49] Amanda Lazar and David H Nguyen. 2017. Successful Leisure in Independent Living Communities: Understanding Older Adults' Motivations to Engage in Leisure Activities. In *Proceedings of the 2017 CHI conference on human factors in computing systems*. 7042–7056.

[50] Tuck Wah Leong and Ole Sejer Iversen. 2015. Values-led participatory design as a pursuit of meaningful alternatives. In *Proceedings of the annual meeting of the australian special interest group for computer human interaction*. 314–323.

[51] Tuck Wah Leong and Toni Robertson. 2016. Voicing values: laying foundations for ageing people to participate in design. In *Proceedings of the 14th Participatory Design Conference: Full papers-Volume 1*. 31–40.

[52] Jersey Liang. 1986. Self-reported physical health among aged adults. *Journal of Gerontology* 41, 2 (1986), 248–260.

[53] Yi-Tien Lin, Mingchih Chen, Chien-Chang Ho, and Tian-Shyug Lee. 2020. Relationships among leisure physical activity, sedentary lifestyle, physical fitness, and happiness in adults 65 years or older in Taiwan. *International journal of environmental research and public health* 17, 14 (2020), 5235.

[54] Yuhan Luo, Young-Ho Kim, Bongshin Lee, Naeemul Hassan, and Eun Kyoung Choe. 2021. Foodscrap: Promoting rich data capture and reflective food journaling through speech input. In *Designing Interactive Systems Conference 2021*. 606–618.

[55] Yuhan Luo, Bongshin Lee, Donghee Yvette Wohn, Amanda L Rebar, David E Conroy, and Eun Kyoung Choe. 2018. Time for break: Understanding information workers' sedentary behavior through a break prompting system. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–14.

[56] Aileen M Lynch, Sean Kilroy, Heather McKee, Fintan Sheerin, Monique Epstein, Ariane Girault, Pierre Gillois, Jean Luc Bosson, Carole Rolland, Mary Harkin, et al. 2023. Active older adults goal setting outcomes for engaging in a physical activity app and the motivation characteristics of these goals (MOVEAGE-ACT). *Preventive Medicine Reports* 31 (2023), 102084.

[57] Elizabeth J Lyons, Maria C Swartz, Zakkoyya H Lewis, Eloisa Martinez, and Kristofer Jennings. 2017. Feasibility and acceptability of a wearable technology physical activity intervention with telephone counseling for mid-aged and older adults: a randomized controlled pilot trial. *JMIR mHealth and uHealth* 5, 3 (2017), e6967.

[58] Jaclyn P Maher and David E Conroy. 2017. Daily life satisfaction in older adults as a function of (in) activity. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 72, 4 (2017), 593–602.

[59] Silvio Maltagliati, Philippe Sarrazin, Sandrine Isoard-Gautheur, Ryan E Rhodes, Matthieu P Boisgontier, and Boris Cheval. 2022. I sit but i don't know why: Investigating the multiple precursors of leisure-time sedentary behaviors. *Research Quarterly for Exercise and Sport* 93, 3 (2022), 548–563.

[60] Maedeh Mansoubi, Natalie Pearson, Stuart JH Biddle, and Stacy Clemes. 2014. The relationship between sedentary behaviour and physical activity in adults: a systematic review. *Preventive medicine* 69 (2014), 28–35.

[61] Kryss McKenna, Kieran Broome, and Jacki Liddle. 2007. What older people do: Time use and exploring the link between role participation and life satisfaction in people aged 65 years and over. *Australian Occupational Therapy Journal* 54, 4

(2007), 273–284.
[62] Cecily Morrison, Martin Grayson, Rita Faia Marques, Daniela Massiceti, Camilla Longden, Linda Wen, and Edward Cutrell. 2023. Understanding Personalized Accessibility through Teachable AI: Designing and Evaluating Find My Things for People who are Blind or Low Vision. In *Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility*. 1–12.
[63] Dave Möwisch, Annette Brose, and Florian Schmiedek. 2023. Active time use and well-being in older adulthood: Results from a day reconstruction method study. *Work, Aging and Retirement* 9, 1 (2023), 7–18.
[64] Luciara Nardon, Amrita Hari, and Katlin Aarma. 2021. Reflective interviewing—Increasing social impact through research. *International Journal of Qualitative Methods* 20 (2021), 16094069211065233.
[65] Novia Nurain and Chia-Fang Chung. 2023. "I left my legacy, told my story": Understanding Older Adults' Tracking Practices to Promote Active Aging. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference*. 459–475.
[66] Don Nutbeam. 2008. What would the Ottawa Charter look like if it were written today? *Critical Public Health* 18, 4 (2008), 435–441. https://doi.org/10.1080/09581590802551208
[67] National Institute on Aging. 2020. https://www.nia.nih.gov/health/brain-health/cognitive-health-and-older-adults
[68] World Health Organization. 2022. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health
[69] World Health Organization et al. 2002. *Active ageing: A policy framework*. Technical Report. World Health Organization.
[70] Hannah M O'Rourke and Souraya Sidani. 2017. Definition, determinants, and outcomes of social connectedness for older adults: A scoping review. *Journal of Gerontological Nursing* 43, 7 (2017), 43–52.
[71] Neville Owen, Adrian Bauman, and Wendy Brown. 2009. Too much sitting: a novel and important predictor of chronic disease risk? *British journal of sports medicine* 43, 2 (2009), 81–83.
[72] Carley O'Neill and Shilpa Dogra. 2016. Different types of sedentary activities and their association with perceived health and wellness among middle-aged and older adults: a cross-sectional analysis. *American journal of health promotion* 30, 5 (2016), 314–322.
[73] Alison Phinney, Habib Chaudhury, and Deborah L O'connor. 2007. Doing as much as I can do: The meaning of activity for people with dementia. *Aging and Mental Health* 11, 4 (2007), 384–393.
[74] Katrina L Piercy, Richard P Troiano, Rachel M Ballard, Susan A Carlson, Janet E Fulton, Deborah A Galuska, Stephanie M George, and Richard D Olson. 2018. The physical activity guidelines for Americans. *Jama* 320, 19 (2018), 2020–2028.
[75] GH Rawlings, RK Williams, DJ Clarke, C English, Claire Fitzsimons, I Holloway, R Lawton, Gillian Mead, A Patel, and A Forster. 2019. Exploring adults' experiences of sedentary behaviour and participation in non-workplace interventions designed to reduce sedentary behaviour: a thematic synthesis of qualitative studies. *BMC public health* 19 (2019), 1–16.
[76] RescueTime. 2023. RescueTime. https://www.rescuetime.com/. [Accessed 14-09-2023].
[77] Ryan E Rhodes and Chris M Blanchard. 2011. Time displacement and confidence to participate in physical activity. *International journal of behavioral medicine* 18 (2011), 229–234.
[78] Ryan E Rhodes, Alison Quinlan, and Chetan D Mistry. 2016. Do other goals influence physical activity? A systematic review examining the relationship between other goals and physical activity behavior. *Preventive Medicine* 91 (2016), 306–317.
[79] Dori E Rosenberg, Amy K Lee, Melissa Anderson, Anne Renz, Theresa E Matson, Jacqueline Kerr, David Arterburn, and Jennifer B McClure. 2018. Reducing sedentary time for obese older adults: protocol for a randomized controlled trial. *JMIR research protocols* 7, 2 (2018), e8883.
[80] John W Rowe and Robert L Kahn. 1997. Successful aging. *The gerontologist* 37, 4 (1997), 433–440.
[81] Jungsu Ryu and Jinmoo Heo. 2018. Relationships between leisure activity types and well-being in older adults. *Leisure Studies* 37, 3 (2018), 331–342.
[82] Shalom H Schwartz. 2012. An overview of the Schwartz theory of basic values. *Online readings in Psychology and Culture* 2, 1 (2012), 11.
[83] Patrice Y. Simard, Saleema Amershi, David Maxwell Chickering, Alicia Edelman Pelton, Soroush Ghorashi, Christopher Meek, Gonzalo Ramos, Jina Suh, Johan Verwey, Mo Wang, and John Wernsing. 2017. Machine Teaching: A New Paradigm for Building Machine Learning Systems. *CoRR* abs/1707.06742 (2017). arXiv:1707.06742 http://arxiv.org/abs/1707.06742
[84] Anuradha Singh, Saeed Ur Rehman, Sira Yongchareon, and Peter Han Joo Chong. 2020. Sensor technologies for fall detection systems: A review. *IEEE Sensors Journal* 20, 13 (2020), 6889–6919.
[85] Stephanie Stockwell, Patricia Schofield, Abi Fisher, Joseph Firth, Sarah E Jackson, Brendon Stubbs, and Lee Smith. 2019. Digital behavior change interventions to promote physical activity and/or reduce sedentary behavior in older adults: a systematic review and meta-analysis. *Experimental gerontology* 120 (2019), 68–87.
[86] James D Stowe and Teresa M Cooney. 2015. Examining Rowe and Kahn's concept of successful aging: Importance of taking a life course perspective. *The Gerontologist* 55, 1 (2015), 43–50.
[87] PAL Technologies. 2023. PALT Technologies Ltd. https://www.palt.com/. [Accessed 14-09-2023].
[88] Yonatan Vaizman, Katherine Ellis, Gert Lanckriet, and Nadir Weibel. 2018. Extrasensory app: Data collection in-the-wild with rich user interface to self-report behavior. In *Proceedings of the 2018 CHI conference on human factors in computing systems*. 1–12.
[89] Dimitri Vargemidis, Kathrin Gerling, Vero Vanden Abeele, Luc Geurts, and Katta Spiel. 2021. Irrelevant gadgets or a source of worry: exploring wearable activity trackers with older adults. *ACM Transactions on Accessible Computing (TACCESS)* 14, 3 (2021), 1–28.
[90] Dimitri Vargemidis, Kathrin Gerling, Katta Spiel, Vero Vanden Abeele, and Luc Geurts. 2020. Wearable physical activity tracking systems for older adults—a systematic review. *ACM Transactions on Computing for Healthcare* 1, 4 (2020), 1–37.
[91] John Vines, Gary Pritchard, Peter Wright, Patrick Olivier, and Katie Brittain. 2015. An age-old problem: Examining the discourses of ageing in HCI and strategies for future research. *ACM Transactions on Computer-Human Interaction (TOCHI)* 22, 1 (2015), 1–27.
[92] Christopher K Wong, Helena M Mentis, and Ravi Kuber. 2018. The bit doesn't fit: Evaluation of a commercial activity-tracker at slower walking speeds. *Gait & posture* 59 (2018), 177–181.
[93] Hyejin Yoon, Won Seok Lee, Kyoung-Bae Kim, and Joonho Moon. 2020. Effects of leisure participation on life satisfaction in older Korean adults: A panel analysis. *International journal of environmental research and public health* 17, 12 (2020), 4402.
[94] Min Zhao, Sreenivas P Veeranki, Shengxu Li, Lyn M Steffen, and Bo Xi. 2019. Beneficial associations of low and large doses of leisure time physical activity with all-cause, cardiovascular disease and cancer mortality: a national cohort study of 88,140 US adults. *British journal of sports medicine* 53, 22 (2019), 1405–1411.
[95] Wei Zhao, Ryan M Kelly, Melissa J Rogerson, and Jenny Waycott. 2023. Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of Self-Determination Theory. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–17.
[96] Xiaojin Zhu, Adish Singla, Sandra Zilles, and Anna N. Rafferty. 2018. An Overview of Machine Teaching. *CoRR* abs/1801.05927 (2018). arXiv:1801.05927 http://arxiv.org/abs/1801.05927
[97] Abigail Zimmermann-Niefield, Makenna Turner, Bridget Murphy, Shaun K. Kane, and R. Benjamin Shapiro. 2019. Youth Learning Machine Learning through Building Models of Athletic Moves. In *Proceedings of the 18th ACM International Conference on Interaction Design and Children* (Boise, ID, USA) *(IDC '19)*. Association for Computing Machinery, New York, NY, USA, 121–132. https://doi.org/10.1145/3311927.3323139

APPENDIX

A JOURNALING ACTIVITIES

Table 1: A summary of the activity types that participants logged, number of reports and participant counts for each activity type. Twenty nine activity types are grouped into nine higher-level semantics. Because the activity types are multi-coded the sum of the percentages of reports is over 100%. This table is reproduced from [45].

Semantics / Types		Reports		Participant(s)
House-keeping	Cleaning/arranging/carrying	263	21%	13
	Preparing food	123	10%	13
	Driving/in a vehicle	108	9%	12
	Gardening	99	8%	11
	Caring for pets	68	6%	7
	Offline shopping	36	3%	11
	Other	12	1%	6
Self-maintenance	Eating food	186	15%	13
	Dressing	36	3%	9
	Personal hygiene	24	2%	8
	Treatment	10	1%	6
Non-exercise / stepping		171	14%	12
Screen time	Computer	164	13%	11
	TV	151	12%	12
	Mobile device	27	2%	4
	Device unspecified	17	1%	5
Exercise	Cardio	118	10%	11
	Strength/stretching	51	4%	8
	Other	10	1%	4
Paperwork / desk work		68	6%	10
Hobby/leisure	Reading on paper	59	5%	10
	Playing puzzle/ table game	17	1%	6
	Crafting/artwork	15	1%	4
	Seeing at a theater	11	1%	3
	Playing a musical instrument	8	1%	2
Resting	Nothing/waiting	54	4%	12
	Napping	19	2%	7
Social	Face-to-face interaction	39	3%	9
	Voice call	36	3%	8