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Design Empowering Active Aging: A Resource-Based Design Toolkit

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ABSTRACT

The aging population is often labelled as a social problem, with a focus on their functional decline. Design interventions for aging usually play a role in functional compensation, which may risk damaging older people's agency. Therefore, it is necessary to reimagine aging and change the mindsets of designing for aging. Inspired by empowerment theories, this study regards older people as resources and active agents; they can address many of their issues and continue making contributions to society. Case studies were conducted to identify different means of empowerment. Four modes of design empowerment strategies were identified. A set of design tools based on older people's resources and the empowerment modes was developed to help transfer knowledge into practice. A design workshop was organized to evaluate the toolkit; it suggests the positive impact of the toolkit on the participant designers' understanding of, and responses to, aging.

1. Introduction

The number and proportion of older people in the world are increasing. Based on World Population Prospects 2019, the percentage of population aged 65 years and over in the world is over 9 in 2019. It is expected to be nearly 12 in 2030 and 16 in 2050. In Europe and Northern America, the percentage is project to grow to 22% in 2030 (WHO, 2019).

This demographic transition underscores the fiscal and political pressures that many countries will likely experience in the coming decades (Ma et al., 2021). It has caused the public's concern about population aging. Ageism and the negative image of older people are common (Minichiello et al., 2000; Oró-Piqueras, 2014; Rashedi et al., 2021). Old age is discussed primarily as a social burden (Jongen et al., 2015) and a problem (Makita et al., 2019). Older people are often stereotyped as frail, sick, burdensome, dependent (Cook, 2011) and low in competence (ter Stal et al., 2020; Andreoletti et al., 2015). A large amount of research has paid attention to the potential adverse impact of aging on individuals, such as the decline of physical functions (Liu et al., 2020), the shrink of social networks (Wrzus et al., 2013), the loss of family members (Bordone et al., 2020), as well as the impact on social systems, such as the climbing healthcare cost and associated fiscal pressures (Buja et al., 2021; Wood et al., 2020).

1.1. Design intervention based on models of deficiency

Influenced by the negative stereotypes, researchers and designers tend to have preconceptions of older people based on the models of deficiency (Dankl, 2017) and view older users as "old" first and "users" later (Östlund, 2005). As a result, Gerontechnology design is often provided as compensation for physical and cognitive declines (Romero et al., 2010); services and products for older people tend to take over part of the responsibility for older people (Neven, 2018), such as care robots (Zlatintsi et al., 2020).

These aging designs have brought convenience to older people and caregivers, but also have adverse effects. For example, Seven-eleven's food delivery services for older people proved to be a failure. Older people preferred to take food by themselves to keep socially and physically active (Kohlbacher & Herstatt, 2011). What is more, designs for older people are usually narrowly scripted, leaving few choices for older people to decide for product use based on their needs (Giaccardi et al., 2016). Existing studies show that some telecare monitoring systems provide an alarm pendant with only one operable button; older people must report their critical condition with the button. This has restricted older people's agency to report their diverse demands, and ultimately impact their mental health (Aceros et al., 2015). Manzini advocated that older people are not "people with problems" but "people with capabilities" and they are active agents to problem-solving (Manzini, 2015). Design interventions should promote social participation of older people rather than merely focusing on the care needed (Jongen et al., 2015).

1.2. Empowerment-oriented design interventions and resource-based perspectives

The empowerment theories developed in political theory and social psychology disciplines are defined as the process of

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gaining mastery over events, outcomes, and capacity to mobilize resources (Avelino, 2017; Fawcett et al., 1994). Patient empowerment interventions advocate involving patients in the care process to play a more active role in decision-making (Acuña Mora et al., 2022). This has challenged the authority role of caregivers and constructed a collaborative and participatory relationship between patients and professionals (Anderson & Funnell, 2010; Te Boveldt et al., 2014). Empowerment interventions were initially introduced in healthcare as a means for health promotion and had a positive impact on more excellent health (Wakefield et al., 2018). Research on empowerment theories encourages a resource-based mindset of social work practitioners, where older people's strength, instead of their problem, plays a crucial role in social work (Chapin & Cox, 2002). The theory of empowerment in other fields suggests two critical issues for designers: viewing older people from a resource perspective and redefining the role of design interventions.

Existing research provides a wealth of supporting evidence of older people as resources, such as providing care to their spouse or partner (Blank & Fleury, 2021), educating grandchildren (Gao & Ye, 2017), helping pupils improve reading skills (Gattis et al., 2010), listening and offering advice to young people (Kincade et al., 1996), keeping historical and cultural tradition (Paoletti, 2015), and even overcoming hardship under disaster and emergency situations (Howard et al., 2017). Older people as resources can provide practical, emotional, intellectual, social, and cultural support to others.

Researchers on design for social innovation have accepted the idea of empowerment; they paid attention to the resource of older people in design, shifting the role of design from creating more dedicated professional social services to providing the condition for facilitating user participation (Manzini, 2015; von Busch & Pazarbasi, 2018). Nesta (2012) presented many healthcare services where older people have played a critical role in collaborative service production. The emerging practice suggests the great potential that innovative technology and design practice can help maintain older people's autonomy. For example, mobile health technology engages people to establish their role in self-care and decision-making in health management (Anthony et al., 2018; Storni, 2014). However, how design empowers active participation of older people has yet to be clarified.

This paper aims to identify the means of design empowerment in emerging practices. The resource-based and empowerment-oriented design toolkits were developed to transfer the knowledge into practice. The toolkits were then evaluated in a design workshop and proved to be effective.

2. Methods

This research follows a case study method. Initial cases were selected from publicly available, authoritative reports by the authors, such as the reports from World Health Organizations (WHO). Further case selections followed three principles: relevance to the topic, diversity of interventions, and convenience in data collection.

To check relevance, the authors examined cases by looking at whether they aimed to encourage active participation and empowerment of older people. Existing research provides six dimensions of psychological empowerment, including relatedness, autonomy, competence, impact, meaning, and resilience (Avelino et al., 2020), which were also utilized to judge the relevance. For example, the website shows that the goal of Experience Corps (a case selected) is to "empower adults 50 and older to serve in their community," and its volunteers' feedback demonstrates its emphasis on the psychological empowerment dimension of meaning. Based on that, Experience Corps was selected as a relevant case.

In selecting cases, we also tried to balance different design interventions to cover services, interface design, and tangible products. Convenience of data collection was to ensure that sufficient data from different sources could be collected for each case.

Based on the above consideration, six cases (see Table 1) were selected. Data sources include the official case website, media reports, and interviews conducted by the first author with the relevant users and/or designers.

In order to link the empowerment means with the empowerment ends, the authors analyzed the cases using the Means-Ends Chain (MEC) model. This method is based on the assumption that people choose a product (or services) because they suspect specific attributes (means) lead to beneficial consequences concerning their value (Gutman, 1982). MECs can represent hierarchical sequences of design attributes (A), perceived consequences (C), and underlying personal values (V) (Wiese et al., 2021).

Data related to the six cases were analyzed using content analysis through open and axial coding. A category system related to attributes (A), consequences (C), and values (V) was generated. In total 38 essential elements, including six predetermined dimensions of psychological empowerment, were identified (see Table 2). Coding and categorization refer to existing theoretical terminology in social participation and empowerment to incorporate bottom-up and top-down knowledge. The six psychological empowerment dimensions were used as the value people pursued. The generated categories were initially clustered into different hierarchical levels following the A-C-V structure, and then A and C was each expanded into two, i.e., the "attributes" level was divided into attributes of Empowerment Means and attributes of Empowerment Features; the "consequences" level was divided into functional consequences of Participated Activities and abstract consequences of the Empowered Outcome. The V focuses on the value of Empowered Experience.

The relationships between the five levels were illustrated in the "Hierarchical Value Map" (HVM) (see Figure 1). This map gives a visual overview of the links between the empowerment means to the ends. The circles and the linking lines in Figure 1 with bold outlines show a means-ends

Table 1. Six cases aiming to encourage participation and user empowerment.

Case title	Place	Brief introduction	Weblink
"Older kids"	Shanghai, China	A digital platform and offline service where older people can share ideas in blogs, ask for help in online groups and organize leisure activities together.	http://www.oldkids.cn/
"Agewell"	Cape Town, South Africa	An elder care coordination project to employ able older people as companions, provide social engagement through home visits, and deploy a mobile health screening tool to identify and address evolving health and social problems before they escalate.	https://www.agewellglobal.com/
"Abtswoude Bloeit"	Delft, The Netherlands	A co-housing project where older people, students, and clients marginalized people such as drug addicts live together under one roof and interplay with each other by Art Intervention.	https://abtswoudebloeit.nl/
"Connected Resources"	Delft, The Netherlands	An IoT intelligence product-service system that provides IoT components to support older people create new functions based on their contextual needs and a digital platform to share their designs for communication and mutual-learning.	Giaccardi & Nicenboim, 2018.
"Rio Vivido"	Rio, Brazil	A tourism hospitality service that older people with spare rooms provides room and in-depth guide's services, such as sharing the personal stories about the city's history.	http://riovivido.com.br/
"Experience Corps"	Many cities, America	An intergenerational volunteer-based tutoring program to empower adults age 50 and older to serve in their community and help children who are not reading at grade levels to become great readers.	https://www.aarp.org/experience-corps/

Table 2. 38 key elements from data analysis.

Empowerment means	Empowerment features	Participated activities	Empowered outcome	Empowered experience
Positive role	Matching	Leisure activities	Resource accumulation	Relatedness
Incentive mechanism	Connected	Interpersonal interaction	Social engagement	Autonomy
Relationship structure	Inspiring	Interpersonal collaboration	Social support	Competence
Encounter	Responsive	Learning	Social appraisal	Impact
Information channel	Compatible	Talent show	Health benefit	Meaning
Right to speak	Inclusive	Volunteer work	Capability improvement	Resilience
Communication channel	Easy to use	Tool operation		
Operational devices	Open	Function negotiation		
Physical resources				
Infrastructures				

chain. Among the five levels, empowerment means are what can be designed.

3. Results

The cases clustered a total of ten means of design empowerment, namely Positive Role Setting, Incentive Mechanism, Relationship Structure, Encounter, Operating Device, Physical Resources, Infrastructure, Information Channels, Right to Speak, and Communication Channel. The ten means demonstrate different strategies of empowerment. Some of them emphasize stimulating the intrinsic motivation of older people, such as Incentive Mechanism, while some aim to connect older people's external social networks and resources, such as Relationship Structure. The intrinsic internal and external interventions construct a pair of comparative perspectives. Meanwhile, some of the empowerment means tend to provide physical and tangible support to older people for their daily activities. In contrast, some emphasizes intangible supports, such as providing information and allowing older people to express their opinions. Tangible and intangible interventions form another pair of comparative characteristics. Based on the two comparative dimensions, the ten means were clustered into four modes, i.e., motivational empowerment, relational empowerment, artificial empowerment, and informational empowerment (see Figure 2). Positive Role Setting and Incentive Mechanism belong to the motivational empowerment mode, while Relationship Structure and Encounter belong to the relational empowerment mode. Operating Device, Physical Resources and Infrastructure were clustered into the artificial empowerment mode, while Information Channels, Right to Speak, and Communication Channel were clustered into the informational empowerment mode.

The four modes constitute a systematic empowerment path, from motivating, connecting, supporting, to communicating. The four modes will be explained below in more detail.

3.1. Motivational empowerment

Motivational empowerment is a means to stimulate older people's intrinsic motivation to keep active. A sense of personal meaning makes people more autonomous (Deci & Ryan, 2000). Therefore, design interventions can empower older people by creating a sense of meaning. Setting a positive role for older people is an effective way. The Agewell project takes older people as professionals, and they are

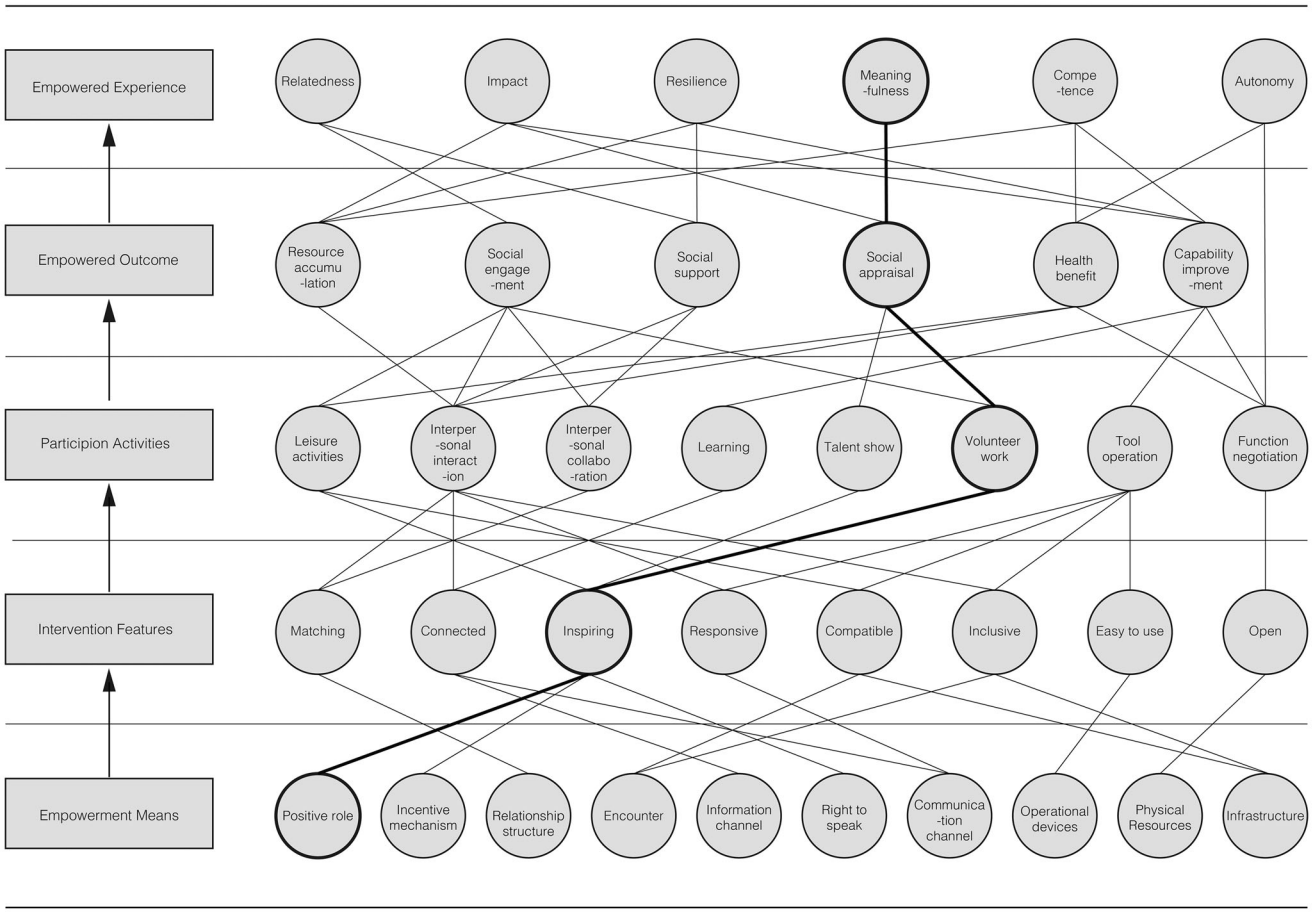

Figure 1. Hierarchical Value Map, depicting the links between Attributes (A), Consequences (C), and Values (V).

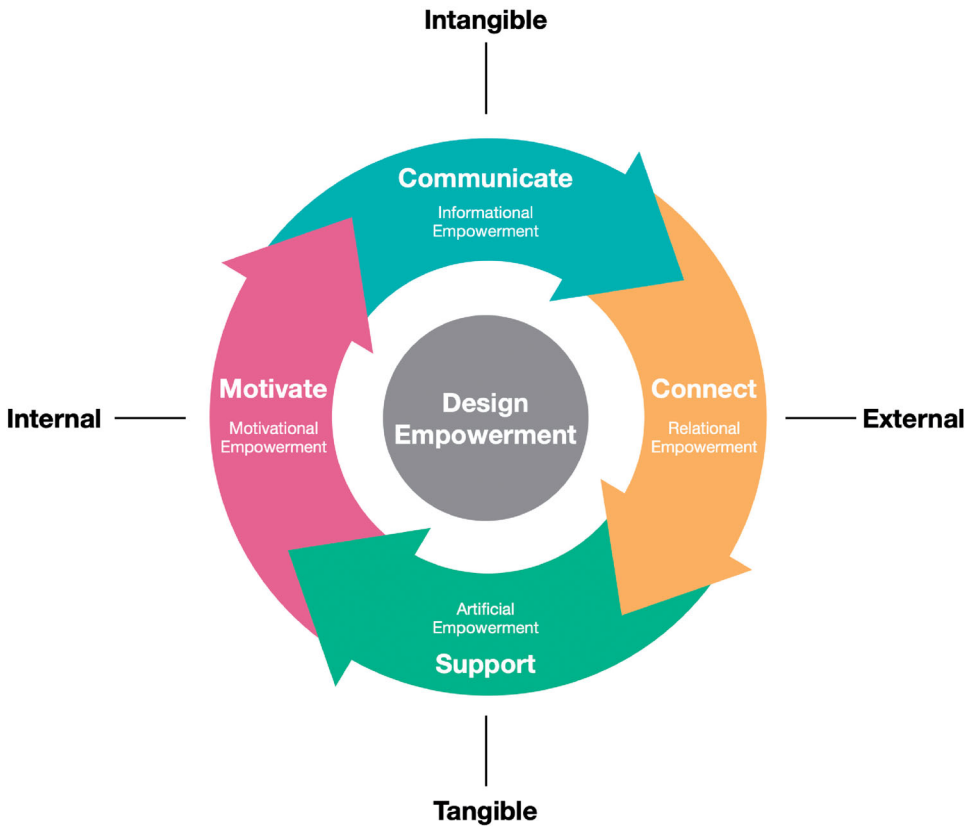

Figure 2. Four empowerment modes of design interventions.

invited to participate in health screening. They are called "Agewells". This professional role rewards them with a sense of achievements. Thus, they are more willing to participate in volunteering work and keep socially and physically active.

Besides intrinsic motivation stimulation with a positive role setting, motivational empowerment also helps design extrinsic motivational incentive mechanism. For example, the project of Older Kids employs a time bank mechanism. As a result, older people who contribute to others will be rewarded with corresponding credits, which can be used to exchange daily life necessities. In the Experience Corps project, volunteers can also gain incentive reimbursement.

3.2. Relational empowerment

Relational empowerment aims to improve the capability of problem-solving through mutual help. Designers need to think about relationship structures strategically and how to create an encounter for connection. Cases suggest two kinds of relations. One is constructed based on homogeneous interaction, which means people with similar demands and interests group together and accumulates more resources to solve common problems. The other is constructed based on heterogeneous interaction, where older people exchange their different resources and solve their problems respectively. Heterogeneous interaction usually happens between different age groups or people with different backgrounds. For example, Rio Vivido involves local older people as a part of the "cultural heritage" in Rio. In this case, local older people and tourists construct a collaborative relationship. Older people provide accommodation services and share exciting life stories, or good experiences linking the city to the tourists. In return, their social isolation risks were reduced with the company of tourists.

To bridge connections between different people, encounters need to be well planned to trigger interaction. The concept of "encounter" adapted from the "service encounter" (Bitner et al., 1990) means a period of time and related activities for interpersonal interaction. The cases show different forms of activities popular for older people, including training activities, volunteer activities, and talent shows. These activities connect people and create opportunities for relationship construction and resource mobilization. For example, the Experience Corps project provides regular meetings for volunteers, where older people socialize with each other and solve the problem coming up from volunteer work (WHO, 2015). With the enhancement of technology literacy among older people, the online encounter can be a supplement.

3.3. Artificial empowerment

Artificial empowerment aims to support older people with tangible products that can be physical or digital. The cases show three kinds of artifacts, namely operational devices, physical resources, and infrastructure. These three concepts come from Borgmann (1987)'s distinction of "things" and "devices," Giaccardi and Nicenboim (2018)'s "resource," and Manzini (2015)'s "infrastructure". "Devices" only provide usability with a specialized function, while "things" call for users' participation. Resources are open scripted and allowed a variety of use for multiple purposes. Infrastructure (e.g., the Internet) means the fundamental condition that supports people's agency.

The cases give examples of three kinds of empowering artifacts. In the Agewell project, each "Agewells" is provided with a smartphone with an easy-to-use health screening app. They can help with screening through an on-site quick interview involving 20 questions with "yes" or "no" answers. With the support of the smartphone and the app, older people can participate in professional work and gain a sense of competence and respect. Agewells are engaged in professional work supported by healthcare big data. Based on the health data input of Agewells, Algorithms trigger referrals to appropriate care and service providers. In Connected Resources, the resource for older people at home includes four open components: a messaging bell, a linking frame, a light clip, and a navigating compass. Each component provides a different primary function. The components can be combined to create new functions. For example, the combination of a messaging bell and a lighting clip works as a sound detector. When the messaging bell detects sounds, the lighting clip starts glowing. People with hearing impairments can transfer sound messages into visual messages with the support of the components. All these empowering artifacts provide assistance to older people, supporting their participation in daily life activities.

3.4. Informational empowerment

The aging process is accompanied by retirement and the disruption of social roles, during which older people gradually have a weaker voice. Meanwhile, the rapid-developing digital technology blocks older people with less technology literacy from the digital world. Informational empowerment includes three aspects: the channel for receiving information, the right to speak, and a two-way communication channel. For example, the Abtswoude Flowers project provides an online platform and printed advertisements to make sure people are informed with local activities. In the Connected Resources project, older people can learn how other users redesign the function of IoT components from the online platform. The Old Kids project provides a blog for older people to share their stories and life experiences. These data are treasured as social resources for the younger generation. What is more, Old Kids can ask for help within their virtual groups. Information can also be exchanged between groups.

4. Transferring knowledge to practice

Better understanding on the user and the design strategy is very important for a design process. The case studies summarized knowledge on empowerment-oriented intervention modes which can be utilized in design ideation. To support a complete design process, knowledge about the user is also necessary. Previous literature demonstrates that older people

Figure 3. The "Design Empowering Active Aging" framework.

can be resources for coping with their problems and solving social problems (Fitzgerald, 2009; Gao & Ye, 2017; Howard et al., 2017; Inaba, 2016; Kincade et al., 1996; Olivastri, 2021; Paoletti, 2015). The authors summarized these resources into five categories: *practical, emotional, intellectual, social, and cultural resources*. Besides that, sufficient spare time after retirement makes the above five resources accessible to others and older people themselves. Therefore, older people's resources can be summarized into six categories: *practical, emotional, intellectual, social, cultural resources and spare time*. The resource categories provide important knowledge and positive perspectives to understanding older people. They formed the knowledge basis of older people.

To transfer this knowledge on older people and the aforementioned design intervention strategy to practice, a design toolkit was developed. With this toolkit, the authors aimed to change the negative stereotypes of older people and to improve the empowerment attributes of design interventions.

4.1. Toolkit development: Design Empowering Active Aging (DEAA)

The toolkit was entitled "Design Empowering Active Aging (DEAA)". It followed the process adapted from Design Thinking (Institute of Design at Stanford, 2009) and provided supports in six phases: Emphasize, Define, Ideate, Develop, Prototype, and Evaluate & Optimize (Figure 3). The toolkit included two main parts: one was the design guide template where a set of detailed tasks were given to guide the design process; the other was a set of cards to provide references for designers. The cards included the categories of user resources, empowerment means, and findings from the case studies to provide inspiration for different phases (Figure 4).

In the "Emphasize" phase, designers were asked to understand older people from a positive perspective with the input of User Resource Cards. The cards delivered the positive images of older people with textual introduction to each resource and corresponding pictures. The Empowerment Means Cards served as the input to inspire designers in the "Ideate" phase. These cards aimed to make designers understand the different means of design interventions to empower active participation. In this phase, designers will be asked to propose empowerment-oriented intervention ideas. For example, considering older people's life experience and reading skills (intellectual resources), a design concept could be developed to make use of the resource by motivational empowerment and relational empowerment modes, as shown in the case of Experience Corps. This case gives an encouraging role, Experience Corps, to the volunteers experienced in reading through motivational empowerment.

Our case studies also explored the empowerment features of design interventions; these were transferred into Empowerment Features Cards as input in the "Develop" phase. These cards helped designers refine the

Figure 4. The "Design Empowering Active Aging" toolkit.

empowerment quality of interventions. In addition, six dimensions of psychological empowerment, namely relatedness, autonomy, competence, impact, meaning, and resilience, composed the six Empowerment Value Cards, which provides multiple dimensions to evaluate the intervention's empowerment effect.

4.2. Evaluation

To evaluate the effectiveness of the toolkit, workshops were organized with 18 designer volunteers. Six of them participated in the pilot workshop. Twelve designers participated in the formal evaluation workshop (Figure 5). The participants in the formal workshop were from different backgrounds: industrial design, environment design, and service design. Six participants were design students, four were designers from industry, and two were lecturers from design schools. They were divided into four groups to balance their disciplines and years of experiences. Each group was asked to complete a design task relating to "empowering older people through design" within a day (around 7.5 h). Considering the limited time, the designers were not asked to make prototypes during the workshop, so they only experienced the five phases: Empathize, Define, Ideate, Develop, and Evaluation. The formal workshop generated three design proposals, as follows.

1. Silver Digital Citizen
   Silver Digital Citizen is a digital platform that allows older people to play different roles and contribute to society with their life experience. For example, they can play as a marriage counselor and provide advice to people whose marriages are in trouble. After finishing a set of tasks on the platform, they can gain credits which can be used to redeem goods and services. Smart TVs provide a Silver Digital Citizen program channel where older people create contents, such as "Life Tavern," a chatting TV program where older people share their life experiences with the audience.
2. Life Confusion Drifting Bottle
   Life confusion drifting bottle provides online and offline services where older people handle queries from the younger generation. The offline service provides empty glass bottles and sticky notes in community centers. People write notes and put them in the bottle. Experienced older people can open the bottle and answer the questions. The questions and answers can be translated into digital forms and presented online. The online platform allows the bottles to "drift" further.
3. Morning Tea Market
   LAO PIAO ZU (aging migrant workers) is a phenomenon in the background of rapid urbanization in China. They are migrant older adults who travel from their hometown to an unfamiliar city to take care of their grandkids. LAO PIAO ZU from different places possesses different cultural resources, such as local specialties, food culture, and dialect culture. The designers built a platform for LAO PIAO ZU to meet, interact and share different cultures. Collaborating with the traditional morning tea restaurants, cultural activities can be organized with different geographical themes to attract people from the same place. After sending their grandchildren to kindergartens, older people are welcome to participate in the restaurant activities and interact with others over morning tea. They play the role of "Cultural Ambassadors" of their hometown. This way, the traditional morning tea restaurant can become a place for cultural interfusion and social interaction.

4.3. Effect of DEAA

After the evaluation workshop, the participants were asked to share their feedback to the design toolkit, through questionnaires and interviews. The questionnaire focused on whether the method, especially the cards, can change designers' mindsets of older people and provide valuable knowledge for design empowerment. Table 3 presents the questions and results.

The scores indicate that the process and tools effectively enriched the designers' understanding of older people; they were helpful to support the design process for older people's participation.

Figure 5. The formal evaluation workshop.

Table 3. Results of the questionnaire.

Questions	Average score (not at all) 1—5 (extremely)
1-I have a more positive understanding of older people after the workshop.	4.8
2-This workshop deepens my understanding of 'how design can facilitate active participation of older people.	4.5
3-The workshop provides a systematic knowledge of design empowerment means for older people.	4.6
4-The User Resource Cards helps look at older people with a more positive mindset.	4.6
5-The Empowerment means Cards helps generate ideas.	4.3
6-The Empowerment Feature Cards helps develop the design ideas.	4.4
7-The Empowerment Value Card helps evaluate design proposals.	4.2
8-I can understand the contents of the cards by myself.	3.8
9-I agree with the contents of the cards.	4.4
Grand average	4.4

Interviews were conducted to collect the participants' reflections on the strengths and weaknesses of the design methods, mainly focusing on the impact of User Resource Cards and Empowerment Means Cards. The User Resources Cards were mainly used in the Empathize phase and the positive feedback included "User Resources Cards make me realise the positive impact older people could make"; "the cards were categorized in detail and were clearly explained"; "it helps me to understand older people more comprehensively and multi-dimensionally"; "the resource model is very impressive and easy to remember". One participant said, "I used to be skeptical about empathy in design because it makes me generate a sense of sympathy and compassion and hesitate to take action. The Empathize phase and User Resources Cards have aroused positive emotion and give clear guidance for design activity. It is helpful." One participant suggested providing more materials beyond words and pictures, such as videos. Some thought the categories of resources were too detailed, making designers "lazy" to think about older people's resources by themselves. However, some believed the detailed categories were an advantage. The feedback on the Ideate phase and Design Intervention is as follows: It "helps to find empowerment-oriented solutions"; it "provides multi-dimensional inspiration and expands ideas," and "the pictures in the cards help me understand design's role". However, "it is not clear how to integrate ideas from different dimensions into a final solution".

The participants believed that the design process supported by the toolkit could effectively "help implement the concept of empowering older people," "help open people's minds of design for aging and related topics," help "generate ideas in a relatively short time" and produce "meaningful" solutions. The large number of visually stimulating cards help arouse the designers' enthusiasm through the entire process. The participants suggested using the toolkit in design projects for older people and other disadvantageous groups. The participants also pointed out some limitations. One was that the terminology was not easy to understand, so they suggested refining some items and providing more cases as examples. The other was providing more detailed instructions to facilitate the use without facilitators. Overall,

the feedback affirmed the effectiveness of the toolkit and suggested the directions of future work.

5. Discussion and conclusion

Viewing older people based on the model of deficiency leads to a design stance of compensation (Dankl, 2017). Design interventions for older people often worked as compensation for capability decline. In contrast, our resource-based perspective focused on empowering older people based on their advantageous resources in a positive way. This shares the similar consideration of Social Innovation which regards people as asset (Manzini, 2015) and is in line with the advocacy of the Active Ageing Framework (WHO, 2002). Literature on older people's resources lays the knowledge foundation for a mindset shift towards empowerment (Chapin & Cox, 2002). Although some designers are already aware of retaining older people's agency (e.g., Anthony et al., 2018), in general, practical strategies and design methods are missing. Designers often lack empowerment literacy when designing for an aging society.

Our research summarized the intervention means based on the case studies. Four modes of empowerment were identified, namely, motivational empowerment, relational empowerment, artificial empowerment, and informational empowerment. The former two modes reflect the motivational construct of psychology empowerment (Thomas & Velthouse, 1990) and the relational construct of community empowerment (Christens, 2012; Neal & Neal, 2011). The latter two suggest the material and non-material attributes of design interventions. They suggest a comprehensive path of empowerment: i.e., motivating-communicating-connecting-supporting. Additionally, this research transferred the findings into design supporting cards. The empowerment modes and path, as well as the corresponding design toolkit expanded the practical and procedural knowledge of design empowerment.

The significance of this study is twofold. First, it expanded the knowledge of empowerment-oriented and resource-based design. This study identified the four modes of empowerment to facilitate active participation of older people; it suggested an empowering path for design practice. Even though the knowledge was developed from the aging perspective, it has the potential to inspire designers when they solve problems with other groups whose resource are undervalued, as suggested by the workshop participants. Second, this study developed a toolkit towards active participation of older people in society, which proved effective in enhancing designers' understanding of older people in a more positive way, and in inspiring their empowerment-oriented design ideation. Methodologically this study has embedded a positive approach to design for aging; practically the toolkit will support the designer in each phase of the process. Overall, the application of the empowerment theories to design, and the DEAA toolkit have the potential to provide a useful support for designers to respond to the ageing society in a positive way.

There are some limitations of the study. Empowerment theories were applied to design, but the review of relevant theories could be more systematic. Although the evaluation workshop simulated the five of the six design phases, it was not a real design context. The twelve participants' previous experience differed, and whether they had designed for aging population, or how their relevant experience had impacted on their use of the toolkit was not studied.

Several aspects of the toolkit can be improved. One is accessibility. The workshop revealed that some of the items in the cards were not easy to understand. e.g., the item "I can understand the contents in the cards by myself" achieved the lowest score (3.8) in the evaluation. The terminology generated from academic research could be made more understandable to designers. The second is the lack of close connection between the specific user resources and empowerment means. The authors are refining the toolkit and will conduct further studies to address these limitations.

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