Never Stop Creating: A Preliminary Inquiry in Older Adults' Everyday Innovations

Xiying Wang
Pennsylvania State University
University Park, PA
jennwang404@gmail.com

Tiffany Kneareem
Pennsylvania State University
University Park, PA
tak54@psu.edu

John M. Carroll
Pennsylvania State University
University Park, PA
jmcarroll@psu.edu

ABSTRACT

Participation in activities of personal interest and passion facilitates older adults' health and well-being. In this study, we investigated older adults' experiences related to their engagement and development of personal interests. We found out that older adults actively generated creative concepts and turned those ideas into innovative activities and artifacts, which positively revitalized a community, sustained an organization, and supported other people. Although any activity may be beneficial for older adults' health and well-being, we argue that everyday innovations play a particularly important role, and present an important opportunity to enhance their quality of life. We conclude by proposing design strategies to support everyday innovations to promote healthy aging.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; *Empirical studies in HCI*; • **Social and professional topics** → Seniors;

KEYWORDS

Active aging, older adults, everyday innovations, health, well-being

ACM Reference Format:

Xiying Wang, Tiffany Kneareem, and John M. Carroll. 2019. Never Stop Creating: A Preliminary Inquiry in Older Adults' Everyday Innovations. In *The 13th International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth'19)*, May 20–23, 2019, Trento, Italy. ACM, New York, NY, USA, 8 pages. <https://doi.org/10.1145/3329189.3329192>

1 INTRODUCTION

Aging has been a popular focus in Human-Computer Interaction (HCI) for decades. There are two major approaches to understand aging and to design technology to enhance older adults' health and well-being. One approach is often referred to as '*deficit-driven design*' [6], which investigates the issues (e.g., functional declines) that older adults may encounter, with the aim to design assistive technology to support their participation in everyday tasks. For example, monitoring systems that track health conditions such as food intake and blood pressure [5] or sensor-based home tracking

systems [e.g., 13, 16, 24, 33] that are designed for use by older adults themselves, their family and other caregivers. In this approach, older adults are often treated as dependent on external assistance in order to maintain their health or manage deficits related to aging.

In contrast, the other approach views older adults as active and able participants in the promotion of their own health and well-being [e.g., 6, 31]. In this approach, researchers aim at understanding the active aspects of aging, such as socializing [e.g., 32, 34], playing games [14], volunteering [6], sharing information [18], and exercising [20], in order to design technology to facilitate older adults to live a quality life. By focusing on older adults' strengths and the positive experiences in their lives, this approach can broaden the realm of design opportunities that can contribute to aging well [6].

In line with the active approach, our study aims at understanding active aging through the lens of personal interest development. Previous research suggests that when older adults engage in activities related to their hobbies and interests, these activities can enhance their well-being [14, 23, 32]. In this paper, we further investigate the development and maintenance of interest-related activities in the aging process, discussing how those activities and the products of those activities may play an important role in active and healthy aging.

For this study, we focused on older adults who age in place rather than in an assisted living community. In recent years, the number of older adults who choose to live at home is rapidly growing, making up to almost 90% of the 12.1 million older adult population in the United States [30]. In addition, compared to those residing in an assisted living community, people who live in their own home may not have easy access to recreational facilities [22]. For example, many assisted living communities provide a variety of social activities based on their residents' interests, e.g., art class, photography club, etc. Those activities are successful in promoting older adults' health and well-being through engagement in social life [14].

However, it is still unclear how older adults who age in place contribute to their own health and well-being without convenient access to organized activities. To answer that, we conducted 20 semi-structured interviews with healthy older adults who live in their own home to investigate the following research questions: 1) How do older adults engage in activities related to their interests and passions, 2) How do older adults find opportunities to develop and maintain their interests or passions, and 3) What impact do these experiences have on their health and well-being, on both individual and social levels.

Our study contributes to the Human-Computer Interaction (HCI) community and active aging in two ways. First, our study provide an alternative understanding on active aging through the lens of

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

PervasiveHealth'19, May 20–23, 2019, Trento, Italy

© 2019 Copyright held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-6126-2/19/05...\$15.00

<https://doi.org/10.1145/3329189.3329192>

interest development. We found that older adults create and develop what we have called *everyday innovations*, which are the creative ideas and artifacts that they produced in the process of developing personal interests and passions. These everyday innovations play an important role in shaping older adults' health and well-being. The processes around innovation are inherent to active aging, which redefines the traditional view of older adults spending their retirement years in a sedentary lifestyle, e.g., watching TV. They are no longer solitary participants who passively consume the artifacts of modern life. Instead, we posit that they are actively looking for opportunities to engage in activities that make their lives more interesting and contribute to the society. Second, we provide insights on how technology can leverage older adult's creativity to promote a stronger foundation for a more active aging, an *innovative aging* through technology. In this view, we propose that technology needs to support older adults as innovators in their life to promote active aging.

Throughout this paper, we use term *older adults* to describe people aged 65 years or above who reside in their own home. First, we discuss related literature in active aging, leisure activities, and aging in place. Second, we explain our study methodology, procedure and analysis. We then report on our findings and contribute insights into how older adults utilize their creativity in interest-related activities. We found that they create everyday innovations through engaging in interest development and in an active lifestyle. These everyday innovations play an important role in the vitality of their community and the continuity to an organization that they belong to. We conclude by discussing design opportunities to promote active aging with the consideration of everyday innovations.

2 RELATED WORK

In this section, we draw on literature from gerontology and Human-Computer Interaction (HCI) to discuss active aging, personal interests, and aging in place. We then explain why older adults' engagement in interest building can uncover design opportunities to promote healthy aging.

2.1 Hobbies, Leisure Activities, and Active Aging

Hobbies and personal interests are an important part of active aging [e.g., 4, 14, 17, 21, 25]. Older adults are found to perceive hobbies and interests as a necessary aspect of good health [26]. On average, they spend more time on their hobbies and interests than younger people do [29].

Previous research suggests that participation in personal interests has many health benefits for individuals. For older adults, doing things they like may sharpen their minds [11], maintain a positive feeling such as happiness [19], prevent functional declines [28], and improve learning [12]. For example, Gow et al. found that engaging in enjoyable activities was associated with a decrease in cognitive decline for older adults [11]. This indicates that doing things that are of interest to older adults may help them engage in thinking activities and become mentally sharp. From a six-year study, Menec et al. learned that engaging in hobby activities could make older adults feel happy about their lives [19]. Other studies suggested

that doing things related to personal interests could prevent some of the physical declines that many older adults face [e.g., 28].

Socially, engagement in hobbies and interests facilitates interpersonal relationships, which is beneficial to well-being [2]. For example, older adults who participated in a choir group created strong social bonds with their cohort [12]. They felt welcomed in the choir and more included in the wider community [12]. Greater devotion to personal interests is also reported to be associated with higher satisfaction with regards to health and well-being [12]. In addition, a handful of research has explored personal interests and active aging through the lens of social well-being [14, 23, 32]. Rosner et al. found that older adults with similar interests would gather together to participate in hobbies, such as knitting [23]. Lazar and Nguyen argued that leisure activities were closely related to active aging [14]. Wang et al. further discussed how older adults actively connected with others and formed interest-based social circles [32].

However, outside of forming social bonds, it is still unclear what other factors within interest development could motivate older adults to engage actively in activities that they are passionate about. In the process of interest building, we are not clear as to the outcomes of active interest building and how the overall experience influences the aging process. In this study, we aim to unpack the activities, outcomes, and relevant experiences of interest development and examine how they may play a role in older adults' quality of life.

2.2 Aging in Place

In modern American society, more and more people choose to age in their own home instead of an assisted living community [30]. This rapidly growing population is estimated to reach more than 14 million by the year 2029 [7]. Compared with those who live in an assisted living community, it may be difficult for older adults who age in place to access to external support, assistance, and services. For example, they may have to take care of themselves during times of illness or injury. Socially, they may need to come up with their own ways to stay connected to others, e.g., search for information to stay informed about social activities in their communities [32]. One major concern involves the risks and difficulties that older adults may encounter when dealing with injury, illness, or loneliness by themselves [3]. For example, older adults may unexpectedly encounter an illness that no one else in their life is aware of [1]. In addition, sometimes they lose track of their daily tasks, e.g., pill intake [15]. And they may feel socially isolated due to the lack of access to pre-existing social arrangements [8].

As a result, a large body of work has targeted on how to help older adults to deal the aforementioned health-related issues [e.g., 6, 9, 31]. For example, tracking and monitoring systems are built to make sure family members and caregivers can keep an eye on the daily activities of older adults [e.g., 1, 16, 33] and to remind older adults to perform important health activities [e.g., 15, 16]. Those systems highlight the risks (e.g., trips and falls) of aging in place, aiming to support older adults who live by themselves to overcome those deficits.

Durick et al. pointed out that not every older adult had a deficit-related problem to be solved [9]. They can live independently [9], define their own personal and social values [6], and stay socially

active [34]. In this contemporary approach, older adults are considered to take an positive role in maintaining their own health and well-being. Understanding their role from an active and positive standpoint is important and necessary to unpack the myths of aging [9] and broadens the design opportunities for health and well-being [31].

Following this contemporary approach, we choose to focus on healthy older adults who are aging in place and investigate their interest development and maintenance. We aim to examine their natural process of interest building, understand their experiences of the process, and explore the design implications for promoting healthy aging.

3 METHOD

We conducted 20 semi-structured interviews with older adults to understand the role of personal interest development in their everyday lives. All participants were healthy seniors aged 65 years old or above, who were living in their own home.

3.1 Recruitment

All of our participants were recruited from two local senior centers or various community groups in a medium-sized city in the Eastern United States. We used the following strategies to generate engaging conversations with participants in order to explore personal history, life events, and activities with relation to their interest development.

First, we visited each senior center weekly for six months to build rapport and get to know more about the personal experiences and stories of the older adults who regularly went to those centers. For example, we held casual conversations and played games together. Second, we participated in various local community groups' meetings, events, and discussions with the aim to understand more about older adults' activities, interests, and passions. For example, we regularly attended clubs and non-profit groups organized by retired people. Through this, we were able to develop some common ground with the older adults. We used these stories, activities, and experiences as examples to engage participants in semi-structured interviews and were able to facilitate rich conversations on the topic of building interests and passions.

We then recruited 20 participants based on the following criteria: healthy older adults 1) who were willing to participate in the study, 2) who were 65 years old and above, and 3) who were currently aging in place. All of our participants voluntarily took part in the study without compensation.

3.2 Participant

Among the participants (see Table 1), 14 were female and six were male. More than half (11 out of 20) had a domestic partner, four were in a romantic relationship, and the rest were either widowed, single or divorced. The majority (13 out of 20) of the participants were living with at least one member of their family, with the remainder living alone. Our participants were interested in a range of topics (see Table 1). History, heritage preservation, environmental sustainability, socializing, volunteering, and exercising were some common interests shared among the participants.

3.3 Study Procedure and Analysis

We conducted 20 semi-structured interviews to understand active aging through the lens of interest and passion development. In particular, we probed our participants with stories and events that we learned from them to engage in rich conversations. For example, we asked questions about what they were interested in doing in their daily life, to share examples or stories about their passions, how they developed their personal interests, and experiences that made them feel good or proud. Then we further probed the activities, events, and artifacts they created or designed based on those experiences and stories. Each interview lasted from one hour and a half to three hours, depending on the conversation between the participant and the researcher. Each interview took place at a convenient location for the participant, for example, a private room at a local cafe.

All interviews were fully transcribed and iteratively analyzed following the comparative analysis by Glaser and Strauss [10]. First, five interviews were coded with comments and memos. Second, the codes of those five interviews were restructured into a list of new codes, e.g., "innovation: heritage preservation: old house event". Third, we used the new codes to re-code the first five interviews and analyze the rest 15 interviews, adding new emerging codes using the same structure. Last, we grouped all the codes into different themes, with associated memos, comments, and participants' quotes. Many themes were generated from the interviews. In this paper, we present in detail the set of themes around the everyday creations and innovations that stemmed from interest building.

4 EVERYDAY INNOVATIONS OF OLDER ADULTS

Our participants told us that they engaged in a wide range of interests and activities. Heritage preservation, historic architecture, outdoor activities such as fishing and farming, knitting, socializing, and learning new things were common interests. For example, Jim, who was very interested in heritage preservation and historic houses, often spent time finding "traces" of the previous owners in his old house. One of his favorite leisure activities was looking up the history of his house in the archives from different historic centers and libraries. Afterwards, he tried to find evidence in his house to validate the historic archives.

"There's that whole thing of forensics where you go and you just look and there are clues hidden everywhere...another time in the house where the couple that lived there had no children, so they too adopted. So this is their daughter that they adopted. I think I have her name on a door down in the cellar that she painted her name on the door." (Jim, male, interested in heritage preservation)

Unearthing history in his house made Jim happy. In particular, he was excited when he could locate some evidence in the house that verified the content of the archives that he read at the centers. Similarly, Harry enjoyed fishing with his friends. They would drive up to Canada every year to fish for trout. Others, like Marie, Margret, Nick, Betty, and Caroline, were fond of social activities. They often organized small gatherings with friends for lunch or coffee. All of our participants felt good about doing the activities they were

Table 1: Participant demographics

Pseudonym	Gender	Marital Status	Living Situation	Personal Interests
Lina	Female	Married	Lives with family	Knitting
George	Male	Engaged	Lives alone	Environmental sustainability, politics
Doris	Female	Divorced, has a boyfriend	Lives with family	Traveling, socializing
Patricia	Female	Divorced, has a boyfriend	Lives with family	Socializing
Ruth	Female	Widowed	Lives alone	Exercising
Marie	Female	Single	Lives alone	Volunteering, socializing
Margaret	Female	Widowed	Lives alone	Volunteering, socializing
Hazel	Female	Widowed	Lives alone	Exercising, food
Faye	Female	Married	Lives with family	Socializing
Helen	Female	Married	Lives with family	Cooking, history
Joe	Male	Separated, has a girlfriend	Lives alone	History, old houses, farming, heritage preservation
Joy	Female	Married	Lives with family	Outdoor activities
Nick	Male	Married	Lives with family	Socializing, learning
Betty	Female	Married	Lives with family	Socializing, reading
Jane	Female	Divorced	Lives alone	History, heritage preservation, reading, helping others
Martha	Female	Married	Lives with family	History, heritage preservation
Jim	Male	Married	Lives with family	History, heritage preservation, old houses, house redesign and repair
Roy	Male	Married	Lives with family	Singing, Christianity
Harry	Male	Married	Lives with family	Fishing
Caroline	Female	Married	Lives with family	Socializing

passionate about. But engaging in personal interests does more than bringing in personal satisfaction with life.

We found out that older adults' engagement in hobby activities has a broader contribution to society which serves as an important motivation for them to sustain their hobby practices. They often generate creative ideas around their interests and passions. They then naturally turn those ideas into actions and artifacts, which have a positive impact on local towns, existing organizations, and other people in the community. At the same time, they are constructing their own health. We call this pattern *everyday innovations*: the practice through which older adults create, develop, and establish creative artifacts, activities, and solutions in their everyday life, which engages older adults in an active lifestyle.

The remainder of our findings section is divided into three themes: revitalizing local communities, sustaining existing organizations, and supporting others. Due to the high volume of interest-based stories related to everyday innovations, we first describe some key participant experiences and creations that define each

of the sections. Next, in each section, we describe one full story in greater detail in order to explain the active role that older adults take through the everyday innovation process in revitalizing their community, sustaining groups, and supporting other people.

4.1 Revitalizing Local Communities

During the interviews, our participants told us many stories related to the things they were passionate about. One important aspect of those stories is how they actively and naturally turned their personal interests into innovative ideas and activities that contributed to the liveliness of their local community.

For example, Martha had a great passion for historical events and activities. She was motivated to create various projects to promote the historic value of her hometown, a place her family had been a part of for generations. One of her highlights was hosting a storytelling event in a local museum, a program she developed for local people to share stories related to the town's history.

"We've got quite a following because we have people that are coming, that they walk away saying, 'I never knew that happened in my town', 'I never knew this place did this, that this happened here', 'Wow, I didn't know that'." (Martha, female, interested in history)

This event turned out to be a success, which increased people's awareness of the town's heritage. At the same time, Martha was also working on her other idea, which aimed to attract tourists interested in the town's history to facilitate local economic development. In Martha's mind, her town served as the mid-point for a long bus ride from one city to another, and thus provided a great opportunity for bus riders to break up their trip. She seized this opportunity and provided guided tours for those travelers to the historic sites around town.

Other participants also mentioned similar interest-based ideas and activities that made a positive impact on the local community. For example, during the time of our interview, Caroline was in the process of organizing a pop-up outdoor theatre because she was fond of movies. She was executing her idea to re-purpose an empty outdoor space for recreational use, aiming to invite people for movies and fun. Another participant, Lina, loved to knit. She came up with the idea of putting the extra scarves that she knitted on a statue in a busy downtown area. The purpose was that pedestrians could take them if they felt cold in the winter time. In this case, she creatively solved the problem of excess scarves.

Story: An Educational Event on Old Buildings. Joe chose to reside in the same small town where he was born and raised. Around a century ago, the town was a flourishing and exciting place with many opportunities. Unfortunately, it gradually declined over the years and became a place with lots of unused historic buildings dating back to 1700s. Ever since childhood, Joe had a special bond with old houses and he valued their beauty.

"We [Joe and his wife] did live for two years in a modern development...and it was a horrible experience. I was extremely unhappy...I did finally realize my dream [of living in an old house]...The chimneys in the house were like this...when it would snow, you know, the snow would come down the chimney and leaves would come down the chimney...I got very comfortable with that...I think it lulls us and we forget how transitory all this is." (Joe, male, interested in history, old houses, and farming)

It was unsettling for Joe to witness the decline of his hometown, a town with many beautiful old houses. He started to collect information and came up with an idea for an educational conference that focused on re-purposing old buildings for housing and economic development.

"The reason you want to bring them (refers to old buildings) back to life is because if a town has got a number of these buildings and there's not much happening in the buildings, then there's not much happening in much of the town. So there's a desire to rehabilitate these buildings, to re-purpose them." (Joe, male, interested in history, old houses, and farming)

In order to make the conference happen, Joe actively sought partnerships with heritage preservation organizations, created fundraisers and brought keynote speakers in for the event. He wrote emails

to many different organizations and had meetings with individuals interested in sponsoring the event. He attended lectures, networked, and searched online for suitable speakers for the conference. In the interview, Joe laughed that he had to write a lot every day to get the partnerships, and luckily, he liked to write.

Two years after the first conference, the results were becoming visible in the town. The event caught the community's attention, spotlighting heritage preservation and positively influencing the town's economic development. As Joe recalled, the fact that one attendee put renovation of old buildings into action made him very happy.

"This guy who's the presenter of this scheme, actually is trying to implement the scheme that he was explaining. So this delighted me...this is exactly what I was hoping would happen as a result of the [conference]." (Joe, male, interested in history, old houses, and farming)

Joe's experience and the other participants' stories demonstrate that the process of pursuing personal interests and passions is a process of generating and executing creative ideas. They actively developed their ideas into everyday innovations, which had a positive impact on the vitality of their community. The innovation process also facilitated them to stay active and creative.

4.2 Sustaining Existing Organizations

Another important aspect related to older adults' everyday innovation is that it helps to sustain an organization or a group, which in turn, has a positive impact on active aging. Older adults kept organizations or groups alive through building and developing their own personal interests and passions. In return, they could participate in, organize, or manage the group in a sustainable way.

After retirement, Joy volunteered in a senior group that monitors water quality (e.g., pH, flow, salinity) in local streams because she liked outdoor activities. Before the advent of Google spreadsheets, Joy creatively used the existing Google Docs system to manage the collected water quality data, even though the system was not explicitly created for data management. Every member in the group benefited from Joy's idea, easily entering their data online.

"But knowing about the Google Docs platform, I thought, 'Wow.' And the ability of forms for our members to enter the data into the forms to make it easy. I thought that's the perfect one for us at this time." (Joy, female, interested in outdoor activities)

More importantly, Joy's idea also played a key role in maintaining the water group. It largely reduced the burden of data entry and storage for other older adults in the group. They found it easy to adopt the data entry method and maintain the practice, even if they did not have much expertise in computing.

Similarly, other participants helped to sustain different groups by devoting themselves to the things they were passionate about. Interested in exercising, Ruth successfully increased the participation in her exercise class by adjusting the class schedule to a more suitable time for the other older adults. In return, she became more motivated to maintain the class because of the increase in participation.

Story: A Group to Support People with Visual Impairment. Jane was a director of a non-profit group that connected people with

visual impairment (PVI) to sight services. She was active in the group for a long time, serving as a volunteer, a board member, and finally taking on a director role in the group. One important reason that she kept active in the group was because she enjoyed helping people in need.

"I just saw people in need, and I wanted to help people. So that's just been a theme throughout my life. And it really wasn't until I got involved with the blindness community that I really found a way to do that...I get passionate about this." (Jane, female, interested in history and helping others)

Jane also experiences visual impairment. She has tunnel vision that only allows her to see things by looking straight at them. Influenced by her loss of vision, she felt motivated to support PVI. She actively connected PVI with resources they may need.

Two years ago, the group fell apart when the previous director abruptly stepped down. Jane began working to reassemble and sustain the group by implementing a new structure. Her idea was to collaborate with other vision services to attract new members to her group, share vision resources, and connect members with social services and resources during a monthly luncheon. The new structure was well-received and Jane's idea helped the group to continue growing. By doing so, Jane also found herself motivated to stay active as the director of the group.

"What we've done is we've brought three different groups together. And that was my idea, and Keith's idea [pseudonym], to work together. It's a very different model, and that's why it's working... And so I think we're all a little surprised at how well it's going." (Jane, female, interested in history and helping others)

Jane's efforts to help people experiencing visual impairment coupled with the other participants' stories illustrate how older adults' everyday innovations contribute to the continuity of an organization, which also sustains their engagement in the group. Their experiences highlight a creative problem-solving process with the desire to sustain something they were passionate about. The experiences of Joy, Joe, Ruth, and Jane are all great examples of how older adults came up with functional solutions to challenges in their interest development. By actively solving problems, they sustained their participation in doing the things they like.

4.3 Supporting Others

The third aspect of older adult's everyday innovation has an important, positive impact on other people. Our participants demonstrated that engagement in interested-related activities could provide external support to others (e.g., friends) while simultaneously making them actively engaged in their own life. For example, as a self-motivated volunteer, Martha contributed to the bicentennial history of her hometown because of her passion in heritage preservation. She felt proud to preserve the town's heritage while providing a learning opportunity for other people through her storytelling abilities.

Another participant, Hazel, liked food. She often cooked dishes and baked cookies by herself. Because she lived alone, she could not finish the food she prepared most of the time. She often saved some and brought it to her friends who did not have time to cook.

During our interview, Hazel also told us that she felt happy when her friends enjoyed her dishes and baked goods.

Story: A Bagpipe Blog. Jim was a retired technician who liked to write computer programs in his spare time. Before retirement, he was the second webmaster of a large university's website. He also taught web programming courses at that university. Jim told us that his friend Eli (pseudonym) started a personal blog on the Scottish musical instrument bagpipes. One day, his friend Eli found out that his blog was listed as one of the "worst" websites on a well-known site called "Worst of the Web". Many visitors clicked through that site to check out the "worst" bagpipes blog, which made Eli very sad because he did not see his site as something to be mocked.

Jim was very excited to help Eli with this problem because he had a chance to do web programming again. Jim used his coding passion and skills to design and implement a function which detected the referral click-through source to Eli's blog. If the function detected the click-through from the "Worst of the Web" site, Eli's bagpipe blog would not load. Instead, the function redirected that user back to the "Worst of the Web" site.

Jim felt a sense of achievement when he turned his interest in programming into a capacity that was helpful for Eli. Ever since, Jim felt more motivated to further develop his programming skills.

"That [refers to the explanation of the function] was my introduction to JavaScript. That's how I got to be a JavaScript expert. Just got started on stuff like that." (Jim, male, interested in old houses and computer programming)

Martha's writing on bicentennial history, Hazel's cooking for her friends, and Jim's function to thwart a joke in the bagpipes story all demonstrated how older adults engaged in their passions to help and support other people. In return, they felt more motivated to continue to develop what they liked because they enjoyed the artifacts that came out of their interests. At the same time, they were delighted that their everyday innovations were meaningful to other people.

5 INNOVATIVE AGING

In our society, the general perception of aging is that older adults often have poor health, are dependent, lose vigor, and are unable to be productive [27]. Many people tend to think that older adults often lack creativity and they do not have the ability to be productive [9].

Similar to Carroll et al.'s proposal on older adults being the gatekeepers of their community [6], our study shows that older adults are innovative leaders and advocates through participation in the things they are passionate about. In this case, they do not follow the general perception that society places on them, rather they seek out opportunities to do the things they like. They engage themselves in activities to keep their life meaningful. This shifts the view of what aging could look like: older adults are capable of enhancing their life by making it interesting, meaningful, and active.

In particular, older adults do surprising things when they engage in their personal interests and passions. They produce innovative ideas, artifacts, activities, and solutions in the process of building personal interests. Their interest development played a key role in organizing events to improve local communities, implementing

creative structures to sustain organizations, and designing practical solutions to help others. These contributions posit that older adults are more than capable of meeting their own needs. They also generate novel ideas which positively influence the communities, organizations, and people around them. At the same time, they create benefits to their own health and well-being. All these activities, such as identifying opportunities, turning novel ideas into actions, and continuing to pursue interest development, facilitate older adults to live an engaged life. For example, through everyday innovations, they become more motivated in engaging in their communities. They are able to sustain their active participation in existing groups by creatively maintaining those groups. In this point of view, older adults' everyday innovations lead to happiness, motivation, and a more active lifestyle.

This view further explains that active aging is not only about being active in the traditional sense, e.g., exercising, socializing, but it can also be an innovative process. When older adults do things that are important and interesting to them, they generate novel ideas, and take initiative to turn those ideas into products. This innovation process may become increasingly important for older adults to stay active and fit in the modern time. For example, they become more engaged in building their passion when everyday innovations positively influence their communities. They prolong their participation in a group through creatively sustaining the group. They are more motivated to learn and improve their skills in their interest topics when their creations become meaningful to others. More than being active in life, older adults take initiative in creating valuable and meaningful artifacts or activities through everyday innovations. This indicates that aging is *innovative*.

We propose that technology can support innovative aging by facilitating older adults in the development and maintenance of an active and engaged lifestyle. First, designing technology to support older adults' health and well-being can be collaborative. Technology design should reflect older adults creative qualities, taking the influence of everyday innovations on their communities into consideration. For example, technology can help older adults connect and communicate with community members and groups to identify opportunities to create something valuable for their community while further developing their interests.

Taking the case of Joe and his old house educational event, technology could facilitate Joe to identify potential collaborators by facilitating discussion between Joe and others in the community around his ideas to preserve historic buildings. Technology could also recommend other experts who have successfully revitalized historic towns. Joe could use their experience and expertise to refine his ideas around the utility of historic architecture. Technology can also suggest potential partners and sponsors based on their charitable activities, which might make it easier to recruit support for his idea. In sum, technology can be used as a collaborative innovation incubator for older adults, where it facilitates communication among the community, provides outreach support, and helps bring awareness to everyday innovations.

Another aspect of technology design is that it can bring awareness to older adults about their own impact on their communities, organizations, and other people. Making them feel good about their actions may encourage them continue to create everyday innovations or further explore interest development. In return, this may

lead to an even more active lifestyle. In this context, we propose designing technology to demonstrate the impact of everyday innovations and facilitate the visibility of those innovations. The impact on health and well-being may hold especially true for social impact innovations. For instance, technology can support community members in sharing of stories and experiences related to older adults' everyday innovations. In Joe's case, audience members may share their experiences and takeaways from his conference on historic houses. Technology can also help older adults to identify the value of their innovations as a way to encourage more active participation in interest development.

Second, designing technology to support innovative aging can be thought about from a long-term perspective. As our interviews suggest, developing personal interests and coming up with novel ideas based on those interests is a naturally evolving and dynamic process. We have seen how opportunities and challenges can change over time. For example, Jane's ideas of how to best maintain her group for people with visual impairment evolved based on changes in external situations. She came up with a new collaborative model to keep the group alive when it was in danger of falling apart. In Jane's case, we noticed the actions Jane took through her everyday innovation changed to meet the needs of her group. The design strategies to support older adults' everyday innovations should consider these evolution-based changes in situation, context, and personal experience. Keeping track of situations, identifying challenges, and providing resources and information may help to facilitate the realization of an everyday innovation. To successfully support healthy aging, we propose technology that keeps track of the progress of building interest to sustain everyday innovations over the long term.

6 CONCLUSION AND FUTURE WORK

In the process of constructing, developing, and maintaining personal interests and passions, older adults actively *innovate*. They come up with creative ideas and take initiative to turn those ideas into functional solutions, artifacts, and actions. In return, they create opportunities for themselves to become more active and engaged in life. We call those interest-based ideas, activities, and solutions the *everyday innovations* of older adults. We propose that technology supports older adults' everyday innovations to facilitate the development of personal interest and passions to promote health and well-being.

In the future, we plan to broaden our investigation by looking towards other groups whose missions involve the creation and implementation of innovative ideas. We will explore how those innovations impact the community, and see if there are collaboration opportunities within these groups. We will also design systems based on the findings of our everyday innovations studies. This involves development of interactive prototypes, and evaluation with older adults to see if those ideas could promote active aging through interest development.

Limitations. In this study, we only recruited healthy older adults. We aimed to explore how older adults maintain an active, healthy lifestyle through the lens of interest development. Therefore, we chose to focus on healthy older adults to understand their initiative in constructing health and well-being through interest development.

We hope that through this understanding, we can open up design opportunities for older adult's involvement in their own health and well-being. We suggest that the readers keep this limitation in mind while remaining open to the discussion around everyday innovations.

ACKNOWLEDGMENTS

We thank our anonymous reviewers for their insightful comments and helpful suggestions. We would also like to thank all the voluntary participants for sharing their stories with us. This work is supported by National Science Foundation Smart and Connected Health Program under Grant No.5102176.

REFERENCES

- [1] Ingrid Arreola, Zan Morris, Matthew Francisco, Kay Connelly, Kelly Caine, and Ginger White. 2014. From Checking on to Checking in: Designing for Low Socio-economic Status Older Adults. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 1933–1936. <https://doi.org/10.1145/2556288.2557084>
- [2] Robert C Atchley. 1980. *The social forces in later life: An introduction to social gerontology*. Wadsworth Publishing Company.
- [3] Stinne Aaløkke Ballegaard, Thomas Riisgaard Hansen, and Morten Kyng. 2008. Healthcare in Everyday Life: Designing Healthcare Services for Daily Life. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '08)*. ACM, New York, NY, USA, 1807–1816. <https://doi.org/10.1145/1357054.1357336>
- [4] Ann Bowling. 2008. Enhancing later life: how older people perceive active ageing? *Aging and Mental Health* 12, 3 (2008), 293–301.
- [5] Clara Caldeira, Matthew Bietz, Marisol Vidauri, and Yunan Chen. 2017. Senior Care for Aging in Place: Balancing Assistance and Independence. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, USA, 1605–1617. <https://doi.org/10.1145/2998181.2998206>
- [6] John M Carroll, Gregorio Convertino, Umer Farooq, and Mary Beth Rosson. 2012. The firekeepers: aging considered as a resource. *Universal access in the information society* 11, 1 (2012), 7–15.
- [7] Sandra L Colby and Jennifer M Ortman. 2014. The baby boom cohort in the United States: 2012 to 2060. *Population estimates and projections* (2014), 1–16.
- [8] Erin York Cornwell and Linda J Waite. 2009. Social disconnectedness, perceived isolation, and health among older adults. *Journal of health and social behavior* 50, 1 (2009), 31–48.
- [9] Jeannette Durick, Toni Robertson, Margot Brereton, Frank Vetere, and Bjorn Nansen. 2013. Dispelling Ageing Myths in Technology Design. In *Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration (OzCHI '13)*. ACM, New York, NY, USA, 467–476. <https://doi.org/10.1145/2541016.2541040>
- [10] Barney G Glaser and Anselm L Strauss. 1967. The discovery of grounded theory: strategies for qualitative theory. *New Brunswick: Aldine Transaction* (1967).
- [11] Alan J Gow, Alison Pattie, and Ian J Deary. 2017. Lifecourse activity participation from early, mid, and later adulthood as determinants of cognitive Aging: the Lothian birth cohort 1921. *The Journals of Gerontology: Series B* 72, 1 (2017), 25–37.
- [12] Julene K Johnson, Jukka Louhivuori, and Eero Siljander. 2017. Comparison of well-being of older adult choir singers and the general population in Finland: A case-control study. *Musicae Scientiae* 21, 2 (2017), 178–194.
- [13] Elizabeth Kaziunas, Mark S. Ackerman, Silvia Lindtner, and Joyce M. Lee. 2017. Caring Through Data: Attending to the Social and Emotional Experiences of Health Datafication. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, USA, 2260–2272. <https://doi.org/10.1145/2998181.2998303>
- [14] 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 (CHI '17)*. ACM, New York, NY, USA, 7042–7056. <https://doi.org/10.1145/3025453.3025802>
- [15] Matthew L. Lee and Anind K. Dey. 2011. Reflecting on Pills and Phone Use: Supporting Awareness of Functional Abilities for Older Adults. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, USA, 2095–2104. <https://doi.org/10.1145/1978942.1979247>
- [16] Matthew L. Lee and Anind K. Dey. 2015. Sensor-based Observations of Daily Living for Aging in Place. *Personal Ubiquitous Comput.* 19, 1 (Jan. 2015), 27–43. <https://doi.org/10.1007/s00779-014-0810-3>
- [17] Bruce W Lemon, Vern L Bengtson, and James A Peterson. 1972. An exploration of the activity theory of aging: Activity types and life satisfaction among in-movers to a retirement community. *Journal of gerontology* 27, 4 (1972), 511–523.
- [18] Andrew R. McNeill, Lynne Coventry, Jake Pywell, and Pam Briggs. 2017. Privacy Considerations when Designing Social Network Systems to Support Successful Ageing. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 6425–6437. <https://doi.org/10.1145/3025453.3025861>
- [19] Verena H Menec. 2003. The relation between everyday activities and successful aging: A 6-year longitudinal study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 58, 2 (2003), S74–S82.
- [20] Soud Nassir, Tuck Wah Leong, and Toni Robertson. 2015. Positive Ageing: Elements and Factors for Design. In *Proceedings of the Annual Meeting of the Australian Special Interest Group for Computer Human Interaction (OzCHI '15)*. ACM, New York, NY, USA, 264–268. <https://doi.org/10.1145/2838739.2838796>
- [21] Erdman Palmore. 1979. Predictors of successful aging. *The Gerontologist* 19, 5_Part_1 (1979), 427–431.
- [22] Leon A Pastalan. 1990. *Aging in place: The role of housing and social supports*. Vol. 6. Psychology Press.
- [23] Daniela K. Rosner and Kimiko Ryokai. 2008. Spyn: Augmenting Knitting to Support Storytelling and Reflection. In *Proceedings of the 10th International Conference on Ubiquitous Computing (UbiComp '08)*. ACM, New York, NY, USA, 340–349. <https://doi.org/10.1145/1409635.1409682>
- [24] Jim Rowan and Elizabeth D. Mynatt. 2005. Digital Family Portrait Field Trial: Support for Aging in Place. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '05)*. ACM, New York, NY, USA, 521–530. <https://doi.org/10.1145/1054972.1055044>
- [25] John W Rowe and Robert L Kahn. 1997. Successful aging. *The gerontologist* 37, 4 (1997), 433–440.
- [26] Robert B Tate, Leedine Lah, and T Edward Cuddy. 2003. Definition of successful aging by elderly Canadian males: The Manitoba follow-up study. *The Gerontologist* 43, 5 (2003), 735–744.
- [27] James E Thornton. 2002. Myths of aging or ageist stereotypes. *Educational gerontology* 28, 4 (2002), 301–312.
- [28] Kimiko Tomioka, Norio Kurumatani, and Hiroshi Hosoi. 2016. Relationship of having hobbies and a purpose in life with mortality, activities of daily living, and instrumental activities of daily living among community-dwelling elderly adults. *Journal of epidemiology* 26, 7 (2016), 361–370.
- [29] Lois M Verbrugge, Ann L Gruber-Baldini, and James L Fozard. 1996. Age differences and age changes in activities: Baltimore Longitudinal Study of Aging. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 51, 1 (1996), S30–S41.
- [30] Grayson K Vincent and Victoria Averil Velkoff. 2010. *The next four decades: The older population in the United States: 2010 to 2050*. Number 1138. US Department of Commerce, Economics and Statistics Administration, US Census Bureau.
- [31] 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 Trans. Comput.-Hum. Interact.* 22, 1, Article 2 (Feb. 2015), 27 pages. <https://doi.org/10.1145/2696867>
- [32] Xiyang Wang, Tiffany Kneare, Fanlu Gui, Srishti Gupta, Haining Zhu, Michael Williams, and John M. Carroll. 2018. The Safety Net of Aging in Place: Understanding How Older Adults Construct, Develop, and Maintain Their Social Circles. In *Proceedings of the 12th EAI International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth '18)*. ACM, New York, NY, USA, 191–200. <https://doi.org/10.1145/3240925.3240935>
- [33] Lu Xiao, Xueheng Yan, and Alison Emery. 2013. Design and evaluation of web interfaces for informal care providers in senior monitoring. In *Proceedings of the 76th ASIS&T Annual Meeting: Beyond the Cloud: Rethinking Information Boundaries*. American Society for Information Science, 8.
- [34] Chien Wen Yuan, Jessica Kropczynski, Richard Wirth, Mary Beth Rosson, and John M Carroll. 2017. Investigating older adults' social networks and coproduction activities for health. In *Proceedings of the 11th EAI International Conference on Pervasive Computing Technologies for Healthcare*. ACM, 68–77.