AN ABSTRACT OF THE DISSERTATION OF

Jennifer L. Davidson for the degree of Doctor of Philosophy in Computer Science presented on June 10, 2014.
Title: Involving Older Adults in the Design and Development of Free/Open Source Software

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Carlos Jensen

An age-wave is upon us where many older adults are reaching retirement. Technically experienced older adults have skills that could be directly applied to free/open source software (FOSS) communities, such as project management, programming, and/or knowledge of a rapidly growing end-user population. FOSS is a widely popular, low-cost way to create software solutions. FOSS is in need of new contributors, as it is mostly volunteer-driven and has a high contributor turnover rate. Also, FOSS communities are homogenous, comprised mostly of young white male contributors. My research goal is to change the current FOSS demographic by investigating how to involve older adults in FOSS design and development. This is a unique problem because older adults may have different motivations, experiences, and abilities than their younger counterparts. This research is comprised of two phases: involving older adults indirectly through participatory design, then investigating how to involve older adults more directly in development. This work is a portfolio of five peer-review quality conference publications that culminate in the following research deliverables: a list of benefits and barriers of older adults' involvement in FOSS, guidelines for including older adults in FOSS, and a prototype workshop curriculum for encouraging participation in FOSS by older adults.

Involving Older Adults in the Design and Development of Free/Open Source Software

by
Jennifer L. Davidson

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

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Jennifer L. Davidson, Author

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CONTRIBUTION OF AUTHORS

Jennifer L. Davidson is first author on every publication and did the vast majority of the writing for each publication. Carlos Jensen was involved in advising the design of each research study, and edited all documents. In Chapter 4, Rithika Naik helped write the last paragraph of the introduction and performed data analysis with Umme Ayda Mannan, Amir Azarbakht, and Jennifer L. Davidson. In Chapter 5, Umme Ayda wrote the daily diary section of the literature review and Rithika wrote the barriers to joining free/open source software section of the literature review. Umme Ayda, Rithika, Ishneet, Jennifer, and Carlos worked together on the data analysis for Chapter 5. Rithika and Rana Almurshed helped with data collection for Chapter 6. Rithika performed the self-efficacy data analysis, and Rana Almurshed helped with the engagement analysis in Chapter 6.

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Chapter 1. Introduction to Body of Work

1. What is Free/Open Source Software?

Free/Open Source Software (FOSS) is a type of software development that is driven by volunteers [6] who create software that is available for anyone to modify, edit, and redistribute [30]. According to BlackDuck, an open source research firm, there are over 200,000 FOSS projects [25]. Some popular FOSS projects are Linux [31], Apache [32], and Firefox [33]. FOSS projects have a variety of management models and joining process requirements [9]. Researchers are continually studying FOSS communities [1,4,6,14] and contributor motivations [3,7,11,26] to better understand how FOSS communities work and how to ensure their sustainability.

2. Motivation

My dissertation was born out of a simple question asked while I was working in industry, namely, "What will older software professionals do in retirement?" The US population is aging rapidly [27], and older adults are increasingly using technology like the Internet and social media [5,12,22]. Additionally, surveys show that FOSS communities lack age diversity [1,6]. While efforts have focused on gender diversity [18,20,23,29] and on including students (who are oftentimes novice programmers) in FOSS [8,15,28,34], there is a lack of efforts where researchers are not investigating how to increase age diversity by involving *older* adults in FOSS. This research seeks to address that gap through investigating older adults and their involvement in FOSS. Note that this research does not focus on teaching older adults how to program or teaching computer literacy. We focus on how older adults can apply their existing skills by contributing to FOSS.

3. Potential Benefits

When beginning this research, we saw many factors making our efforts worthwhile. First, we saw an opportunity to increase the size of the FOSS contributor pool, which is needed because FOSS has a high contributor turnover rate [21]. Second, including older adults would address the aforementioned issue of age diversity.

In terms of benefits to older adults, contributing to FOSS could be a way to stay cognitively active during retirement. Volunteering and staying cognitively active have been shown to have health benefits for older adults [16,19], and because contributing to FOSS is a volunteering activity that uses higher cognitive functions, we would expect to see the same benefits. Tun and Lachman show that computer use is associated with higher levels of cognitive ability across the lifespan [24]. While measuring the benefits of participating in FOSS is outside the scope of this research, we assume that these exist.

Aside from being cognitively beneficial, the Continuity Theory of Aging [2] states that retired people are likely to continue with tasks that were similar to their working life, to ease the transition from working to post-working life. For older adults with technical skills, contributing to FOSS would align well with this theory. A telling quote from a potential research participant who was not able to participate in a research study due to scheduling conflicts exhibits the idea, *"Rats... I'm a retired software professional and miss doing useful work."* FOSS would give older adults the opportunity to do useful work in a context with no mobility requirements, so they could participate long into retirement. In fact, older adults participate in virtual volunteering organizations such as the United Nations Volunteers Program [35], SeniorNet [36], and VolunteerMatch [37] to

avoid mobility requirements and have a more flexible volunteer experience [17]. However, none of these programs address the potential of contributing to FOSS as a form of virtual volunteering.

On a societal level, the United States has a "youth culture", where youth is "preferred" and ageist beliefs are entrenched in our society [13]. In fact, Joyce et al. argue that technology design and creation is ageist [10]. My research is disruptive, in that it challenges this youth culture by showing how older adults can have a positive and meaningful impact on a technology community.

4. Research Questions

The following research questions framed the development of four research studies. Before investigating involving new contributors, it was important to look at the current state of the field. **RQ1** is a formative question about how older adults fit in the existing free/open source software (FOSS) ecosystem including their roles, motivations, and community perceptions. Again, before developing interventions to enable older adults to contribute to FOSS, we investigated barriers and benefits of *existing* and *first-time* older contributors (**RQ2**). The final question asks if the intervention we crafted had an impact on overcoming barriers and enabling older adults to contribute (**RQ3**). A full list of research questions is below, along with Table 1 that shows a mapping of research questions to chapters.

RQ1. How do older adults fit into the existing FOSS ecosystem?

RQ1.1 What do older adults contribute to FOSS (and what are their roles)?

RQ1.2 What are older adults' attitudes toward FOSS?

RQ1.3 What are older adults' motivations for contributing to FOSS?

RQ1.4 What are FOSS community leaders' attitudes toward older adult contributors?

RQ2. What are the benefits and barriers that older adults face in FOSS?

RQ2.1 What can older adults contribute to FOSS, socially and technically?

RQ2.2 What benefits exist that may encourage/enable older adults to successfully contribute to FOSS?

RQ2.3 What barriers exist that inhibit older adults from successfully contributing to FOSS?

RQ3. How can we overcome barriers and highlight benefits to contributing to FOSS for older adults?

RQ3.1 Do we see a change in self-efficacy of contributing to FOSS due to the workshop's interventions?

Table 1. Research questions mapped to chapters.

Ch	Research questions answered
2 & 3	**RQ2.1** What can older adults contribute to FOSS, socially and technically?
4	**RQ1.** How do older adults fit into the existing FOSS ecosystem? **RQ1.1** What do older adults contribute to FOSS (and what are their roles)? **RQ1.2** What are older adults' attitudes toward FOSS? **RQ1.3** What are older adults' motivations for contributing to FOSS? **RQ1.4** What are FOSS community leaders' attitudes toward older adult contributors? **RQ2.2** What benefits exist that may encourage/enable older adults to successfully contribute to FOSS? **RQ2.3** What barriers exist that inhibit older adults from successfully contributing to FOSS?
5.	**RQ1.3** What are older adults' motivations for contributing to FOSS? **RQ2.** What are the benefits and barriers of involving older adults in FOSS? **RQ2.1** What can older adults contribute to FOSS, socially and technically? **RQ2.2** What benefits exist that may encourage/enable older adults to successfully contribute to FOSS? **RQ2.3** What barriers exist that inhibit older adults from successfully contributing to FOSS?
6	**RQ1.2** What are older adults' attitudes toward FOSS? **RQ1.3** What are older adults' motivations for contributing to FOSS? **RQ3.** How can we overcome barriers and highlight benefits to contributing to FOSS for older adults? **RQ3.1** Do we see a change in self-efficacy due to the workshop's interventions?

5. Research Process

To investigate the research questions listed in the previous section, we designed, developed, and executed four related research studies. Figure 1 shows the goal and participant demographic of each research study, and Figure 2 shows the order in which each study was run, coupled with the chapters that cover each study.

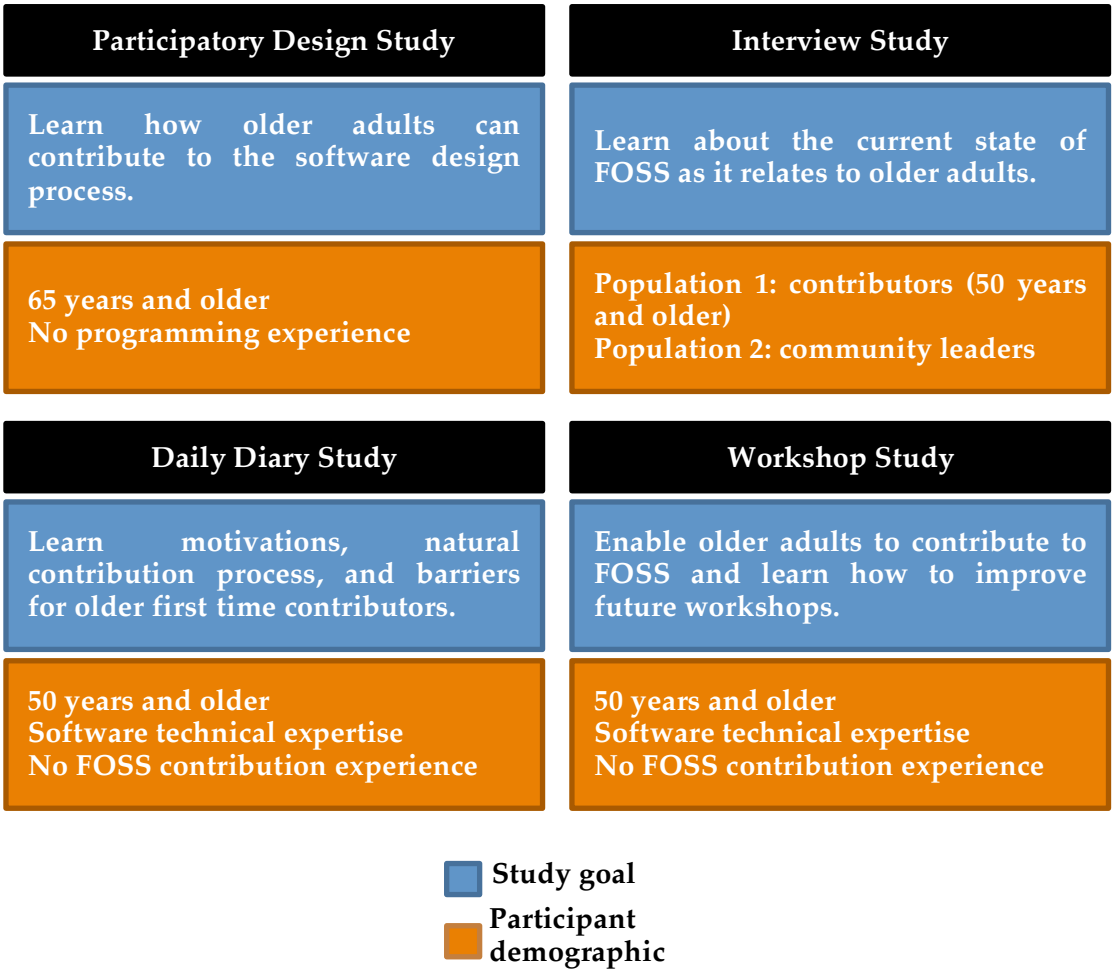

Figure 1. Goals and participant demographics of research studies

First, older adults took part in a participatory design study that was only tangentially related to FOSS. The goal for the participatory design study was to learn how older adults could contribute to the software design process, even if they do not have a programming background. Chapter 2, "Participatory Design

with Older Adults: An Analysis of Creativity in the Design of Mobile Healthcare Applications" reviews the participatory design study methodology and focuses on the level of creativity in each design. Chapter 3, "What Health Topics Older Adults Want To Track: A Participatory Design Study" focuses on the health topics in participants' designs, and compares them with what was available in the market.

The remaining chapters were directly related to FOSS contributions. Chapter 4, "On Older Adults and Free/Open Source: Reflections of Contributors and Community Leaders" describes the interview study that included an investigation into motivations of older contributors, barriers faced by older contributors, perceptions of discrimination in FOSS communities, and ways in which older contributors could add value to FOSS communities. In the daily diary study, we asked older adults who had no FOSS contribution experience to attempt to contribute and log their experiences over a period of two months. Chapter 5, "On Older Adults and Free/Open Source Software: A Diary Study of First-Time Contributors" reviews the daily diary study, shows participants' contribution paths, and insights into how to enable older adults to contribute to FOSS successfully. Finally, the workshop study is a culmination of the empirical work from the interview study and the daily diary study, as well as insights from computer science and adult learning literature. Chapter 6, "Practice Makes Perfect: Lessons Learned from Teaching Older Adults to Contribute to Free/Open Source Software" describes the workshop, participants' self-efficacy, motivations, engagement, and barriers, and ways to improve future outreach efforts to onboard older adults in FOSS. Chapter 7 is a conclusion of findings that address Appendices A, B and C which include the three research deliverables: a list of benefits and barriers of older adults' involvement in FOSS,

guidelines for including older adults in FOSS, and a prototype workshop curriculum for encouraging participation in FOSS by older adults.

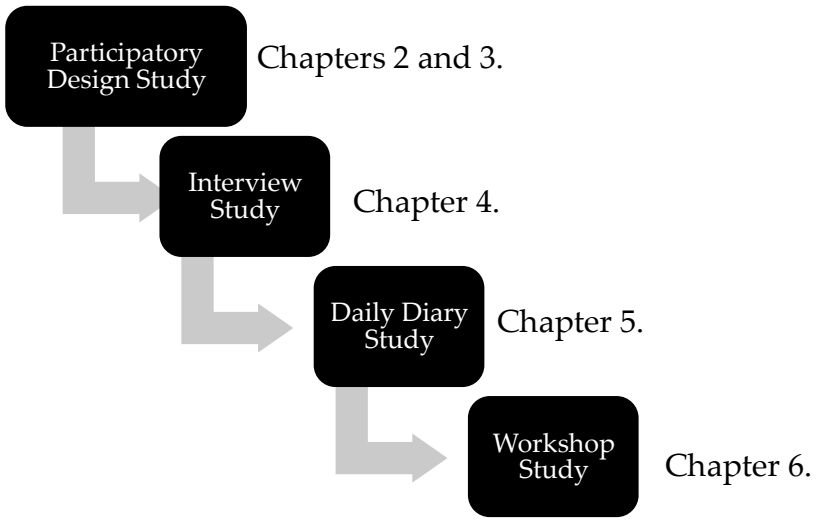

Figure 2. Research study order and related chapters.

Note: The included five conference papers (Chapters 2, 3, 4, 5, and 6) appear as they have been published or submitted, except for formatting, minor typos, and de-anonymization.

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Chapter 2. Participatory Design with Older Adults: An Analysis of Creativity in the Design of Mobile Healthcare Applications

Jennifer L. Davidson, Carlos Jensen

Davidson, J. and Jensen, C. Participatory Design with Older Adults: An Analysis of Creativity of the Design of Mobile Healthcare Applications. *9th ACM Conference on Creativity and Cognition*, ACM (2013).

1. Abstract

Researchers often use participatory design – involving end-users in technology ideation – as this is found to lead to more useful and relevant products. Researchers have sought to involve older adults in the design of emerging technologies like smartphones, with which older adults often have little experience. Therefore, their effectiveness as co-designers could be questioned. We examine whether older adults can create novel design ideas, and whether critiquing existing applications prior to ideation helps or hinders creativity. Panelists from industry and academia evaluated design ideas generated by focus groups of older adults. Out of five groups, the most creative design idea came from one with no smartphone experience or critique exposure. We found that while only some designs scored high on the novelty dimension of creativity, participants were enthusiastic about participating and adapted quickly. We found evidence that critiquing existing applications prior to ideation did more harm than good, potentially due to design fixation. We recommend continuing to involve older adults in the technology design ideation phase.

2. Introduction

An age-wave is upon us. According to United States census projections, 20% of the US population will be over 65 by 2030 [8]. Similar trends are seen globally. Additionally, a Pew Internet Research survey shows that 66% of older adults

who use the Internet look for health or medical information online [7]. Increasingly people are accessing information through smartphones; a Pew survey found that 47% of surveyed adults access local news from mobile devices [17]. Thus, researchers should determine how best to provide healthcare information for older adults through smartphone applications.

Because older adults are at the tail end of adoption, younger developers design many healthcare applications, often with little or no input from the population they hope to help. In part, this is because small teams write smartphone applications, which may not have the necessary means to adopt complex requirements gathering and evaluation processes. Therefore, there is a potential disconnection between what developers *think* will be useful and usable, and what the target population wants or needs.

Researchers try to involve their target audience in the design process, and more are trying to involve older adults in the design of mobile and Internet technologies [11,14,15]. Involving older adults in the process is a potentially low-cost way of improving the end result, and could be adopted in the design of smartphone applications. However, older adults may not have extensive experience with new technologies such as smartphones, which may affect their effectiveness as co-designers. Their lack of experience may lead them to pursue technologically impossible designs, pursue ideas that have already been explored, be too fixated on ideas from other domains, or limit themselves to less ambitious ideas because they lack an understanding of the capabilities and possibilities smartphones offer.

Ageism plays a role in the discussion of involving older adults in the technology design process. Joyce et al. performed an analysis of technology, science, and

ageism, stating that technology design is ageist [10]. They claimed technologies such as computers and the Internet are designed for younger people, thereby excluding older adults from comfortably using these technologies. While they do not propose a solution, involving older adults in the design of new technologies would directly address our current ageist landscape. Furthermore, involving older adults could help to enable active post-working lives. Older adults could contribute in a meaningful, empowering, and cognitively engaging way to the design of new technologies. Lindsay et al. point out that we as a community need to work harder to show more examples of how participatory design with older adults can lead to novel ideas so as to gain broader acceptance of the practice in industry and to dispel incorrect stereotypes regarding older adults [12]. These were some of the things that motivated us to do this study.

To this end, our research questions are as follows:

RQ1: Can involving older adults with little or no previous smartphone experience in participatory design result in novel insights and ideas?

> In addition to asking if they can produce novel insights, we need to examine *how to best* foster the creation of novel design ideas. Many researchers encourage critiquing before or in lieu of design sessions [14,15,21,22,23], claiming "seniors were better critics than designers" [15] and "critique is important not only in identifying problems, but also in beginning to address them" [22]. However, it is unclear how critiquing affects the novelty of the user's proposed design ideas. Perhaps older adults will identify more novel ideas because their technical naïveté prevents design fixation. On the other hand, their lack of experience could lead them to fixate on the familiar or ignore the possibilities

presented by novel technology. This leads us to our second research question:

RQ2: How does critiquing existing software prior to the participatory design process affect the creativity of participants?

Exposure to existing applications and designs may result in decreased creativity due to design fixation. Conversely, exposing inexperienced participants to interesting examples may increase their familiarity with technological and design possibilities, leading to more ambitious and innovative designs.

These are large and overarching questions, which cannot fully be explored in the context of a single paper or study. We present a first exploration of this topic, in hopes of providing concrete findings and guidelines for others seeking to work in this area.

To evaluate our research questions we organized five focus groups of 3-4 older adults (aged 65 and older) who had no previous experience with software development or design, and limited or no experience with smartphones. We asked them to help us design a health-related smartphone/tablet application. Two panels, one of industry experts and one of academics, evaluated the creativity of the resulting designs using the Creative Product Semantic Scale (CPSS) [3].

The rest of the paper is organized as follows: first we explain key concepts related to our work and our theoretical foundations, then we describe our participatory design sessions and creativity rating methods. Next, we present examples of designs generated in our design sessions to ground our findings, followed by quantitative and qualitative results from the creativity panels. We conclude with a discussion of considerations for designing with older adults,

shortcomings, and summarize our findings and recommendations for how to leverage older adults in the design of novel technologies.

3. Background

As our work is inherently interdisciplinary, we drew upon a variety of fields to gain a better understanding of how to conduct participatory design with older adults, and how to evaluate designs. To explore our second research question, we looked to the research on design fixation and writer's block.

3.1 Participatory Design and Older Adults

There is a track record of researchers who have involved older adults in software development. Abeele and Rompaey [1] performed an ethnographic inquiry to develop a model based on the "passions" of older adults for a digital game. Massimi et al. [15] conducted participatory activities involving older adults in the evaluation of mobile phones. There has been a significant effort in the UK on designing with older adults. Vines et al. performed participatory design exercises with eighty-somethings which led to the creation of a novel digital payment system called "Cheque Mates" [22,23]. However, researchers devised the system based on *feedback* from older adults, rather than older adults' ideation of a possible solution. Also in the UK, Uzor et al. conducted a participatory design study with older adults to create a fall rehabilitation tool [21]. They were able to create ideas for new tools using a co-design process with older adults, and claimed that they empowered older adults by involving them in the design process. Lorenz et al. [14] created an application for monitoring the health of older adults, but they followed a user-centered approach that did not include participatory design sessions.

Researchers including Lorenz et al. [14], like many others, examined usability requirements for older adults in a deficit model which focused on addressing older adult's impairments rather than their needs and desires. We built on the lessons from Convertino et al. [5] of focusing on positive implications of involving older workers and from Lindsay et al. [12] who eloquently stated, "Designing digital technologies for older people is not simply a matter of addressing the immediate consequence of the most obvious functional impairments."

We followed the advice of Lindsay et al. [12] on how to conduct participatory design with older adults. They provided a model with four steps: 1) identification and recruitment of stakeholders, 2) video prompt creation, 3) exploratory meetings and 4) low fidelity prototyping.

3.2 Creative Product Semantic Scale (CPSS)

In "Fifty Years of Creativity Research" [16], Mayer found that most researchers agreed that *originality* and *usefulness* are essential characteristics of creativity. The CPSS [3] is a method for evaluating creative products in a structured manner that includes the concepts of *originality* and *usefulness* but refers to them as *novelty* and *resolution*, respectively. CPSS in its full form is a 55-point scale of opposing adjectives along a Likert scale. The CPSS has been used to evaluate the creativity of products in a variety of domains including advertising [19] and Information Systems [13].

Lobert and Dologite [13] used a modified CPSS with 22 opposing adjective-pairs. Notably, they used CPSS on *ideas,* rather than a finished product. To better fit Information System design ideas, they introduced three overarching perspectives into the CPSS: project idea, organizational, and technical. Under

each of the perspectives there are four categories: novelty, resolution, and synthesis & elaboration. Each category has adjectives associated with them, evaluated on a Likert scale.

Thang et al. [13] implemented a shortened version of CPSS to determine if prototyping or brainstorming resulted in higher creativity scores. Fifteen master's students examined sixty designs. They asked a similar research question to one of ours, "How creative and innovative is the contribution of children in the participatory design process?" They found that prototyping (i.e. physically constructing an idea, rather than just explaining an idea) resulted in lower creativity scores. However, they recommended prototyping because it resulted in workable designs.

3.3 Writer's Block and Production Blocking

We predicted that groups who did not have experience with, or who were not allowed to critique existing smartphone applications prior to their design session would have lower creativity scores than those who did. Our hypothesis builds on the idea that designers may not know where to start when they start with a "blank slate". Another way to look at this, is that they may suffer from a phenomenon analogous to writer's block, defined in the Oxford English Dictionary as "a periodic lack of inspiration afflicting creative writers" [24], meaning that they may have a sort of "designer's block". We looked toward the literature around writer's block to support our hypothesis.

In an experiment with high school students, two types of instructions were tested after the appearance of writer's block: one that included discourse prompts about the structure of the text, and one that included only motivational messages [2]. They found that more "idea units" were created when discourse

prompts were included in the instructions. Rose analyzed writer's block in college students and found that students who followed more rigid writing rules or attempted to use unhelpful planning strategies experienced writer's block, whereas those who used less rigid rules, did not [18].

Similar to writer's block, there is an idea of *production blocking*, which occurs when an individual's ideas cannot be expressed because the structure of group work inhibits them [6].

3.4 Design Fixation

Another possible scenario is that writer's block is not a problem for our population, and that critiquing examples prior to a design session may result in lower creativity scores as designers are conditioned to focus on the examples they have seen. To explore this idea we examined literature on design fixation.

Design fixation, also described as being "stuck in a rut," is when a designer mimics designs without challenging existing concepts or introducing novelty. Jansson and Smith discussed design fixation, comparing it to functional fixedness in engineering conceptual design [9]. They recruited engineering design students and showed half one example and the other half no examples prior to performing a design task. They repeated a similar study with engineering professionals. Chyrsikou and Weisberg [4] showed pictorial examples prior to a design task. Both studies [4,9] showed that there is such a thing as design fixation; primed groups produced fewer design ideas and their ideas contained more elements from the examples compared to the groups that were not shown examples.

4. Methods

4.1 Participants

We recruited 18 adults over the age of 65 through the LIFE Registry[1], by posting flyers in a senior center, a senior gym, assisted living facility, and through participant word of mouth. Table 1 gives an overview of participant demographics.

Save Group 5, every group had one person who owned a smartphone, and was thus at least somewhat familiar with the potential functionality of these devices. Participants were randomly assigned to groups and groups randomly assigned to conditions (randomization of steps 4 and 5 in the protocol, see Figure 1). We did not control for gender, age distribution, or prior smartphone experience. The average participant age was 71.76 with a range from 65 to 88, and two-thirds of participants were women. We specifically recruited older adults with no programming experience who self-identified as healthy and active to avoid health-related confounding artifacts. Participants received $20 in compensation and gas money if they traveled more than 30 miles. Sessions were video recorded and two researchers took handwritten notes.

[1] http://health.oregonstate.edu/healthy-aging/life-registry

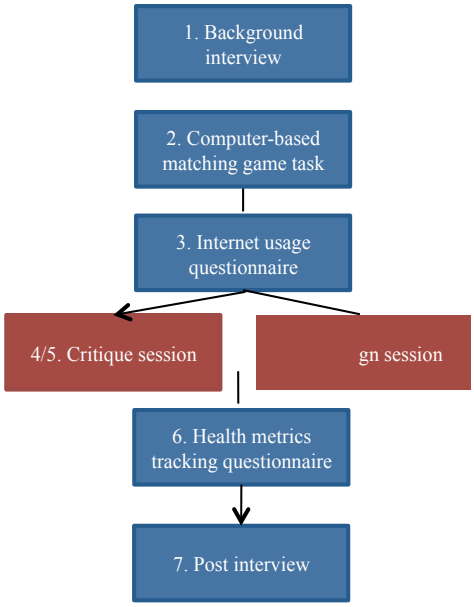

Figure 1. Study Protocol

Table 1. Participant Demographics

Group	Participant	Age	Gender	Smartphone Owner
1	18	83	W	No
1	3	88	M	No
1	27	67	W	Yes
1	23	65	W	No
2	6	73	W	No
2	28	71	W	No
2	11	71	M	Yes
3	16	72	W	No
3	19	72	M	No
3	32	72	W	No
3	1	65	W	Yes
4	4	66	M	Yes
4	9	82	W	No
4	30	85	W	No
5	12	65	M	No
5	20	71	W	No
5	8	67	M	No
5	7	68	W	No

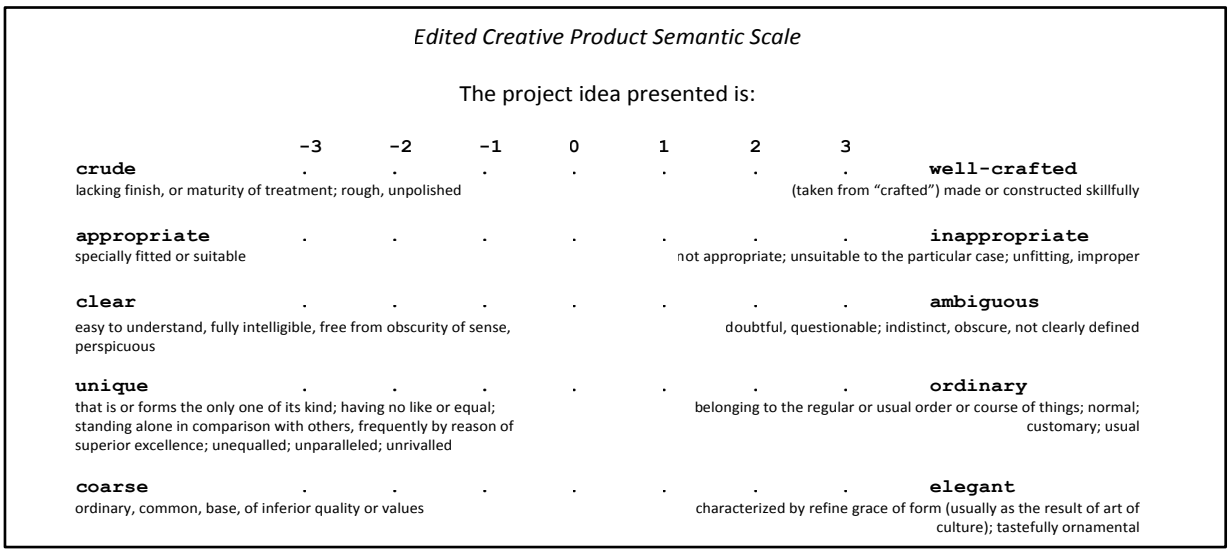

Figure 2. Excerpt of Edited Creative Product Semantic Scale with Oxford English Dictionary definitions.

4.2 Design Sessions

Sessions lasted 2.5 hours, following the procedure outlined in Figure 1. Red steps were performed in groups of 3 or 4 to facilitate intimate collaboration, and blue steps were done individually. Steps 4 and 5 were randomized; some critiqued designs first, and others designed first.

For the critique sessions, participants chose two smartphone applications to examine from a set of four. All but one group examined a prescription reminder application and an app that claimed to help users live happier lives. The final group chose to critique an application that helped track user heart rates and the application that claimed to help users live happier lives. Critique sessions lasted 20 minutes. Three groups critiqued applications before designing their own app, and 2 groups after.

During the design session, we asked participants to work together to sketch an idea for an application that tracked whatever health metrics they thought were

most important to their lives, for only thirty minutes. They were given pens, colored pencils, markers, flashcards, cardstock, and rulers. We gave a few verbal examples of health metrics to all groups, and emphasized creativity as well as our wish for them to create a design for a smartphone application that they would *want* to use.

4.3 Creativity Assessment Panels

We determined novelty and relative creativity using descriptive statistics gained from the CPSS analysis and qualitative data provided by panelist discussions. We organized two panels to evaluate the creativity of the *design ideas*. They were *not* rating the group's creativity. Panelists were chosen based on their expertise in at least one of the following areas: user-centered design, health-related technologies, and/or fields that focus on older adults (see Table 2). The first panel was composed of industry professionals. The second panel was composed of professors at a local research university.

Table 2. Information about panelists

Panelist	Gender	Occupation	Area
1	W	Health-related smartphone app start-up	Industry
2	W	Anthropologist in health technologies	Industry
3	W	User experience designer	Industry
4	W	Anthropologist in health technologies	Industry
5	W	Professor; Design & Human Environment, Gerontechnology	Academia
6	M	Professor; Info Vis, Gerontechnology	Academia
7	W	Professor; Public Health, Gerontology	Academia

We implemented the abridged CPSS instrument from Lobert and Dologite [13], and augmented it with brief Oxford English Dictionary definitions for the terms they used (see Figure 2)[2]. We supplemented the CPSS scores with panelist rankings and discussions based on suggestions from Besemer and O'Quin [3].

Each panel lasted approximately 2 hours and included a practice creativity rating session where participants individually rated the five design ideas, ranked overall creativity, group discussion, and a revision of ratings based on the discussion. The practice rating session used a sample design.

Notes from the panels were transcribed from the handwritten copies of both researchers, checked against each other, and quotes and themes were extracted.

Table 3. Cronbach-Alpha Scores. Unreliable scores shown in red (less than 0.7).

	Project Idea			Organizational			Technical		
Group	Novelty	Resolution	Synthesis & Elaboration (S&E)	Novelty	Resolution	S&E	Novelty	Resolution	S&E
1	**0.94**	-	**0.65**	**0.76**	**0.30**	-	**0.97**	**0.81**	-
2	**0.95**	-	**0.06**	**0.90**	**-0.63**	-	**0.87**	**0.74**	-
3	**0.93**	-	**0.78**	**0.95**	**-0.02**	-	**0.97**	**-0.41**	-
4	**0.83**	-	**0.57**	**0.86**	**-0.75**	-	**0.74**	**-0.15**	-
5	**0.82**	-	**0.58**	**0.87**	**-0.57**	-	**0.98**	**-0.49**	-

4.4 Creativity Analysis

In the CPSS, adjectives were ordered randomly to force panelists to think critically about their ratings. After the panels, we ordered adjectives from

[2] For access to the full assessment tool and full sized images of designs, see people.oregonstate.edu/~davidsje/pd_study.html

negative to positive (i.e. Inappropriate to Appropriate) and each pair was assigned a score of 1 to 7 according to the Likert-scale rating of the panelists. Then, we calculated mean scores for each category (Novelty, Resolution, Synthesis & Elaboration) across each perspective (Project Idea, Technical, Organizational). To view categorized adjectives, see [13]. We calculated an overall mean across the perspectives. To determine reliability, we performed a Cronbach-Alpha analysis on each category that had more than one adjective associated with it (see Table 3). Novelty was the only category found to be reliable across all perspectives.

5. Designs

To ground results, we give a brief presentation of the design ideas[2] and reactions from panelists.

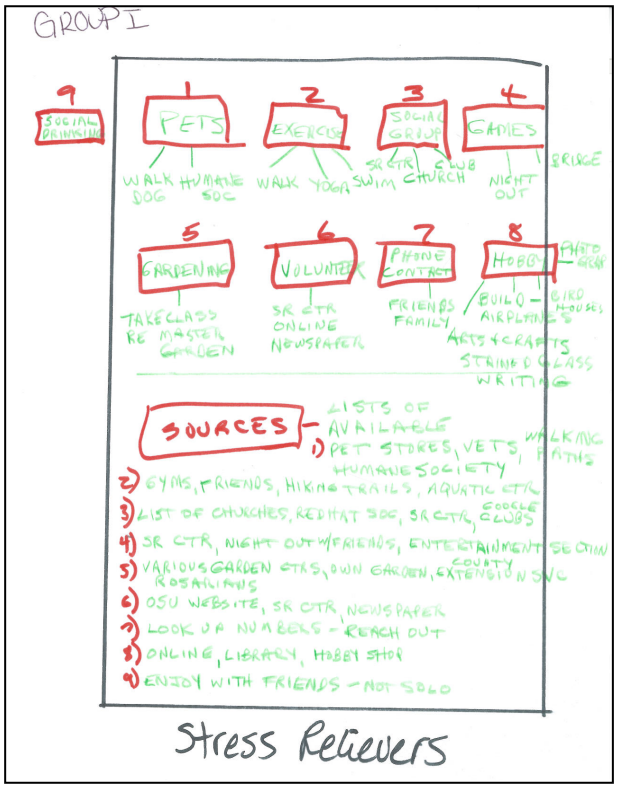

Figure 3. Design Idea for Group 1: Stress Relievers

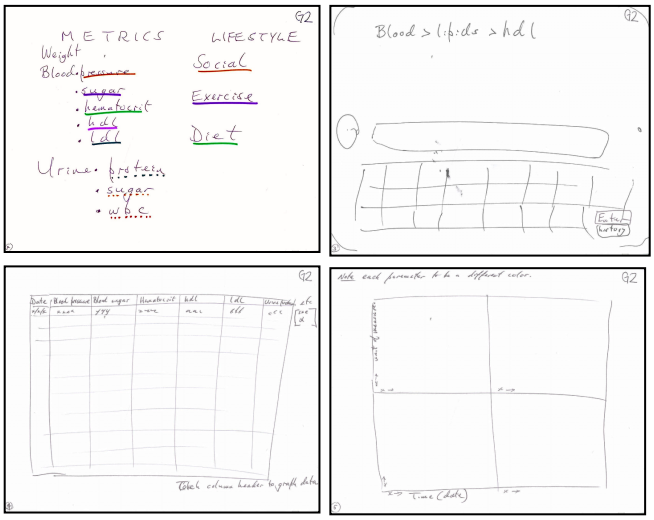

Figure 4. Design Idea for Group 2: Metrics/Lifestyle Tracking

5.1 Group 1: Stress Relievers

Group 1 developed an idea for an application that would give suggestions for stress relieving activities (see Figure 3). The design is more of a flowchart than an app. Panelist 2 found that the group stretched the definition of "health metric" in a positive way. Panelist 7 said, *"It would be a great resource to have if it's all in one place; I personally like that."* However, according to one panelist, *"This could be a one page church flyer"*. The academic panelists agreed that the design idea could be improved by dynamically populating information.

5.2 Group 2: Metrics/Lifestyle Tracking

Figure 4 shows an application designed to track a variety of metrics. Half the metrics would be transcribed from the user's lab results, including cholesterol levels, urine sample information, and a few other metrics. The other half of the app would be used to track information about diet, social activities, and exercise. After entering metrics, users would be presented with a spreadsheet. Each column title would be clickable and show a graph of the metric. Panelist 2

thought that this is *"like you're being watched from all angles."* Panelist 4 said, *"it was ambitious which is admirable, but that was also a drawback,"* referring to the number of metrics they wanted to track.

5.3 Group 3: Nutrition/Rest/Exercise

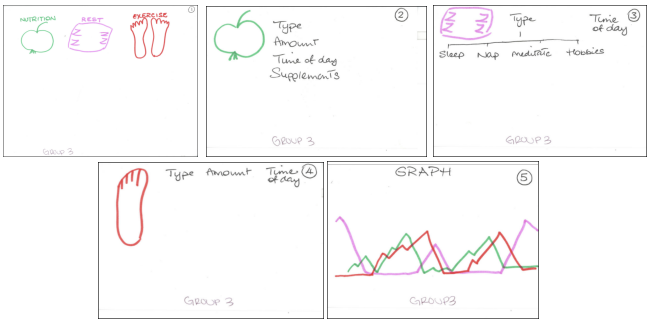

Figure 5. Design Idea for Group 3: Nutrition/Rest/Exercise

Figure 5 shows Group 3's idea to help users track their diet, rest, and exercise. The user would input the information for the three. The last screen shows a time-based graph for the three metrics. Panelist 7 mentioned, *"It's interesting to see that they have 'rest' in there because you don't see it often."* Panelist 3 praised the idea for being clear and simple. On the other hand, Panelist 5 criticized the usability and notes, *"Its effectiveness would be reliant on the data entry."*

5.4 Group 4: Balance

"Balance in your life" was the title for Group 4's design idea (see Figure 6). The application would teach the user about proper posture. Then, there would be a series of exercises to measure your balance. The last screen would be for encouragement and states, "And don't forget to breathe. Good luck." Panelist 1 claimed that application is *"relevant for old age and goes beyond what the doctor tells you to do*." Panelist 6 stated, *"They didn't take advantage of the medium they're working on"* in reference to how they could have used the accelerometer's capabilities in their app.

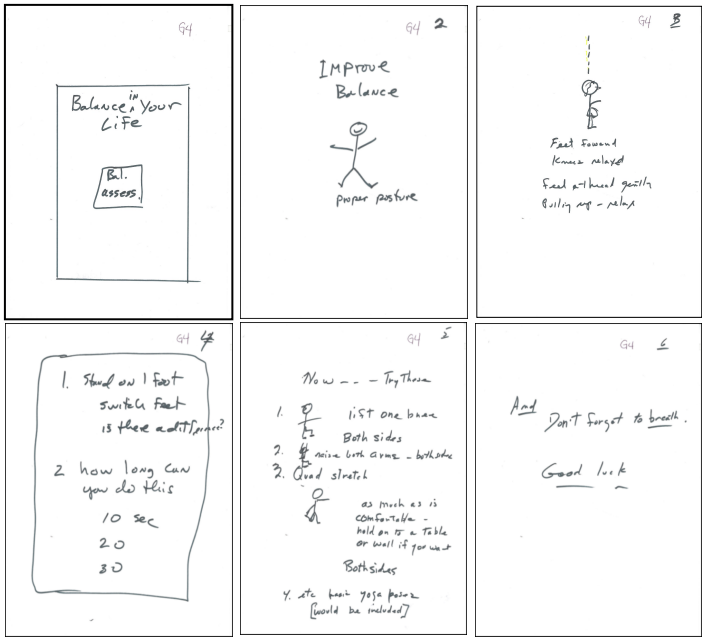

Figure 6. Design Idea for Group 4: Balance

5.5 Group 5: RxMedApp

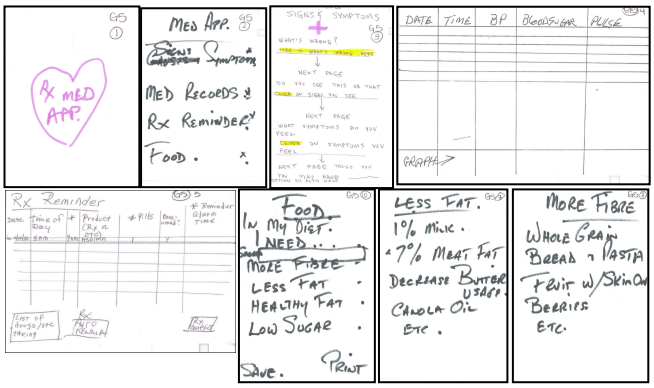

Figure 7. Design Idea for Group 5: RxMedApp

The last group devised an app called "RxMedApp" with four elements (see Figure 7). "Signs and Symptoms" would allow the user to self-diagnose problems. Then, there is a section for medical records that could be graphed. The third section would allow the user to enter prescription information with the option to auto-renew with a click. The app could also determine conflicts between prescriptions. The last section would give suggestions related to food intake based on desired outcomes (i.e. if the user wanted to lower their fat

intake, the app would give them tips on how to accomplish this). Panelist 6 liked the app because *"they stretched the idea of what could be done"* and panelists 3 and 5 *"liked the functionality related to prescriptions."* Similar to feedback about Group 2's design idea, Panelist 6 mentioned, *"There are too many features that might be incompatible."*

6. Results

We discuss the creativity and novelty of designs to aid in answering our research questions. Then we review panelist feedback regarding designs and the process of involving older adults.

6.1 Creativity scores

Table 4. Mean creativity scores. Standard deviation in parenthesis. * Critiqued apps after design. Red lowest score, green highest.

Group	Creativity Score	CPSS Score
1	4.14 (2.04)	3.94 (1.56)
2*	4.00 (1.80)	4.15 (1.24)
3	4.33 (2.04)	3.78 (1.07)
4	3.67 (2.73)	3.73 (1.68)
5*	5.50 (1.80)	5.12 (0.83)

Table 5. Mean novelty scores from each perspective. Standard deviation in parenthesis.

Group	Project Idea	Technical	Organizational
1	3.76 (1.74)	2.86 (1.70)	2.76 (1.90)
2	3.10 (1.45)	2.93 (1.54)	2.64 (1.25)
3	3.29 (1.65)	2.64 (1.52)	3.00 (1.66)
4	3.24 (1.95)	2.64 (1.77)	2.43 (1.43)
5	4.81 (1.18)	3.86 (1.52)	3.86 (1.75)

Table 4 shows the composite creativity and CPSS scores for the five design ideas. "Creativity Score" refers to an item on the CPSS where we asked panelists to rate the overall creativity on a Likert scale from *uncreative* to *creative*.

Every group's idea scored above average in Creativity, showing that designs were considered to be more creative than uncreative. Therefore, we can claim that involving older adults in the design process yields creative results.

The novelty scores were generally lower than the Creativity and CPSS scores (see Table 5), with all novelty scores lower than 4 except for the "Project Idea" category for Group 5's design idea. In fact, Group 5's design idea had the highest novelty score in all areas.

This shows evidence to support the idea that our participants were somewhat conservative in their design ideas. This could be because they have little technology experience and thus do not know what has been tried or what is possible. Alternatively, novelty scores may have suffered because they know their target audience better than younger designers, and therefore feel the need to be more conservative in the application space.

7. Panelist Feedback

7.1 Panelist Discussion Themes

Common themes emerged from panelist discussions about the designs. We review three of the themes in this section.

7.2 Grouping design ideas

Both panels agreed that designs from Groups 1 and 4 included more innovative ideas of what constitutes a health metric. As panelist 2 said, designs from groups 2, 3, and 5 *"all use the same visual metaphor that doctor's use."* Panelist 5 agreed

about groups 2 and 3 and claimed, *"Groups 2, 3, and 4 were not creative because they replicated what you could already do."* Panelists were not aware of the critiquing treatment but were able to determine novelty based on their experience and it was obvious to them that some groups had more novel designs than others.

7.3 Insufficient use of technology

While designs from Groups 1 and 4 were thought to be creative, both panels found that *"there was a lack of the technical piece behind it."* Similarly, Panelist 7 said, *"they may not have a clue as to what's possible."* The insufficient use of technology may help to explain the lower novelty scores.

7.4 Usability issues

Both panel sessions mentioned the issue of data entry and usability. Panelist 2 asked, *"where is the data coming from?"* and *"all of them have issues with user input."* Panelists agreed that dynamic rather than manual entry would improve designs.

7.5 What do you think of involving older adults in this way?

In addition to a discussion of the design ideas, we asked panelists for feedback about our approach to help gain an appreciation of an expert's view about participatory design with older adults. We believe our panelists offered a good cross-section of design professionals, whose work could directly benefit from running focus groups with older adults, and thus their evaluation of the pros and cons of this design technique should be poignant and meaningful.

Most panelists said that they saw direct value in involving older adults in design. However, Panelist 1 stated, *"we might be able to get more information about their needs if we interviewed them."* Lindsay et al., in their research, counter this

sentiment by arguing the dangers of such an approach: "Interpreting their utterances without properly engaging them in the design process is not an appropriate solution" [12]. Instead, Lindsay et al. argue that the "proper way" to involve older adults is to involve them as design partners, actively participating in design sessions. Certainly, we would argue that a middle ground sounds reasonable, as neither approach precludes the other. In fact, we interviewed participants and administered questionnaires. Panelist 2 agreed with Lindsay et al. and explained that there is more to it than understanding needs. She felt the participatory design process *"does not yield the power to the designer. It is empowering for the end user."* Echoing this, Panelist 5 said, *"I'm a big proponent for involving end users in the design. Measuring usability at the end of the process is too late."* Panelist 4 stated, *"Through this exercise the important problems related to health bubble up, which is neat."*

From the discussions we learned that most panelists agree with us and with Lindsay et al. [12], that involving older adults in participatory design is worthwhile and useful. This is especially true if costs and barriers can be kept to a minimum, as we did in this experiment. Panelists saw value in this process, as it identified participant needs and seemed to be empowering process for end-users.

8. Advice for Designing with Older Adults

To aid future researchers in conducting participatory design sessions with older adults, we provide some considerations from our experience with this study. We expect that many of these considerations can be extended across populations, and are not limited to working with older adults.

Lindsay et al. experienced four challenges when working with older adults:

maintaining focus and structure in meetings, representing and acting on issues, envisioning tangible concepts, and designing for non-tasks [12]. Massimi et al. provide another list of considerations for future researchers: provide alternative activities, create temporary subgroups to overcome deficits, minimize crosstalk, make participation an institutional affair, provide activity structure, speed up or down to suit the group, and blend individual and group sessions [15]. While we adhered to many of these considerations, we have more to contribute to the list based on our experiences.

8.1 Keep design sessions short

To overcome the challenge that Lindsay et al. [12] and Massimi et al. [15] faced with keeping focus and crosstalk, we recommend keeping design sessions short. We had no problems with crosstalk or focus because we only allotted thirty minutes for design sessions. This put some pressure on the focus groups to design quickly and efficiently. However, there is a trade-off to consider when deciding on design session length, as our short time may have been a contributing factor to the lower novelty scores.

8.2 Allow for informal socializing

Vines et al. framed their design sessions as "tea parties" and found benefit in allowing informal discussions between researchers and participants [23]. As recommended by Massimi et al. [15], we combined individual and group activities by individually interviewing participants before the group design and critique sessions. Therefore, there were times when most of the group was in a waiting room. Similar to Vines et al., we provided coffee, tea, and snacks to participants. One researcher was in the waiting room with the participants and kept informal discussion going. This eased participants greatly and helped to

solidify the "design team". We recommend facilitating informal socializing prior to the design session, so by the time they are asked to work as a group, participants have gotten to know each other.

8.3 Encourage participation

During the critique sessions, we had a list of questions we wanted the group to answer after viewing each application. The researcher went through each question and asked for a response from the group. We found it necessary to "call on" specific people, otherwise they would not contribute their ideas. As with any group setting, some people talk more than others, however we found that the "non-talkers" had valuable insights to make regarding applications.

8.4 Balancing Researcher and Participant Input

We found it necessary to be cognizant of how much the researcher was involved in the design process. We took a "hands-off" approach to the design sessions. We allowed participants to ask questions if they got stuck, but encouraged them to work together. This helped the design process because it allowed participants to freely express their ideas without paying attention to researcher reactions. However, we recommend doing a follow-up session with researchers, experienced designers, and older adults to build on ideas from the participant-only design sessions in an attempt to increase the novelty of the designs.

Overall, we found the process of involving older adults to be surprisingly easy, low-cost, and rewarding to both researchers and participants.

9. Research Questions

In the end, we must turn our attention back to our original research questions. In response to **RQ1**: "Does involving older adults with little or no design and

programming experience in the design process of an application result in novel insights and innovation?", we can see from the novelty scores in Table 5 that designs were considered novel, though not highly so. We see this as a positive result given that we brought together older adults with little domain expertise, who worked together for a very short period of time. By looking across the results of several design sessions, more experienced designers can identify and refine novel ideas. We saw this with our expert panel, where some of them expressed surprise and were inspired by the concepts our participants had created.

Above the purely numerical, from panelist and design participant feedback, we found that involving older adults identifies their needs and is empowering. While some older adults found the design session task "daunting" in the beginning, by the end of the study most were excited about it. Multiple participants asked if they could come back for another session. Also, it demystifies the technology design process for older adults. We recommend continuing to involve older adults in participatory design. The designs of our participants revealed insights into needs, priorities, and ways of thinking that may not be evident to younger designers. Participatory design also changes the power dynamic compared to other ways of engaging with older adults in design work, especially as the more common passive evaluators of the ideas generated by others. Once processed by people who have technical or design expertise, their ideas could evolve into highly novel creations.

In response to **RQ2**: "How does the activity of critiquing existing software prior to the design process affect the creativity of the resulting design?", the most creative design came from a group that did not critique existing applications. While this is too small a sample to definitively settle the question, we saw some

evidence in our experiment of design fixation, in terms of what they had become habituated with from doctor visits, but no evidence of "writer's block." Therefore, this question should be researched further.

In our study, Group 5's design was clearly the most creative according to both the creativity score and the CPSS score. This aligned well with the panel discussions. Two of the 4 industry panelists agreed that group 5's design was the most creative. Panelist 3 found *"it gave more feedback to the user. It seemed like a useful utility."* Panelist 2 agreed, *"it was the most worked through idea."* Academic panelists agreed that Group 5's design was the most creative.

Notably, no one in Group 5 had experience with smartphones. In addition to Group 5, Group 2 did not critique applications before creating an idea of their own. Group 2 ranked second in terms of their CPSS score. However, the panelist discussions did not favor Group 2. Therefore, it is likely that other factors were influential in terms of creativity. Our prediction that participants may experience writer's block if they did not critique before designing was not supported. In fact, panelists found that some groups tried to incorporate *too many* ideas.

While more research should be done to determine whether our results hold across populations, we cannot recommend that researchers require critiquing before the creation of design ideas, especially when involving older adults. However, many panelists agreed that most of the design ideas did not take full advantage of the technology at hand. This could be overcome through a follow-up session that involves design experts.

10. Shortcomings

As with any study, there are shortcomings. First, we had a small sample size of 18 participants in 5 groups. Therefore, our results may not generalize to a different population. However, the small sample size gave us rich data to combine with panelist discussion.

It was problematic that panelists were shown ideas with a short explanation from the researcher. Panelist 4 suggested, *"The conversations that the older adults had about their designs might be more interesting than the designs themselves."* Therefore, we recommend giving panelists access to the design rationales of the older adults along with any design artifacts to ensure ideas are communicated effectively. We only gave panelists design artifacts and a brief description. Lobert and Dologite [13] gave panelists a written design proposal and Thang et al. [20] gave panelists transcripts rather than artifacts. Showing a video summary of the session and the design artifact could prove to be the most effective.

In an ideal real-world setting, one would see evaluators or trained designers working directly with older adults rather than artificially separating these groups. This would not only add more context and information, but would also allow for the formation of a strong feedback loop.

We did not control for the occupational backgrounds of the participants, except for programming knowledge. Other types of backgrounds (design, healthcare, etc.) may have confounded the creativity scores. Furthermore, the creativity scores may have been confounded based on the creativity trait in each individual. We did not measure creativity in individuals due to a lack of resources and in an attempt to keep study sessions to a reasonable length.

10.1 Reliability

In terms of the reliability of the Creative Product Semantic Scale (CPSS) used to measure creativity of design ideas, Synthesis & Elaboration was unreliable in 4 of 5 groups (see Table 2). Besemer and O'Quin found their version of the CPSS reliable, but they found that individual adjectives under the Synthesis & Elaboration category were independent of one another and were rated differently by panelists [3]. This aligns well with our findings, suggesting that the lack of similarity between the adjectives may have negatively affected the reliability of the category.

The technical and organizational perspective were not present in the original CPSS scale devised in [3] and their reliability was not evaluated in [13]. Both panelists asked for a clarifying definition of "technical perspective" and "organizational perspective". While we explained the concepts, one panelist admitted to not following our instructions. Instead, they rated the level of technicality from the viewpoint of the user. The questions asked by panelists aligned with the adjectives determined to be unreliable as measured by the Cronbach-Alpha. Therefore, we recommend future researchers to do a full analysis of the reliability of the edited CPSS.

11. Conclusions

While researchers agree that involving the target audience in design is beneficial to the process, the fact that older adults may have less experience with many cutting-edge technologies like smartphones may lessen their effectiveness as co-designers because their ideas may not be novel. From our study, we found that the older adults we worked with not only took to the design process despite having no previous experience, but also developed relatively creative design

ideas, as evaluated by industry and academic experts using the Creative Product Semantic Scale.

Exposing participants to existing ideas through critiques did not appear to improve the quality of designs, nor lead to meaningful design fixation. It also appeared to be unnecessary, as most groups came up with too many features. Given our findings, we recommend involving older adults in participatory design because it is empowering and serves to reveal their needs. Lack of experience played a role, as many ideas did not make good use of existing technological features. Therefore, we recommend a second phase of the design process that involves technology experts paired with older adults.

In the future, our experiment should be tried on a larger sample across domains. Our goal is to take this process one step further by involving older adults as not just co-designers but as developers of open source healthcare applications.

12. Acknowledgements

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Chapter 3. What Health Topics Older Adults Want To Track: A Participatory Design Study

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1. Abstract

Older adults are increasingly savvy consumers of smartphone-based health solutions and information. These technologies may enable older adults to age-in-place more successfully. However, many app creators fail to do needs assessments of their end-users. To rectify this issue, we involved older adults (aged 65+) in the beginning stages of designing a mobile health and wellness application. We conducted a participatory design study, where 5 groups of older adults created 5 designs. Four groups identified at least 1 health metric not currently offered in either the iPhone app store or the Google Play store. At the end of the sessions we administered a questionnaire to determine what health topics participants would like to track via smartphone or tablet. The designs included 13 health topics that were not on the questionnaire. Seventeen of eighteen participants expressed interest in tracking health metrics using a smartphone/tablet despite having little experience with these devices. This shows that older adults have unique ideas that are not being considered by current technology designers. We conclude with recommendations for future development, and propose continuing to involve to older adults in participatory design.

2. Introduction

An age-wave is upon us. According to the US Census, the population of people over 65 is projected to double by 2030, going from 12% to 20% of the population [13]. In addition, older adults are increasingly consumers of technology. A 2010 Pew Internet Research survey shows that 47% of older adults (aged 50-64) used social media, a sharp increase from 25% in 2009 [25]. In a survey conducted of 36 countries in 2011, 61% of older adults had access to a mobile device [36]. According to a Pew Internet Research survey in February 2012, 31% of older adults (aged 50-64) owned a smartphone, a statistically significant jump up from 22% in 2011 [30]. As of January 2013, 71% of older adults (aged 50-64) who use the Internet, sought health information online [9]. Seeing as these trends will probably continue as more technology-savvy baby boomers reach retirement age, it seems vital that older adults be involved in mobile application development, specifically related to health.

mHealth is an area of research and product development focused on the development of mobile applications to support healthy living, either from a personal perspective, or a healthcare industry perspective. A report on mHealth and older adults talks about a "vicious cycle" of technology development – one that excludes older adults and results in lower adoption rates and higher rates of cognitive decline [16]. If we continue our current trajectory, we will perpetuate this vicious cycle. According to the model, the vicious cycle will lead to a higher cost for our society, as older adults would not age-in-place successfully. They also speak of a "virtuous cycle" where older adults are involved in technology development, and specifically mHealth applications. They claim that this virtuous cycle will not only improve how the needs and desires of consumers are met, but encourage participation of older adults, and thereby reduce the amount

or speed of their cognitive decline. This is supported by a study which found that computer use is associated with lower rates of cognitive decline (in their words, "use it so you won't lose it") [31].

To help implement the "virtuous cycle", Davidson and Jensen showed that even without software development experience, older adults are able to provide meaningful contributions to smartphone application design [7]. This is important because it significantly broadens the pool of potential design partners, making these types of design activities more viable in a real-world setting. Ultimately it is life experience and an understanding of the needs of this population that is more important than an intimate understanding of the underlying technologies.

As researchers, we should enable the desires of older adults to be heard, to further support this "virtuous cycle". The work presented here is based on the same research study reported in a previous publication which analyzed the creativity of the designs [7]. Our novel contribution of this publication is to provide researchers and developers with a set of possible directions for mHealth designs specifically targeted for *personal use* by older adults. Many mHealth developers focus on how to increase connectivity between doctors, health insurance companies, and patients [16].

Rather than a *patient*-centric approach, we take a *user*-centric approach. With our results, we are aiding the design of health-related applications that focus on what the *user* wants, instead of focusing solely what the doctor and/or medical insurance industry wants.

Our research questions are as follows:

RQ1. What health topics do older adults want to track?

RQ2. Are current mHealth tools tailored to meet the needs of older adults?

We answer these research questions through a two-step process:

1. A participatory design study with 18 older adults (65+) with no programming experience that involved an interview, group sketching session, and a questionnaire.
2. A comparison of the health topics in our study to what is available in the current smartphone app market.

The rest of the paper is organized as follows: first we review related work in mHealth (both from an industry and an academic standpoint), and personal informatics. Then we review our methodology, followed by our results. We conclude with a discussion of shortcomings and future work.

3. Related Work

For our discussion about designs for a mobile health and wellness application, there are three main areas of research that are relevant: technology design with older adults, mHealth, and personal informatics. We start with a brief mention of technology design with older adults then move onto a discussion of industry reports related to mHealth. Finally, we provide a brief overview of the breadth of work being done in these two areas, and where they overlap (see Figure 1).

3.1 Technology Design with Older Adults

There are a handful of research teams who have conducted participatory design activities with older adults [1,21,24,26,32,33]. None of these teams have worked with older adults to design a health and wellness mobile application. For a more in-depth literature review of this area, see our previously published work [7].

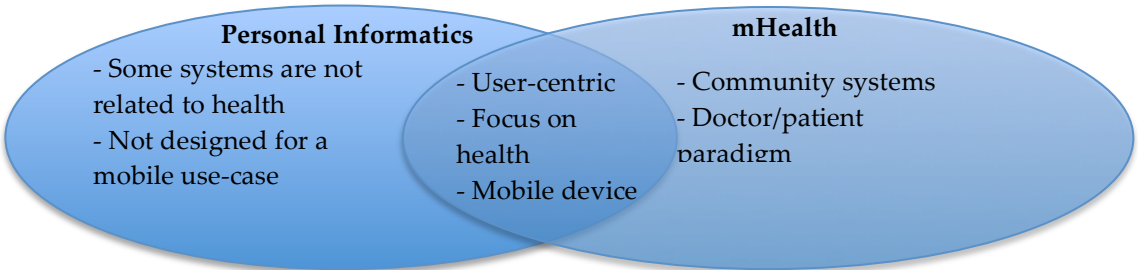

Figure 1. Venn diagram showing the overlap and difference between personal informatics and mHealth.

3.2 mHealth Reports

A recent report published by the mHealth Alliance and funded by Pfizer speaks about mHealth specifically related to older adults [16]. In addition to proposing two models of development, one that is beneficial to older adults and one that is not, they provide recommendations for mHealth developers to follow. Their results are much more broad and medical-industry-focused than our work, but are nonetheless relevant. They claim that primary outcomes of mHealth should include data quality, lifestyle modification, and collecting data separated by age and gender. Their recommended secondary outcomes of mHealth applications are that they should focus on compliance, cost-effectiveness, and biomarker readings.

In addition to this recent report, the March 2013 monthly "Health Information Technology" report by Circle Square claims that mHealth is in a new stage of growth, with over 97,000 mHealth apps on the market [18]. They also claim that a "major driver [of mHealth market's growth] is the growing penetration of smartphones" [18]. Both of these reports explain how mHealth can be used to change behaviors and/or enhance patient compliance [16,18]. In our study, we did not emphasize behavioral change, rather we focused on "tracking your health". Regardless, these two reports show that mHealth is a current issue that is receiving growing attention from industry.

3.3 mHealth and Personal Informatics

Figure 1 shows a Venn diagram comparing the fields of mHealth and personal informatics. The overlap between mHealth and personal informatics is the area that is most relevant to the study presented in this paper. We focused on understanding what users wanted, and asked our focus groups to draw designs for a mobile health application that they would personally want to use to track a health topic of their choosing, regardless of whether this was something they believed or knew already existed on the market or not. Our work is situated in the overlap between personal informatics and mHealth.

To provide the reader with a better understanding of the breadth of work in the area of personal informatics and mHealth, we provide a review of selected systems in this area.

3.4 Mobile Personal Informatics Systems

Most personal informatics systems have one or more of the following purposes: self-diagnosis, awareness of routines/self-reflection [20], and/or behavioral change. Li et al. describe these purposes as a "stage-based model": preparation, collection, integration, reflection, and action [19]. The systems mentioned in this brief review cover some of the stages, however, not all systems have a goal of "action".

The systems described in the paragraphs below live in the middle of the Venn diagram (Figure 1), as they are user-centric, related to health, and are available on a mobile device.

One of the few personal informatics/mHealth studies specifically related to older adults, is a self-diagnosis application that aids in diagnosing vision problems [2].

The other applications discussed in this section did not have an explicit emphasis on older adults.

Sleep tracking is an area of significant interest to the mHealh community. One example of an application in this area is ShutEye, an application that encourages healthy sleep patterns, and therefore seeks behavioral change [4]. Gartenberg et al. also conducted a study related to an application that enabled users to track their sleep patterns, but does not explicitly seek behavioral change [12]. Similar to sleep trackers, Ahtinen et al. mention an application entitled SelfRelax, which provides a way for people to relax (by playing background sounds, for example) [3].

Diet is another area of great interest to researchers creating mobile applications. Freyne et al. ran a clinical trial of applications that support dietary change [11]. SapoFitness is another application that seeks behavioral change by changing one's diet [29].

Exercise is a third area that has been explored in the overlap of mHealth and personal informatics. Ubifit garden encourages users to get more exercise [6]. In a similar vein, WalkMinder seeks to create behavioral change by interrupting users after long periods of no movement, and encourages them to take a walk [14]. As part of a comparative usability study, Ahtinen et al. mention Wellness Diary and Mobile Coach, which are two applications aimed at tracking exercise routines [3].

Not only are there applications about general health and well being, there are also applications that relate to specific conditions. For example, Kanstrup et al. discuss a design for an mHealth application that aids in diabetes management [15]. This is related to personal informatics because it enables users to track their

personal information for their needs. It also has the goal of adherence and improvement of a routine for treating diabetes.

Xue et al. discuss the design of a mobile health application for women in Singapore [35]. The specifically focused on women's health needs, and it was an application geared toward awareness, rather than behavioral change.

3.5 mHealth

It is important to note that not all mHealth systems fall within the same purposes listed above (self-diagnosis, etc.). Some mHealth systems are designed to act on a community level. These systems would fall under the right side of the Venn diagram in Figure 1. For example, Littman-Quinn et al. discuss the adoption of an mHealth system deployed in Botswana [22]. The system's aim was to provide medical assistance to those with HIV/AIDS in the area. Similarly, Purkayastha et al. discuss the deployment of a system in Malawi [28]. They provide insights on how to do mHealth deployments in the future. One of their insights is to be respectful of the local needs of the community.

In addition to the community level deployment, some mHealth applications do not follow a user-centric paradigm when designing or deploying solutions. Rather, they follow a doctor/patient paradigm, where the focus of the application is for communicating data to and from a healthcare professional. One such application was geared toward rehabilitation through exercise, and where doctors would provide electronic feedback about the patient's exercises [5]. The doctor/patient paradigm is also apparent in eEmergency systems, where the goal is to provide immediate healthcare [17].

Researchers in mHealth and personal informatics have covered a lot of ground in recent years. One major difference between our work and previous work is our

methodology. Many of the mHealth and personal informatics systems have a solution to a supposed problem, they create the solution, then test it with users (usually through a field/clinical trial) [3,4,5,6,11,12,14]. We decided to take a step back. Instead of asking participants to work with us to create a specific app (for example, an exercise tracking app), we asked older adults what they wanted. We asked them to work as a group to sketch an application to track health topics. They were free to choose *which* health topics. In this way, we were assessing the needs of our local community, as recommended by Purkayastha et al. [28] prior to developing a system. Another difference between most of the cited systems and our work is that many of them do not focus on the needs of older adults. Our work is specifically geared to older adults (in this case, aged 65 and older).

4. Methodology

4.1 Participants

We recruited people with no prior programming or software development experience to get an "end user" perspective of health applications as most smartphone owners are end users. We did not want experience with software development to potentially hinder or interfere with the creativity of the product ideation process, as software developers might be more familiar with the limitations of the system, and thus "locked in" to a set of biases and preconceptions.

Eighteen participants were aged 65 years and older (median age 71), and 12 of them were women. They were volunteer participants with a wide range of professional backgrounds (see Table 1).

We administered a self-reported health scale adapted from Winter et al. [34]. The participants were healthy overall. They provided self-rated health scores

(0=terrible, poor, fair, good, 4= excellent), and had an average of 3.5, which would fall between good and excellent. Our results were similar to Winter et al., with no participants choosing the lowest measure of health.

Seventeen participants owned a cell phone, 4 of those smartphones. Three of the smartphone owners had applications on their phone related to healthcare. Seven participants tracked health metrics (either on paper, computer, or phone). Even though our sample size is small, the fact that 75% of smartphone owners used their phone for health-related apps indicates that older adults should be involved in the design process.

We recruited participants from the LIFE Registry [38], a registry of Oregon residents aged 50 and older who have given their permission to be contacted about research studies. We also recruited participants by hanging flyers in senior centers and assisted living centers, and through participant word-of-mouth.

They were paid $20-$50 (depending on traveling distance) for their participation. The entire study session lasted approximately 2.5 hours. It was conducted on the university campus. We did 5 group sessions of 3-4 participants each.

4.2 Interviews

After brief introductions with the group, we individually interviewed each participant. Our goal was to learn about their backgrounds and experience with technology, specifically related to smartphones and health. We asked about 13 questions, and each semi-structured interview took 10-20 minutes.

Table 1. Participant Demographics

Gender	Age	Occupation Pre-Retirement	Education
Group 5			
M	65	Police Officer	Associate's
M	67	Electrical Contractor	Some college
F	71	Small Business Owner	Bachelor's
F	68	Executive Director of Credit Counseling	Master's
Group 4			
F	85	Accountant	Some college
M	66	Chemist	Master's
F	82	Homemaker	Master's
Group 3			
F	65	Human Metrology Researcher	High School
F	72	Counselor	Some college
M	72	Detective	Bachelor's
F	72	Homemaker	Some college
Group 2			
M	71	Office Manager	Bachelor's
F	73	Director of County Health	Master's
M	71	Professor	PhD
Group 1			
F	67	University Staff	Some college
F	65	Accountant	Bachelor's
F	83	Advertising Coordinator	Some college
M	88	Petroleum Engineer	Master's

4.3 Participatory Designs

After the interviews, we conducted participatory design sessions. Three of the groups critiqued existing health-related iPhone applications before sketching an idea for an application. The other two groups sketched an idea for an application then critiqued existing applications. Each group sketched 1 design, as a group. The critique session lasted for 10-20 minutes, and the sketching session lasted for 30 minutes. During the sketching session, the researcher took a "hands-off"

approach, and allowed the groups to work as independently as possible. The instructions prior to the sketching session emphasized creativity and creating an idea for an application that they (the participants) would actually *want* to use.

4.4 Questionnaires

4.4.1 Online activities questionnaire

Prior to the design session, we administered an Online Activities Questionnaire. We were aiming to learn how older adults use the Internet. The survey contained 24 items (such as "look for health/medical information online"), and each item was followed with "yes", "no", "maybe", and a space for written comments.

4.4.2 Health topics questionnaire

After the design session, we administered a questionnaire to see what kinds of health topics older adults would want to track using a smartphone application. We iterated on the topics to be included with a group of graduate HCI researchers and gerontology researchers. There were 14 items (i.e. "cholesterol"). Each item was followed by "yes", "no", and a space for comments.

5. Results

5.1 Sample Design

To help readers understand the context of the results, we provide a sample design (see Figure 2). This design was found to be the most creative (from a panel of 7 domain experts using a modified Creative Product Semantic Scale [23]), and was created by a group where participants had no prior smartphone experience, and who did not critique existing applications before their design session [7]. To see the backgrounds of the participants, see Table 1 - Group 5. The design is entitled "RxMedApp". First, it allows the user to determine ailments by walking through a "signs and symptoms" checklist. It also allows users to record

and graph health records. There is functionality to allow users to record prescription information. It includes a method for auto-renew of a prescription, and a method to automatically determine if there was a conflict in prescriptions. Finally, it provides suggestions for users on how to change their diets based on their needs. For example, the user could choose "less fat" from a pull-down menu, and it would give the user suggestions on how to ingest less fat. The design team included a way for the user to print these suggestions.

As with each of the 5 designs from the participatory design study, we extracted health topics that were represented in the design. This design touched on the following health concepts:

- Blood pressure
- Blood sugar
- Prescription auto-renew
- Prescription conflict reminder
- Prescription reminder
- Pulse
- Suggestions for eating healthier based on what the user wants to change in their diet
- Symptom tracking

Many of the other designs were less complicated than this example. It was one of three designs that included a way to graphically represent health information. Next, we report responses from an online activities questionnaire, to show that our participants use the Internet to find health information online.

To answer RQ1, *"What health topics do older adults want to track?"*, we present responses from the online activity questionnaires, a list of health topics that were in the designs, and results from a questionnaire about what health topics they would want to track using a smartphone.

Figure 2. Example Design called RxMedApp. It allows you to track symptoms, track health metrics, track prescriptions, and provides suggestions on health eating.

5.2 Online activity questionnaires

Prior to the design sessions, we asked older adults to respond to questionnaires about what activities they participated in online. The questionnaire included the same metrics as a Pew Internet Research Survey about older adults and internet use habits [10]. Only 1 of 18 participants did not use the Internet at all. Table 2 shows that many older adults use the Internet to find health information. There were 2 metrics related to finding health metrics online (see grey shaded areas in Table 2), and the vast majority of participants reported that they looked for health information online (83.33%). Our result was similar to the 2012 Pew Internet Research survey that found that 71% of older adults look for health information online [9]. The slightly higher percentage may be because our participants self-selected to be in this research study related to health software. Regardless, these results indicate that the idea of using and promoting these types of applications may be natural and desirable for this population.

5.3 What health topics were in designs?

Table 3 shows 21 health topics that were targeted in the designs generated by our focus groups. Additionally, we counted how many health topics appeared in multiple designs. Out of the 21 health topics in the designs, only 4 appeared in more than 1 design, and no health topic appeared in more than 2 designs. This shows that our participants provided a diverse range of ideas. Some of the health topics were very specific, and related to a participants' personal needs. This aligns well with a Pew Internet Research Survey that found that 43% of health topics searched for online by older adults were regarding a specific disease or medical problem [9]. Other designs were much more generic and focused on broader wellness issues. Also, the designs showed health topics that were different than the health topics in the questionnaire. The participants thought of 13 health topics that appeared in their designs but were not listed in the questionnaire.

5.4 What health topics would they like to track according to the questionnaires?

While Table 3 shows an analysis of designs compared with the app store, Table 4 shows the health topics that our participants would like to track with a smartphone application. These were results from a 14-item questionnaire. One participant of 18 did not want to track *anything* regarding health topics. This was the same participant who did not use the Internet. The most popular health topic was "health appointments" with a total of 15 participants. Surprisingly, health appointments were not in any of the designs. This suggests that we should not only include older adults in participatory design, but we should also administer questionnaires and interviews, to get a broader understanding of their needs and desires in relation to technology design.

Table 2. Online activity questionnaire.

Online Activity	Rank	Yes %	Yes Count/Total
send or read e-mail	1	94.44	17/18
use a search engine to find information	1	94.44	17/18
look for information on a hobby or interest	1	94.44	17/18
look for information from a government website	1	94.44	17/18
buy a product	1	94.44	17/18
research a product or service before buying it	2	90.00	9/10
go to web sites that provide information or support for a specific medical condition or personal situation	3	88.89	16/18
get news	3	88.89	16/18
look for political news or information	3	88.89	16/18
look for health or medical information	4	83.33	15/18
buy or make a reservation for travel	4	83.33	15/18
get financial information	5	77.78	14/18
check the weather	5	77.78	14/18
download other files such as games, videos, or pictures	6	72.22	13/18
bank online	6	72.22	13/18
surf the web for fun	7	64.71	11/17
check sports scores or information	8	55.56	10/18
play a game	9	38.89	7/18
research your family's history or genealogy	9	38.89	7/18
make a phone call online	10	33.33	6/18
send instant messages	11	27.78	5/18
buy or sell stocks, bonds, or mutual funds	12	23.53	4/17
participate in an online auction	13	22.22	4/18
look for religious or spiritual information	14	16.67	3/18

Table 3. A comparison of health topics to the iPhone store and the Android app store. There were 5 health topics in the designs that were not in either of the app stores.

Health Topics in Designs	iPhone App?	Android App?
rest tracking	✖	✖
social interaction tracking	✖	✖
suggestions for eating healthier based on what you want to change in your diet	✖	✖
suggestions for local stress relief activities	✖	✖
hematocrit	✖	✖
urine protein	✔	✖
urine sugar	✔	✖
urine wbc	✔	✖
balance assessment	✔	✔
blood pressure	✔	✔
blood sugar	✔	✔
cholesterol	✔	✔
diet tracking	✔	✔
exercise tracking	✔	✔
prescription auto-renew	✔	✔
prescription conflict determiner	✔	✔
prescription reminder	✔	✔
proper posture	✔	✔
pulse	✔	✔
symptom tracking (diagnosis / 911)	✔	✔
weight	✔	✔

5.5 Market Analysis

To answer RQ2, *"Are current mHealth tools tailored to meet the needs of our older adult participants?",* we examined the current offerings in the iTunes App store and the Android App store and compared what we found to the list of health topics identified by our participants. We chose to examine those two app stores because according to the International Data Corporation, iPhones and Android phones represented 87.6% of the smartphone market in 2012 [37]. We did a

keyword search for each topic, and manually searched through titles and descriptions of the resulting applications.

Table 4. Responses from "What health topics would you track using a smartphone?" questionnaire.

Questionnaire Health Topic	Yes Count (n=18)	Yes %	In their designs?
health appointments	15	93.75	✖
cholesterol	11	78.57	✔
weight	12	66.67	✔
heart rate	11	61.11	✔
blood pressure	10	55.56	✔
pedometer	10	55.56	✖
exercise diary	9	50.00	✔
injury log	8	50.00	✖
food diary	7	38.89	✔
pill reminder	6	33.33	✔
mood diary	5	31.25	✖
social interactions	5	31.25	✔
calorie counter	5	27.78	✖
stressful events diary	4	25.00	✖

We found that most of the health topics were covered by apps in either store. However, there are still gaps between what the market offers and what older adults want to track. We found 5 topics that were not present in either app store (see Table 3). One of these was very trivial (recoding hematocrit), so we will leave it out of this discussion.

5.5.1 Restful Tracking

One health topic that researchers and designers could focus on moving forward is expanding what is offered in terms of tracking rest. There are many apps that

allow you to track sleep patterns, but to our knowledge, no apps allow you track a variety of restful activities. One group was interested in tracking sleep and other restful activities like meditation, yoga, or gardening.

5.5.2 Social Interaction Tracking

Another aspect of a design that was not represented in the app stores, was social interaction tracking. Positive social interactions are vital for older adults, as it is correlated with a positive well-being [8]. This topic appeared in one design, where they wanted a way to log their social activities. This would be beneficial to older adults, to learn about their social tendencies. Tuan et al. created a way for older adults to track social goals and moods using an online form [27]. They also included an interactive visualization to allow users to explore their data. However, this application was for research purposes and was not designed for use on a smartphone. We would recommend using the health topic of social interaction tracking (perhaps without goals as a constraint) to complement the existing research in the field, and create an application that could be available in app stores.

5.5.3 Local Stress Relief Activities

Another idea for an application was to have a database of suggestions for activities to do in your local community that could relieve stress. Some of these activities included "gardening", "volunteering for a pet walking service", and "social drinking". Currently, there are no apps on the market of this nature. Many apps related to stress relief focus on meditation techniques[1].

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[1] https://play.google.com/store/apps/details?id=com.bestappsforphone.relaxmeditationtechniques3 , https://play.google.com/store/apps/details?id=net.feathertech.meditationtechniques, https://play.google.com/store/apps/details?id=com.meditationoasis.rest

5.5.4 Healthy Eating Suggestions

As part of one of the designs (discussed in Section 5.1), the participants wanted a way to receive advice on how to change their diet based on their desires. There are applications that exist that focus on "low carb" eating[2] or "the Mediterranean diet"[3], but no apps allow you to choose your *outcome* out of a *list* of outcomes (i.e. "less fat", "more fiber", etc.), and give you tips on how to achieve that outcome. From these results, there are many directions that application designers could take to develop apps that better suit older adults' desires.

Interestingly, the first 3 health topics (restful activity tracking, social interaction tracking, and local stress relief activities) show that our participants had a definition of health that went beyond *clinical health*, and included aspects of the mind, body, *and* soul. It was surprising to the panelists who were grading the designs for creativity, that there was such a breadth of topics covered in the designs, with everything from very specific health metrics (such as hematocrit and blood pressure) to very broad health-related topics (such as suggestions for local stress relief activities). These topics showed that our participants had an interest in some hard-to-measure health topics, which are more subjective than blood pressure, for example. This provides an opportunity for researchers to collaborate from different disciplines (gerontology, sociology, psychology, and computer science) to help tackle the difficult issue of tracking subjective measures in a meaningful, relevant way.

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[2] https://play.google.com/store/apps/details?id=com.atkins.android.carbcounter
[3] https://play.google.com/store/apps/details?id=com.andromo.dev117641.app119156

6. Discussion

As with any empirical work, there are some limitations to our study. First and foremost, because we were interested in qualitatively analyzing the data and gathering rich data from design sessions, we had a small sample size. This may contribute to lowering our external validity, and our results may not generalize to a different population.

That said, the take-home message of involving older adults in the design process, and using results from studies like these to shape future technology design and creation still holds. We strongly encourage future researchers to not only include older adults in actively designing applications, but also be sure to administer questionnaires and interviews. Simply put – the more data, the better. Each method has its strengths, and as we found in our study, these methods complement each other. We should keep in mind that this is a dynamic process. The next generation of older adults will be different and have different needs than the current generation of older adults, so we should continually conduct studies of this nature.

By conducting this participatory design study, we were able to identify gaps in the current market, and we also learned health topics that older adults find important. We propose that this method be applied to future research in the development of mHealth systems, to accurately assess the needs of the community of interest. This methodology will allow us to uphold the "virtuous cycle" of technology development, where we purposefully include older adults. Researchers can take this idea of a "virtuous cycle" further by conducting more longitudinal studies on mHealth system development that includes older adults from the beginning stages of design to deployment and use.

7. Conclusion

People are living longer, and baby boomers are reaching retirement. Because of the increase in technology adoption by older adults and because they look for health information online, it is important to include them in the technology design process. Our novel contribution was to provide researchers and designers with directions for mobile health-related applications. To answer our first research question, *"What health metrics do older adults want to track?"*, we suggest looking into these four areas: Social Interaction Tracking, Rest Tracking, Suggestions for Local Stress Relief Activities, and Suggestions for Eating Healthier based on what you want in your diet.

These health topics were identified during participatory design sessions with older adults, and as of the writing of this paper, there are no apps in either the Android app or iPhone app store that cover these areas. This helps to answer our second research question, which was *"Are current mHealth tools tailored to meet the needs of our older adult participants?"* While the majority of the health topics that were found in participants' designs were in either app store, there were 5 topics that were not present.

We suggest continuing to involve older adults throughout the technology design process. As a next step, we plan to involve older adults directly in the development of free/open source software, as another way to continue the "virtuous cycle" mentioned earlier. By involving older adults in our rapidly changing technology process and keeping their needs and desires at the forefront of technology innovation, we may enable older adults to age-in-place more successfully, and may help to delay the onset of cognitive decline.

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Chapter 4. On Older Adults in Free/Open Source Software: Reflections of Contributors and Community Leaders

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1. Abstract

Researchers have investigated the lack of diversity in Free/Open Source Software (FOSS) communities, but there have been few studies on age diversity. We interviewed 11 older FOSS contributors and 6 FOSS community leaders (of any age). This formative study reports on 4 key findings from those interviews: 1) motivations of older contributors, 2) benefits and challenges to contribution, 3) older adults' views on discrimination in FOSS, and 4) ways in which older adults enrich FOSS communities. We found that older adults' contributions are driven by intrinsic motivation, altruism, and community identification. In older adults' most recent contributions, we found that there were more social than technical challenges to participation. Interestingly, the majority of older adults claimed to have witnessed discrimination towards others in FOSS, especially against non-native English speakers and women. This stands in contrast to what the general male FOSS developer population reports. Participants identified 10 ways that older adults add value to FOSS communities. We conclude with guidelines for onboarding older adults.

2. Introduction

The US Census Bureau projects that by 2030, 20% of the US population will be 65 or older [1]. At the same time we face an increasing demand for people with software development skills. The US Bureau of Labor Statistics projects that there will be a 22% growth in software development jobs from 2012 to 2022, which is a much higher growth rate than other occupations [2]. We therefore expect that more people will have technical skills going into the future. The first wave of these technically experienced people is reaching retirement. We suggest that contributing to FOSS could be a fulfilling retirement activity that keeps up cognitive activity, enabling older adults to remain active members of the technical community. Keeping up cognitive activity is important because staying cognitively active into retirement has been shown to have health benefits [3]. In this paper, unless otherwise noted, we define "older" as 50 years and older because that is eligibility threshold for the American Association for Retired Persons (AARP) [4].

Another motivation for this work is that increasing age diversity may have benefits to Free/Open Source Software (FOSS) communities. One benefit is an increase in the size of the developer base. One may claim that the FOSS developer base should be as diverse as its user base. The lack of gender diversity in FOSS is well-noted [5], however very few people have noted the lack of age diversity. There have been some efforts to introduce *younger* people and novice programmers to FOSS [6], however, no one has focused on older adults.

In a 2013 survey of 1,620 FOSS contributors, Arjona-Reina et al. found that only 7.09% are 50 and older, and only 12.03% are 45 and older [7]. Why are there so few older contributors? According to the US Bureau of Labor Statistics, 31.7% of

software developers are 45 years and older [8], so FOSS is an outlier. A 2010 survey found that 98% of respondents reported that their technology companies use FOSS [9], so it is difficult to argue that FOSS is an obscure niche. We therefore suspect that something about FOSS communities deters older adults from joining, be it technical, motivational, or cultural. Before we explore ways to involve more older adults in FOSS we must develop a deeper understanding of these barriers. We start by evaluating the current state of the field by interviewing 11 older contributors and 6 FOSS community leaders. Our research questions are as follows:

RQ1. *What roles and motivations do older adults have in FOSS communities and how do these change over time?*

RQ2. *What are the benefits and challenges facing older adults?* This will provide insight on how to highlight benefits and reduce challenges in future outreach efforts.

RQ3. *Do older adults experience or witness discrimination in FOSS communities?* There may be something about FOSS communities that deter older adults from contributing.

RQ4. *Do older adults offer anything to FOSS communities that is different from their younger counterparts? If so, what?* To encourage FOSS communities to be more welcoming of older participants, it is important that both groups understand the value that older adults bring.

The remainder of the paper is as follows. The literature review focuses predominantly on diversity in FOSS, the FOSS joining process, theoretical benefits for older contributors, and virtual volunteering. Then we move on to

discuss the study participants' demographics and data analysis methods. Results outlines answers to our research questions. Shortcomings highlights the limitations with this study. The final sections present possible paths for future work in this area.

3. Literature Review

3.1 Diversity in free/open source software

The impact of FOSS is far-reaching. Recently, 98% of surveyed individuals reported that their companies use FOSS [9]. As use of FOSS becomes more widespread and diverse, it should follow that the developer base should be diverse as well. Though one criterion of the Open Source Definition is that *anyone* should be able to view and edit the code [10], there is a serious lack of diversity in FOSS. Regarding gender diversity, even when recruiting from women-focused FOSS groups, a survey found that only 10.35% of FOSS contributors are women [7]. In contrast a more general survey found that only about 2% of FOSS contributors are women [11].

Nafus, Leach, and Krieger shed light on the lack of gender diversity and propose methods to increase participation by women [5]. The United Nations Educational Scientific and Cultural Organization (UNESCO) gives attention to the gender diversity issue by gathering resources that encourage women to participate in FOSS communities [12]. There is also a FOSS Outreach Program for Women where organizations, such as GNOME and Linux, offer internships for women [13].

Ghosh et al. found a lack of geographic location diversity in FOSS contributors [11]. There has been a plethora of research on comparing geographically distributed teams to co-located teams [14, 15]. However, to our knowledge, no

academic research has been done on how to increase geographic diversity purposefully – rather it is seen as a phenomenon that needs investigating.

With regards to diversity of experience, Reagans and Zuckerman show that organizational tenure (how long the person worked at the organization) did not have a negative impact on team productivity [16]. There have been some efforts to encourage "newbies" or those new to programming to contribute to FOSS. The Google Summer of Code is a program that pays students to contribute to FOSS [17]. Morelli et al. use Sahana to increase undergraduate interest in computer science and FOSS [6]. OpenHatch runs workshop to encourage university students to contribute to FOSS [18]. However, there has been no research or outreach done on how to involve those with a high level of software development expertise into FOSS communities.

Other types of diversity including racial, socio-economic status, and age diversity remain to be explored. To the best of our knowledge, Morrison and Murphy-Hill are the only researchers to study older software developers and their roles in online communities. They showed that StackOverflow reputation increases with age, into the participant's 50's [19].

3.2 Free/Open Source Software Joining Process

The Onion Model [20] is the traditional explanation of joining a FOSS community. The idea is that new contributors start on the outskirts as a "lurker"; perhaps they join a project mailing list and watch other interactions, then they slowly become more involved in the project. In more recent research, Jergensen et al. propose that joining FOSS projects may be more like an "Onion Patch" where contributors transfer skills from one project to another, and may specialize around certain tasks (i.e. not all bug reporters wish to become code contributors)

[21]. OpenHatch documented some newcomers' experiences and potential on-boarding processes [18], but has not performed a rigorous research study.

3.3 Benefits of Contributing to FOSS for Older Adults

To explore the benefits of contributing to FOSS for older adults, we look to psychology literature. First, contributing to FOSS can be likened to volunteering, which has been found to be beneficial to older adults. In a survey of 253 older adults, Tang et al. show that there is a positive association between volunteers who perceive that their contribution is useful and their mental health [22]. Morrow-Howell et al. [23] cite other studies that show that volunteering is associated with reduced mortality [24] and increased levels of self-rated health [25]. One can hypothesize that the same benefits may be seen with contributing to FOSS, as it is a volunteer activity.

Researchers have also shown that the brain is like a muscle: use it or lose it [3]. They found that performing complex cognitive activities may slow the rate of cognitive decline. Contributing to FOSS is a complex cognitive activity, as it requires domain knowledge, problem solving, and executive functioning. Therefore we may see the same benefits.

3.4 Virtual Volunteering and Older Adults

Mukherjee interviewed 22 older adults (aged 53-65) to explore benefits and barriers of virtual volunteering for older adults [26]. This study can be seen as a foundation for our work, in that we extend the definition of virtual volunteering to include contributing to FOSS. Mukherjee identified multiple benefits: flexible work hours, flexibility in choice of task/organization, ability to participate for those with mobility issues, and ability to continue using technical skills into retirement. He noted multiple barriers including accessibility issues with the

organization's website, using a mouse, lack of timely communication with the organization, broadband connection issues, and a mismatch in expectations. We compare his results to ours in the Results section.

3.5 Participants

For this study we interviewed a group of older contributors, and a separate group of project leaders. Table 1 gives an overview of our older participant demographics. We recruited 11 participants aged 50 or over (avg=58.9, std.dev=7.56) through FOSS developer mailing lists and publicly posted flyers. Despite attempts to recruit through women-centered mailing lists, all older participants were male. This may be due to the general lack of diversity in FOSS communities, which means that we were looking for a double-minority.

We recruited 6 FOSS community leaders (avg=35.9 std.dev=14.33) by emailing them directly, through contacts, or through flyers at a conference. Table 2 gives their demographics. One leader was an older adult, but for the purposes of this study they counted as a leader. The only data we included from that leader into the older adult data were responses to the Self-Perceptions of Aging Scale [27].

Table 1. Older participant demographics. Bolded numbers show average and standard deviation respectively.

Age	Years in FOSS	Education
50	18	Bachelor's
60	14	Bachelor's
53	11	Master's
57	7	Bachelor's
55	4	College
59	11	PhD
69	10	Master's
53	28	Bachelor's
74	54	Bachelor's
59	30	Bachelor's
50	8	PhD
58.9 *(7.56)*	**17.7 (*14.61*)**	

Table 2. Leader demographics. Bolded numbers show average and standard deviation respectively.

Gender	Age	Years in FOSS	Education
M	27	10	Master's
F	36	9	Bachelor's
F	25	4	Master's
M	32	10	High School
M	64	18	Master's
M	31	13	Master's
	35.8 (*14.33*)	**10.7 (*4.63*)**	

Table 3. Leaders' project demographics.

# of contributors	Contributors 50+	# of retirees
25-50	1 person	0
7,500	About 5%	0
1,000s	Less than 5%	2
40-50	5 or 6 people	Unknown
35	25%	0
2	1 person	0

Table 3 shows that we interviewed leaders from a variety of projects, both small and large. Very few of their contributors were 50 years or older, and almost none of their contributors did this as part of a retirement activity.

Interviews of older participants explored the following topics, with many open-ended questions: 1) participant background (age, educational background, first exposure to FOSS), 2) self-perceptions of aging, 3) motivations of contributions, 4) benefits and challenges of contributing, 5) discrimination, either witnessed or experienced, in FOSS communities, and 6) if older adults offer anything different than their younger counterparts, and an explanation. The leader interviews covered the same topics (save the self-perceptions of aging), but also included questions about their interactions with older adults, and demographics of the projects they lead.

The interviews ranged from 30 to 75 minutes. Interviews were done over phone, Skype, or in person. 16 of the 17 interviews were audio recorded. Notes were taken and, if audio recorded, transcribed by the authors.

4. Data Analysis

4.1 Self-Perceptions of Aging Scale

We used the Attitudes Toward Own Aging subscale [27], analyzed similar to Levy et al.'s study [28]. This subscale poses the following options: "Things keep getting worse as I get older ", "I have as much pep as I did last year", "As you get older, you are less useful", "I am as happy now as I was when younger", and "As I get older, things are (better, worse, or the same) as I thought they would be." The first four items were yes/no questions. Negative responses were marked with 0, and positive responses with a 1. For the last item, "better" or "the same" were marked with a 1. The marks are summed and the final score ranged from 0 to 5, with a higher score showing a more positive aging self-perception.

4.2 Code Creation

Codesets for roles (Table 4), motivations (Table 5), and discrimination/age-related topics (Table 6) were pre-defined and derived from the literature. Codes for benefits, challenges, and responses to RQ4, "Do older adults offer anything to FOSS communities that is different from their younger counterparts?", were not pre-defined.

The **role codeset** was developed from Ye and Kishida's work [20]. The **motivation codeset** was created from the FOSS literature [11, 29, 30] and researchers ensured that each motivation could be mapped to the volunteering literature in the psychology field [31], [32]. After reading through the data, we added a code (described in Results).

Discrimination/age-related codes were derived from the psychology literature [33, 34, 35, 36] and FOSS surveys about demographics [5, 7, 11]. Most codes in

Table 6 are self-explanatory, except “overaccomodation communication style” (OCS) [39], which is when an older adult speaks down to a younger adult. Similarly, it also includes younger adults speaking too slowly or too loudly to older adults. OCS can lead not only to poor communication, but also to upholding negative views of aging. Note that there is no code for “Positive Stereotypes Toward Younger People”, as it only came up once.

Table 4. FOSS Contributor Roles (from Ye and Kishida)

Role	Description
project leader	The project leader is often the person who has initiated the project. They are responsible for the vision and overall direction of the project.
core member	Responsible for guiding and coordinating the developer of a FOSS project. They have been involved for a relatively long time and have made significant contributions.
active developer	Regularly contribute new features and fix bugs
peripheral developer	Occasionally contribute new functionality or features in the existing system. Their contribution is irregular, and the period of involvement is short and sporadic.
bug fixer	They either discover bugs themselves or are reported by other members. Bug Fixers have to read and understand a small portion of the source code of the system where the bug occurs.
bug reporter	Discover and report bugs
release manager	Coordinates software releases
reader	Active users of the system - they may read the source to learn more but they don't contribute code
passive user	Uses the system in the same way as most of us use commercially available software

Table 5. Motivation Codes

Hars and Ou [29]	Our Codes	Ghosh et al. [11]
Internal		
Self-Determination	**Intrinsic Motivation**	None
Altruism	**Altruism**	Share knowledge and skills
Community Identification	**Community Identification**	Participate in the OS scene
None	**Internal Values**	Software should not be a proprietary good
	Learning	None
External		
Future Rewards	**None**	None
Selling Products	**Career-Related Benefits**	Improve job opportunities
Human Capital		
Self Marketing		
Peer Recognition	**Reputation**	Get a reputation in the OS community
Personal Need	**Personal Project Need**	Get help in realizing an idea for a software project
None	**"I'm doing it because someone asked me to."**	None

Table 6. Discrimination / Age-Related Codes

Code
Age-related Negative Self Stereotype
Age-related Positive Self Stereotype
Awareness of Age-Related Change
Negative Stereotypes Against Younger People
Age-related Negative Stereotypes (towards others) - older adults
Age-related Positive Stereotypes (towards others) - older adults
Overaccomodation Communication Style
Gender-based Discrimination
Non-native English Speaker Discrimination
Experience vs. Novices / Insider vs. Outsider Discrimination

4.3 Code Application

Each codeset was applied to the chunked transcriptions of the interview data. **Role** codes were assigned by one researcher and verified by the other. The coding process for **benefits**, **challenges**, and **RQ4 responses** was similar to Dearmen et al.'s application [37] of "affinity coding" grounded theory [38]. One researcher categorized barriers, challenges, and RQ4 responses into themes. A second researcher verified those themes and with two iterations, full agreement was reached between two researchers.

Motivations and **discrimination/age-related** codes were applied borrowing methods from grounded theory [39], but using pre-defined codes. Two researchers independently coded 3.5 interviews (20.6% of the data collected) for motivations and discrimination/age-related themes and reached very high agreement (Cohen's Kappa coeffecient = 0.94). After calculating agreement, one researcher coded the remaining data.

5. Results

5.1 RQ1: What roles and motivations do older adults have in FOSS communities and how do these change over time?

We categorized older participants into different roles using Ye and Kishida's list [20]. There were 3 timepoints for role analysis: their first contribution, their most recent contribution, and what they feel their role is in general.

Older participants assumed a variety of roles, from reader to project leader (see Table 7). We found that 8 older participants were *active developers* in their first contribution, and 5 of those 8 remained as *active developers* when asked about their general role in FOSS communities. This shows a relative lack of role migration. Further evidence of this is that there was one participant who had

remained a bug reporter for 14 years. There was also one participant who moved from a central role to a more peripheral role. Only 4 older participants moved from a more peripheral role to a more central role. Thus, our findings align better with the idea of an Onion Patch [21] than the Onion model [21].

Table 7. Number of older participants in each role at their first and most recent contributions, and in general.

Role	First	Recent	General
passive user	0	0	0
reader	1	1	0
bug reporter	2	1	1
peripheral developer	0	0	1
active developer	8	4	6
release manager	0	1	0
core member	0	3	1
project leader	0	1	2

We investigated motivations for first contribution, most recent contribution, and in general. This differs from previous work on FOSS contributor motivations, which only ask about motivation in general [20, 29]. One survey asked for reasons for "joining" and "sticking with" FOSS development, but did not ask about specific contributions [11].

We identified a motivation not seen in previous FOSS studies, namely, "**I'm doing it because someone asked me to.**" Three older participants and one leader gave this as a motivating factor. Older participants may have more experience than younger counterparts, so people may ask them to address particular problems that align with their known skill-set. It may also be an added motivation for older adults; an explicit acknowledgement of the usefulness or need for their work.

The top 3 motivations for older participants were intrinsic motivation (10 of 11), community identification (9 of 11), and altruism (9 of 11). The top 4 motivations for leaders were learning (6 of 6), personal project need (5 of 6), career-related benefits (5 of 6), and community identification (5 of 6).

Intrinsic motivation

> *"I enjoy it. It's just so much more fun than watching TV or whatever. I just get a great kick out of it."*
>
> *"I haven't gone for two days without writing code, in the past 33 years, and part of it, it's just like exercise for me. I feel bad if I cannot do it."*

Community identification

> *"…but you continue because of the people and the social side of it. I like a lot of people in the community I care about. So that's nice."*
>
> *"I'd say, there's certainly an element of the community itself, being a place I like to be, you know, it's almost like, you go hang out at a neighborhood bar, or something, some people like to do that."*

Altruism

> *"I wish I could cure the common cold and solve the world's energy problems. That's out of my steer of abilities and interests. So I can do software and it helps other people."*
>
> *"Part of it is because I actually like helping people."*

As shown in Figure 1, older participants' reasons for contributing seem to differ than the general FOSS population surveyed in Hars and Ou [29] and Ghosh et al. [11]. This may mean that outreach for older adults should emphasize on intrinsic factors and social aspects rather than on learning new skills or how contribution can benefit their reputation/career. This comparison comes with caveats. Our sample was very small, and we asked participants many questions about their

motivations, whereas surveys have only asked 1 or 2 questions. This means that our participants had more opportunity to list motivations. When comparing "motivation codes" to other studies, we acknowledge that interpretations had to be made. We tried to map the codes that correlated most closely (see Table 5), but we are aware that this is not a perfect mapping.

5.2 RQ2: What are the benefits and challenges to contribution for older adults?

There were multiple benefits mentioned by older participants (see Table 8). Related to community identification, they found that **community** was a benefit. **Satisfaction**, **widespread use**, **improved skills**, and **ease of use** were other benefits.

Table 8. Benefits of FOSS Contribution.
OA %=Percentage of older adults. LD %=Percentage of leaders.

Benefits of Participation	OA %	LD %
Community	36.36	66.67
Satisfaction	27.27	16.67
Improved skills - coding, knowledge, leadership	18.18	66.67
Widespread use	18.18	0
Ease of use	9.09	0

Additionally, we see a benefit in participants' self-perceptions of aging. We used this scale because: *"Self-perceptions of aging had a greater impact on survival than did gender, socioeconomic status, loneliness, and functional health in this cohort"* [28]. With an average of 4.08 out of 5 (where 5 is the highest and best, std.dev=0.67), our participants had highly positive self-perceptions of aging. This brings up more questions than it answers. One may hypothesize that those with positive self-

perceptions of aging are more likely to contribute to FOSS communities, or that FOSS helps older adults develop a more positive self-perception of aging. As one of our subjects explained: *"It's great when people finally meet you and they go 'Oh!'. It changes their perception of aging and that feels – ya, open source opens all of that."* However, there is also the possibility that since we interviewed mainly "young-old" participants, their self-perceptions of aging may be more positive than "old" or "old-old" participants.

Regardless of the reason for the high scores for self-perceptions of aging, the result shows that contributing to FOSS does not *harm* their self-perception. Therefore we argue that older adults should be encouraged and empowered to participate in FOSS communities.

The **social challenges** mentioned in interviews were: (1) general (e.g. the participant said there were social challenges but did not describe them in detail), (2) company doesn't allow it/makes it difficult, (3) conflict with others, (4) difficulty with communication, and (5) mismatch in expectations. **Technical challenges were**: (1) general, (2) not understanding the code base, (3) introducing bugs, (4) adopting new tools/ languages/ processes, and (5) licenses. Notably, we also asked if participants found anything **particularly easy** about contributing. Responses to that included (1) general, (2) licenses, (3) development process, (4) tools, (5) social aspects, and (6) having experience with the topic. Six of 11 older participants and 5 of 6 leaders note time as a barrier to contribution.

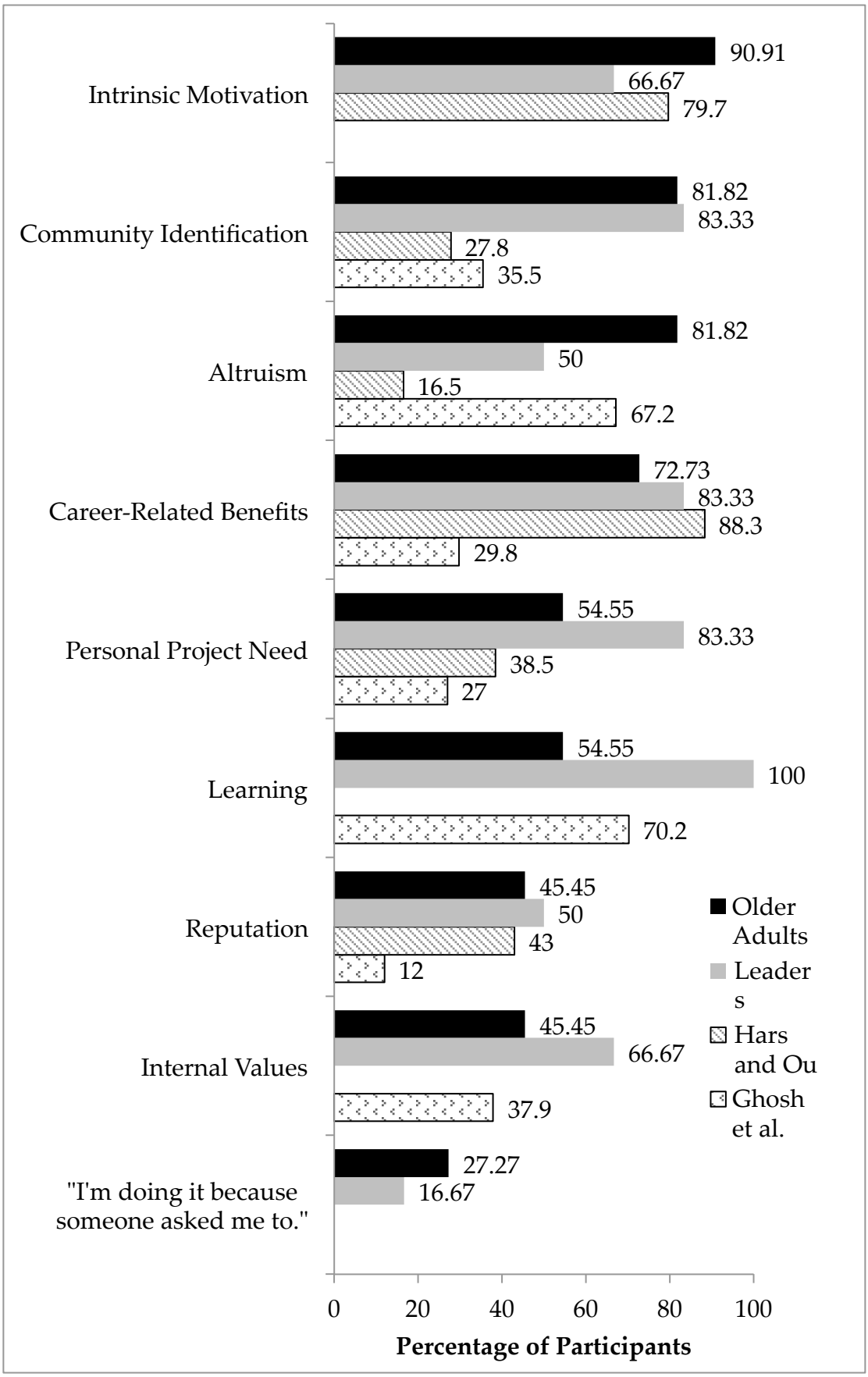

Figure 1. Contributor Motivations

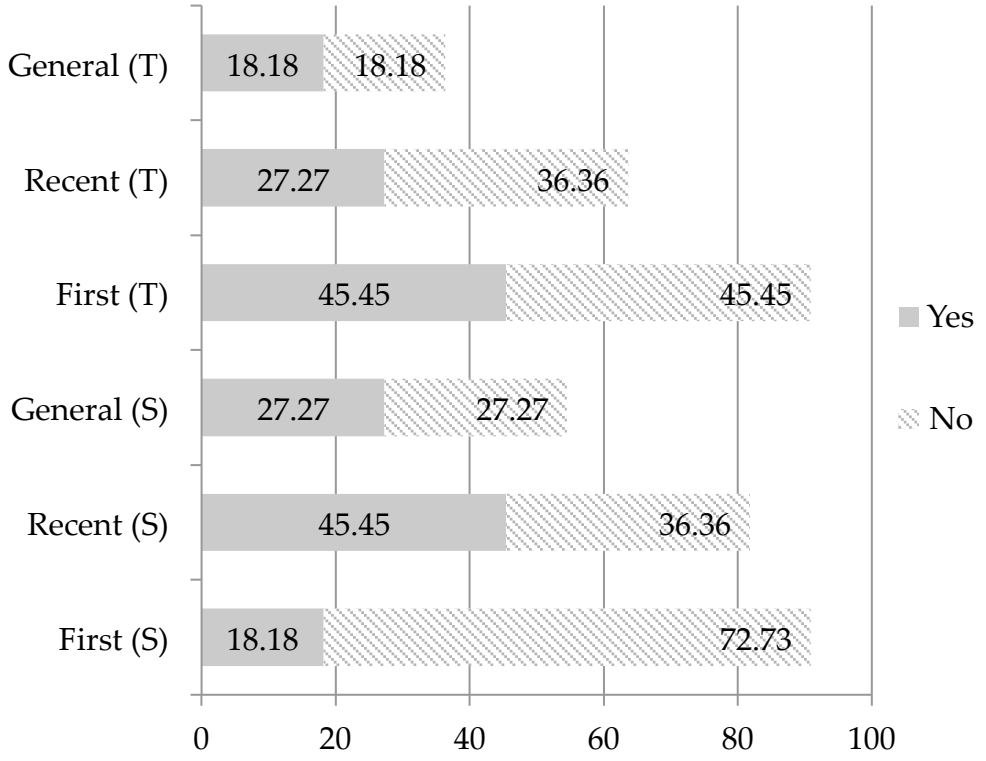

Figure 2. Percent of older participants experiencing challenges. Graph shows Social (S) and Technical (T) challenges for first contribution, most recent contribution, and in general.

As shown in Figure 2, older participants faced more technical challenges on first contribution, and more social challenges in more recent contributions. Note that Yes/No responses will not add up to 100%. If the participant *only* mentioned social challenges, we did not mark that as a "no" for technical challenges because they did not explicitly state that they did not have technical challenges.

If we compare these challenges to the older adult virtual volunteering literature [26], we see similar social challenges, including a lack of responsiveness from host organizations and a mismatch in expectations. Hinds and Mortsensen find that employees reported more conflict in geographically distributed teams [40]. While FOSS teams may not be *geographically* distributed, they are distributed and much communication happens online. In addition to the notion that there may be

more conflict in FOSS teams, older adults may find such conflicts more annoying, as they may have worked in a co-located corporate setting for many years longer than their younger counterparts.

The technical challenges mentioned in Mukherjee's study [26] were related to broadband connection issues, using a mouse, and website usability. These did not mirror the technical challenges in our findings, as our participants are technically experienced, which was not necessarily the case in the virtual volunteering literature.

These findings suggest that outreach efforts should emphasize the social aspect of contributing because there were social motivations and social challenges. That said, there *are* technical challenges, so those should be addressed as well.

5.3 RQ3: Do older adults experience or witness discrimination in FOSS communities?

We coded interviews for discrimination against gender, age, native language, and experience. We asked open-ended questions about discrimination, and then a follow-up question about ageism. Notably, 8 of 11 older adults mentioned witnessing discrimination against non-native English speakers in FOSS communities: *"I have definitely seen it when there are people from outside of the US that are participating. Recently, particularly, Indian or Middle Eastern names tend to not get taken seriously."*

Seven of 11 older adults mentioned gender discrimination. For instance: *"The worst of it I think I have seen is kind of sexism at the sort of objectifying of women, the weirdness around women particularly as a minority in the communities. And sometimes it's weird and uncomfortable and sometimes it's worse than that."* In Nafus, Leach, and Krieger's analysis, they found that of the male FOSS contributors surveyed, only

20% reported observing or experiencing gender discrimination, whereas about 75% of women reported observing or experiencing it [5]. Because the survey was over 10 years ago, it may be the case that gender discrimination has become more salient in recent years. Even though all of our older participants were male, 63.63% reported observing or experiencing gender discrimination. Older adults may be more aware and mindful of social issues compared to the general FOSS contributor population.

No one mentioned experiencing or witnessing ageism. However, we coded for ageist themes against younger people, and negative age-related stereotypes toward older people. Five of 11 older participants said something that was coded as negative stereotypes against younger people. In a comment about both gender-discrimination and one loaded with negative stereotypes against younger people, one subject commented: *"I expect it's more of the younger, more testosterone-laden ones being chauvinist pigs."*

Four of 11 older participants made statements coded as *age-related negative stereotypes towards others*. This does not mean that participants share that stereotype necessarily; in some cases they were recounting an event where someone in the community held that view. One subject recounted how someone had an age-related negative stereotype applied to him: *"Anyway, he was very like, to me, 'grey beard, that's like grandpa stuff'. He didn't like talking to me."* It appears that there is some ageism in FOSS, both toward younger and older people, though no one explicitly labeled it as ageism.

Though online communities assure some level of anonymity, 10 of 11 older participants reported that at least some part of the community knew their gender, background, or age. After asking leaders why they think ageism may not

be apparent in FOSS community, one replied that that there were not enough older adults in the community to witness ageism. This may be true. However, it may be that since ageism is completely entrenched in Western Society [41], people do not think of it as a form of discrimination when compared to other types of "socially unacceptable" discrimination.

5.4 RQ4: Do older adults offer anything to FOSS communities that is different from their younger counterparts?

Only 1 of 17 participants thought that older adults contributed nothing unique. The others identified 10 distinct ways older adults benefit FOSS communities. They were:

1. Software development experience
2. Understanding technology trends
3. Life experience as a user, parent, spouse
4. Experience in general
5. Maturity
6. Understanding computer/software architecture
7. They may have more time
8. They may have more connections/networking
9. Wisdom
10. Professional experience in general

Regarding understanding technology trends, one leader stated: *"They have seen technologies wash over. They know what's out there." [...] "They have insights about open source."* On an entertaining note, another leader explained how experience with marriage could benefit FOSS: *"Older men – They may be married, so they understand long-term relationships. They have learned how to compromise, have rational discussions and communicate. These skills are of profound importance but young folks think it doesn't matter."* These responses show that participants see many benefits for involving older adults, and we suggest that these benefits should be made clear to the FOSS community at large.

6. Shortcomings

As with any empirical work, our study is not without limitations. First, the sample size was small, which is an artifact of the small population we are studying and the exploratory nature of our research. Another limitation is that participants were on the "young-old" spectrum. Our results may have varied greatly if we were to interview only contributors over 65, for example.

Another limitation is that we did not interview technically experienced older adults *who are not* contributors for contrast. Doing interviews of this type may help explore why there are not more technically experienced older adults contributing. We plan to investigate this population in the future.

7. Guidelines For Involving Older Adults in FOSS

From the information gleaned from this study, we plan to develop a workshop curriculum to help older adults join a FOSS project for the first time. This will be in the same vein as OpenHatch workshops [18], but instead of being geared toward traditionally aged CS undergraduate students, they will be tailored for older adults. We identify three guidelines that we intend to apply in a future workshop:

Focus on the social aspects. Teach participants how to communicate effectively in a FOSS community. Highlight that contributing is not only about technical skills – it is also about building community, making friends, and communicating. Build cohorts of older contributors. We plan to do this through a private forum that will serve as a safe-haven for older contributors to share their experiences. We plan to inform new contributors of in-person user groups, conferences, etc. that they can attend to get to know others interested in FOSS.

Match contribution efforts to individual motivations. Continue to ask participants *why* they are contributing. Be sure to identify how those motivations can be met through FOSS. Perhaps pick projects that align well with their motivations. If they are deeply interested in altruism, it may make sense to encourage them to contribute to a humanitarian FOSS project.

Don't ignore the bad stuff. Talk about discrimination and potential barriers to communication. Provide participants with the tools to change the community – give them the language they need to resist/deter discrimination. Introduce them to resources that they may use to overcome barriers.

8. Conclusion

Given the lack of age diversity in free/open source software (FOSS) communities, we conducted a formative study by interviewing 11 older contributors and 6 community leaders (of any age). We found that older participants have a variety of roles in FOSS communities. Their top 3 motivations for contributing were community identification, altruism, and intrinsic motivation. In their most recent contributions, older participants experienced more social than technical challenges. Many older participants had witnessed discrimination against non-native English speakers and women in FOSS communities. On a positive note, older participants and leaders identified 10 unique ways that older adults add value to FOSS communities. From these findings, we propose three guidelines for onboarding older contributors: 1) focus on social aspects, 2) match contribution efforts to individual motivations, and 3) don't ignore the bad stuff. Finally, we see an untapped opportunity for enabling older adults to contribute to FOSS, where they are able to remain productive long into retirement.

9. Acknowledgment

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Chapter 5. On Older Adults in Free/Open Source Software: A Diary Study of First-Time Contributors

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1. Abstract

The global population is aging rapidly, and older adults are becoming increasingly technically savvy. This paper explores ways to engage these individuals to contribute to free/open source software (FOSS) projects. We ran a daily diary study to explore motivations, barriers, and the contribution processes of first-time contributors in a longitudinal, qualitative manner. In addition, we measured their self-efficacy before and after participation. We found that what motivated participants were intrinsic reasons, altruism, and internal values, which differed from previous work with older adults and with the general FOSS population. We also found that self-efficacy did not change significantly, even when participants encountered significant barriers or setbacks. The top 3 barriers were lack of communication, installation issues, and documentation issues. We found that asking and receiving help, and avoiding difficult development environments were keys to success. We recommend that future outreach efforts involving older adults focus on how to effectively communicate and build community amongst older contributors.

2. Introduction

Both the US and global populaton is aging at a rapid rate. Figure 1 shows the projected growth rate of people aged 65 and older [34]. According to this data, over 1/5 of the population will be 65 years and older by 2030.

With the increase in the size of the older population, we expect to see an influx in technically experienced older people, as suggested by a Pew Internet Research survey that found that 82% of older adults (aged 65 and older) who use the internet, go online at least 3 times a week, which is higher than previous surveys [31]. This increase in use of technology may lead to more technically experienced older adults in the future.

Volunteering, as contributing to FOSS could be considered, has been shown to have health benefits for older adults [23]. Contributing to free/open source software (FOSS) may be beneficial to older adults, as staying cognitively active into retirement is related to higher health and well-being [28]. An influx of older adult contributors could also benefit FOSS communities, as the number of FOSS projects is growing at an exponential rate [12].

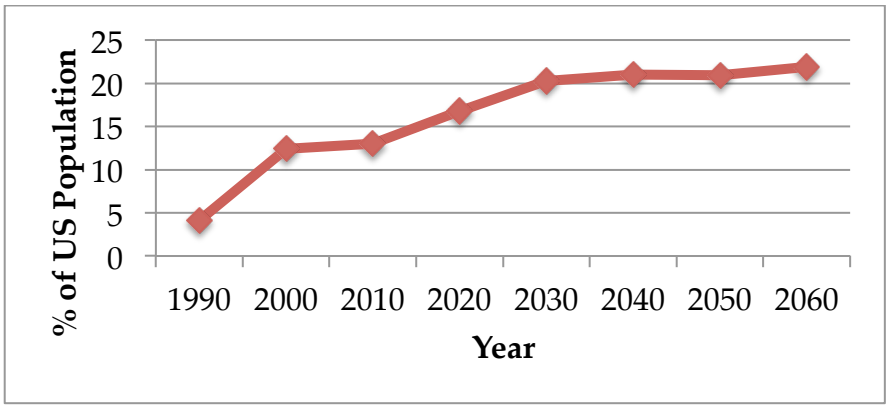


Figure 1. US Population Projection (65 years and older). Data source: US Census Bureau, Population Division.

FOSS communities are quite homogeneous and often lack age diversity, with only 7.09% of contributors being 50 years and older [2]. Older adults' increased participation may benefit FOSS communities. Davidson et al. interviewed people aged 50 and older who were already contributors [10] as well as community leaders and found 10 unique benefits associated with older adults participating in FOSS communities such as: having a wealth of software development and professional experience, having seen and understand technology trends, having life experience as a user, parent, and spouse, and having general wisdom and maturity.

While the interviews done by Davidson et al. [9] provided valuable insights, it is necessary to study how motivations and benefits/barriers affect the "natural" contribution process as older adults try to contribute to FOSS projects for the first time. We are especially interested in the first-time experience, because this first experience is the key to whether people ultimately manage to integrate with the community [18]. Because it may be difficult for experienced developers to remember the details of their first experiences, we decided to run a daily diary study where technically experienced older adults (aged 50 and older) logged their daily experiences of attempting to contribute to a FOSS project for the first time. Note that we chose 50 as our age cut-off because it is the eligibility threshold for the American Association for Retired Persons (AARP) [29]. Our research questions are as follows:

RQ1. *Does participation in FOSS impact the participants' self-efficacy?*

RQ2. *What motivates older first-time contributors?*

RQ3. *What are the benefits and barriers faced by older first-time contributors?*

RQ4. *What is the "natural" contribution process for older first-time contributors?* The reason why we pursue RQ4 is to develop an understanding of the contribution process to help us identify healthy and unhealthy paths, in order to help ensure healthy paths for future contributors.

The rest of the paper includes a literature review of the research on the FOSS joining process, motivations for contributing to FOSS, barriers to joining FOSS projects, and research on daily diary studies. This is followed by a description of the study methodology and subsequential data analysis. Then, results are reviewed, focusing on self-efficacy, motivations, barriers, and successful/unsuccessful contribution processes. The paper concludes with guidelines for future researchers regarding involving older contributors in FOSS projects.

3. Literature Review

First, we review the FOSS joining process, as we are studying the joining process of older first-time contributors. Additionally, we review motivations of FOSS developers with the goal of comparing motivations of older first-time contributors to existing literature. We also look toward the literature in virtual volunteering because contributing to FOSS is a form of virtual volunteering. As we witness older first-time contributors' barriers to participation in the daily diary portion of our study, we review literature around barriers to joining FOSS communities. The last portion of the literature review focuses on daily diary studies, as that is the methodology employed in this study.

3.1 FOSS Joining Process

There are many models for FOSS project structures and their joining processes. The most well known is perhaps the Onion Model, which describes a project as a hierarchy, where people become contributors by first being passive users, then bug reporters, then eventually code contributors [33]. Another model is the Onion Patch, where its proposed that skills are transferrable between projects, and the hierarchical process is not necessary to join a project [19]. Crowston and Howison posit that different projects have different structures and contributors may want to stay in a particular role and may not have the goal of advancing through the ranks [8]. To the best of our knowledge, there have been no studies looking at the step-by-step process of someone looking to join a FOSS project, and none have focused on that process for older first-time contributors.

3.2 Motivations of FOSS Developers

Assuming someone decides to join a FOSS project, and how to do so, it is important to understand what drives them. Understanding why people contribute to FOSS helps researchers and communities recruit enough people, and helps them recruit a diverse enough contributor population to ensure a sustainable future for FOSS projects. It also helps projects put forth compelling rationales for why someone should join or contribute, and align rewards in an optimal way.

Hars and Ou [17] and Ghosh et al. [14] among others [5, 22, 30, 33] have explored what motivates FOSS developers to contribute. Key motivations included both internal and external reasons, for example “altruism” and “developing human capital”, among others. Different demographics may be driven to contribute by different motivations, as they are dealing with different stages and challenges in

life. This is why we were interested in examining the motivations of older adults for contributions. For our research, we built on the list of motivations developed by Davidson et al. [10] in interviews with older adults: Intrinsic Motivation, Altruism, Community Identification, Internal Values, Learning, Career-Related Benefits, Reputation, Personal Project Need, and "I'm doing it because someone asked me to". These motivations align with motivations from the FOSS literature [14, 17] and adult volunteering literature [7, 20].

3.3 Virtual Volunteering and Older Adults

Older adults participate in a wide-range of volunteer activities and have been shown to volunteer more than younger adults [24]. Mukherjee interviewed 22 older adults aged 53 to 65 about their experiences with virtual volunteering [25]. Mukherjee's work is relevant because the definition of virtual volunteering can be expanded to include FOSS contributions. Benefits and barriers were uncovered. Examples of benefits were flexibility and the ability to participate with mobility restrictions. Barriers included organization communication, website usability, and broadband connection issues. Davidson et al. compared Mukherjee's findings with their study of experienced older FOSS contributors and found that there was an overlap in the barrier related to organization communication, but that other barriers (such as website usability and broadband connection issues) were not relevant to older FOSS contributors [10].

3.4 Barriers to Joining/Contributing to FOSS

Researchers have looked into the barriers new developers face while joining or contributing to a FOSS project. According to King et al., when newbies try to join a FOSS community the first step is participating in the mailing list [18]. One of the main issues here is the effect of a new contributors' gender or nationality

towards the kind of replies that they receive over the mailing list. In most cases this is not a barrier as the community tries to remain as neutral and helpful as possible. There have however been instances where a rude reply has discouraged someone from continuing to contribute. Another result that stood out was the low number of female participants. It was not just technical issues that lead to this but rather the culture, reward structure, and social aspects that acted as barriers [18].

Steinmacher at al. [32] found 5 categories of barriers to newcomers:

- Social interactions,
- Finding ways to start,
- Code issues,
- Documentation problems,
- Newcomer's previous experience.

These were among the main issues commonly found in FOSS communities after a systematic review of 21 candidate papers on the topic. Davidson et al. conducted a study of experienced older FOSS contributors and categorized challenges of contributing in two main categories: social challenges and technical challenges [10]. *Social challenges* included "general", company doesn't allow it/makes it difficult, conflict with others, difficulty with communication, and mismatch in expectations. *Technical challenges* included "general", not understanding the code base, introducing bugs, adopting new tools/languages/process, and licenses. Section 4.3 shows barriers found in the current study as compared to Davidson et al.'s work.

3.5 Daily Diary Studies in Computing

The daily diary study methodology has been used to collect longitudinal data in many disciplines, including psychology, health and medicine, education,

anthropology, architecture, etc. There have also been daily diary studies in various settings within computer science. For example, Begel and Simon used daily video diaries to collect data about important events of the day of eight novice developers at Microsoft [4]. Kersten and Murphy used diary study to evaluate their Eclipse plugin Mylar [21]. Czerwinski, Horvitz, and Wilhite used diary studies to understand how information workers provide multiple tasks among interruptions [9]. Diary studies in computer science are also designed to capture activities that occur in real environments with some kind of technology currently under investigation, or one subject to design [1].

Normally participants in a diary study are asked to keep record about a particular activity throughout the day or at specific times of the day. In a study conducted by Grinder et al., participants were asked to keep records of every time they use text messaging functions on their mobile phone [16]. These diaries can be highly structured, with specific pre-defined task [9, 16], or unstructured. In an unstructured diary study, participants are asked to keep records of all loosely related activities. For example in the study conducted by Palen et al., participants were asked to give entries of all the activities they do with their mobile phone for six weeks [26]. In another study, Palen et al. used both structured and unstructured diary studies to expand the dairy study from solely paper to include voicemails to collect data easily [27]. In diary studies, data entries by participants can be paper-based [1], digital (such as the use of spreadsheets) [9], videotaped [4], or over the phone [26, 27].

Regular interaction between the investigator and participants is very important, because it helps participants understand the scope and importance for the diary entries. This interaction can be done through daily interviews or over email. Though diary studies have high external validity (showing participants'

experiences in the real world), there are also drawbacks. For example, it is almost impossible to be completely sure that participants are responding to the daily diary questions in an unfiltered way. The second concern is that daily diary studies follow a case-study approach. The goal here is to get a depth of understanding of a handful of individuals' experience rather than statistical validity. The sample sizes therefore are typically smaller than a comparable controlled study, but tend to gather more longitudinal data. This is why our study is only intended as a first exploration; future studies will need to be done to explore the generalizability of our results.

The study in this paper has a daily diary component. We chose to conduct a diary study because it was not realistic to do a direct observation of our participants as they try to contribute to FOSS for the first time. Our participants worked in their own way in their chosen time. We could not have been with them every time they tried to contribute or work with FOSS communities. Our diary study was structured as we provide the participants a pre-defined set of questions to answer on a daily basis.

4. Methodology

As mentioned, the study reported in this paper is a daily diary study. Participants were recruited through a database of older adults called the LIFE Registry[1], flyers, social media, and email announcements. The participants were required to meet the following criteria:

- 50 years or older
- Fluent in English

[1] http://health.oregonstate.edu/healthy-aging/life-registry

- Self-proclaimed expertise in software related activities including documentation, coding, QA, management, web development, graphic design
- Never contributed to a FOSS project
- Have an interest in contributing to FOSS as a volunteer

For this study, we were interested in finding people interested in FOSS, but who for whatever reason have never contributed before. Therefore, our outcomes will not tell us why some older adults are not interested, but rather will shed light on how to ensure successful contributions for those who are interested.

Table 1. Participant Demographics

Participant	Age	Gender	Employment	Education
1	64	F	Retired	Master's, Computer Science
2	53	M	Part-Time	Bachelor's, Human Resources
3	58	M	Full Time	Bachelor's, Computer Science
4	68	M	Retired	Bachelor's, Anthropology

Four participants were enrolled in the study. Participant demographics can be found in Table 1. Similar to Begel and Simon [4], our sample size is quite small. Even with compensation and lack of age restrictions, Begel and Simon were only able to enroll 8 participants in their study. With our need to study participants' motivations for FOSS contribution, we decided not to offer any compensation, as we did not want monetary compensation to confound their motivation to participate. With compensation, we may have seen a higher enrollment number. Despite this small sample size, we were able to uncover useful insights for future outreach efforts toward older first-time contributors.

4.1 Study Procedure

After obtaining verbal consent and confirming their eligibility, we performed a pre-interview with the participants that covered the following areas: personal background/demographics, their motivations for wanting to contribute to FOSS, and their reasons for not having done so yet. Then, we sent a follow-up email and asked them to choose their "start date" for the daily diary portion of the study (i.e. when they wanted to start trying to contribute). During the following 2 months, participants were asked to attempt to figure out how to contribute to a FOSS project. We pointed them to 3 example projects including Apache, Dreamwidth, and Sahana, but explained that they could work on any project they desired.

After the start date, the participants were asked via a daily reminder email to fill out an online form. The online form had the following topics:

1. If they did not work on FOSS that day, an explanation of why not
2. Name of the project they worked on
3. Amount of time spent on activity
4. Session goal
5. Rate the success of the session (5-point Likert, 5 is the highest)
6. What was the most successful thing they tried
7. What did not go as expected
8. If they interacted with anyone on the project, rate the helpfulness of the interaction (5-point Likert, 5 is the highest)
9. Additional comments

There were 3 ways for participants to terminate the daily diary portion of the study: 1) drop out – they stop filling out the daily diary and stop responding to emails, 2) they email when they feel they are done and would like to stop, or 3)

researchers email them at the 2 month point and ask them if they would like to continue or do a post-interview.

After the daily diary study portion had ended, we requested to do a post-interview with the participants. Post interviews were conducted for 3 of the 4 participants over Skype. The post interviews covered a range of topics including asking them to explain missing/skipped days, barriers related to contributing, benefits related to contributing, their likelihood of continuing contributing, and a rating of their experience with contributing. We plan to follow-up again with participants 6 months from their post-interview to see if there is any continued participation in FOSS communities.

The pre- and post- interviews were recorded and transcribed. All data from the online daily diary forms, pre-interviews, post-interviews, and any email communication between the participants and researchers were coded using grounded theory affinity coding, similar to the work of Dearman et al. [11, 15].

First, we chunked the data into small portions representing a full thought on one theme. There were a total of 250 "chunks". Then, 2 researchers grouped that data into similar topics. After grouping the data, codes (themes) were assigned. This was done for all data except "motivation", where we started with predefined themes from Davidson et al.'s study [10]. All other data was coded using true affinity coding (where no codes were decided beforehand).

Table 2. Codes: Motivation, Benefit, Personal Barrier, Project Barrier.

Code	Count	Quote
Motivation		
Intrinsic	6	*You know just having fun. Coding.*
Altruism	5	*Well, you know, giving back a little bit because I use an awful lot of it.*
Internal Values	4	*First, I'm interested in the concept of open source. The fact that it's open to revision, and it's free and available to people.*
Benefit		
Personal Project Need	6	*Certainly there's a lot of open source projects out there available for me to use them in any of my projects, personal projects. So that's a benefit to me.*
Free/Cheap	1	*One of the people in the group of guys I do photography with, is on a limited income. So he was interested in this.*
Mental Challenge	1	*Well the personal thing is it's definitely a mental challenge and that's something that people in my age group need to keep up.*
Personal Barrier		
Competing Obligations	13	*Part time job until 1:15, drive back from [location] to home, then worked on marketing my business product in local community.*
No Time	13	*No time today.*
Family	9	*Up in [location] all day for our grandson's 2nd birthday.*
Travel	9	*But, and there was a couple of days that were just on a short trip to the coast or something like that.*
Health	9	*Rather ill today - had to go in to see the doctor.*
Holiday	6	*Offline for the Christmas holidays until Jan 6 so I won't report again til then.*
Weather	5	*Another snowy day and dealing with snow build-up on and around the house. Lots of shoveling of snow have left me rather weary.*
Social Mismatch	2	*And it just strikes me that many of their concerns which are very real to them were social concerns that I didn't have, like dating type of things. If anything, I just took that as this is not the place for me.*
Project Barrier		
Lack of communication	18	*I didn't have any interaction, which is discouraging in itself.*
Installation Issues	14	*So it was a huge installation process that I never got fully successfully installed the thing. And that was one of the questions I was trying to ask. So I moved on from there.*
Documentation Issues	12	*Documentation is out of date with the current toolset and non-functional*
Didn't ask for help	5	*Realizing that it's not going to be easy to find what I want to help with. I need to focus on what I want to help with; so define that first.*
Outdated Project	4	*The Git repo looks old; not sure that it is the right code base.*
Don't know how/ who to talk to	4	*Couldn't find an email address for the owner of the [name of] project*
Unhelpful communication	3	*I got kind of a non-committal answer that was basically "probably" to both questions.*
Download Issues	2	*Found that I will need to get further support for the download and use of the windows-integrated software platforms.*
Feeling like an outsider	2	*You know what, I felt like a novice to put the question that I wanted on the mailing list. That was my feeling that the mailing lists were for more about the active devs and I guess I didn't feel comfortable putting a newbie question out there.*

Table 3. Contribution Process Codes

Code	Count	Quote
Contribution Process		
Researching Projects	9	*I used [resources] to research potential open source projects and found several to look into ([project name], [project name]).*
Choosing a Project	12	*So far, I am comfortable with the decision made to move to a different open source software product, since this product seems still to be much more open to receiving input from users.*
Using Software	6	*Did use the [project name] open source software for part of the processing as a way to familiarize myself with the software.*
Look through documentation	12	*Tomorrow I will continue my review of the documentation. So far, the documentation is logical and appropriately sequential in its layout.*
Look through new contributor info	3	*Watching a video for new developers*
Setting up environment	6	*Installed MacPorts; updated Xcode*
Finding bugs/WHAT to contribute	8	*I did find documentation bugs. I can try that next in parallel with getting [project name] installed in AWS.*
Asking for help	5	*Located and reviewed logs. Signed up for [project name] user forum and posted a question about my issue.*
Success in contributing	5	*I joined the French translation team and actually contributed 5 simple translations. Whoo hoo! :-) The system they have set up for translating makes it easy to do this.*
Failures	4	*It appears that I can navigate at least some of the project's aspects, there is becoming apparent to me that I do not have the fundamental understanding of how to interact with the foundation as a developer.*
No Opportunity for Contribution	15	*Of the thirty projects I have looked at so far, none needed my skill sets. (Perl, C, Java are not in my tool bag).*

Table 4. Daily Diary Participation Data

Participant	# of Entries	Ratio of "Days Worked"	Length of Participation (in days)
1	45	0.59	75
2	4	0.25	3
3	5	0.8	12
4	35	0.43	49

Two researchers iterated over the data twice until agreement was reached. Then, a third independent researcher reviewed the coded data and provided input. Then, all 3 researchers iterated twice until they all reached agreement on the coded data. The codes are shown in Tables 2 and 3 with examples of each code

from the dataset. Inter-rater reliability is not reported (which is in line with Dearman et al.'s approach [11]) because we took an iterative approach until researchers reached complete agreement.

Table 4 shows that participants ranged from 4 entries in the daily diary to 45. As one option of the online form was to explain why they hadn't worked on the FOSS project that day, the third column shows the ratio of how many entries reported participants working on the FOSS project vs. not having had any activity that day. One measure of participation in this study is the length of time (in days) they spent on the daily diary portion (date of last entry – date of first entry). With this metric, Participants 1 and 4 were the most successful in this study.

5. Results

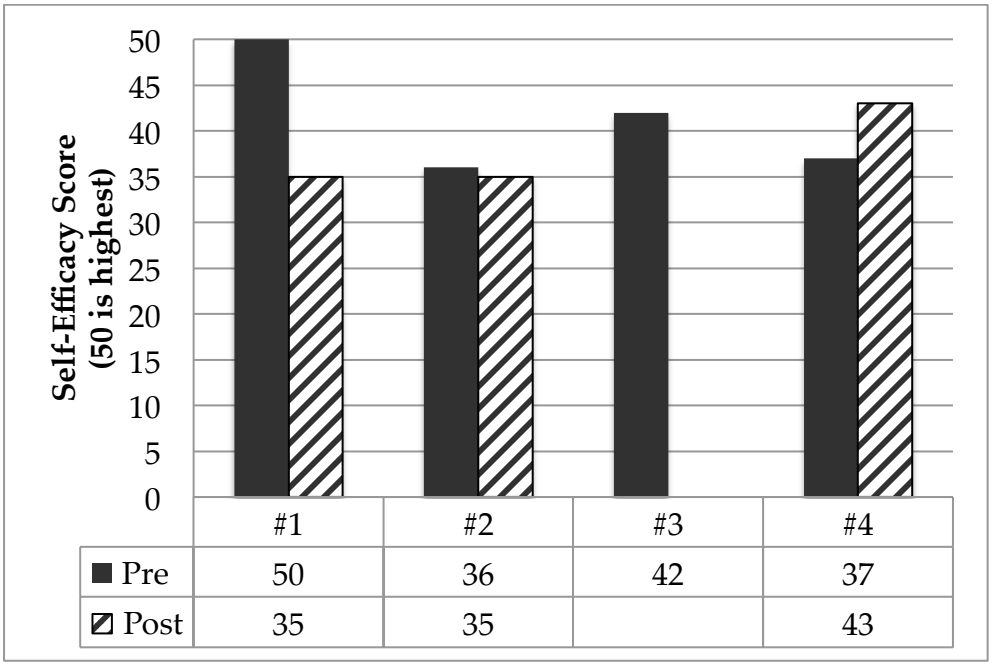
5.1 Self-Efficacy

Self-efficacy is a measure of ones confidence in their perceived ability to perform a task [3]. Self-efficacy can impact ones' actual ability to complete a task [3]. It is correlated with people's willingness to stick with a learning task, and has been studied in the context of computer science education [6]. We expected that self-efficacy would go down because of the phenomenon "you don't know what you don't know," which means that most people are overly optimistic going into poorly understood tasks. Because the participants had technical experience but no FOSS experience, we thought they may have high initial self-efficacy and possibly run into FOSS-specific issues that would result in lower self-efficacy.

We asked participants to answer 10 questions related to self-efficacy of contributing to free/open source software (FOSS). The pre- and post- self-efficacy scores are reported in Figure 2. Interestingly, Participant 1 who had the highest

amount of objective success (discussed in Section 5.4.1.1) also had the highest drop in self-efficacy. Participant 3 dropped out of the study and became unreachable. The other two participants showed relatively little change in their self-efficacy of contributing to FOSS.

To answer *RQ1: Does participation in the study impact participants' self-efficacy?*, there is no consistent trend in their self-efficacy scores.



	#1	#2	#3	#4
Pre	50	36	42	37
Post	35	35		43

Figure 2. Self-Efficacy Scores

5.2 Motivations

We asked participants about their motivations with the goal of comparing results from previous studies and to tailor future outreach efforts. Hars and Ou's survey of the general FOSS population found the top three motivations to be: Career-Related Benefits, Intrinsic Motivation, and Reputation [17]. For people nearing or at retirement age we did not expect all of these to be important. Ghosh et al.'s survey shows the top three motivations as Learning, Altruism, and Internal Values [14]. Davidson et al. found that older contributors' top motivations were

Intrinsic Motivation, Community Identification, and Altruism [10]. In response to *RQ2: What are the motivations of first-time older contributors?* – the participants from the daily diary study only reported three motivations: Intrinsic Motivation, Altruism, and Internal Values. These results are shown in Table 5. Surprisingly, we only found 3 motivations in the current study, however the motivations align well with Davidson et al.'s findings. One reason for not finding community identification as a motivation in the current study may be because first-time contributors have not realized the full potential of FOSS for making friends and developing a personal community.

Table 5. Comparison of top 3 motivations of free/open source software contributors from various studies. They are in rank order of % of participants who cite that motivation.

Hars and Ou	Ghosh et al.	Davidson et al.	Current Study
Career-Related Benefits	Learning	Intrinsic Motivation	Intrinsic Motivation
Intrinsic Motivation	Altruism	Community Identification	Altruism
Reputation	Internal Values	Altruism	Internal Values

5.3 Benefits and Barriers

5.3.1 Benefits

Three benefits of contributing to FOSS were **Personal Project Need**, **Free/Cheap**, and **Mental Challenge**. In other studies, Personal Project Need is considered to be a motivation [17]. However, in the way that participants spoke about it (see quote in Table 2), it was clear that they thought that contributing to FOSS could benefit a personal project of theirs. The second benefit mentioned was "Free/Cheap", or the lack of monetary cost associated with volunteering in FOSS. Participant 3 mentioned, "*One of the people in the group of guys I do photography with, is on a limited income. So he was interested in this."* Oftentimes, there is no cost

in purchasing SDKs, trying out the software, or traveling somewhere to participate in volunteering for FOSS. The final benefit mentioned was that contributing to FOSS provides a mental challenge, which according to Participant 3, is "*something that people in my age group need to keep up.*" As mentioned in Section 1, staying cognitively active into retirement is beneficial [28], and it appears from this study that at least one participant was aware of that benefit and chose to participate in activities that challenged their mental capacities.

5.3.2 Personal Barriers

In the daily online form and the post-interview, participants were asked why they skipped days. In response to those questions, personal barriers were uncovered. These were barriers not related to project issues, but rather personal conflicts or issues. Participants noted 8 different personal barriers (see Table 2), with the top 2 barriers as "Competing Obligations" (13 occurrences) and "No Time" (13 occurrences). Competing obligations included reasons for not participating that were related to being "busy" in specific ways, such as part-time work, meetings, etc.

5.3.3 Project Barriers

In the daily online form, we asked, "What if anything did not go as expected?" In addition, we asked about barriers in the post-interview. In response to these questions, we uncovered 9 project barriers. The top 2 barriers were lack of communication (18 occurrences) and installation issues (14 occurrences). A close third was documentation issues (12 occurrences).

Davidson et al. uncovered a variety of barriers from older adults who are experienced FOSS contributors [10]. Interestingly, the barriers were similar to the challenges encountered in Davidson et al.'s study. However, every barrier was

different, which shows the necessity of investigating the contribution process *in real time*. The combined list of barriers s shown in Table 6.

Table 6. FOSS contribution barriers faced by older adults.

Social	Technical
Davidson et al.	
General	General
Company doesn't allow it/makes it difficult	Not understanding the code base
Conflict with others	Introducing bugs
Difficulty with communication	Adopting new tools/languages/processes
Mismatch in expectations	Licenses
Current Study	
Feeling like an outsider	Installation Issues
Lack of communication	Documentation Issues
Don't know how/who to communicate with	Outdated Project
Unhelpful communication	Download Issues
Didn't ask for help	

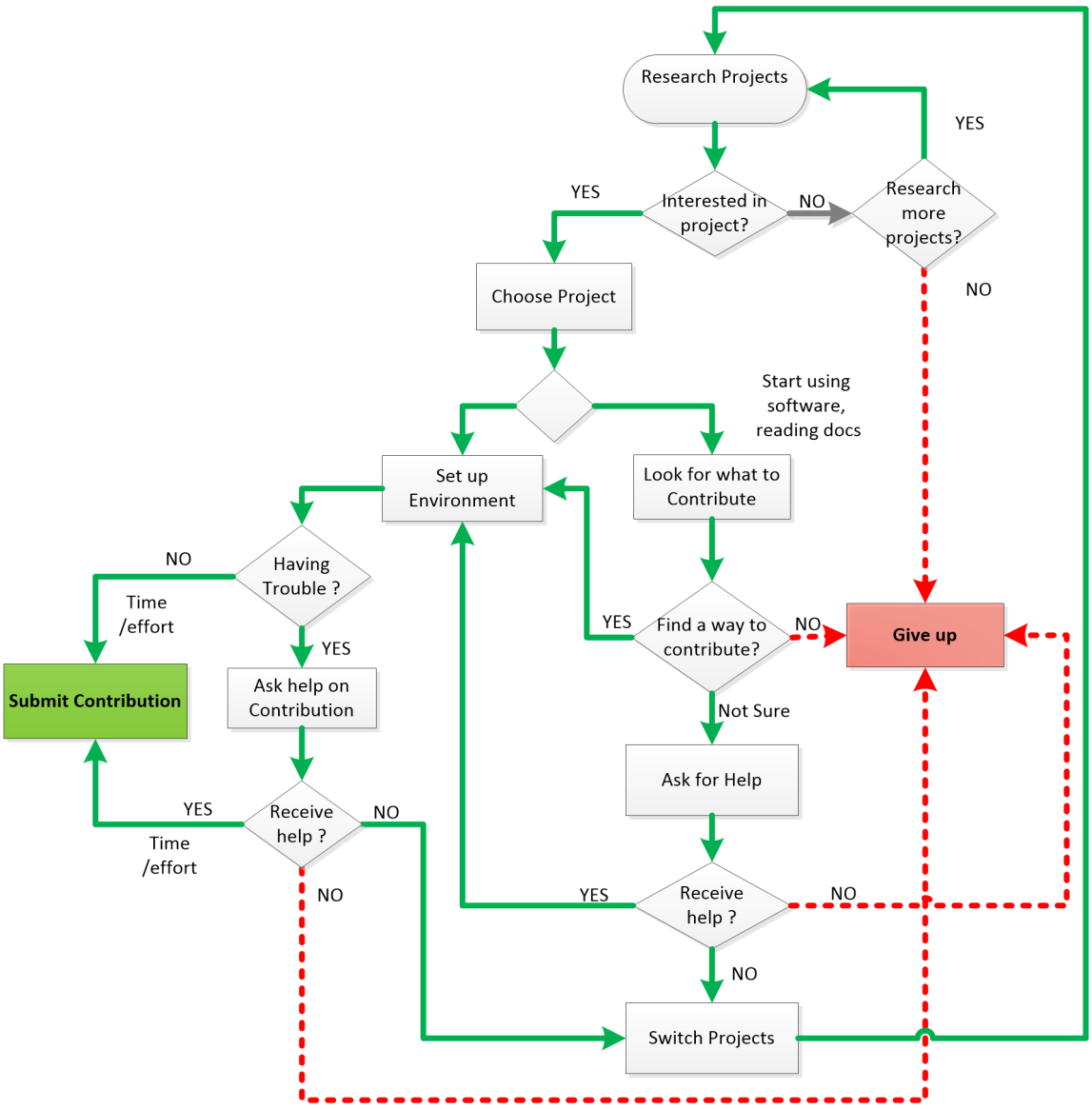


Figure 3. Contribution Process. Green (solid) lines are "healthy" contribution paths. Red (dotted) lines are "unhealthy" contribution paths.

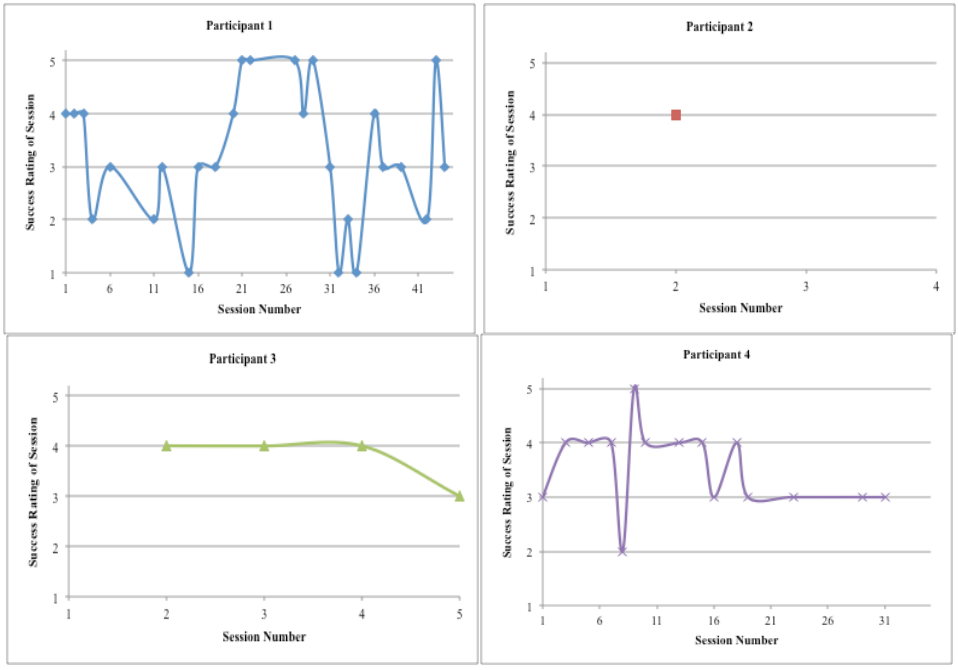


Figure 4. Success Rating of Sessions. Participants ranked the success of the session from 1 (low) to 5 (high). *Top Left*: High points: contributing translations (Sessions 21, 22, 29), reading helpful documentation (Session 27), and identifying a bug fix (Session 43). Low points: installation issues (Sessions 15, 32, 34). *Top Right*: Participant 2 was trying to find a project to invest time in (Session 2). *Bottom Left*: Low point: documentation issues (Session 5). *Bottom Right*: Low point: Did not know how/who to communicate with on the project (Session 8). High point: reading documentation and feeling hopeful about ways to contribute (Session 10).

5.4 Contribution Process

Another finding from this work was the creation of a contribution process diagram (see Figure 3). The daily diary study showed participants' *natural* contribution process, where researchers performed no intervention, other than requesting they fill out the daily online form. The green (solid) lines highlight the "healthy" contribution paths that could lead to a successful contribution. The red (dotted) lines highlight the "unhealthy" contribution paths. The findings from this research found 4 "unhealthy" paths that led to participants giving up. Figure 4 shows participants' success rating for each session reported in the daily form.

The following subsection reviews participants' experiences with the FOSS contribution process.

5.4.1 Participant Experiences

5.4.1.1 Participant 1

Project Interests. There were many projects of interest to this particular participant, and they switched projects 4 times due to lack of communication or installation issues.

Original Goal. They had the goal of contributing code to a FOSS project.

Accomplishments. Participant 1 was objectively the most successful participant in this study in terms of making a contribution. They were successful in that they were able to provide translation contributions to a FOSS project. However, they did not *perceive* that they were successful because they were not able to contribute in the way they had originally wanted to – through code. They also did not get feedback about their translation contributions from the FOSS project.

"Give Up" Mode. The failure mode with Participant 1 happened because there was a lack of a response from the repository owner regarding an identified bug fix, which would be the red (dotted) line from "Receive help?" to "Give up". This participant was very frustrated at the point of the post interview, as explained in an email, *"I think I will stop trying to do any open source work for now. I've had a less than satisfying experience and I want to work on some other projects".*

5.4.1.2 Participant 2

Project Interests. They were interested in finding a mobile application that related to the emergency response industry because they have past experience in that area.

Original Goal. They wanted to apply their coding skills they have learned from their small business to contribute code to a FOSS project.

Accomplishments. The participant only filled out 4 daily forms and did not cite any accomplishments, other than coming to the realization that they need to define better what kind of projects they would be willing to commit to.

"Give Up" Mode. Another failure mode happened with this participant, where they stopped participating because they could not find a project that aligned well with their skill set, as exemplified by the following quote: *"Of the thirty projects I have looked at so far, none needed my skill sets. (Perl, C, Java are not in my tool bag)".* This would be the red (dotted) line from "Find a way to contribute?" to "Give up". During the post interview they expressed concern that, "*I don't know that the infrastructure is there yet for the type of stuff we're looking for*".

5.4.1.3 Participant 3

Project Interests. They wanted to find a project related to health to contribute to because of professional experience in the area.

Original Goal. As they were a professional full-time developer, they wanted to contribute code to a FOSS project.

Accomplishments. According to the responses from the daily form, they were able to get "tools installed" for a health-related project.

"Give up" Mode. Unfortunately, Participant 3 dropped out of the study and became unreachable after a few days of filling out the daily online form. The last entry explained, *"tried to reinstall tools based on documentation. Docs are out of date."* It appears that were attempting to reinstall tools and failed because of documentation, but did not proceed to ask for help. "Didn't ask for help" was

one of our barriers, which may prevent first-time contributors from experiencing success.

5.4.2 Participant 4

Project Interests. This participant started with a project that had a humanitarian focus because of their altruism motivation. After having communication issues with the project, they switched projects to one that aligned better with their hobby.

Original Goal. They wanted to contribute documentation to a project. They had taught students in past how to use FOSS, and found documentation issues, so they wanted to improve documentation geared toward users.

Accomplishments. Participant 4 was the second most successful participant in the study, as they found a project of personal interest to them that they wanted to contribute to.

"Give up" Mode. After finding a project relevant to their photography hobby, the participant wanted to contribute documentation edits to tutorials in a photography-related application. However, they found the documentation so well written, they felt like they had no way to contribute *("I didn't find a way to add anything to what they had"*). Their red (dotted) line or failure mode happened from "Find a way to contribute?" to "Give up". Even though they decided to give up with a documentation contribution at that point, they had high hopes of contributing by evangelizing their use of photography-related software to friends and possibly hold workshops to teach other people how to use the software.

5.4.3 Encouraging Healthy Paths

A major takeaway from the observed contribution process is that communication is vital for our participants to make a successful contribution. First, it's important for the participant to ask for help *in the correct way.* Second, it's important for the project to respond *in a helpful way.* Additionally, like with the photography-related application, it's important to value contributions other than code, to allow people from all backgrounds to contribute. However, as with Participant 1, there should be pathways for people to contribute in any way they want, including code.

6. Lessons Learned

6.1 About older adults

To provide information for future researchers and the FOSS community at large, we list guidelines learned from this research. First, it is important to educate first-time older contributors how to communicate effectively in FOSS projects. Also, it may be beneficial to educate first-time contributors about a typical "healthy" contribution process. Third, projects should be picked that align well with motivations related to altruism and internal values to potentially appeal to older adults. We hypothesize that a potential demographic who may be more successful in FOSS contribution than others is "freshly retired" older adults. Both Participants 1 and 4 were "freshly retired" and were also the most successful participants in the project. This may be because they have not fully planned their retirement activities, and may be open to trying new activities that use their skillset. It may also be because they are experiencing the well-documented "honeymoon phase" of their retirement, where early retirement is marked by more enthusiasm than later retirement [13].

In addition to these insights, Participant 1 provided suggestions for future older newcomers to FOSS. First, they said, *"I think it's hard to contribute to a project if you've never used the product"*, so they recommended that one use the software extensively before trying to contribute. They stated, *"The complexity of the installation is really crucial to the success of you starting to contribute. […] It was really easy contributing to a website, easier than contributing to an app. Installing an app is more complex."* Therefore, they recommended that newcomers could do web-based contributions because it does not require setting up a complicated backend development environment.

6.2 About projects

To enable older adults to have successful contributions, it's important to consider how projects can aid them in the joining process. First, projects should make contribution paths obvious to newcomers. With their many years of technical experience, there should be no reason that any older newcomer feel like they cannot make a meaningful contribution to a project. Clear documentation on different ways to contribute is important. Many projects have taken to developing a list of good starting projects, but our experience shows that these can quickly become out of date, and people can get very frustrated when led down the wrong path. Second, responding to newcomers is important, even if they are asking questions in the wrong channel or in an inappropriate way. Finally, it is important to provide positive feedback if a contribution was accepted to encourage future contributions from that contributor.

6.3 Shortcomings & Future Work

The main shortcoming of this research is a small sample size. However this is true of many daily diary studies. The daily diary study has high external validity

and allowed for the creation of a contribution process model. This model can be validated by further research into this area. As far as future work, we are in the process of conducting a workshop study to use the results from this research study and results from Davidson et al. [10] to attempt to overcome barriers.

7. Conclusion

Four older adults (aged 50 and older) participated in a daily diary study where they attempted to contribute to a free/open source software (FOSS) project while logging their daily experiences. We uncovered three motivations of older adults (Intrinsic Motivation, Altruism, and Internal Values) that differed from previous research surrounding motivations and FOSS contributors. The top two barriers of making a contribution were lack of communication and installation issues. Additionally, the research resulted in a contribution process model that showed that asking for help, receiving help, and finding a way to contribute were all vital to making a successful contribution. The paper concluded with guidelines for future work in this area that focuses on teaching effective communication between FOSS project members and older adults, and FOSS projects providing feedback. The next step in this research is to conduct a workshop for first-time older FOSS contributors to investigate which barriers can be overcome with scaffolding and how to build community amongst newcomers.

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Chapter 6. Practice Makes Perfect: Lessons Learned from Teaching Older Adults to Contribute to Free/Open Source Software

Jennifer L. Davidson, Rithika Naik, Rana Almurshed, Carlos Jensen

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1. Abstract

As the global population is aging rapidly, we propose engaging technically savvy older adults in contributing to free/open source software to provide meaningful societal contributions and cognitive stimulation into retirement. To that end, we conducted a workshop to teach the basics of contributing to free/open source software, followed by 2 weeks of individual work, and concluded with a debrief meeting. We measured changes in self-efficacy, motivations for contributing, and sense of community. There was little positive impact on participants' self-efficacy. Motivations were dynamic over the 2 weeks, and "learning" as a motivation was reported to be more important than in previous studies with older contributors. While having a community to rely on was of high importance to participants, the workshop only fostered a sense of community for 3 of the 7 participants. We found that participants were engaged in the initial workshop, but their engagement dropped off sharply afterwards. We learned how to further improve instructional design to meet the needs of older adults. Using minimalist learning theory did not appear to have a positive impact, and we recommend instruction that includes more practice and time to explore. The workshop setting shows promise to enable older adults to contribute, as the majority voiced interest in continuing to contribute after the conclusion of the study.

2. Introduction

The work presented in this paper is an extension on foundational work with older adults in free/open source software (FOSS) [5,6], and continues to address the rapidly growing aging population [17], the fact that only 7.09% of FOSS contributors are 50 years and older [1], and that volunteering is beneficial for older adults [11]. Our guiding question was, "How can we overcome barriers and highlight benefits of contributing to FOSS for older adults?" Building on empirical [5,6,18] and theoretical foundations [4,10], we developed and conducted a workshop study. Our research questions and expected results were as follows:

RQ1. How did participants' **self-efficacy** change over the course of the workshop, as compared to previous work with older adults?

Expected Result. Due to the instruction, we expected that self-efficacy scores would increase over the 2-week study. However, previous work showed no coherent trend in self-efficacy scores when comparing self-efficacy prior to FOSS contribution and after [5]. It may also be the case that self-efficacy would decrease because of the idea that "you don't know what you don't know".

RQ2. What were participants' **motivations** for contributing to free/open source software, how did they change, and how does this compare to previous work?

Expected Result. We expected motivations to be the same as previous work with older adults in FOSS [5,6] and include internal motivations such as: intrinsic motivation, community identification, internal values, and altruism.

RQ3. Can the workshop foster **community**, and do participants care about having a community of support for FOSS contributions?

Expected Result. With the intervention of the face-to-face workshop where group work was encouraged, and the private discussion forum, we expected their sense of community to increase over the 2 weeks. We expected that community would be of high importance due to the expected "community identification" motivation. In previous work, older adults mentioned community identification as a motivation for contribution [6]. Therefore, we expected that community identification would be a motivation for these participants. It would follow that they would want to build community, and care about having a community, if their motivations were related to community identification.

RQ4. What **barriers** to contribution did participants encounter, and were they able to overcome them?

Expected Result. We expected that participants would have barriers similar to previous studies, however we expected to encounter fewer social barriers thanks to a focus on these issues in the workshop. The study was designed to enable participants to overcome barriers, but we were aware that setting up a development environment ("installation barrier") is a large barrier [5,15]. We therefore did not expect every participant to overcome all technical barriers.

RQ5. Were participants **engaged** during the workshop and throughout the study?

Expected Result. The workshop content was designed to engage participants and encourage active learning. Therefore, we expected the level of engagement to be high during the workshop. With discussion prompts and questionnaires over the 2 weeks, we expected engagement to be high throughout the study as well.

RQ6. Do participants **plan on continuing** to contribute to FOSS after the conclusion of the study?

Expected Result. We hoped that participants would plan on continuing to contribute because of their positive experience and intrinsic motivation.

While the overall goal was to learn about the effectiveness of the workshop we had planned, we were also interested in learning more about how this group of participants differed from previously studied FOSS populations, as there is a dearth of research into older FOSS contributors as well as people actively navigating the joining process.

The remainder of the paper is as follows: first we describe empirical and theoretical underpinnings of this work, then move on to a description of the study methodology. Then, we discuss responses to the research questions. We conclude with lessons learned to improve future outreach efforts for onboarding older adults.

3. Empirical Foundations

3.1 Older Adults and FOSS

Davidson et al. conducted two studies with older adults and provide guidelines from each one [5,6]. First, Davidson et al. interviewed existing older contributors and community leaders [6], then they conducted a diary study to study real-time contribution efforts of older adults trying to contribute to FOSS for the first time [5]. They offered the following guidelines in their work, which we implement in the instructional design of the study described in this paper:

"Focus on the social aspects." Because they found that motivations were social in nature, in that older adults were motivated by "community identification", they recommended focusing on the social aspects of contributions.

In addition, they recommend educating first-time older contributors how to communicate effectively because they saw evidence of older adults attempting to communicate through incorrect or unexpected channels.

"Match contribution efforts to individual motivations." In an effort to increase engagement, they recommend asking potential contributions about their motivations, in order to pick projects and tailor curriculum to match their motivations. Specifically, they recommend picking projects that align with altruism and internal values, as these appear to be the leading motivations of older adults.

"*Don't ignore the bad stuff."* They mention the importance of addressing possible communication barriers and address the occurrence of discrimination in FOSS communities. Jensen et al. found that newcomers may be adversely affected by flaming, which is where people may respond overtly negatively to a mailing list post, and consider not participating even if the flaming is not directed at them [8]. To that end, Davidson et al. recommend talking with newcomers about these possible issues to help encourage perseverance despite the "bad stuff".

One participant from their previous study recommended that newcomers *"use the project first before trying to contribute"* and *"try web-based contributions as an entry-point"*. These recommendations were also included in the instructional design for the workshop.

In addition to educating older adults on FOSS contribution, they recommend educating FOSS project communities. While changing multiple communities' practices was not feasible prior to this research study, we contact the FOSS communities' prior to the workshop study (described in **Methodology**).

Finally, we seeded questionnaires with barriers and motivations uncovered in that work.

3.2 OpenHatch Workshops

OpenHatch is a non-profit organization whose purpose is "to match free contributors with communities, tools, and education" [18]. They run workshops for undergraduate computer science students, in a series called "Open Source Comes to Campus" [19]. While they tend to work with traditionally aged undergraduate students, they have a commitment to diversity in open source (specifically gender diversity). However, they were very interested in the aspect of age diversity. This workshop was designed in close collaboration with the leadership of OpenHatch, in an effort to leverage their experience with FOSS newcomers.

Many of the instructional materials were adapted from OpenHatch's Open Source Comes to Campus curriculum [20] as they have conducted events at 27 schools, and have had time to improve and disseminate their materials.

4. Theoretical foundations

4.1 Minimalist Learning Theory

Due to its use with computer science instruction [13], we implemented minimalist learning theory [4] in this workshop. The main tenets of minimalist instruction are described by Carroll in the following way [4]:

- *"Choose an action-oriented approach"* where learners get hands-on experience as quickly as possible.
- *"Anchor the tool in the task domain"* so learners are not doing throw-away tasks, and each task has a direct relation to a domain.
- *"Support error recognition and recovery"*, to minimize barriers as much as possible.
- *"Support reading to do, study, and locate"*, by which succinct documentation points to further reading as needed.

In general, minimalist instruction espouses what we interpret as "just-in-time" learning and exploratory learning in, ideally, a real-world environment. Teaching learners what they need to know, as they need to know it, to get the task completed.

4.2 Older Adult Learning

In addition to minimalist learning theory, we also leveraged literature on adult learning. Mast, Zimmerman, and Rowe reviewed age-related changes in the brain and showed that older adult learning is still possible, even for people with dementia/Alzheimer's Disease [10]. Even though we are not involving an audience of that age, it is still important to note that learning can happen at any age. They found that older adult learners will follow a selective, optimization, compensation model. Older adult learners will focus on fewer activities, optimize their goals based on their expertise, and use methods to compensate for any age-related changes.

Furthermore, research suggests to allow adult learners to go at their own pace, to avoid timed exercises, to avoid tests or quizzes, and to allow learners to work together if they like [10].

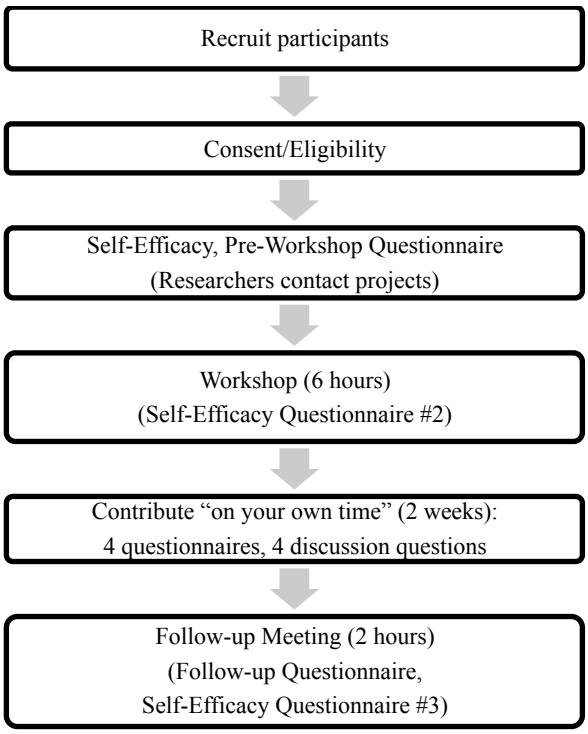

Figure 1. Study Methodology

Table 1. Workshop Day - Detail

Part 1	Introductions
Part 2	Introduction to Open Source
Part 3	Project Scavenger Hunt
Part 4	Tool Time (Git, IRC, Command Line)
Break	
Part 5	Social Training
Lunch	
Part 6	Open Contribution Time
Part 7	Self-Efficacy Questionnaire, Sticky-Note Feedback

Table 2. Participant Information.

Participant	Age	Gender	Git	Version Control	IRC	Command Line	Employment Status	Technical Expertise
1	52	Male	No	No	No	Yes	Part Time	Systems administration, Management
2	59	Female	No	No	No	Yes	Seasonal	Programming
3	64	Male	No	Yes	No	No	Retired	Programming
4	58	Male	Yes	Yes	Yes	Yes	Full Time	Networking services
5	57	Male	No	Yes	Yes	Yes	Volunteering, looking for paid work	Management
6	50	Male	No	No	No	No	Full Time	Management, Programming
7	59	Male	No	Yes	No	Yes	Part Time	Management, Programming

5. Methodology

5.1 Overview

An overview of the study methodology is shown in Figure 1. Participants were recruited through mailing lists, flyers, social media, and word-of-mouth (snowball sampling). Inclusion criteria were: 50 years and older, software expertise, have never contributed to FOSS before, but have an interest in contributing to FOSS. After potential participants showed an interest in the study, we went through informed consent procedures before checking whether they indeed met our eligibility requirements. Then, we emailed each enrolled participant a self-efficacy questionnaire and a pre-workshop questionnaire. The self-efficacy questionnaire was a 10-item questionnaire used to measure their confidence in contributing to FOSS. The pre-workshop questionnaire collected basic information about their background and experience, as well as questions related to their motivations, the importance of community to them, and any worries they had about contributing to a FOSS project. Finally, participants were asked why they had never contributed to open source before.

Researchers chose 3 sample projects based on the motivations of contributors. Prior to the workshop, one researcher contacted FOSS projects via Internet Relay Chat (IRC) and email. Two of the three FOSS projects responded and agreed to have at least one contributor on IRC during the workshop session.

The workshop was 6 hours long on a Saturday and was held at the Mozilla office in Portland, Oregon. Parking reimbursement and food were provided for participants, however no other compensation was offered. More details about the workshop are in **Workshop Details**.

Immediately after the workshop, we administered another self-efficacy questionnaire. Following the workshop, participants had 2 weeks to try to contribute to a FOSS project in their own time. During that time, we administered 4 questionnaires (asking about their experience, barriers, etc.) and 4 discussion questions on a private forum. The private forum was used to try to increase participants' sense of community, and provide a safe space to ask questions to each other. Following those 2 weeks, a 2-hour follow-up meeting was held at the Mozilla office in Portland, Oregon. At the beginning of the follow-up meeting we administered a final self-efficacy questionnaire, along with a follow-up questionnaire to measure changes in motivation and sense of community and barriers encountered. We also asked for suggestions for improving the workshop. Note that 4 participants attended the follow-up meeting in person. Two participants were interviewed individually due to scheduling conflicts, and 1 participant dropped out of the study due to illness.

5.2 Data Analysis

During the workshop and follow-up meeting, researchers took notes. There was no audio recording. Self-efficacy (RQ1), sense of community (RQ3), rating their

contribution experience, and likelihood to continue contributing (RQ6) were analyzed on Likert Scales.

Motivations (RQ2) were listed as checkboxes on each questionnaire (see Table 3 for a full list of motivations).

Barriers (RQ4) were also listed as checkboxes on questionnaires (except for the pre-workshop questionnaire), however, we uncovered additional barriers during the follow-up meeting. A full list of barriers is in Table 5, with bolded barriers representing "new" barriers uncovered in this study.

We measured engagement (RQ5) similar to the measurement of programming engagement in Kelleher's work [9]. Specifically, engagement was measured by counting:

- How many participants worked through breaks during the workshop?
- How many participants left the workshop early?
- How many participants stayed late at the workshop and follow-up meeting?
- How many questions did each participant ask during the workshop?
- How many participants filled out questionnaires and engaged in discussion on the private forum?

Researchers extracted themes from notes taken during the follow-up discussion about how to improve the workshop.

5.3 Workshop Details

As mentioned, the workshop curriculum was crafted based on findings from previous empirical work [5,6,18] and theoretical foundations of minimalist learning theory [4] and older adult learning [10]. Figure 2 shows the setting for the workshop. Table 1 shows each step of the workshop. First, to ensure that everyone felt they were part of team, we did introductions in an informal

environment. We also asked participants who had the same operating system installed to sit together and explicitly encouraged teamwork. Next came an introduction to FOSS. As opposed to giving a textbook definition, we attempted to make this personally relevant to the participants by showing them *their* definitions of FOSS, and example projects from the pre-workshop questionnaire. We also gave examples of ways in which people can contribute and gave an overview for the rest of the day.

Figure 2. Participants watching a video on Git.

The following is a description of how each component of the workshop aligned with minimalist learning theory.

First, minimalist learning theory suggests to *"Choose an action-oriented approach"*. Instead of doing a long introduction to projects and key components of open source projects, we administered a Project Scavenger Hunt. We gave participants the names of 3 FOSS projects (GNOME Accessibility, Sahana Eden, and Ushahidi) and they spent 30 minutes finding answers to scavenger hunt questions (questions like, where is the developer mailing list, what's the link to the code repository, what's the project's mission, etc.). Because we wanted participants to use Piazza (a private forum) after the event, we asked them to post their scavenger hunt responses to this forum so they would gain fluency with it.

The **second** tenet of minimalist learning theory is to *"anchor the tool in the task domain"*. Starting with the Project Scavenger Hunt was also a way to *anchor the task in the domain.*

Note that the three projects were chosen due to their relevance to the altruism motivation, which every participant noted as important in the pre-workshop questionnaire, and as recommended by previous research [5].

After debriefing on the Project Scavenger Hunt, we conducted a Tool Time session (Part 4). During the Tool Time session, we had brief explanations and exercises related to IRC, the command line, and Git. For each component of "Tool Time", if participants felt advanced, they were encouraged to look at our documentation and perform the exercise right away (without listening to our instruction). This aligns with the research on older adult learning [10], which states that learners will optimize their learning to their expertise, and to let learners learn at their own pace. Each Git, IRC, and Command Line task was done within the context of the project. For example, in the IRC task, we briefly explained what IRC was, then provided documentation on how to download IRC and how to connect to each project's IRC channel.

After the Tool Time session, there was a break for participants to grab a snack or use the restroom. Following that, Part 5 was "Social Training". Instead of calling this "Social Training" (which may sound demeaning) in the workshop, we entitled it "Starving the Trolls: How to Communicate in Free/Open Source Software Communities". As suggested in previous work [5,6], we spent 30 minutes talking about how to communicate in FOSS communities, what kind of negative interactions they may see, how to avoid those negative interactions, and how to ask for help. We held an interactive discussion around examples of

communication. We explained to participants that even though they may see negative interactions, it is still important to ask for help in a way that is Public, Polite, and Persistent. We learned from previous research that older participants might want to email an individual, instead of emailing a mailing list or participating in a public chat [5]. This is because emailing an individual is the more effective solution in a corporate work setting, and because many feel like an outsider and do not want to post "newbie" questions to a public forum. We addressed these issues directly, and strongly encourage participants to ask for help in an appropriate way, on an appropriate channel.

The **third** tenet of minimalist learning theory is to *"support error recognition and recovery"*. To support error recovery, we had 4 researchers present. Two researchers served mentors to aid in error recognition and recovery, and 2 were note-takers. However, the note-takers participated in problem-solving at least once during the workshop.

The **fourth** and final tenet of minimalist learning theory is to *"support reading to do, study, and locate"*. Every piece of documentation created by the researchers was brief (2 pages, maximum – and it was only that length because we included instructions for each operating system) and linked to more documentation if they needed.

During Part 6, "open contribution time", as used the advice from previous research [5] and asked participants to use the software they were interested in before trying to set up their development environment.

At the very end of the day in Part 7, participants filled out a self-efficacy questionnaire. Then, we asked participants to write their feedback about the workshop on paper sticky notes (see Figure 3), similar to what is suggested in

Lukas Blakk's "Learn to Teach Programming" [3]. Participants were asked to stick their sticky notes up as they left the workshop. This allowed participants to give anonymous, immediate feedback. We gathered the feedback and posted it on a discussion thread on Piazza. Even though we asked for feedback on the post-survey (which was 2 weeks later, at the follow-up meeting), we wanted to get their immediate feedback.

Figure 3. Sticky-note feedback from the workshop. Green (top) sticky notes represent "good things". Blue (middle) sticky notes represent "comments". Pink (bottom) sticky notes represent "issues".

6. Participants

Participant demographics (see Table 2) were asked in the pre-workshop questionnaire that was emailed to participants before they participated in the workshop. Seven participants participated in this study. The age range of participants was 50 – 64 with an average age of 57 (std.dev=4.69). One participant was female. We attribute the lack of gender balance to the small number of women in technical fields [7]. Participant 1 dropped out of the research study after the initial workshop due to illness; therefore follow-up survey data only includes 6 participants.

7. Results

Now, we turn to each research question and answer it with the data gathered from this study.

7.1 Self-Efficacy

*RQ1. How did participants' **self-efficacy** change over the course of the workshop, as compared to previous work with older adults?*

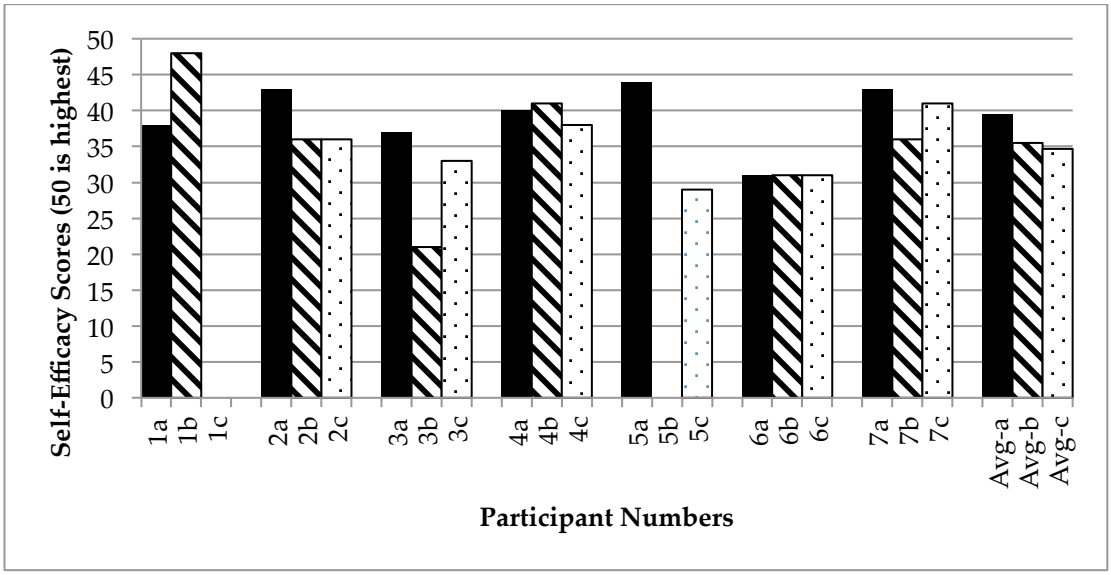

Figure 4. Participants' Self-Efficacy Scores (Confidence in Contributing to a Free/Open Source Project), before (a), immediately after (b), and (c) two weeks after the workshop. Average scores shown in the last column.

Self-efficacy is related to a person's confidence in performing a task [2]. Self-efficacy is important because it relates to the person's *actual* ability to perform a task [2]. In other words, if a person thinks they can do task, they are more likely to succeed at that task.

As shown in Figure 4, participants' self-efficacy did not increase for all participants. The average self-efficacy score before the workshop was **39.43**, immediately after the workshop: **35.5**, and two weeks after the workshop: **34.67**. This shows that participants faced a slight decrease in their self-efficacy throughout their 2 weeks of attempting to contribute to free/open source software (FOSS).

If we look at the trends per participant, we see that 1 participant had a *strict increase* in self-efficacy, 2 had *strict decreases*, 2 had a *u-shaped* experience where their self-efficacy went down then up after spending time on the project, 1 had a *parabola-shaped* experience where their self-efficacy slightly increased then decreased over the 2 weeks, and 1 had *no change* over the two weeks.

This variation in trends is similar to Davidson et al.'s diary study [5] where the only intervention was to ask participants to log their experiences with contributing to FOSS over a period of 2 months. In that study, 2 participants showed a decrease in self-efficacy and 1 participant showed an increase in self-efficacy. The average self-efficacy before the diary study was **41.5**, and after the study, it was **39.33**. While there was a smaller decrease than depicted in this workshop study, it may have been because 1 participant in the diary study redefined his definition of "contribution" to include evangelizing the software and was somewhat confident he could do that.

We attribute the decreases in self-efficacy to the idea that “you don’t know what you don’t know”. Our participants had many years of technical experience, so it would follow that their confidence in performing technical skills (such as contributing to FOSS) would be high. Then, after experiencing the barriers to FOSS over a short period of time, their self-efficacy would decrease because those barriers were unknown before attempting to contribute. In the cognitive science literature, Kass et al. found that if participants experienced failure, their self-efficacy decreases significantly [14], which could help explain our findings. Because participants experienced unexpected barriers, it would follow that their self-efficacy would decrease. We expect that their self-efficacy will increase as they spend more time contributing. Participants were at the very early stages of contribution, and they experienced many barriers. After they have climbed the initial "on-ramping" hill, we would expect self-efficacy to increase.

7.2 Motivations

*RQ2. What were participants’ **motivations** for contributing to free/open source software, how did they change, and how does this compare to previous work?*

The top 4 motivations for both the pre- and post-surveys were Altruism, Learning, Intrinsic Motivation, and Internal Values (see Table 3). With a similar population, the only motivations mentioned by Davidson et al.'s diary study of 4 first-time older contributions were Intrinsic Motivation, Altruism, and Internal Values [5]. Davidson et al. also studied older adults who are already contributors and found their top 3 motivations to be Intrinsic Motivation, Community Identification, and Altruism [6]. Note that “learning” was not a top motivation in either of those studies where the study population was similar to this one. “Learning” may have appeared as a top motivation because participants signed up to attend a workshop, where it was probably assumed that there would be

some instruction. Similar to previous studies with older adults, we did not find "external motivations" or those related to career or reputation to rank highly, which be explained by the fact that some older adults have established careers, and others are retired.

Also, note that motivations change over time, and are not stagnant. We saw different motivations from the pre-survey and the post-survey, even with just a 2-week experience with FOSS. It appears that intrinsic motivation remained constant throughout the study. We saw decreases in other motivations (altruism, learning, internal values, community identification, etc.) This may be related to the decrease in self-efficacy. If participants felt discouraged, they may have lost some of their motivation to contribute.

Table 3. Motivations for Contribution to Free/Open Source Software.

Motivation	Pre-Survey (n=7)	Post-Survey (n=6)
Altruism	7	5
Learning	7	4
Intrinsic Motivation	6	5
Internal Values	6	4
Community Identification	5	2
Career-Related Benefits	3	1
Personal Project Need	1	1
Reputation	0	0
"I'm doing it because someone else asked me to"	0	0
Other	It's good for my health.	

7.3 Sense of Community

*RQ3. Can the workshop foster **community**, and do participants care about having a community of support for FOSS contributions?*

Table 4. Sense/Importance of Community (1=strongly disagree, 5=strongly agree).

Participant	**Pre** Sense of Community (Comm.)	**Post** Sense of Comm.	**Pre** Comm. is important	**Post** Comm. is important
1	3	-	5	-
2	2	4	4	5
3	3	2	3	3
4	3	3	5	5
5	3	1	5	5
6	2	3	4	4
7	1	2	5	4
Average	**2.43**	**2.5**	**4.43**	**4.33**
Std.dev	**0.79**	**1.05**	**0.79**	**0.82**

Table 4 shows scores from the pre and post-survey, where we asked participants if they have a community they feel they can turn to for support for questions related to FOSS (we refer to this as a "sense of community"). This question was on a 5-point Likert Scale from strongly disagree (1) to strongly agree (5). We found that 3 participants' sense of community increased over the 2 weeks, 2 participants' scores decreased, and 1 participants' score stayed the same. As mentioned earlier, one participant dropped out of the study, so the post-survey had 6 responses. While we did not find a large increase in their sense of community (only a .07 increase on average) from before the study compared to after the study, it remains clear that having a community is important to participants. Our attempt at using Piazza, the discussion forum, to build community was not successful. In addition, our use of face-to-face time and allowing for teamwork did not appear to build community, either. Our goal of building community may have been overly optimistic, given the short timeline of our study (2 weeks). This is discussed more in **Lessons Learned**.

7.4 Barriers

*RQ4. What **barriers** to contribution did participants encounter, and were they able to overcome them?*

Table 5 shows the list of barriers and how many participants encountered each barrier. The list of barriers was derived from Davidson et al. [5]. The shaded barriers were the most prevalent barriers, and the bolded barriers were ones that were uncovered during the follow-up meeting.

The top three barriers were *feeling like an outsider*, *don't know how or who to communicate with*, and *general technical challenges*. Interestingly, technical challenges were more prevalent than expected, given the technical background of participants. In fact, Participant 3 who had over 20 years of software development expertise claimed that, *"It's like they feel like they don't need to make it easy to use, because it's for "red hot computer scientists". Apparently it's [making it easy to contribute is] not a driving force for open source."* This is fascinating, given the fact that FOSS has high turnover [12], and projects are in need of more contributors. It points to the need for FOSS communities to improve the user experience of joining their projects.

The perceived or potential barriers uncovered in the follow-up discussion were:

Perceived: Personality mismatch with the project. As stated by Participant 4, *"I think there are alpha personalities where they want to be the center of the room. And makes it unpleasant for people who don't want to be around alphas."* Participant 3 agreed with that statement, and said that *he* did not want to be around that kind of behavior.

Potential: Issues with intergenerational working. Three participants mentioned this as a potential issue. Participant 4 explained, *"Talking to young people, the tools*

we're using and they're using are different. I don't think there is anything exciting about Ruby – I understand that websites need to get up. I know that there are people who are comfortable with what it is that they understand. I think that's an impediment for different backgrounds working together."

Outdated skills. Participant 3 explained, *"My hypothesis is that it's not mainly social, mainly that our skills are from a previous decade and not applicable to the current decade."* However, it should be noted that of the 4 participants who attended the follow-up meeting, only 2 agreed with this sentiment.

Another barrier listed in one questionnaire was **difficulty in understanding the purpose of the project**. In this case, Participant 7 wanted to see the software in action, but did not find an acceptable way to do that without setting up a development environment, and they were unable to understand the purpose of the project from just the documentation.

7.4.1 Overcoming barriers

We saw one example of overcoming the installation barrier - Participant 7 was able to get their development environment successfully set up, and one example of overcoming the "don't know how or who to communicate with" barrier - Participant 7 again posted to the project mailing list and received a helpful response. We hypothesize that we did not see other instances of overcoming barriers because of the short timeline of the study.

As shown in Table 6, only 1 of the participants who responded rated their experience as "bad" (arguably our most successful participant, Participant 7), so even with barriers, there was some positive impact on their experience. According to the follow-up meeting questionnaire, 5 of the 6 participants felt like the workshop was a good use of their time

Table 5. Barriers.

Challenge	Participants (n=6)
Social Challenges	
General social challenges	1
Feeling like an outsider	4
Lack of communication	0
Don't know how or who to communicate with	4
Unhelpful communication	0
Didn't ask for help	3
My company makes it difficult to contribute to open source software	
Conflict with others	
Difficulty with communication	1
Mismatch in expectations	1
Difficulty understanding the code base	2
Perceived: Personality mismatch with project	**2**
Potential: Issues with intergenerational working	**3**
Technical Challenges	
General technical challenges	4
I introduced bugs	
Difficulty with the development process	1
Difficulty adopting/learning new tools, languages, or processes	2
Difficulty understanding/applying licenses	
Installation issues	3
Documentation issues	3
Outdated project	1
Download issues	1
Outdated skills	2
Other	
Time	3
Difficulty understanding the purpose of the project	1

Table 6. Participants' Rating of their FOSS Contribution Experience (on a Likert Scale from Very Good to Terrible).

Participant	Contribution Experience Rating
2	Good
3	Neutral
4	Good
5	Good
6	Neutral
7	Bad

7.5 Engagement

*RQ5. Were participants **engaged** during the workshop and throughout the study?*

Participants showed high engagement during the in-person workshop, as shown in Table 7. Five of the 7 participants worked through the break, and 3 participants worked through lunch. Sixty questions were asked during the workshop. There was lower engagement during the 2-week period of individual contribution time. According to the follow-up discussion, the pacing of questionnaires and discussion posts during that 2-week period did not work with 5 of the participants' schedules.

Table 7. Engagement

How many participants worked through the break during the workshop?	5
How many participants worked during lunch?	3
How many participants left the workshop early?	1
How many participants stayed late at the workshop?	4
How many participants stayed late at the follow-up meeting?	2
How many questions did each participant ask during the workshop?	60 total Participant / Questions Asked 1: 4 2: 15 3: 20 4: 5 5: 6 6: 3 7: 7
How many participants filled out questionnaires and engaged in discussion on the private forum?	2 participants completed all 4 questionnaires. 3 participants were involved in the discussion forum.

7.6 Plans to Continue

*RQ6. Do participants **plan on continuing** to contribute to FOSS after the conclusion of the study?*

Table 8. Likelihood of Continuing to Contribute to Free/Open Source Software. 1=Not at all likely, 2=Somewhat likely, 3=Likely, 4=Very likely.

Participant	Likelihood to continue
2	3
3	2
4	4
5	4
6	1
7	2
Average	**2.67**
Std.dev	**1.21**

Table 8 shows participants' likelihood to continue contributing to FOSS. Despite the barriers, only one participant said they were not at all likely to continue trying to contribute. While the average was 2.67, there were 3 participants who were either likely or very likely, and 2 participants who were somewhat likely to continue contributing, which shows that the workshop helped them in pursuing FOSS contribution.

8. Lesson Learned

8.1 Minimalist Learning Theory vs. Behaviorism

Through the follow-up meeting discussion, we hypothesize that minimalist learning theory may not be the best approach for this particular population. It is probably the case that most of these participants were taught from the behaviorist approach, when they were in school [16], where instruction includes

a large amount of practice, and has goal-oriented learning, as opposed to "in-the-wild" learning, like we applied with minimalist learning theory. We saw evidence of participants' preference for behaviorism in their comments during the follow-up meeting.

8.1.1 Practice Makes Perfect

Participants 3, 4, and 5 agree that they would prefer a "sandbox" location where they could practice before entering the "real world". Interestingly, one participant stated, *"I'm only going to submit something if I'm darned sure it'll be useful."* This shows a certain amount of mindfulness in their contribution, which may not be prevalent in younger, less experienced contributors.

Participant 3 suggested having a "hello world" project that would allow them to practice all of the components needed for open source contribution in a well-designed environment.

8.1.2 Personal Goal-Setting

Participant 3, 4, and 6 agreed that at the end of the first workshop session, each participant should be encouraged to write down a goal for the following two weeks, to help guide their work. While there was a general goal of "contributing to a free/open source software project" followed by examples of different types of contributions, participants suggested having personalized explicit goals.

8.1.3 Longer Timeline, More Scaffolding

All 6 participants who either attended the follow-up meeting or were interviewed individually stated that a longer timeline with more scaffolding would have helped. Not only did they want more time, but they also wanted to have additional workshop sessions. If implemented, this timeline may help to foster successful contributions, which would improve self-efficacy scores.

Participant 2 suggested having one workshop that was solely dedicated to an

introduction to open source and exploring projects, then a second workshop to set up development environments. Similarly, participants 3, 4, 6, and 7 talked about a need to find projects that aligned more closely with their interests. Altruistic themes were not enough; they wanted a project that they personally connected with, and felt passionate about.

8.2 Importance of Community

Participants agreed that they would have benefited from more face-to-face time. Participant 7 stated, *"A longer timeframe, but it would be useful to have the in-person meetings in that stretch. You can get kinda jazzed up when you're around other people. There's some motivation that comes from being in this together with other people. I don't feel that online in quite the same way."*

In a similar vein, Participant 4 stated, *"I learn better with face-to-face interactions with other people. To get the motivation, direction, big picture. We could have a meeting, then come back with more."*

So, while the two-week period was given to allow for participants to learn at their own pace, it appears that even if they appreciate the time to learn at their own pace, they still want more face-to-face interaction.

This face-to-face interaction would also enforce the sense of community and, a feeling that "we're all in this together." The Piazza discussion forum was intended to do that, but it was not successful as 4 participants complained about Piazza's user experience (3, 4, 5, 6), and found it difficult to use. Participant 7 appreciated the discussion questions and questionnaires during the 2-week period, as it gave them a reminder to reflect and to continue trying to contribute.

Participants 3 and 4 were very passionate about the idea of starting a project from the ground-up, instead of contributing to an existing project. This may be because they expressed concern over the potential barrier of a personality mismatch in existing projects. These two participants stayed 45 minutes late (until we had to leave the space), during the follow-up meeting to discuss their project idea. Participant 5 was also interested in this. However, participants 6 and 7 did not want to start a project from the ground up.

9. Conclusion

Addressing the low numbers of older adults participating in (FOSS) communities [1] and society's rapidly growing aging population [17], we conducted a workshop based on previous empirical work and theoretical foundations to enable older adults to contribute to free/open source software (FOSS) for the first time. The 6-hour workshop was followed by 2 weeks of individual contribution time. There was also a 2-hour follow-up debriefing meeting with participants. There was a decrease in self-efficacy on average over the course of the study, possibly due to the fact that participants experienced unexpected barriers. We found that *learning* was a strong motivation for participants to contribute to FOSS, which differs from previous work. We uncovered potential and perceived barriers related to the perception of having outdated skills, possible issues with intergenerational communication, and a potential barrier of too many alpha personalities in FOSS communities. In terms of the workshop instruction, we recommend implementing a more behaviorist approach as opposed implementing minimalist learning theory because participants wanted methodical practice before entering the "real world" of contribution. Additionally, we found participants wanted more face-to-face meetings over a longer timeline to enable their contribution and increase self-efficacy. All in all,

participants were likely to continue contributing to FOSS after the study. We encourage future research and outreach implement a series of face-to-face workshops. The workshop format appears to be a successful way of engaging this population in FOSS contribution.

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Chapter 7. Conclusion

The work presented in this dissertation was motivated by our rapidly aging society, and the possibility of older adults contributing to free/open source software (FOSS). Involving older adults would not only benefit older adults in terms of providing a cognitively engaging retirement activity, but also could also benefit FOSS by providing experienced technical contributors along with age diversity. First, we conducted a study to engage non-technical older adults in participatory design (Chapters 2 and 3). We found that older adults had ideas for mobile healthcare applications that were creative and that did not exist in the smartphone app market. Therefore, we claim that older adults should be involved in every step of the software development process, including design. The next phase of the research was to investigate older adults' direct involvement in FOSS communities. In Chapter 4, we interviewed 11 older FOSS contributors and 6 FOSS community leaders. We found that motivations of older contributors differ from motivations of the general FOSS population, barriers to contribution were more social than technical, and participants listed 10 unique ways older adults could add value to FOSS communities. In Chapter 5, we conducted a daily diary study, where we asked older adults who had technical backgrounds to attempt to contribute to a FOSS project and log their experiences. We found a variety of barriers that were different than barriers in Chapter 4, which showed the importance of witnessing the contribution process in *real time*. From the findings of Chapters 4 and 5 and theoretical foundations, we designed and conducted a workshop study (Chapter 6) to enable older adults to contribute to FOSS. We learned that the workshop study should be longer than 2 weeks, have more face-to-face interaction, and focus on practicing skills before entering a real-world FOSS project. The research deliverables from this research are a list of

benefits of barriers of older adults' involvement in FOSS (Appendix A), a list of guidelines for involving older adults in FOSS (Appendix B), and a prototype workshop curriculum (Appendix C).

APPENDICES

Appendix A: List of Benefits and Barriers of Older Adults' Involvement in Free/Open Source Software

Table 1. Benefits

Benefits to Older Adults	Benefits to Free/Open Source Software Communities
Personal Project Need	Software development experience
Free/Cheap	Understanding technology trends
Mental Challenge	Life experience as a user, parent, spouse
Community	Experience in general
Satisfaction	Maturity
Improved skills - coding, knowledge, leadership	Understanding computer/software
Widespread use of something they created	Knowledge of software architecture
Ease of use - improve the ease of use of software	They may have more time
	They may have more connections/networking
	Wisdom
	Professional experience in general

Table 2. Barriers

Social Barriers	Technical Barriers
General social challenges	General technical challenges
Feeling like an outsider	I introduced bugs
Lack of communication	Difficulty with the development process
Don't know how or who to communicate with	Difficulty adopting/learning new tools, languages, or processes
Unhelpful communication	Difficulty understanding/applying licenses
Didn't ask for help	Installation issues
My company makes it difficult to contribute to open source software	Documentation issues
Conflict with others	Outdated project
Difficulty with communication	Download issues
Mismatch in expectations	Outdated skills
Difficulty understanding the code base	
Perceived: Personality mismatch with project	
Potential: Issues with intergenerational working	
Personal Barriers	**Miscellaneous Barriers**
Competing Obligations	Times
No Time	Difficulty understanding the purpose of the project
Family	
Travel	
Health	
Holiday	
Weather	
Social Mismatch as a Personal Barrier	

Appendix B: Guidelines for Involving Older Adults in Free/Open Source Software

- Focus on social aspects. Educate older adults on how to communicate effectively in free/open source software projects.
- Match contribution efforts to individual motivations. Choose projects related to individual participants' motivations (perhaps related to their hobbies).
- Don't ignore the bad stuff. Talk with older adults about discrimination and barriers in free/open source software communities, and give them the tools to have a positive experience.
- Provide a series of face-to-face workshops over a long period of time
- Focus on community building
- Give ample time to practice skills before applying them to "real" projects
- Encourage individualized, realistic goal-setting for contribution efforts
- Regarding projects:
    - Make all types of contribution paths obvious
    - Respond to newcomers, even if they ask questions in incorrect channels
    - Provide positive feedback if a contribution was accepted

Appendix C: Prototype Workshop Curriculum

Table 1. Saturday 1: Agenda

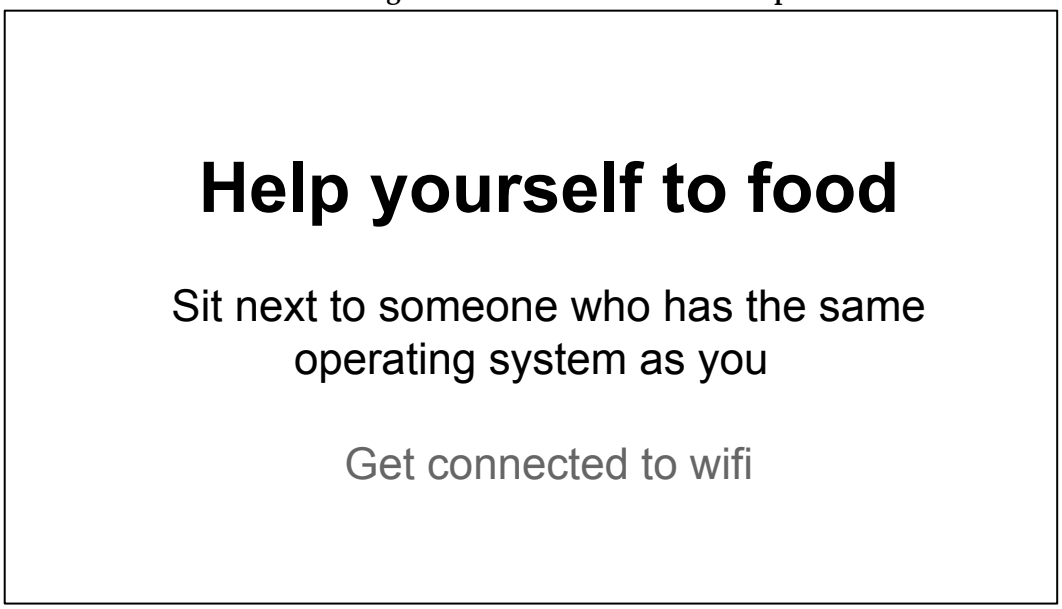
Time	Activity
9:00am-9:20am (20 minutes)	Continental Breakfast, Mingle
9:20am-9:30am (10 minutes)	Introductions
9:30am-10:00am (30 minutes)	Project Scavenger Hunt
10:00am-11:00am (1 hour)	Tool Time
11:00am-11:15am (15 minutes)	Break (snacks are provided)
11:15am-12:00pm (45 minutes)	Social Training
12:00pm-12:30pm (30 minutes)	Lunch
12:30pm-2:30pm (2 hours)	Open Contribution Time
1:00pm	Come back as a group - ask what is going well, and what is going poorly
1:30pm	1 hour warning. Come back as a group - ask what is going well, and what is going poorly
1:30-1:45 (15 minutes)	Break
2:00pm	30 minute warning
2:30pm-2:35pm (5 minutes)	Break (if needed)
2:30pm-2:40pm (10 minutes)	Self-efficacy questionnaire (online)
2:40pm-3:00pm (20 minutes)	Wrap-up

Table 2. Saturday 2 (2 weeks later): Agenda

Time	Activity
9:00am-9:30am (30 minutes)	Follow-up meeting questionnaire (online) Self-efficacy questionnaire (online)
9:30am-9:40am (10 minutes)	Get breakfast
9:40am-9:50am (10 minutes)	Eat breakfast and review comment questions, barriers, and stories. • Before the follow-up meeting, researchers will go through Piazza and gather these.
9:50am-11:00am (~1 hour)	Discussion

* Note: Based on our research, we recommend splitting the first Saturday into multiple sessions, with longer time to practice at each step. Therefore, the second Saturday (in Table 2) would most likely be many weeks after the first Saturday.

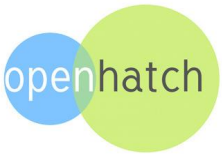
Figure 1. Slides from the workshop



Welcome!

mozilla

Thanks!



Link to these slides:
Slides adapted from http://openhatch.org

Introductions

Workshop Goal

For you to learn how to contribute to free/open source software.

This is hands-on! Plan to get your hands dirty and dig in to a project today.

What does “Open Source” mean to you?

- Software that is written by anyone that is **available to all** to use as needed.
- Software for which the source code is **freely available**, not just for viewing but for modification and improvement. Open source software was historically created by a team of **volunteers**, but commercial enterprises have embraced it as well.
- Software where the source code has been created to be **used**, **shared**, **modified**, **checked**, and **redistributed freely** without compensation.
- Source **code available**. Typically also available as compiled rpm or pkg. Any of several **licenses**: the GPLs, BSD, Apache etc.
- The source code is **easily accessed**, and can be **read** and **modified**.

What does “Open Source” mean to you?

Free as is freedom

Free as in beer

Anyone can contribute code

Historically volunteer-driven

Ways to contribute

Lead a project

Code

Documentation

Translation

Testing and quality assurance

User interface design

Logos and branding

Creating demos

Maintaining servers

Maintaining websites

Release Manager

Project management

Community management

Submit bug report

Triaging and reproducing bugs

Fix a bug

Answer questions on a mailing list

...and more!

Workshop Agenda

Project Scavenger Hunt

Tool Time

Starving the Trolls: How To Communicate in Open Source Communities

Lunch

Open Contribution Time

Next Steps

Piazza Discussion Forum

You should have received a Piazza invite yesterday.

http://bit.ly/piazza-foss

This will be a space for you all to communicate with each other, share experiences, and ask questions.

Projects

GNOME Accessibility

Sahana Eden

Ushahidi

(If you'd rather investigate a different project, feel free!)

Project Scavenger Hunt

GNOME Accessibility **Ushahidi**
Sahana Eden

1. Name 1 lead maintainer or developer. Can you find their personal email address? *(Good, now forget it. Don't use it.)*
2. Find the mailing list for developers.
    a. Subscribe to the mailing list.
3. Find where the code repository is located.
4. Find the developer IRC channel.
5. What is the mission statement of the project?
6. Do they have documentation for new contributors? Share the link, if so.

Tool Time

Step 1. IRC

Step 2. Command Line

Step 3. Git

http://bit.ly/irc-intro

Tool Time

Step 1. IRC

Step 2. Command Line

Step 3. Git

http://bit.ly/command-line-intro

If you're comfortable with the command line, help a neighbor or take a sneak peak at Git: http://bit.ly/git-instr.

Tool Time

Step 1. IRC

Step 2. Command Line

Step 3. Git

If you just want to check out code from a project: http://bit.ly/git-instr

Git: Video Introduction

Git is a **version control system** that allows people to work on files collaboratively.

http://git-scm.com/video/what-is-version-control

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

This gets a copy of the code onto your machine

$ cd repositoryname

$ git status

$ vim jen.txt

$ git status

$ git add jen.txt

$ git remote

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

Change directory to the folder with all of the code

$ git status

$ vim jen.txt

$ git status

$ git add jen.txt

$ git remote

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

$ git status

Check the status of the repository. Are there any new files? Changes to files? ..that haven't been "pushed" back to the "master" repository?

$ vim jen.txt

$ git status

$ git add jen.txt

$ git remote

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

$ git status

$ vim jen.txt

Create a new file using vim.

$ git status

$ git add jen.txt

$ git remote

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

$ git status

$ vim jen.txt

$ git status

This checks the status again. It will tell you that you have a new file.

$ git add jen.txt

$ git remote

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

$ git status

$ vim jen.txt

$ git status

$ git add jen.txt

So we'll need to tell the repo to **add** this file as one that you want to **version**.

$ git remote

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

$ git status

$ vim jen.txt

$ git status

$ git add jen.txt

$ git remote

This will tell you the **remote handle** of the remote server.

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

$ git status

$ vim jen.txt

$ git status

$ git add jen.txt

$ git remote

$ git push origin master

Then we'll **push** the file to the git server.

Then, you'd need to submit a "pull request" through GitHub

Git: Example

On your machine

$ git clone https://github.com/yourusername/repositoryname.git

$ cd repositoryname

$ git status

$ vim jen.txt

$ git status

$ git add jen.txt

$ git remote

$ git push origin master

Then, you'd need to submit a "pull request" through GitHub

Git

1. Get Git
2. Get source code

http://bit.ly/git-instr

Break

Starving the Trolls:

How to Communicate in Open Source Communities

What's in a troll?

Usually, they just derail conversations for their personal entertainment.

There's also *bullying*, or just *ineffective communication*.

Let's look at an example.

Troll, Bully, or Ineffective? Example 1.

I tend to hold things off after -rc4 because you scare me more than Greg does ;-)

Have you guys *seen* Greg? The guy is a freakish giant. He *should* scare you. He might squish you without ever even noticing.

Greg might be a giant and he might squish people without ever even noticing, but that's just a grave, deadly physical threat no real kernel hacker ever feels threatened by. (Not much can hurt us deep in our dark basements after all, except maybe earthquakes, gamma ray eruptions and Mom trying to clean up around the computers.)

So Greg, if you want it all to change, create some _real_ threat: be frank with contributors and sometimes swear a bit. That will cut your mailqueue in half, promise!

…

You may need to learn to shout at people.

Source: http://geekfeminism.wikia.com/wiki/Linux_kernel_civility_discussion

Troll, Bully, or Ineffective? Example 1.

Seriously, guys? Is this what we need in order to get improve -stable?
Linus Torvalds is advocating for physical intimidation and violence.
Ingo Molnar and Linus are advocating for verbal abuse.

Not *f'ing* cool. Violence, whether it be physical intimidation,
verbal threats or verbal abuse is not acceptable. Keep it professional
on the mailing lists.

That's the spirit.

Greg has taught you well. You have controlled your fear. Now, release your anger. Only your hatred can destroy me.

Come to the dark side, Sarah. We have cookies.

Source: http://geekfeminism.wikia.com/wiki/Linux_kernel_civility_discussion

Troll, Bully, or Ineffective? Example 2.

Subject: libreoffice broken again in updates-testing

- **Person 1:** why do whe have that always with libreoffice?
- **Person 2:** I will send a note to the editors of Oxford English Dictionary that "always" has been redefined to mean "in less than 10 % of cases". If I count correctly, we have issued 26 updates for F-20 that made it into stable (plus a few others that were obsoleted by a later one). One of these had a problem. Now there is a second one.
- **Person 1:** the main question is why

Troll, Bully, or Ineffective? Example 3.

- **Person 1:** … Emperor's New Cloths syndrome, no doubt.
- **Person 2:** Clothes. (Cloths: materials; clothes: garments.)
- **Person 1**:
  s/Cloths/Clothes/
  (pedantic: Characterized by a narrow, often ostentatious concern for book learning and formal rules) :-P
- **Person 3**:
  No, just correct spelling. Example:
  I would love to meet your sister.
  I would love to meat your sister.
  So, does it make a difference?

Trolls happen, but what to do?

You may *(very rarely)* see offensive posts toward women, toward non-native English speakers, or toward newbies.

When faced with a troll, you have options:

1. Ignore
2. Fight (respond politely and succinctly): **Be cautious!**

   Example: "I think this thread has changed topics. Let's try to get back to the topic of the original post."

1. Ask for support
2. Respond personally/off-list *(usually don't do this. It's asking for bullying.)*

Public. Polite. Persistent.

The best way to be successful in an open source project is to **ask for help**

> Hello.
> I have a lot of packaging experience for ALT Linux and some experience with Python programming, but no experience with Debian Python packaging (I have some understanding of general Debian packaging). I want to help with Python in Debian, what can I do?

- Email public mailing lists
- Participate in public chats
- Read documentation you can find, but don't be afraid to ask questions!
- Introduce yourself! Be friendly.

Lunch

Open Contribution Time

http://bit.ly/open-time

1. Test out project
2. Set up development environment
3. Investigate bug databases

Survey:

http://bit.ly/foss-questionnaire

Closing Discussion

1. Greenish - Good Things
2. Blue - Comments
3. Red - Issues