Design for Inclusion, Vol. 45, 2022, 104–114
https://doi.org/10.54941/ahfe1001875

How to Co-Design with Older Adults on Community-Level Behavior Change Interventions: Insights from a Rapid Review

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ABSTRACT

Given the unclear long-term effect and use of interventions for active aging, it is urgent and important to understand the facilitators and barriers via co-design with older adults at the community level. This study aims to lay the theoretical background on developing toolkits for co-designing community-based behavior change interventions with older adults. Rapid reviews were conducted in three disciplines to understand i) the effective behavioral change techniques for older adults, ii) how to co-design with older adults for community-based interventions, and iii) how to design tools for behavior change that are easy-to-use for older adults. The outcomes are a list of effective behavioral change techniques for older adults; guidelines for co-designing with older adults on community-based interventions; and a checklist for developing user-friendly tools for designing behavior change. These elements will serve as the foundation for developing the toolkit on co-designing with older adults for community-based behavior change interventions.

Keywords: Behavior change design, Community-based design, Ergonomics in aging, Co-design, Design tools

INTRODUCTION

The long-term effect and use of interventions developed for promoting active aging have been reported to be unclear (Sansano-Nadal et al., 2019). The urgent and important research question is how to facilitate the process of designing for active aging. Specifically, we aim to address three gaps in this paper.

First, the Behavioral Change Wheel (BCW) developed by Michie et. al. offers a systematic way to develop interventions for the health behavior change (Michie et al., 2014), yet some Behavioral Change Techniques (BCTs) proposed by the BCW that are effective for young adults may not be effective for older adults. For example, as people age, their executive function decreases (Ferguson et al., 2021). Besides, in later life, people's life goals become more focused on maximizing meaning and positive emotions; and improved

health is associated with delayed future payoffs, which is of less concern to older adults (Löckenhoff & Carstensen, 2004).

Second, including users and other stakeholders in the design process can lead to designs that meet their needs and preferences (Sanders & Stappers, 2008). Co-design has been proposed to be integrated into the intervention development process for ethical reasons and to improve sustainable behavior change (Niedderer et al., 2017). The emerging literature on behavior change has put increasing emphasis on community involvement (Axon, 2016; Verplanken & Roy, 2016). It has been found that community-based interventions can sustainably engage residents cognitively, affectively, and behaviorally (Axon et al., 2018). However, a guideline is lacking on how to co-design with older adults' communities for behavior change.

Third, existing tools for facilitating designing interventions for behavior change were created for designers and evaluated by designers. (Hermsen et al., 2014; Konstanti et al., 2021; Lockton, 2018; Ren et al., 2017). Whether these tools can be used to co-design with target users is not yet known. Our previous work on Ergonomics in Aging uncovered the capability differences between young adults and older adults (Wang et al., 2018), which could offer as a foundation for the development of design tools that are user-friendly for older adults.

Therefore, the aim of this study is threefold. First, we will identify the BCTs that are effective for behavior change in older adults. Then, we will extract a guideline on how to co-design with older adults' communities. Lastly, we will formulate a checklist on how to develop tools that are user-friendly for older adults on designing behavior change. The ultimate goal is to create the theoretical foundations for developing a toolkit for designers to co-design with older adults for lasting active aging at the community level.

METHODS

For each research gap mentioned above, we conducted a rapid review to extract evidence and learnings from previous studies. In a rapid review, sources are limited due to time constraints of searching, however transparent and reproducible search methods are still used (Harker & Kleijnen, 2012). This method is used given the urgency to develop the toolkit for co-designing with older adults for lasting active aging at the community level. A literature search was done in early December 2021. The database Scopus was searched. All the relevant articles published with available full text were collected, and the duplicates were removed. No hand search was performed. In Table 1, the three rapid reviews are summarized in terms of "goal of review", "review type", "search terms", and "studies included (n)". The flowchart depicting each literature search can be found via the Open Science Framework (OSF) link: https://osf.io/g6479.

The effective BCTs identified were then summarized and categorized based on the stages of behavior change (Niedderer et al., 2017). According to health psychology, people usually go through a few stages from the moment they start thinking about changing their behavior to the moment that they have durably changed it. To facilitate the transition from one stage to the next, the

Table 1. Summary of the three rapid reviews (n: studies included).

Goal of review	Review type	Search terms	n
Identify the BCTs that are effective to older adults	Rapid review of systematic reviews (because of abundant research on this topic)	(TITLE-ABS-KEY ("behavio* change technique*") AND TITLE ("systematic review") AND TITLE-ABS-KEY ("older adults" OR "elderly" OR "senior")).	6
Understand how to co-design with older adults at the community level	Rapid review (because of limited research on this topic)	(TITLE-ABS-KEY ("community-based" OR "community based") AND TITLE-ABS-KEY ("co-design" OR "participatory design") AND TITLE-ABS-KEY ("older adults" OR "elderly" OR "senior")).	5
Understand how to develop design tools for older adults on behavior change	Rapid review (because of limited research on this topic)	(TITLE (toolkit OR tool) AND TITLE ("behavio* change" OR persuasive) AND TITLE ("design"))	4

goal of the design is different, which are "raising awareness", "enabling", "motivating" and "fading-out" (Niedderer et al., 2017). The explanations of the four categories can be found via the OSF link: https://osf.io/g6479. The lessons learned from the second review were extracted to form the guideline on co-design with older adults at the community level. The insights gained in the third review were summarized and combined with our previous finding in Ergonomics in Aging (Wang et al., 2018) to form the checklist for developing design tools for older adults on behavior change.

RESULTS

The BCTs Categorized by Design Goals

The effective BCTs identified are shown in Table 2. No effective BCT fits in the "fading-out" category, some BCTs can play both roles of "enabling" and "motivating" the person for behavior change. The definition of "older adults" varied across the studies, and half of the studies focused on interventions promoting physical activities. It is worth noting that one study concluded that BCTs might be less suitable for older adults (Zubala et al., 2017), while the other studies reported the effective BCTs (Ahmed et al., 2021; Ester et al., 2021; French et al., 2014; Gardner et al., 2017; Lara et al., 2014). Therefore, the evidence for effective BCTs is heterogeneous. The most-mentioned BCT is "problem solving" (by four studies); followed by "goal setting", "action planning" and "social support" (each by two studies). Only four studies reported the effectiveness of the interventions; while two of them reported the effectiveness is limited, the other two studies reported that the interventions are effective. Among the latter two studies, one study reported the effectiveness of the interventions lasts longer than 1 year while the other study reported

Table 2. Effective BCTs for older adults categorized by design goals.

Design goal	Effective BCTs for older adults
Raising awareness	Information about health consequences
Enabling	Action planning
	Problem solving
	Goal setting
	Social support
	Restructuring the physical environment
	Demonstration of the behavior
	Instruction on how to perform a behavior
	Graded tasks
	Adding objects to the environment
Motivating	Feedback on behavior
	(Follow-up) prompts/cues
	Self-monitoring of outcome(s) of behavior
	Restructuring the physical environment
	Reward approximation
	Rewarding completion
	Situation-specific reward
	Adding objects to the environment
	Social reward
	Social support
	Material reward
	Self-reward
	Non-specific reward

that the effectiveness of the interventions beyond 1 year is unclear. An elaborated version of Table 2 (with explanations and examples) and more details about all the studies included in the review can be found via the OSF link: https://osf.io/g6479.

The Co-Design Guidelines

The guidelines summarized for co-designing with older adults for community-based interventions can be found in Table 3. The reviewed studies uncovered three approaches of co-designing with older adults for community-based interventions. The first way is to co-design only with older adults towards an intervention for all the older adults in the community (Castro et al., 2020; Lee & Ho, 2021); the second way is to co-design with older adults and other generation groups (e.g., children, young adults) towards an intervention for facilitating intergenerational bonding in the community (Gomes et al., 2018; Senteio, 2019). The third way is to co-design with older adults and local organizations (e.g., local hospital, local NGO, municipality) towards community-based services for older adults from these organizations (van Velsen et al., 2015). These guidelines are categorized into "involving older adults", "fostering intergenerational bonding", and "connecting local organizations". More details about all the studies included in this review can be found via the OSF link: https://osf.io/g6479.

Table 3. Guidelines for co-designing with older adults for community-based interventions.

Involving older adults
- Select usual meeting centers of participants in the community as the workshop site to make participants feel more comfortable - Allow informal breaks during the workshop to make the environment relaxing - Keep the length of the workshop below 3 hours to avoid fatigue - Keep questions direct and simple to help participants understand the questions - Provide visual materials that all participants can relate to so as to help them connect with things that they are not familiar with - Introduce one or more examples first for technology design to help them ideate based on what current technology can do - Keep the group small (2 - 4 people) to allow each participant enough time to speak - Divide participants into groups based on their digital skills to help participants communicate at the same level - Divide participants into groups based on their attitude to behavior change to help participants communicate at the same level
Fostering intergenerational bonding
- Emphasize on the common goals that all participants share - Emphasize the different skillsets that each generation have - Emphasize the values each generation could bring to each other - Let the team divide the tasks themselves in the workshop to let each participant does the task that he/she is good at within the team - Encourage life story telling to form trust and understanding between participants
Connecting with local organizations
- Determine current roles of organizations - Assessing their potential gains - Determine the roles and tasks each organization would like to have - Reaching consensus over the division of roles and tasks - Confirm with participants about their inputs - Understand the local context, resources, and working procedure - Create a business model to ensure all the different activities are financed and the organizations are rewarded for their efforts

The Tool Development Checklist

The checklist for developing user-friendly tools for designing behavior change can be found in Table 4. The reviewed studies each reports a tool/toolkit for designing behavior change. Three of the four studies used card-set as the tool format (Konstanti et al., 2021; Lockton, 2018; Ren et al., 2017). The other study created a diagram of their developed model as part of the toolkit and the rest of the toolkit was not described (Hermsen et al.,

Table 4. Checklist for developing user-friendly tools for designing behavior change.

Would you like your tool to be self-explanatory?
If yes
- Include an intro card, booklet, article, or website for the tool and its background

If not
- Organize a workshop to introduce the tool and its background to the participants

Would you like the tool to focus on one type of behavior (e.g., physical activity)?
If yes
- Provide examples that are focused on the target behavior in the tool
- Give a brief in the tool to let participants focus on the target behavior

If not
- Provide examples that cover different behaviors in the tool
- Create an exercise in the tool for participants to identify the behavior that they want to target

Have you ensured the accessibility of your tool?
- Create a digital version that allow any people to download and print
- Print on PVC, which is easy-to-clean and durable to use

Have you ensured that the tool is engaging and easy to use?
- Use categories to divide the information into digestible chucks
- Use categories to guide the thinking process of participants
- Give a clear and concise definition and explanation for each category and its relationship with behavior change
- Give examples to each behavior change theory/technique
- Visually illustrate these examples
- Use simple sentences and no jargon to explain the theory/technique
- Transform guidelines to colloquial questions

Have you ensured that older adults could use the tool?
- Can they see the text?
- Can they distinguish the colors used in color-coding?
- Can they associate with all the illustrations given in the tool?
- Can they manipulate the tool easily (e.g., separate two cards from each other)?
- Can the tool communicate with them in a different way other than visually?
- Can they associate with all the examples given in the tool?

Have you associate your tool with other existing tools and toolkits?
- Provide a reference card or booklet

Have you let participants think about what the threats for the behavior change could be?
- Provide questions and examples to provoke this topic
- Provide the opportunity for participants to tailor the tool (e.g., leave space on the cards for participants to add notes on the threats they think of)

Have you gained feedback about your tool from target participants during its development?
- Place the information that participants find useful at the most obvious place (e.g., front of the cards)

Have you conducted a pilot test of your tool with target participants?
- Do they only look at some parts of the tool (e.g., one side of the cards)?
- Do they ask lots of questions or show confusions when using the tool?
- Do they abandon the tool later in the design process?
- Find the reasons behind these questions

2014). Two studies explicitly reported the theories supporting their tools (Konstanti et al., 2021; Ren et al., 2017); while the other two studies reported the disciplines from which the tools are based and did not specify the theories behind them. All studies have evaluated the tool/toolkit developed with either design students or design professionals. Some evaluations are more thorough than others. None of the tools or toolkits has been evaluated in a co-design situation for designing behavior change. This is the main limitation for these tools and toolkits if being applied to co-designing with older adults for behavior change. The other limitation for two of the tools reviewed is that they are focused on designing interactive technologies (Konstanti et al., 2021; Ren et al., 2017); while technology broadens the solution space for design, technology is not an essential element in all the interventions. All the studies reported the useful features of their tools and toolkit in different levels of detailedness while one study reflected on areas for improvement regarding the current features based on the evaluation feedback (Ren et al., 2017).

The checklist consists of questions and recommendations. The types of questions are divided into "would you like…" (offer a choice for the users) and "have you …" (remind users about important features). With "users", we mean the researchers and designers who will use the checklist. There is no particular order with using the checklist, and we encourage users to read through the checklist in detail at the beginning of the development process to be aware of what features could be useful for the tools that they are developing. More details about all the studies included in the review can be found via the OSF link: https://osf.io/g6479/.

DISCUSSION

In this study, we identified effective BCTs for older adults, extracted a guideline on how to co-design with the older adults' communities for behavior change, and formulated a checklist on developing user-friendly design tools to involve older adults in the design process. The evidence collected and the theories explored serve as a foundation for developing a toolkit on co-designing with older adults for lasting active aging at the community level.

Reflection on Effective BCTs

Regarding the effective BCTs, even though the study by Zubala et. al. explicitly concluded that "BCT might be less suitable for older adults", it later argues that "environmental and social supports" are "motivators more meaningful to them" (Zubala et al., 2017). We interpret this study to imply that some BCTs are less suitable for older adults, such as goal setting and action planning, as they rely on one's executive function and long-term vision (short-term pain for long-term gain). Some BCTs do acknowledge the importance of "environmental and social supports" to older adults, such as "adding objects to the environment", "social reward", "social support", and "restructuring the physical environment". Interestingly, "goal-setting" and "action planning" have been mentioned by two reviewed studies as effective BCT

for older adults respectively. Even though the target group of Zubala et al. is community-dwelling people over 50 years old, we cannot guarantee the sample in their review has lower executive functions and more of living-in-the-moment attitude than the samples from other reviews. There are many factors that can affect the effectiveness of BCTs, such as health conditions, culture, and available resources. Therefore, we advise future researchers to use the list of effective BCTs for older adults as a starting point and improvise based on insights gained during co-designing with older adults in the community. This is the topic that we aim to contribute to with the guidelines on co-designing with older adults for community-based interventions.

Reflection on Co-Design Guidelines

These guidelines are based on six studies that satisfied the inclusion criteria, which is a limited amount. As more studies on this topic are carried out in the future, these guidelines could be updated with state-of-the-art insights and advice. We see the guidelines as a starting point to prepare designers to co-design with older adults for community-based interventions. One advice for co-designing with older adults is to provide visual materials that all participants can relate to. We have made this guideline more concrete by providing a checklist on toolkit development to ensure the designers abide by this guideline appropriately. Especially in designing for behavior change, it could also be the first time that the designers get introduced to behavior change theories, how could they prepare to introduce these theories and techniques to older adult participants easily? We will then discuss this checklist for developing user-friendly design tools for behavioral change in the below section.

Reflection on Toolkit Development Checklist

This checklist is developed based on a limited number of studies and the majority of which focused on card-set. Therefore, same as the guidelines, we see this checklist could be updated based on future tool/toolkit developed. Besides, we acknowledge that more insights on how to create user-friendly design tools could be gained by reviewing studies on design tools and toolkits in general. Yet, we would like to keep this review more focused on behavior change and we have seen that specific advice related to incorporating behavior change theories and techniques in tools/toolkits are uncovered in the reviewed studies. Card-set has been found to be a helpful tool for designers, however, we argue the format of the tools for behavior change design should not be limited to card-set. Hence the checklist does not limit to the design of a card-set, and we intentionally phrase the questions and recommendations in the checklist to make them cover broader features. Yet, we do acknowledge that many suggestions are taken from the development of existing tools that are mainly in the format of card-set.

Limitations

This study has only used the Scopus database. We acknowledge that more insights could be gained by extracting relevant articles from multiple databases. Yet, we argue that the rapid reviews offer a sufficient starting point given the urgency for the toolkit development. The strength of this study is

that it combines rapid reviews from multiple disciplines, which will enable the toolkit developed in the future to understand and foster health behavior change for older adults from different perspectives.

CONCLUSION

This study established the theoretical background on developing toolkits for co-designing community-based behavior change interventions with older adults via three rapid reviews. The next step is to develop a toolkit for co-designing with older adults for community-level active aging based on the insights gained from this study. After the toolkit is developed, it will be evaluated with students and older adults on a project regarding promoting active aging in urban neighborhoods. By participating in co-design sessions, older adults might learn about how to use the toolkit to develop interventions for lasting active aging in their local community. This will help involve hard-to-reach older adults for active aging in the community. We posit that this bottom-up approach might complement the top-down approach (e.g., policies) to promote lasting active aging.

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