
Involving Users and Experts in Motion-Based Game Design for Older Adults

Kathrin M. Gerling

University of Saskatchewan
110 Science Place
Saskatoon S7N 5C9, Canada
kathrin.gerling@usask.ca

Jan Smeddinck

University of Bremen
Bibliothekstraße 1
Bremen 28359, Germany
smeddinck@tzi.de

Abstract

Motion-based video games have a variety of positive effects on older adults, but their design remains challenging. Traditional game design often turns towards a user-centered design process, and game design experts are readily available. This paper discusses the challenges and opportunities of this approach in motion-based game design for older adults. We identify core challenges and show how users and experts can be involved in the design process to help game developers create safe, accessible and enjoyable motion-based games for older adults.

Author Keywords

Entertainment, evaluation, game design, older adults.

ACM Classification Keywords

K.8.0 [Personal Computing]: General - *Games*.

Introduction and Background

Motion-based video games (MBGs) have various positive effects on older adults [10], but the potential benefits can only be obtained if games are tailored to meet the needs of the audience [13]. Many currently available games are too complex or physically challenging. User-centered design and the involvement of experts, e.g., game and interaction designers, has largely benefitted the traditional game design

Common Age-Related Changes

Cognitive impairments (e.g., decrements in episodic memory, variances in working memory performance) affect problem solving skills and information processing and can lead to a reduced attention span when working on complex tasks [2], [3].

A *decline of motor skills* includes decrements in fine motor skills and changes in posture and balance. Motor learning of new skills is also negatively affected by age [2], [3]. Physical impairments include decrements in sensory processes affecting the interaction with the environment [2].

Chronic illnesses ranging from arthritis to severe heart conditions have an impact on the physical abilities and mobility of senior citizens, while neurodegenerative diseases such as Alzheimer's also affect older adults' cognition [2].

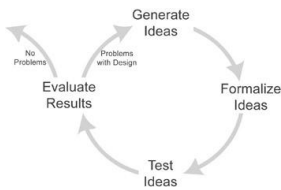


Figure 1: Iterative process diagram for game development after Fullerton et al. [3], page 15.

community by integrating feedback at different stages of the development process [4]. Older adults are a heterogeneous group with a variety of special needs [5], suggesting that user involvement and expert feedback is particularly important. However, existing work reports problems regarding user involvement in the development process, of games for older adults. Interaction problems are reported despite efforts of accounting for common age-related changes and impairments. Only few theoretical considerations regarding motion-based game design for older adults are available [5], and the involvement of game and interaction design experts may not be effective as only few of them have experience in designing for older adults. If MBGs do not meet the needs of older adults, this does not only diminish player experience (PX), but may also put users at risk of injury.

Who can we turn to in order to ensure the suitability of motion-based games for older adults? In this paper, we discuss user and expert involvement, identify relevant experts outside the game design community, and discuss at which stages they can be involved in development. We address core challenges and show how experts can be integrated in the development process to help game developers create safe, accessible and enjoyable MBGs for older adults.

Who Should Be Involved?

User and expert involvement is crucial in motion-based game design for older adults, but different challenges have to be addressed.

Users as Experts: Involving Older Adults

In our research, we found large differences between active and institutionalized older adults in their abilities

to participate in the game design process [7].

Institutionalized older adults often experience a higher degree of age-related changes and impairments, sometimes limiting their ability of being part of the development process [5]. Furthermore, a lack of familiarity with games may cause additional difficulties in the expression of opinions [12]. When working with older adults in nursing homes evaluation sessions have to be scheduled around regular activities and participant availability often has to be determined on a daily basis as health conditions vary. MBGs do not only challenge users on a cognitive level, but also require them to be physically active, leading to additional problems when working with older adults [6]. In this context, it is important to carefully weigh advantages and disadvantages of user involvement.

Non-Gamer and Gamer Experts

A major challenge of expert involvement in motion-based game design for older adults is that few of the experts can be expected to have extensive knowledge in all relevant areas (i.e., video games and characteristics of older adults). Therefore, it is important to consult experts in both fields and consolidate their input: experts on older adults are likely to give feedback on suitable interaction paradigms whereas game development experts can help turn them into appealing game mechanics.

At What Time Should Experts Be Involved?

Modern game design literature highlights the importance of an iterative development process. Starting from player experience goals, Fullerton et al. [4] suggest a multi-stage development model, an iterative cycle (Figure 1) begins for each of the following stages: (1) brainstorming, (2) physical

Non-Gamer Experts such as doctors, therapists and nurses can provide valuable insights into common age-related changes and impairments, give recommendations that help interaction designers implement healthy movement-based game input, and support game developers throughout the evaluation process.



Gamer Experts, e.g., interaction and game designers can build on recommendations provided by non-gamer experts and help convert their insights into enjoyable game mechanics. Given the support of non-gamer advisors, they can also work with older adults to create and evaluate appealing game concepts.

prototype (s), (3) software prototype(s), (4) design documentation, (5) production and (6) quality assurance [4]. This process closely resembles iterative methods from general interaction design, shifting the emphasis from requirements analysis to player experience goals and brainstorming (cf. sidebar) [9].

In the case of MBG design for older adults, conceptual brainstorming is guided by health and safety concerns. Non-gamer experts (medical staff and therapists) play an important role in this phase to ensure the basic suitability of interaction paradigms. Players from the target group should be included beginning at the early prototyping stages to account for issues related to their heterogeneity; motion-based input should be tested before being implemented into electronic prototypes (e.g., by letting users perform preliminary gesture sets). When moving into the production phase, non-gamer experts and gamer experts have to work hand in hand to create senior-friendly game mechanics. In quality assurance, non-gamer experts and users play a central role in validating playability, safety and health aspects as the software matures.

Conclusions and Future Directions

Generally speaking, users and experts should be involved based on their areas of expertise and their kind of connection to the target audience. Feedback needs to be weighed according to users' and experts' experience with games: in our research, we received a lot of feedback on game design ideas from all groups, but non-gamer experts and users often found it difficult to keep in mind the technical feasibility of their suggestions. Nevertheless, the involvement of non-gamers offers the chance of generating fresh ideas and thinking outside the box [14].

In this context, rapid prototyping is an important tool to limit the amount of time spent on implementing inaccessible MBG designs. However, in order to evaluate certain aspects (e.g., suitability of game mechanics and game pacing), functional prototypes are required. This may also prevent confusion amongst users involved in the development process, since rapid prototyping design methods often require an abstract transfer of concepts to potential use-cases, which is not recommended when working with older adults [11]. In addition, a trade-off between rapid testing and exploration of movement types and the validation of therapeutic benefit needs to be found.

Finally, the evaluation of MGBs for older adults requires a careful examination of the accessibility and health implications for the target group before considering PX. Diverging from usual priorities for design and evaluations of games, we suggest the following order: (1) don't harm, (2) make it usable (playable / accessible), (3) make it fun, (4) make it useful. In order to prevent narrowing down the design space too early, the priorities might shift during brainstorming. (1), (4) and to a certain extent (2) are not usually top priorities in game design and they constitute the main reason why users but also non-gamer experts must be involved in the development of MBGs for older adults.

When designing for older adults, game experience and playability are extremely difficult to predict. While first models drawing awareness towards challenges in the design of video games for older adults have been developed [5], design heuristics are often limited to the elimination of basic problems. Thus, user testing is important at any stage of development, and when designing for older adults, the involvement of experts is

The iterative model suggested for game design [4] closely resembles established iterative models from general interaction design:

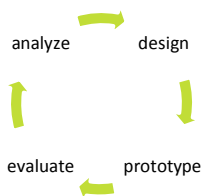


Figure 2: Simplified general usability and user experience iterative user-centered cycle after [9].

User-centered design with users as experts and non-gamer experts in the loop beginning with the software prototype stage was employed in the development of the *WuppDi!* games suite for Parkinson's disease patients [1] and is currently being employed in the *Spiel Dich Fit!* project, which is a commercial follow-up to the *WuppDi!* project with older adults as the target group; the development of the latter being accompanied by weekly playability and game experience evaluations with patients and therapists of a physiotherapy and rehabilitation clinic.

necessary to fill in information that the target audience may be unable to provide. Game developers have to balance the degree to which they rely on external partners: older adults may be exhausted, and medical staff is usually short on time. This challenge increases when trying to evaluate the therapeutic value of motion-based games for older adults. In contrast to the long history of clinical trials in medicine, games user research has not yet developed appropriate protocols.

The development of new methodological approaches could also contribute to the development of games for other user groups that consist of members with heterogeneous abilities and needs, fostering the creation of enjoyable games for vulnerable audiences.

References

- [1] Assad, O., Hermann, R., Lilla, D., et al. 2011. *WuppDi! -- Supporting Physiotherapy of Parkinson's Disease Patients via Motion-based Gaming*. In *Proc. of M&C 2011*, Chemnitz, Germany.
- [2] J. E. Birren and K. W. Schaie. *Handbook of the Psychology of Aging*. San Diego, CA, USA: Academic Press, 2001.
- [3] Czaja, S. J., & Lee, C. C. Information Technology and Older Adults. In: Sears, A. & Jacko, J.A. (Eds.): *The Human Computer Interaction Handbook*. New York, USA: Lawrence Erlbaum Associates, 2008.
- [4] Fullerton, T., Swain, C., and Hoffman, S. *Game design workshop: designing, prototyping, and playtesting games*. Focal Press, 2004.

- [5] Gerling, K., Livingston, I., Nacke, L., and Mandryk, R. 2012. Full-Body Motion-Based Game Interaction for Older Adults. In *Proc. of CHI 2012*, Austin, TX, USA.
- [6] Gerling, K. and Masuch, M. 2011. When Gaming is not Suitable for Everyone: Playtesting Wii Games with Frail Elderly. *GAXID '11 (FDG 2011)*, Bordeaux, France.
- [7] Gerling, K., Schild, J., and Masuch, M. 2010. Exergame Design for Elderly Users: The Case Study of SilverBalance. In *Proc. of ACE 2010*, Taipei, Taiwan
- [8] Gerling, K.M., Schulte, F.P., Smeddinck, J., and Masuch, M. 2012. Game Design for Older Adults: Effects of Age-Related Changes on Structural Elements of Games. In *Proc. of ICEC 2012*, Bremen, Germany.
- [9] Hartson, R. and Pyla, P. *The UX Book: Process and Guidelines for Ensuring a Quality User Experience*. Morgan Kaufmann, 2012.
- [10] Jung, Y., Li, K.J., Janissa, N.S., Gladys, W.L.C., and Lee, K.M. 2009. Games for a better life: effects of playing Wii games on the well-being of seniors in a long-term care facility. *Proc. IE '09*, ACM (2009).
- [11] Lindsay, S., Jackson, D., Schofield, G., and Olivier, P. Engaging Older People using Participatory Design. In *Proc. of CHI 2012*, Austin, TX, USA.
- [12] Nap, H.H., de Kort, Y.A.W., and Ijsselstein, W.A. 2009. Senior gamers: preferences, motivations and needs. *Gerontechnology* 8, 4 (2009), 247-262.
- [13] Siegel, S. and Smeddinck, J. Adaptive Difficulty with Dynamic Range of Motion Adjustments in Exergames for Parkinson's Disease Patients. In *Proc. of ICEC 2012*, Bremen, Germany.
- [14] Vanden Abeele, V. and Van Rompaey, V. 2006. Introducing Human-Centered Research to Game Design: Designing Game Concepts for and with Senior Citizens. In *EA of CHI 2006*, ACM (2006).