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Wizard of Oz Studies with Older Adults: A Methodological Note

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Abstract. Wizard of Oz (WoZ) is a prototyping technique in which users basically interact with what they believe is a fully functioning technology, while, in reality, the system is operated by a researcher, usually concealed from the participants. WoZ technique allows the exploration of user requirements and design concepts at an early stage in the design process and it can provide information about the interaction of different group of users, including older adults. In this paper, we provide a brief overview of WoZ method in HCI and, based on related literature and our experience, we present the methodological value and the potential drawbacks of WoZ approach in User-Centered Design when involving older people. We discuss indications on organizational and ethical aspects of conducting WoZ studies with older participants and highlight the positive impact and possible pitfalls of this approach in sharing vision of future technology and communicating ideas for design.

1 Wizard-of-Oz Studies in HCI

Wizard of Oz (WoZ) is a prototyping technique commonly used in Human-Computer Interaction (HCI) research (Dahlbäck et al. 1993). Similar to other methods for involving users in the design process, such as scenarios discussion, video prompts and low-fidelity prototypes, WoZ prototypes can be used to support conversations about technologies that are not yet developed. Before

discussing our experience in using WoZ with older adults, we briefly introduce WoZ studies and taxonomy.

As reported by Green and Wei-Haas (1985), WoZ technique was firstly applied in the field of Natural Language Processing and then used in different research domains including HCI, Human-Robot Interaction, Usability and User-Centered Design. The WoZ technique allows the involvement of users who operate an apparently fully functioning system, whose missing functions are supplemented by a human operator called "wizard". The wizard, usually hidden to the users, can simulate the effect of one or more functions that are not currently implemented in the system. For example, a system based on an automatic speech recognizer can be evaluated before the recogniser is fully functioning, using a wizard who listens to the commands uttered by the user and let the system manually answer in the appropriate way. The goal of WoZ prototypes is to make users actually trying out an external representation of the final system before it is fully developed. Users can contribute at various stages of the design process mainly by being asked for their opinions on the specific prototype or by being involved in discussing features of future technology.

According to the taxonomy described by Höysniemi and Read (2005) and by Eynon, Davies and Holmes (2012), many different factors characterised the design of WoZ studies, such as:

Technology and experimental set up

- **Functionality of the technology**: which may vary from non-tech prototypes to more sophisticated devices.
- **Wizard control**: the wizard may provide all the functionalities in the systems or be only operating a part of them.
- **Number of wizards**: the device can be operated by one or several wizards; when multiple wizards are involved, each one controls one functionality.

Wizard

- **Discretion of the Wizard**: the wizard may follow pre-defined rules and patterns when operating the system, being constrained to a number of options, or she might be allowed to freely operate the system.
- **Wizard visibility:** the wizard may be seen or unseen / heard or unheard by the participant(s). The operator may be seen but not known to be operating the system, or, his role may have been clearly explained to the participants.
- **Wizard knowledge**: the wizard may be or be not familiar with the technology being studied, with the domain investigated or with the characteristics of the users participating in the study.

Participants

- **User knowledge:** related to the visibility of the wizard is the amount that the user knows about the setup. Levels of deception vary across WoZ studies from the user believing that all is done by a functional interface to the user knowing that the wizard is doing all the manipulation. It is common to give the user knowledge that lies between these two extremes.

- **User understanding**: the extent to which participants understand the true nature of the study, the deception and consequences.

A final but not less important aspect is the evaluation and assessment of the information collected in the WoZ sessions. WoZ technique allows indeed (1) to collect information from the observation of the users' behavior when interacting with the technology and (2) to investigate user reactions and personal opinions with post-session interviews and focus groups.

Generally, the main benefit of using WoZ studies is to give researchers the opportunity to test new user interface concepts before the technology is mature enough, considering different scenarios, even fictional and futuristic ones. Systems used in WoZ studies are usually easy and relatively inexpensive to develop, compared to complete and fully functioning systems. The method also facilitates gathering qualitative and quantitative data on user's preferences and usage patterns, and depending on the study setup it might enable creative responses.

Issues of ethics and research validity are considered as the main drawbacks of WoZ studies (Eynon et al. 2012). Deception is a crucial component of WoZ approach: (all) participants involved in the study should believe that the system is autonomous rather than operated by a person. Following the framework proposed by Adar and colleagues (2012), WoZ studies represent a case of functional deception: they allow participants to believe that they are using a working implementation, but are in fact playing in a semi-functional sandbox, that is operated by a real person. As stated by the same authors, this type of deception can be considered benevolent if "the end-user would prefer an experience based on the deceptive interface over the experience based on the "honest" one" (p.1865, Adar et al. 2012). Given that WoZ studies work exclusively through deception, a countermeasure that researcher can adopt to mitigate the potential harm of deception is to include a debriefing of the session, revealing the true nature of the study (and of the technology functioning) to the participants (Adar et al. 2012).

2 WoZ Studies with Older Adult Participants

This section revolves around the question whether WoZ method is a suitable method for communicating design ideas to older participants and for exploring aspects of future technology. It can be argued that users involved in a WoZ study can actually see how a new technology function and, therefore, they can be more willing to evaluate whether this technology would meet their needs.

2.1 Using WoZ Technique with Older Adults

A number of WoZ studies have been conducted to involve older participants in evaluating prototypes of social robots (Riek et al. 2012), home health care systems (Takahashi et al. 2003), online learning services (Eynon et al. 2012) and voice interfaces (Portet et al. 2014). Within the ECOMODE (Event-Driven Compressive Vision for Multimodal Interaction with Mobile Devices) project, we

used the WoZ technique for investigating older adults' opinions on multimodal interaction. ECOMODE project goal is to develop multimodal human-computer interfaces for mobile devices where the interaction is based on a combination of vocal commands and mid-air gestures, specifically addressing the needs of older adults and visually impaired people. During the first year of the project, we designed a WoZ study, involving 10 older adults (average age 68.9, SD= 3.62) with the aim of (a) exploring how older adults use multimodal interaction when introduced for the first time to a multimodal interface, and of (b) investigating their preferences and opinions on different interaction modalities (vocal, touch and multimodal, meant as combination of mid-air gestures and vocal commands). The WoZ setup comprised a tablet device used by the participant and controlled by a computer operated by the wizard, who was present in the same room together with a facilitator. The task consisted in using the tablet device for taking pictures of the indoor environment by interacting with the tablet using multimodal gestures, i.e., the combination of mid-air one-hand gestures and vocal commands. The task was composed of several sub-tasks (e.g., opening the camera application, shooting a photo, zooming in the scene, etc.) that were suggested by the facilitator to the participants. After completing the task, individual semi-structured interviews were conducted to collect information on the user experience. During the interviews, participants were asked to comment on their experience in using the tablet and to provide feedback on the multimodal interaction. Finally, the participants received full information on the study procedure (the WoZ technique) and on the research goal.
Using the WoZ approach, we were able to engage the participants in discussing their opinions on the technology, even those people less familiar with technology. Although participants used multimodal gestures for the first time, they enjoyed the WoZ experience and reported advantages and limitations of such type of interaction making examples based on their everyday activities. For instance, they spontaneously produced scenarios in which they elaborated on bringing the multimodal tablet on their daily walks or at home, discussing the potential benefits of vocal commands, giving suggestions on how to make the gestures easier to remember and describing situations where multimodal interaction might be inappropriate (e.g., while being in a social situation).

2.2 Benefits and Limitations of WoZ Studies with Older Adults

Informed by related literature and by our experience in conducting the WoZ study, we expanded the taxonomy presented in Section 1 to include indications for the design and organization of WoZ studies with older participants:

Technology and experimental set up

- **Functionality of the technology**: depending on the technical expertise of the target group, the technology should look familiar to users in order to reduce technology fear and interaction barriers (Coleman et al. 2010).
- **Wizard control**: the wizard should operate all functionalities that might hinder participants in interacting with the system and limiting accessibility barriers.

- **Number of wizards**: studies with older adults might require a facilitator always present with the participants in order to facilitate the study procedure (Linsday et al. 2012). The wizard should exclusively operate the technology, remaining preferably in the study location or in a specific room.

Wizard

- **Discretion of the Wizard**: independently of the specific user group involved, the wizard should always follow pre-determined rules when operating the system in order to ensure consistency between different study sessions.
- **Wizard visibility:** our experience suggests that the wizard can be present in the same room of the activity without being discovered or distracting the participants. Having the wizard in the same location might help the participant to fully understand the WoZ setup when revealed.
- **Wizard knowledge**: the wizard should be aware of the type of participants involved in the study, such as older participants, and take into account possible age-related impairments.

Participant

- **User knowledge:** as previously discussed, deception is a necessary element in WoZ studies. It is important that the participants receive a full explanation of the experimental procedure before concluding the study.
- **User understanding**: when dealing with some user groups, especially with older adults or children, participants might be at more risk of harm. This should be always taken into consideration by the researchers conducting the study.

One of the main advantages of using a WoZ setup with older adults is that non-technology experts can take part in the design process more easily as they can use the prototype without having specific technical skills. Moreover, the fact that participants can actually interact with the system is particularly useful when dealing with older adults that might prefer to discuss on practical experiences instead of elaborating on abstract scenarios. In order to reduce the need to engage in deep explorations of abstract concepts, practical or even playful WoZ activities can be helpful to overcome participants' discomfort and to encourage participation (Iacono and Marti 2014). Similar to other techniques, such as video prompt and low-fidelity prototypes (Lindsay et al. 2012), WoZ setup can help designers and researchers to engage older participants in conversation more naturally and quickly, establishing a common frame of reference for the discussion. Moreover, the experience with the WoZ session can support the creation of shared references and of a common ground between participants and researchers based on the actual use of the prototype. This is an important element for helping older participants to express their thoughts and comments and for establishing the right and productive atmosphere during the study (Lindsay et al. 2012).
Even though WoZ studies have important benefits, they also bring some drawbacks:

(1) *Expectation issues*, such as creating too unrealistic views on technology development. This might be an issue especially when involving older participants, who may be less likely to accept and may struggle to use forward-thinking technologies, that might be perceived as too unfamiliar and unaffordable (Coleman et al. 2010). Technology should look and feel familiar to them, and more importantly, researchers should provide older adults with clear and detailed information about the benefits that adopting such technology will bring;

(2) *Wizard issues*, particularly, how the capability of the wizard affects the setup. The wizard might experience high cognitive overload when asked to operate many different functions in the system. When involving older adults, the wizard should be assisted by a facilitator (Lindsay et al. 2012), a second researcher, who will guide the user through the study session and support the wizard in focusing on his task. Moreover, researchers and facilitators should use a clear and understandable language and structured activities in a way that they are accessible and not tiring to participants;

(3) *Ethical issues*, especially the deceptive nature of WoZ studies, which in worst case may lead to unethical research. Researchers should always include a debriefing section, assuring that the participants really understand the deception involved in the study. Afterwards, researchers should also remind the participants that they can withdraw their consent and have their data removed.

Concluding, we presented benefits and limitations of using WoZ studies as an approach for engaging older adults in discussions about design ideas through concrete examples and practical issues. Research has now widely shown that older adults do not reject technology more than other age groups. On the contrary, they are willing to use and discuss about novel technology, when it meets their needs and expectations (Conci et al. 2009; Lindsay et al. 2012). An approach like WoZ, that supports older adults to physically explore and interact with technological prototypes, can improve their engagement and participation in the design process; however, organizational and ethical aspects should be carefully considered as well.

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