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Photo Narrative: Co-Designing a Built Environment with Seniors with Mild Cognitive Impairments

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Abstract: In this paper, we introduce “Photo Narrative,” a novel co-design method tailored to actively engage seniors with mild cognitive impairment (MCI) and their care partners in envisioning and creating a future therapeutic program and built environment. The co-design toolkit addresses the complexity of designing for MCI patients by supporting multidimensional forms of expression and facilitates exploration of various literal and emotional aspects of designing for “healthcare” environments, including type of space, level of interaction in, and look and feel of the built environment. We also introduce and describe a comprehensive data analysis technique, which speaks to the need for and value of interpretations of rich co-design workshop data into insightful design requirements and recommendations.

Keywords: co-design; design method; built environment; mild cognitive impairment (mci); empowerment.

1. Introduction

Co-design enables users to make positive contributions in design by engaging in formulating and solving a problem. Sanders used the term co-design to refer to the “creativity of designers and people not trained in design working together in the design development process” (Sanders & Stappers, 2008, p.2). Nevertheless, the process of engaging users in the design process can be challenging due to the different skills and comprehension levels of participants. This can become an even bigger challenge when involving older adults in the design of new environments or technologies (Newell, 2011). Several attempts have been made in the past by researchers who were working with older people (Hees et al., 2019; Lindsay et al., 2012; Leong & Robertson, 2016; Robertson et al., 2014; Vines et al., 2012); however, many traditional co-design toolkits are too demanding for this population, and their unique needs cannot be fully catered to using conventional research methods.

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Older people find it difficult to conduct creative thinking activities (Otjacques et al., 2010) and so feel uncomfortable when they are asked to draw, sketch, or comment on design-related issues (Mitchell & Nørgaard, 2011; Rice & Carmichael, 2011; Uzor, Baillie, & Skelton, 2012). Moreover, seniors may have limited motor functions in the movement and coordination of hands and arms, which restricts their interactions and engagements with tangible artifacts. So, participatory toolkits and activities that require making and interacting with tangible artifacts (Sanders et al., 2008) should be attentively designed or appropriated for this population. These challenges can be even greater and promptness to respond may be lowered when cognitively impaired elders become part of the design team.

Many well-established co-design techniques require certain levels of communication, abstraction, conceptualization, or creative thinking of the participants (Lazar, Feng, & Hochheiser, 2010; Lindsay, et al., 2012; Muller, 2003). As such, there is a need to adjust these methods when working with seniors with cognitive impairments, and researchers need to develop, adapt, and tailor highly individualized co-design approaches and methods to work with this specific user population (Hendriks et al., 2014).

This paper explores the challenges of co-designing with a unique population: older adults living with mild cognitive impairments (MCI). People with MCI are more likely to engage in cognitively demanding activities as compared to elders with dementia; therefore, they may be able to contribute more in co-design practices than is suggested in some previous literature on co-design with people with dementia cited above (Hendriks et al., 2014; Lindsay et al., 2012). There is a literature gap in understanding how people with MCI can be engaged with co-design processes, and to what extent they are able to participate meaningfully. There is also work to be done in understanding which types of techniques, tools, and/or materials can best support their engagement in co-design activities.

To that end, this paper is aimed at introducing and discussing the use of the “Photo Narrative,” technique with people with MCI. “Photo Narrative” is a co-design method adapted by this research team to actively engage seniors with MCI and their care partners in envisioning and creating a future therapeutic program and built environment through visually enriched activities. In a series of co-design workshops, we engaged seniors with MCI and their care partners in envisioning and creating a healthcare center for behavioral interventions and education. This program and facility is part of an extensive project that is positioned to explore new models of treatment for MCI and prevention of decline by involving behavioral therapy, technology, and the built environment.

Our main intention is to report and reflect on the application of the method and its associated benefits in designing a complex health-related environment with vulnerable populations (in particular people with MCI) and how such a method facilitates capturing participants opinions, perceptions, and insights, and elaborates on the key factors that led to creating a common ground and shared understanding among the collaborators. Our data analysis method, which we will also discuss herein this paper, enabled us to interpret visual data to generate insightful information and design requirements for the architectural team

to consume; this section speaks to the lack of literature and need for research on the notion of analyzing rich visual-tactile data, one of the major research gaps in the co-design field (Bossen et al., 2016).

2. Related Works

2.1 Co-Designing Public Places and Built Environments

Co-design and its applications have received increased attention in recent architecture literature--in particular, placemaking and community-building (Kuiper, 2007). Design for public interest applies co-design approaches as a means to reshape conventional modern architectural practice: in structuring design around the needs of a community and allowing individuals to have a say in the design of their own built environment (Feldman et al., 2018).

Additionally, there has been increased interest in exploring new ways of designing complex spaces. New strategies have been explored and efforts made to elicit the subjective qualities of people's experiences of and relationships with public place by involving participants in sequentially exploring topics, such as their memories, sensations, sense of place, and stories (Wakkary et al., 2014). The notion of involving "users as partners" (as opposed to subjects) became a preferable approach in co-designing healthcare environments: for example, with nurses involved in co-designing an ideal future patient room or co-creating a concept for ideal workflow on a patient floor (Sanders & Stappers, 2008).

In a more recent attempt, Reay et al. (2017) involved designers, students, patients, and hospital staff in co-designing a hospital space through collaborative prototyping. Another study, Herriott (2018), shed new insight on designing hospitals and made recommendations for changing the design approach to user participation in larger architectural projects. Ludden et al. (2019) proposed technology-enhanced design interventions in built-environments that reduced restlessness behavior and provided meaningful sensory experiences for people with dementia. Jakob & Collier (2017) explored the role of textiles in facilitating multi-sensory enriched environments and meaningful occupation for people living with dementia living in care-homes. While the notion of co-design in built environments and public places is well-studied, people with cognitive impairments were rarely involved in co-design processes.

2.2 Co-Designing with Individuals with Cognitive Impairments

Recent literature on co-design examined approaches and guidelines for designing with users living with cognitive or sensory impairments. While some studies involved only proxies (care givers) as informants, Brereton et al. (2015) highlighted that involving proxies alone is insufficient in co-design because the self-expression of the person with cognitive impairment is crucial, as care partners and family members may provide biased information. To allow actual user participation, researchers attempted to use tailor-made co-design techniques, which include complex tasks such as prototyping. As an example, following "design after

design” by Ehn (2008), a new participatory approach was introduced to inform design choices through simple and functional prototypes. In a similar effort, Wilson et al. (2015) suggested using high-fidelity prototypes (as opposed to the commonly used low-fidelity prototypes) to elicit more insightful feedback from users.

Even though attempts have been made to find universal ways of interacting with patients with cognitive impairments, researchers found it impractical to create generalized co-design methods that work for all and suggested tailored activities to engage participants with varied types of impairments in co-design. Gaudion et al. (2015) advocated a bottom-up phenomenological approach that evolved throughout the study. They started by understanding autistic adults’ daily life experiences to inform creating meaningful co-design activities. As a result, the design was not driven by preselected, autism-friendly methods, but built using a progressive approach that enabled researchers to understand users’ preferred activities with everyday objects and props. Hendriks et al. (2015) further explored the feasibility of creating generalized and highly personalized co-design approaches for people living with cognitive or sensory impairments (CSI). They suggested a new tradition of sharing experiences in order for researchers and designers to learn from each other in the form of method stories. Following the path of tailoring co-design methods, Branco et al. (2017) introduced a personalized approach that drew upon person-centered dementia care values and contributed to the uniqueness and personhood of people with dementia through exercises that enabled them to select content and co-design artifacts, simultaneously allowing family members to be involved in the group activities.

Winton and Rodgers (2019) adopted “designed with me,” a collaborative approach to produce a series of textiles and products, where inputs from people living with dementia were highly valued in the same esteem as other collaborators (their carers and dementia support workers). Rajapakse et al. (2019) suggested using “respectful design,” an approach to work with people with cognitive or sensory impairments (CSI) that emphasizes mutual learning, self-expression, and self-determination, which enables participants to express their insights to the design team. Treadaway et al. (2019) introduced “compassionate design,” an empathic participatory approach to design a collection of playful objects to support the wellbeing (happiness) of people living with advanced dementia. Rogers (2018) used a number of co-designed interventions with the goal of changing public perceptions of dementia by showing that individuals living with dementia can contribute positively to society. In these studies, the co-design activities and interventions connected people with dementia to their community and helped build their self-esteem, identity, and dignity.

3. Research Context and Methodology

3.1 Cognitive Empowerment Program

This research is part of a therapeutic program entitled the “Cognitive Empowerment Program” (CEP), a collaborative effort between Georgia Institute of Technology and Emory

University Hospital that aims to explore new models of support and treatment methods for people with MCI and their families. The program's vision is to create a "living lab" that empowers seniors with MCI and their care partners using evolving therapies, technologies, and physical environments that will revolutionize how MCI is managed. The program's new space in particular facilitates research efforts to increase understanding of MCI and supports ways to improve cognition, social support, community engagement, independent living, and in general the quality of life of MCI patients and their families.

3.2 Characteristics of the Program's User Group: Seniors with MCI

MCI, often a precursor to Alzheimer's disease, affects up to 20% of adults older than 65. Common cognitive domains affected include memory, language, executive function (e.g., planning), attention, and concentration. While these changes are not severe enough to stop someone from completing day-to-day tasks, they are greater than normal age-related changes and may cause subtle difficulties with complex daily tasks (e.g., taking medication, finances). People with MCI differ from dementia patients since they usually do not present "substantial" functional changes that disrupt instrumental daily activities and require the assistance of others (Brown, 2011). Misplacing items, repeating questions, and trouble keeping track of dates and appointments can be observed in this population. Additionally, those with MCI may not communicate easily due to word-finding difficulties and slow auditory comprehension. Some other issues include, but are not limited to, difficulty with wayfinding, driving, and carrying out everyday activities such as managing money, medications, and cooking (Alzheimer's Association, 2019).

Eleven people with MCI and their care partners participated in the first workshop, and eight participated in the second. All participants were over 65 years old, had different professional backgrounds, and were retired (with the exception for one care partner). The people with MCI and their families were initially approached by clinicians from the Emory University Hospital to act as the Patient Family Advisory Group in the development of the Cognitive Empowerment Program (CEP). They were introduced and invited to participate in the project based on their interest and availability.

3.3 Procedures for Data Collection

We conducted two co-design workshops that each included two activity sessions. We followed each workshop by debriefing the activity and collecting participants' opinions on the workshop activities and their design. During each workshop, in addition to researchers, architects and clinicians provided one-to-one support to people with MCI and their accompanying care partners to ensure the participants were enjoying the process and that their opinions were valued regardless of their ability. The therapeutic team in particular took into consideration the ethical aspects of protecting MCI patients from probable stressful situations, respecting their needs and assisting them closely during the workshop activities. Each workshop took three hours to complete and occurred on a weekday morning.

4. Co-Design Materials and Methods

4.1 Photo Narrative Toolkit Development

In order to facilitate sharing of insights and experiences of people with MCI regarding the future built environment of the CEP, we developed a flexible visual-textual participatory toolkit that includes both images (e.g., indoor/outdoor spaces, interior layouts, green areas) and textual keywords (objects, actions, interactions, and expressions) associated with built environments.

In designing the toolkit, we considered the cognitive symptoms of MCI that may influence interactions with the kit, including managing memory, executive functioning, and communication. For example, people with MCI encounter difficulties in remembering words to communicate effectively which may lead to frustration and difficulties in managing emotions, whereas being provided a set of words to select from may be easier to handle.

Moreover, we applied an empathetic approach to involving people with MCI, including personalized (Branco, 2017) and respectful (Rajapakse, 2019) strategies. Our higher-level intention was to empower participants through self-expression and self-determination. These empathetic strategies were reinforced through the usage of visual cues (images), verbal cues (keywords), and the orientation of participants in doing each activity. This procedure aimed to support MCI patients with memory recap and enable them to explore and reflect on their personal stories, experiences, and feelings associated with visited places in the past. The participants defined and shared preferences for the type (enclosed/intimate vs. social/open) and look and feel of spaces, in addition to capturing feelings associated with spaces through visual- textual activities (Figure 1). Other factors were taken into consideration to support ease of use and interaction with the toolkit. For example, visual design principles for the elderly such as type size, contrast of text/images, and scale of the cards were applied in the design of the toolkit to avoid legibility complications (Farage, 2012).

Figure 1 *MCI patients engaged in the space look and feel activity. The toolkit was comprised of photo-text components and printed on game card-sized paper to facilitate the participants' ease of use, interaction with the toolkit, and decision-making processes.*

4.2 Workshop Introduction

The workshop was initiated by providing detailed information on the project, and institutions/core teams involved in addition to the location, floor plans, dimensions, and other information related to the future building by the architecture team. The participants were approached as equal partners in the design of the space. The introductory session continued by asking questions about “places that participants visited in the past, a place that they like to go once a month outside of their home, and a place that they do not like to go or somewhere they went once and did not want to go back to.” The goal of this activity was to invite everyone (including the researchers and architects) to participate in the design discourse and the process of relieving tension by encouraging everyone to express themselves regardless of their role or identity, setting the stage for an open and engaged workshop.

4.3 First Participatory Moment: Type of Space and Level of Interactions

In the first hands-on activity of the built environment workshop, the participants were given an “activity matrix” to identify types of spaces where they would prefer to do various therapeutic activities. The matrix was divided into two axes (X and Y), where the Y-axis represented the continuum of open to closed spaces and the X-axis, intimate- social spaces. Each participant was given a set of twelve types of activities and asked to “use the matrix to identify where would they like to do them.” The intention behind the matrix activity was to understand the participants’ higher-level preferences in terms of general forms of built spaces and levels of interactions with other participants while doing different activities. The tool consisted of labels with the printed names of activities and a 2x2 matrix sheet. The participants were asked to associate each given activity with a particular matrix area and place it in that area. Because the notion of a matrix is not new and has been used in many fields (e.g., polarity maps in business), we found it provided a common visual tool which could be easily understood by our participants.

4.4 Second Participatory Moment: Space Look and Feel

In this activity, the participants were given a set of fifty-two cards that involved photos of places with different design, interior decoration, furniture and colors as well as eighty keywords (adjectives) to associate with those photos. The research team initially collected ninety photos and cut the sample down to fifty-two to avoid participants’ physical and mental exhaustion, as suggested by the therapeutic team.

The people with MCI and their care partners were asked to choose six photos each depicting places they like/do not like to go; choose one associated word for each photo; and give a brief description of why they like/do not like to visit those built environments. The intention behind creating this activity was to learn about the participants’ preferences in regard to the quality and type of spaces. We gave each participant a set of fifty-two photo cards, sixty labels with positive and negative adjectives, and a template to combine and place the photos and adjectives (Figure 2).

Figure 2 PD toolkit for the space look and feel activity: set of fifty-two photos cards, eighty positive- negative pairs of adjectives, and a board template with a simple layout. The layout design has image and text placeholders.

4.5 Third Participatory Moment: Space Experience and Associated Activities

Several weeks after the first workshop the patient and family advisory board was invited back for another workshop. In the third participatory moment, the MCI patients and their families were asked to envision and describe the experience of spending a day at the empowerment center in a photo narrative form. They were given a set of fifty-two cards with photos of tasks and activities that can be accomplished in the space with an associated template to facilitate writing an imaginative story of spending a day at the center (Figure 3). The co-design tool was created as a “narrative storyboard,” a common method in interaction design to explore user experiences with an interactive prototype or environment (Greenberg, 2011). Narrative storyboarding uses sequences of images to tell a complete story about people’s interaction with an artifact over time and facilitates creating rich information about the context of use, location where the interaction takes place, and people’s action and interaction with the environment. Both the research and therapeutic teams collaborated in selecting the images to be provided to the participants.

The intention behind this activity was to understand the MCI patients and care partners’ preferences for the type of therapeutic activities to be performed in the space, as well as their preferred sequential order over a day at the empowerment center. This activity also informed the architects on important design requirements to support different therapeutic activities.

Figure 3 An example of a storyboard created by a care partner who imagined and described her one-day experience at the empowerment center.

5. Workshop Analysis and Findings

5.1 Procedures for Data Analysis

After the completion of each workshop, the research team conducted group data analysis sessions, including clinicians, to the visual-textual data. We used document analysis, a form of qualitative data analysis in which documents (texts of various formats, images, audio, or video) are interpreted by the researcher to give voice and meaning around a research topic. The process of analyzing the data was highly iterative and followed a systematic approach. We initiated the process by organizing and transferring the visual-textual data to Excel sheets which were shared with the research team members prior to each analysis session. The data was broken down into both quantitative and qualitative interpretations, providing commentary on the textual-visual data.

Furthermore, each photo was analyzed for the frequency of use and organized in a new table for further synthesis. Extensive focus was placed on group interpretations of visual-textual data to avoid potential biases in the findings. Each analysis session took 2-3 hours to complete.

5.2 MCI Patients' Insights about Ideal Spaces

The analysis of data from the workshop revealed that clear wayfinding and appropriate lighting are important points of consideration in designing built environments for people with MCI, and clean and clutter-free layouts that support social interaction are preferred. This quote from one MCI patient emphasizes the importance of good wayfinding:

“...A lotta doors, because you don’t know which door is where, and trying to get back to where you were is so hard because it will all be new. You would go in one door and come back out, and there are three other doors...you don’t know which one you went through, came out of, or know where you need to go.”

Furthermore, the participants prefer windows in the building that bring the outside in: “I don’t like any windows covered with drapes or blinds so it’s definitely like outside.” Most participants prefer soft, lower light levels and avoid overhead lights: “I like a little light inside instead of the overhead bright lights”; “I don’t always use the overhead lights because I like lamps and kind of lower lighting that just feels comforting and not so stark.” Overall, a medium, balanced lighting system is preferred by participants: “I cannot stand going into a restaurant where you cannot see things. I don’t like it dark in the room, but I also don’t like it too bright, so it has to be that soft light.”

The participants prefer open, clean, and clutter-free spaces with “not too many distractions, just simple themes.” Another participant described that “I like open spaces. I don’t like doors shut or closed-in places”. The built environment may also support social activities, as stated by several participants, that enable them to “[sit] around casually and socialize.” One participant pointing at the furniture pieces in a picture, said: “I think about spaces where people socialize, and they have round tables instead of having square tables. You can see everybody.” A similar viewpoint emphasizes the importance of sensory spaces that support social connectivity:

“A space should intentionally make people feel something...You walk into an old cathedral, you feel the grandeur... we think of places to have lunch meetings not based on food, not based on location, but based on whether you can have a conversation, which is more important to us than food.”

Overall, these findings speak to the participants’ needs and limitations in using current built environments due to their cognitive impairment.

5.3 Built Environment and Associated Attributes

All the participants living with MCI were able to understand the scope of the first, second, and third co-design activities, contribute actively and positively to the activities using images and associated words, provide descriptions of their ideas, and share insights on ideal and non-ideal spaces.

The quantitative analysis of the proposed daily activities of MCI patients and their care partners in the matrix activity revealed that people living with MCI prefer to use intimate and enclosed spaces for activities such as watching TV, using the computer, making a phone call,

and working with support groups. Additionally, the analysis revealed the level of interactions with the environment for each type of activity. The participants had a strong intention to do activities such as exercising, dancing, playing games, and crafting in open spaces that facilitate and support social interactions.

The analysis of the second participatory moment, “space look and feel,” unfolded the space typologies and the interior design principles (e.g., furniture, color, arrangements) that need to be incorporated or avoided in the design of the empowerment center (Table 1). The findings revealed the importance of including natural elements and greenery in addition to providing comfortable sitting areas with appropriate furniture and arrangements. Shiny elements with dominant vibrant colors were not welcomed by the people with MCI and must be avoided in the design to provide a clean and non-distracting environment.

Table 1 The most liked and disliked spaces according to MCI patients’ opinions and implications for built environment design.

	Example one	Example two
Examples of the most liked spaces
Associated attributes and keywords	Open minded, Optimistic, Peaceful, Refreshing, Vibrant	Refreshing, Sociable, Uplifted
Design considerations	Create comfortable and sensible accommodation (e.g. coffee tables, options for sitting); incorporate plants and greeneries; modern design is welcome if it incorporates natural elements such as access to daylight, stone, wood, plants; earth/neutral color tones; a variety of seating arrangements to promote socialization.	
Examples of the most disliked spaces
Associated attributes and keywords	Anxious, Frustrating, Lonely, Overpowering	Awkward, Isolated, Uncomfortable
Design considerations	Should avoid glass rooms, overwhelming colors (bright/unnatural light), dark and low ceiling, cluttered spaces, long and narrow corridors, shiny surfaces, and ill design sitting arrangements (e.g. uncomfortable, awkward).	

The third co-design workshop leant itself to a quantitative analysis of the textual-visual data. The research team started the analysis by creating “codes” for the workshop’s therapeutic activities (Figure 4). All therapeutic activities were organized and divided into three activity types, as follow: 1) structured vs. unstructured, 2) active (or engaged) vs. passive, and 3) social vs. individual. We define structured activities as those that require guiding, supervising, or assisting by therapists or care partners and unstructured activities as those that can be done independently by the MCI patients. Additionally, to further narrow down and detail the codes, we sorted the therapeutic activities into eight identifiable activity categories: relax, make/craft, physical/exercise, game/play/entertainment, learn/reinforce a skill, chores, basic needs, and share/discussion. These categories were identified and refined as we proceeded with the data analysis. The coded data enabled us to create numeric values to define type, order, and the level of interaction for the various activity types relevant for the empowerment center.

An in-depth analysis of the workshop data showed that all individuals with MCI would like to do physical exercise at the center. Also, while the people with MCI are interested in hands-on activities (e.g., craft-making, playing games), their care partners prefer to have discussion sessions to share their experiences and concerns with other care partners and therapeutic staff. All participants would strongly prefer to do “active” activities in the middle of the day (91%), and people with MCI would like to do these activities “socially” (72%). Both parties suggested considering time to gear up and wind down in between activities through laid-back, open-ended, and relaxing activities.

		Dimensions																Changes	Changes/Total/Changes	TOTAL			START UP			MIDWAY			COOL DOWN			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			% Structured	% Active	% Social	% Structured	% Active	% Social	% Structured	% Active	% Social	% Structured	% Active	% Social	
Fellow 1 Ken	Structured vs. Unstructured	U	U	U	U	S	S	S	S	S	U	U	U	U	S	U	4	25%	44%		0%	0%		60%		50%			Fellow			
	Active vs. Passive	P	P	P	P	A	A	A	A	A	A	P	A	A	P	A	4	25%		64%				90%		50%						
	Social vs. Individual	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	3	50%		38%			0%		50%						
Fellow 2 Mari	Structured vs. Unstructured	S	U	U	U	S	U	U	U	U	U	U	U	U	S	U	3	38%	25%		100%			17%		83%	0%	0%	50%			
	Active vs. Passive	A	A	A	P	A	A	A	A	P	A	A	A	P	A	P	3	38%		75%		100%					0%					
	Social vs. Individual	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	4	50%		75%			100%		67%			100%				
Fellow 3 Ben	Structured vs. Unstructured	U	U	S	S	U	S	S	S	S	S	U	U	U	U	S	3	38%	63%		0%			80%		100%		100%				
	Active vs. Passive	P	P	A	A	A	A	A	A	P	A	A	A	P	A	P	3	38%		75%		0%			100%		100%					
	Social vs. Individual	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	1	13%					0%		100%		100%		100%			
CP 1 Will	Structured vs. Unstructured	U	U	U	U	S	U	S	S	S	S	U	U	U	U	S	3	38%	38%		0%			40%		100%		50%				
	Active vs. Passive	A	A	A	A	A	P	A	A	A	P	A	A	A	P	A	2	25%		88%		100%			100%		50%					
	Social vs. Individual	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	2	25%		38%			0%		40%		67%		50%			
CP 2 Sheryl	Structured vs. Unstructured	S	U	U	U	S	U	S	S	S	S	S	U	U	U	S	7	44%	44%		50%	0%		45%		82%	36%	67%				
	Active vs. Passive	P	P	A	A	P	P	A	A	A	A	A	P	A	P	A	6	38%		63%					82%		67%					
	Social vs. Individual	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	5	31%		31%			0%			36%		67%				
CP 3 Lisa	Structured vs. Unstructured	S	U	U	U	S	U	S	S	S	S	U	U	U	U	S	2	25%	40%		100%			25%		100%		100%				
	Active vs. Passive	P	P	A	A	A	A	A	A	A	P	A	A	A	P	A	0	0%		100%		100%			100%		100%					
	Social vs. Individual	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	2	25%		40%			100%		25%		100%		100%			
Chris	Structured vs. Unstructured	U	U	S	S	U	S	S	S	S	S	U	U	U	U	S	7	44%	69%		50%			69%		85%		100%				
	Active vs. Passive	P	P	A	A	P	P	A	A	A	A	A	P	A	P	A	3	19%		81%		50%				100%		100%				
	Social vs. Individual	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	5	31%														
Average Overall																		46%	78%	83%	43%	50%	43%	48%	91%	56%	67%	67%	67%			
Average Fellow																		44%	71%	63%	33%	33%	33%	52%	91%	72%	50%	50%	83%			
Average CP																		48%	83%	46%	50%	63%	50%	45%	92%	45%	79%	79%	54%			
																		% Structured	% Active	% Social	% Structured	% Active	% Social	% Structured	% Active	% Social	% Structured	% Active	% Social			

Figure 4 Numeric analysis of narrative storyboards revealed the potential activity types of MCI patients and their care partners in the future space.

6. Discussion of the Method and Contributions

The Photo Narrative method described here informs and contributes to the co-design community by providing a robust method and analysis plan that addresses the complexity of designing “healthcare” environments for seniors with cognitive impairments by clearly revealing the users’ diverse range of expectations from and associations with the built environment. The toolkit was designed to engage people with MCI and their care partners

in the “pre-design phase” of envisioning the future built environment and their experiences within the space through activating their feelings and memories.

Some of the challenges and limitations of this research were: 1) while the involvement of people with MCI in designing the toolkit and analyzing the outcomes can make a positive impact on engagement in co-design, we could not involve them in this step due to time limitations and participant availability; 2) the need for considering dissociated co-design activities—being involved in a continuous chain of activities can be overwhelming for people with MCI, so we broke sessions up into two workshops; and 3) the need for extensive attention and an ongoing recognition of the cognitive load of MCI patients in designing the generative toolkit, which limits the possibility of creating more advanced toolkits to support divergent thinking. In this research we relied heavily on clinicians to make recommendations on the design of activities to limit cognitive burden and frustration of the participants.

Key factors in making the Photo Narrative method distinct were the multilayered forms of expression accessible to participants through verbal, visual, and textual commentary, which enabled all participants to share their valuable insights easily and independently and complete activities without extensive support from care partners, designers, or clinicians. The care partners also had the option to share their opinion independently, which revealed dissimilar or competing goals in regard to the usage of the future built environment by some dyads. Moreover, the unique format introduced in the Photo Narrative method produced rich findings and design requirements that could be directly applied to architectural design. While the level of engagement of people with MCI and their care partners varied throughout the workshop (e.g., people with MCI were reluctant to write), overall, we observed high level of engagement and responsiveness from both groups as an indication of the effectiveness of Photo Narrative when working with this population.

Our secondary contribution in this paper is the analysis method, which speaks directly to the literature gap and need in co-design for interpretations of rich co-design workshop data into insightful design requirements and recommendation (Bossen et al., 2016). The process of analyzing data in this flexible and at times quantitative way led to insights about the needs and preferences of those with MCI and their care partners in the design of the future therapeutic built environment. The data was shared with architects and clinicians as insight on preferred space typologies, levels of interaction, programmatic activities, time organization, look and feel of spaces, and design considerations that support therapeutic activities inside and outside of built environments.

Although we developed and adapted workshop activities to the symptoms of MCI, we still observed some difficulties during the co-design workshops. Some participants were reluctant to write down their stories in the provided template and limited their story lines to the provided labels and photos. In this case, as soon as we became aware of the lack of interest and/or ability to write, an effort was made to make the process as flexible as possible. Thus, we decided to conclude the workshop by debriefing the activity and asking the participants to share their stories verbally with the larger group. Such a process enabled the people with

MCI to describe their stories in depth and add verbal expressions and details to the visual components. The in-the-moment decision to consider verbal recapitulation was in line with our empathetic approach in engaging participants by employing a flexible and respectful (Rajapakse, 2019) strategy. Given this, we suggest that researchers are open to on-site adaptation of the co-design method when working with seniors with MCI.

Future research can be conducted to explore the Photo Narrative method in the co-design of other types of built environments such as patients' homes. It would also be critical to know if this method can be applied to other populations such people with autism, or older adults who have progressed from MCI to early stage dementia or Alzheimer's disease.

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7. References

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