

# Participatory Design with Older Adults: An Analysis of Creativity in the Design of Mobile Healthcare Applications

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## 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.

## Author Keywords

Participatory design; older adults; creativity; design fixation

## ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## General Terms

Human Factors; Design.

## 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

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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 Creativity 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.

## 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.

### 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.

### 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.

#### 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].

#### 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. Chrysikou 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.

#### METHODS

##### Participants

We recruited 18 adults over the age of 65 through the LIFE Registry<sup>1</sup>, 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.

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

Table 1. Participant Demographics

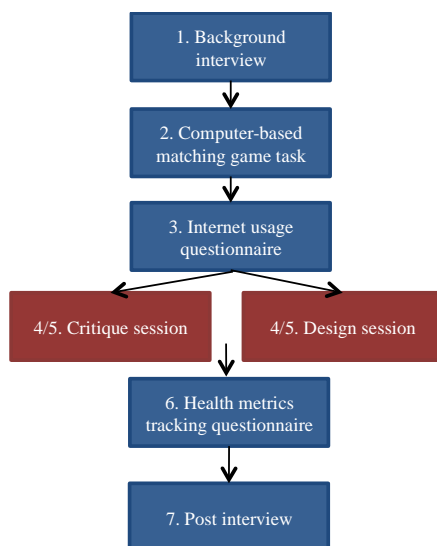
<sup>1</sup> <http://health.oregonstate.edu/healthy-aging/life-registry>

Edited Creative Product Semantic Scale								
The project idea presented is:								
	-3	-2	-1	0	1	2	3	
<b>crude</b> lacking finish, or maturity of treatment; rough, unpolished	.	.	.	.	.	.	.	<b>well-crafted</b> (taken from "crafted") made or constructed skillfully
<b>appropriate</b> specially fitted or suitable	.	.	.	.	.	.	.	<b>inappropriate</b> not appropriate; unsuitable to the particular case; unfitting, improper
<b>clear</b> easy to understand, fully intelligible, free from obscurity of sense, perspicuous	.	.	.	.	.	.	.	<b>ambiguous</b> doubtful, questionable; indistinct, obscure, not clearly defined
<b>unique</b> that is or forms the only one of its kind; having no like or equal; standing alone in comparison with others, frequently by reason of superior excellence; unequalled; unparalleled; unrivalled	.	.	.	.	.	.	.	<b>ordinary</b> belonging to the regular or usual order or course of things; normal; customary; usual
<b>coarse</b> ordinary, common, base, of inferior quality or values	.	.	.	.	.	.	.	<b>elegant</b> characterized by refine grace of form (usually as the result of art of culture); tastefully ornamental

**Figure 1.** Excerpt of Edited Creative Product Semantic Scale with Oxford English Dictionary definitions.

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 2). 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.

### Design Sessions



**Figure 2.** Study Protocol

Sessions lasted 2.5 hours, following the procedure outlined in Figure 2. 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.

### 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 3). The first panel was composed of industry

Group	Project Idea			Organizational			Technical		
	Novelty	Resolution	Synthesis & Elaboration	Novelty	Resolution	Synthesis & Elaboration	Novelty	Resolution	Synthesis & Elaboration
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	-

**Table 2.** Cronbach-Alpha Scores. Unreliable scores shown in red (less than 0.7).

professionals. The second panel was composed of professors at a local research university.

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

**Table 3.** Information about panelists

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 1)<sup>2</sup>. 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.

### 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 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

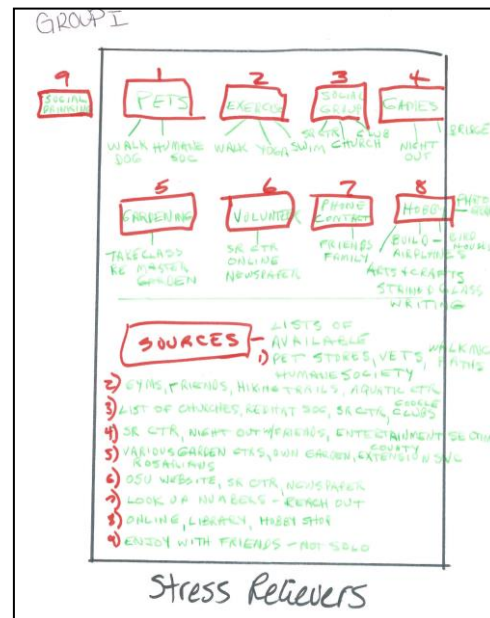
associated with it (see Table 2). Novelty was the only category found to be reliable across all perspectives.

### DESIGNS

To ground results, we give a brief presentation of the design ideas<sup>2</sup> and reactions from panelists.

#### 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.



**Figure 3.** Design idea for Group 1: Stress Relievers

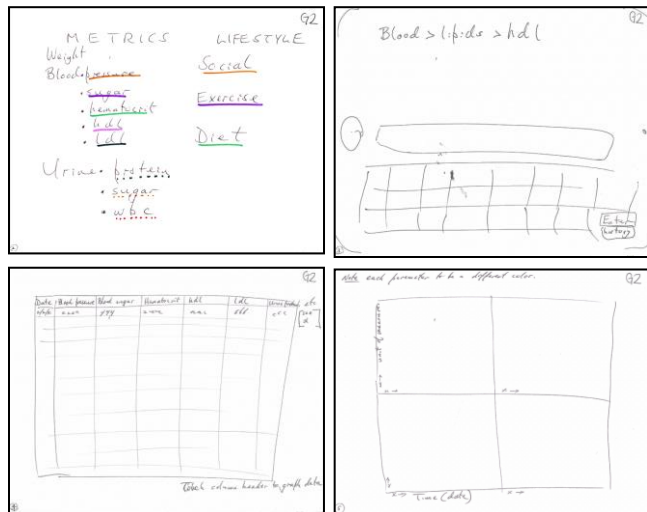
#### Group 2: Metrics/Lifestyle Tracking

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

<sup>2</sup> For access to the full assessment tool and full sized images of designs, see [people.oregonstate.edu/~davidjs/pd\\_study.html](http://people.oregonstate.edu/~davidjs/pd_study.html)



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



**Figure 4.** Design Idea for Group 2: Metrics/Lifestyle Tracking  
number of metrics they wanted to track.

### Group 3: Nutrition/Rest/Exercise



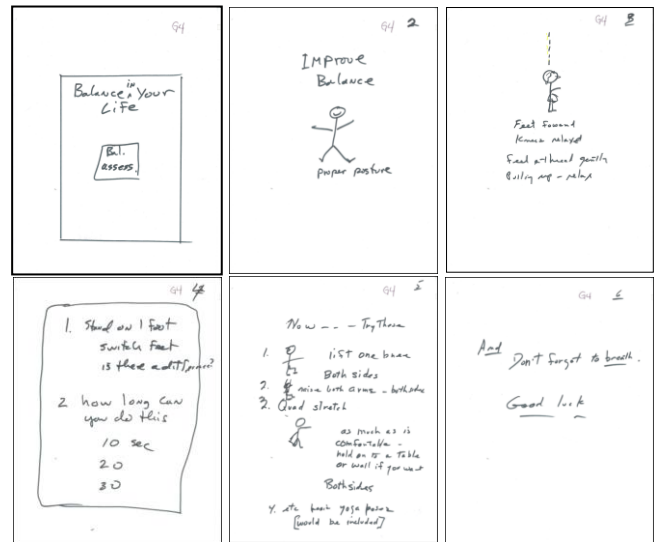
**Figure 5.** Design Idea for Group 3: Nutrition/Rest/Exercise

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.”

### 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

### 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.”

## 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.

### Creativity scores

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

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.

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 5.** Mean Novelty Scores from each perspective. Standard deviation in parenthesis.

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.

### Panelist Feedback

#### Panelist Discussion Themes

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

#### 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.

#### 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.

#### 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.

#### 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.

### **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.

#### *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.

#### *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.

#### *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.

### *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.

### **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 neither 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.

### 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.

### 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.

### 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 Creativity 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.

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