

This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.

Author(s): Kari, Tuomas

Title: Exergaming Experiences of Older Adults : A Critical Incident Study

Year: 2019

Version: Published version

Copyright: © The Author, 2019.

Rights: CC BY 3.0

Rights url: <https://creativecommons.org/licenses/by/3.0/>

Please cite the original version:

Kari, T. (2019). Exergaming Experiences of Older Adults : A Critical Incident Study. In A. Pucihar, M. Kljajic Borstnar, R. Bons, J. Seitz, H. Cripps, & D. Vidmar (Eds.), 32nd Bled eConference : Humanizing Technology for a Sustainable Society (pp. 639-654). University of Maribor. <https://doi.org/10.18690/978-961-286-280-0.34>

Exergaming Experiences of Older Adults: A Critical Incident Study

TUOMAS KARI

Abstract Exergaming is a form of digital gaming requiring physical effort from the player. There has been a growing interest towards exergaming in academia. However, only a very limited number of exergaming studies have given a voice to older adults and investigated their experiences. This study investigates what kinds of exergaming experiences are perceived as the most meaningful ones among older adults (referred in this study as people over 50 years of age). That is, the experiences which they perceive or remember as “unusually positive or negative”. To meet this purpose, this study takes a qualitative approach and uses the critical incident technique, a well-established technique to collect and classify observations of human behavior. The findings suggest that for older adults, the most meaningful positive experiences of exergaming are more due to hedonic and social aspects than utilitarian aspects, although also utilitarian physical activity benefits are valued. The most meaningful negative experiences are due to issues with technology/game or personal physical limitations. Based on the findings, practical implications are also presented.

Keywords: • Exergaming • Exergames • Digital Wellness • Older Adults
• Critical Incidents • User Experience •

CORRESPONDENCE ADDRESS: Tuomas Kari, DSc, Postdoctoral Researcher, University of Jyväskylä, Institute for Advanced Management Systems Research, Jyväskylän yliopisto, Finland, e-mail: tuomas.t.kari@ju.fi.

DOI <https://doi.org/10.18690/978-961-286-280-0.34>
Dostopno na: <http://press.um.s>

ISBN 978-961-286-280-0

1 Introduction

Digital gaming has become highly common in our present society and is today one of the most popular forms of entertainment in the world. Many major technology companies along with a growing number of investors put more and more focus into the gaming industry. Digital gaming is also a rising topic of research in many fields, including information systems (IS) science. One very interesting form of digital gaming is exergaming – a combination of the words exertion and games (Mueller et al., 2016). Exergaming refers to “a form of digital gaming requiring aerobic physical effort – exceeding sedentary activity level and including strength-, balance-, or flexibility-related activity – from the player that determines the outcome of the game” (Kari & Makkonen, 2014, p. 2). During the past decade, researchers have become increasingly interested in exergaming and especially in its potential to provide physical activity and health outcomes (Kari, 2014; Maddison et al., 2013) as well as novel play experiences (Mueller et al., 2016). Studying exergaming has been deemed important (Kari, 2017) for various reasons, for example, exergames are potential in providing entertainment combined with health and wellness related benefits. Whilst the interest towards exergaming has increased in academia, so far the majority of the research has focused on their design and physical aspects instead of user experiences and perceptions. Even though the number of studies focusing on the user-centric aspect of exergames has increased recently, there is still a dearth of understanding on the usage of these games (Kari, 2017). Moreover, as stated by Loos (2017, p. 261) only a very limited number of exergaming studies have given “a voice to older adults” and investigated their experiences. Digital gaming in general is limitedly researched among older age groups (De Schutter & Brown, 2016; Pearce, 2008), yet, they form a group of devoted players having distinct needs and interests (Pearce, 2008).

Wellness related technologies and IS in general are still typically designed for younger populations, yet their growing need and potential also among older users has been presented (e.g., Carlsson & Walden, 2017). As digital games have become a popular pastime (De Schutter & Brown, 2016) and are widely played also among older age groups (Kinnunen, Lilja & Mäyrä, 2018), it is imperative to conduct more research on the experiences older adults have with exergames. Increasing the understanding on the older adults’ IS and exergaming use experiences is essential especially for the developers of exergames in terms of

being able to provide this particular user group the kinds of exergames that take into account their needs and wants, which would likely make the games more accepted, and thus, advance their adoption and diffusion. In addition, it can also be considered important for several other stakeholders, such as the health and well-being actors as well as the society at large, in terms of offering new ways to conduct physical activity and to motivate people towards it. Overall, exergames could be a potential tool in the fight against the increasing sedentary lifestyle and the problems resulting from it. The health benefits of physical activity are well documented, and recent studies show that becoming physically active even later in adulthood can still provide these benefits (Saint-Maurice et al., 2019).

To address the aforementioned research gap, this study investigates exergaming experiences of older adults (defined in this study as people over 50 years of age). More precisely, this study examines older adults' most meaningful exergaming experiences, i.e., critical incidents. That is, the experiences which they perceive or remember as “unusually positive or negative” (Edvardsson & Roos, 2001, p. 253). Such experiences are typically highly influential for human behavior (Flanagan, 1954).

The main research question this study seeks to answer is: What kinds of exergaming experiences older adults perceive as the most meaningful ones and how are the resulting feelings?

In addition to providing further understanding on this topic, this study also answers the calls by Liu et al. (2013) to conduct more IS research on digital games and Loos (2016) to conduct more qualitative studies giving voice to the experiences of older adults playing exergames in natural settings. The study is exploratory in nature and follows a qualitative approach. It is based on a thematic analysis of data collected from 34 older adults through a qualitative survey build using the critical incident technique (CIT) (Flanagan, 1954).

2 Background

2.1 Exergaming

Today, there is an increasing number of different types of exergames. All the biggest gaming console lines as well as computers offer technology and games that enable exergaming in home setting. There are also various portable devices with different sensor technology, such as hand-held consoles and smart phones that provide possibilities for exergaming across different settings and locations. Indeed, exergaming can be conducted in various settings, such as senior centers, medical centers, and fitness centers (Lieberman et al., 2011), as well as in school and work environments (Maddison et al., 2013). Besides the console- and mobile-based exergames, also other types of exergames are available, for example, the ones available in arcades or the ones embedded into exercise apparatus. Existing exergaming solutions can also utilize, for example, climbing walls (Kajastila & Hämäläinen, 2014; Valo Motion, 2019a), trampolines (Kajastila, Holsti & Hämäläinen, 2014; Valo Motion, 2019b), and virtual reality spaces (e.g., Zero Latency, 2019). Whilst the popularity of these kind of “larger” exergaming solutions is steadily increasing, the console- and mobile-based exergames that are commercially available are still the ones that are typically most accessible to the users (Chamberlin & Maloney, 2013; Kari, 2017) and mostly used among older adults. While exergaming seems to be more common in the younger than the older age groups, there is a user base also among older adults (Kari, Makkonen, Moilanen & Frank, 2013).

Exergaming has been limitedly studied among older adults. Whilst there are numerous studies conducted with older adults as participants, they have mostly been related to physical and wellness aspects, balance and falls prevention, or rehabilitation (Nguyen et al., 2017), with only a few touching the subject of user experience (e.g., Loos, 2017; Pyae et al., 2016). Overall, the related findings have been promising. For example, the systematic review by Nguyen et al. (2017) concluded that 75% of the reviewed papers found games to have positive impacts on the well-being of the elderly. Stanmore et al. (2019) conducted an exergaming intervention for people aged 55 years and older and concluded that exergames may be used to improve balance, reduce pain and the fear of falling, and are a cost-effective fall prevention strategy in assisted living facilities. Kappen, Mirza-Babaei & Nacke (2018) conducted a systematic review and identified a taxonomy

of exergames with 9 categories and 19 themes of exergame applications for older adults' physical activity, which could be further grouped into three broader clusters: training, rehabilitation, and wellness. They also concluded that exergames can contribute to the improvement of health and wellness goals of older adults. Pyae et. (2016), who in their study touched also the subject of user experience, found that there are numerous age-related aspects that should be considered when designing exergames for the ageing population, for example, related to controllers, user interface, usability, and safety.

2.2 Critical Incidents

Critical incident is an experience that the person “perceives or remembers as unusually positive or negative” (Edvardsson & Roos, 2001, p. 253). Critical incidents generally are particularly influential for human behavior (Flanagan, 1954). For example, a single critical negative incident may overrule a set of average positive incidents and lead to unwanted behaviors, such as discontinuance with the product or service (Cenfetelli, 2004). Research has shown that critical incidents have a substantial role in forming user perceptions towards products, services, their providers, and thus, in forming customer relationships (Edvardsson & Strandvik, 2000; Payne, Storbacka & Frow, 2008). Thus, they are seen as the most meaningful experiences people have.

Studying the most meaningful experiences, i.e., the critical incidents potentially pose important implications for both research and practice. Previous research has examined critical incidents in several IS related contexts, for example, online shopping (Holloway & Beatty, 2008), mobile applications (e.g., Salo & Frank, 2017) and mobile services (e.g., Gummerus & Pihlström, 2011; Salo, Olsson, Makkonen, Hautamäki & Frank, 2013), augmented reality (Kari, 2016), and self-service technologies (Meuter et al., 2000), but to the author's best knowledge, not in exergames. This study reveals central critical incidents occurring with exergames among older adults.

3 Methodology

To conduct the study, a qualitative approach was chosen. Qualitative research aims to understand people, their sayings and behavior, and the social and cultural context they live in. Central aim is to understand real life phenomena and find new knowledge. One key benefit of qualitative research is that it enables the researcher to see and understand the underlying contexts in which decisions are made and actions take place (Myers, 2013).

To collect the data, an online survey was administered among Finnish consumers during a three-month period in late-2015. The invitation to answer the survey was distributed through different discussion forums of varying topics and through different social media channels. The survey was build and administered by using the LimeSurvey online survey software. The survey questionnaire was based on previous literature on exergaming and critical incident technique (CIT). Further, a qualitative pre-test phase was conducted with fellow IS scholars and based on this, final improvements to the questionnaire were made before launching it. The survey questionnaire included several sections, among others, one about the most meaningful experiences, i.e., the critical incidents. Some of the other sections gathered information outside the purpose of this study. The sections used for this study surveyed the participants' background and the critical incidents. To collect the critical incidents and their descriptions, the CIT was used (Flanagan, 1954).

CIT is a well-established technique involving a set of procedures (Flanagan, 1954) "to collect, content analyze, and classify observations of human behavior" (Gremler, 2004, p. 66). CIT allows the respondents to describe the actual (positive or negative) incidents in their own words. Flanagan (1954) points that CIT is not a single rigid set of rules leading the data collection but rather "a flexible set of principles which must be modified and adapted to meet the specific situation at hand" (Flanagan, 1954, p. 336). CIT has been widely used as a research method across different research fields (Butterfield et al., 2005) including IS (Gogan, McLaughlin & Thomas, 2014), and it has been proven to be a sound research method and well suited for obtaining insights on a previously undiscovered phenomenon (Andersson & Nilsson, 1964; Gremler 2004; Meuter et al. 2000) such as critical exergaming experiences among older adults. Hence, CIT fits the purpose of collecting critical experiences well. Central advantages of

CIT include that the critical incidents are easy to remember and describe and that the respondents report highly important and relevant experiences. Hence, CIT enables to create an accurate and in-depth record of events (Grove & Fisk, 1997), which provides a rich set of data (Gabbott & Hogg, 1996). Obviously, CIT also has certain limitations (Bitner, Booms & Tetreault, 1990; Gremler, 2004). For example, it only gathers crucial incidents and experiences instead of regular ones.

In planning the survey, prominent and widely cited research papers utilizing CIT (Bitner et al., 1990; Meuter et al., 2000) were used. Only the respondents who had actual experience of playing exergames were asked to report their critical incidents. The respondents were asked to describe one single critical incident they had experienced in as much detail as possible. More precisely, the respondents were first asked to “Think of a time when you had an outstandingly positive or negative experience [with exergames]”, followed by a question: “Was this a positive or a negative experience?” Then, to let the respondents describe the incident in their own words, the following open-ended questions were used (translated from Finnish to English): 1) Describe in as much detail as possible: what were you doing and what happened?; 2) What exactly caused the positivity/negativity of the experience?; 3) Why do you feel that this was a significant experience for you concerning exergaming?; and 4) As an outcome of the experience, how did you feel?. The respondents were also asked what was the game related to the reported incident.

The data was analyzed using thematic analysis, which is the most widely used method of analysis in qualitative research (Guest, MacQueen & Namey, 2012). Thematic analysis is a method for “identifying, analyzing and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 79). Thematic analysis enables to organize and describe the data set in rich detail and to interpret the research topic from various aspects (Braun & Clarke, 2006). To assist in conducting the analysis, guidelines from Braun and Clarke (2006) and Patton (2002) were applied. As they suggest, these guidelines were applied flexibly to fit the research questions and the collected data. In addition, the checklist for CIT content analytic studies by Gremler (2004) was applied to further guide the analysis. More precisely, first, the incident descriptions were read and reared to familiarize with the data and all the interesting features were marked. Then, common tendencies were recognized. Based on the incident descriptions and the recognized tendencies, recurring themes were identified and analyzed in more detail. In

doing this, a spreadsheet program was used. As suggested by Braun and Clarke (2006), instead of a linear phase-to-phase process, the analysis process was a recursive one, i.e., the analysis moved back and forth between the different phases. Finally, the report was produced.

4 Results and Findings

The survey was able to reach 230 respondents in the target group of this study, out of which 34 (14.8 %) had experience with exergames and reported their critical experiences. These 34 formed the sample used in the analysis. Out of the reported experiences, 18 were positive and 16 were negative. 23 of the experiences had taken place with console-based exergames, 9 with mobile-based exergames, and two with other platforms. In terms of gender, the sample was quite balanced as there were 15 female and 19 male respondents. The age of the respondents varied between 50 and 68 years, and the mean age was 56.9 years (SD 5.2 years). The description of the sample can be seen in Table 1.

Table 1: Description of the Sample (N = 34)

	n	%
Gender		
Male	19	55.9
Female	15	44.1
Other	0	0
Age		
50–59	26	76.5
60–69	8	23.5
Occupation		
Paid employment	19	55.9
Self-employed	1	2.9
Unemployed	4	11.8
Pensioner	10	29.4

4.1 Positive Experiences

When examining the situations where the most meaningful positive experiences took place, it was apparent that almost all experiences took place during game play when the user was playing the game him/herself (possibly with others). There were two instances where the specific experience had occurred after playing the game, though were still highly related to the previous gaming session.

The most notable things that lead to the positive experiences were fun and enjoyment, sense of getting physical activity, achieving something in the game, and socializing with other people. Fun and enjoyment relates to the overall feeling of getting good entertainment or something amusing happening with the gaming activity. Sense of getting physical activity relates to the player breaking a sweat or feeling physically exerted. Achieving something in the game could be related to either achieving some in-game goal but also to more personal feeling of achievement with the game. Socializing with other people relates to other people playing an important role behind the experience and the experience being shared with others.

The reasons why the respondents felt that the experience was significant for them concerning exergaming most notably related to them finding or realizing something new in one way or another. For example, concerning a new way to be physically active, a new way of spending time with friends or family, or a new form of entertainment. Another occurring reason was the sense of achievement.

Overall, such positive experiences naturally lead to positive feelings. Most occurring feelings resulting from the described positive experiences were the feelings of joy, satisfaction, and good mood. Joy could be either personal or shared. Satisfaction could be related to the user him/herself or towards the game. Good mood was related to general good feeling resulting from the experience. There were also few mentions of getting a so called “wow-effect”, when the game play had led to some unexpected positive experience and left the player positively surprised.

4.2 Negative Experiences

When examining the situations where the most meaningful negative experiences took place, similar to positive incidents, it was apparent that most experiences took place during game play when the user was playing the game him/herself (possibly with others). However, compared to positive incidents, there were few more instances where the specific experience had occurred in between actual game play or right after or during stopping the game play.

The most notable things that lead to the negative experiences were technical issues and physical incapability. There were also few instances of mildly hurting oneself or another player whilst playing. Technical issues relate to the game freezing or not working properly, possibly leading to undesired pauses in gaming or stopping the gaming altogether. Physical incapability relates to not being physically able to conduct all the movements required by the game, for example, the game demanding such movements that were no longer possible or feasible at given age. Hurting oneself could take place by doing a wrong kind of movement that resulted in pain or by swinging an arm or a leg and hitting something external to the game such as furniture or another player, in which case the other player might have gotten hurt.

The reasons why the respondents felt that the experience was significant for them concerning exergaming most notably related to perceiving the games too hard to use or not being of adequate technical quality. Being too hard to use could be related to either perceiving that the game was not designed and meant for their age group (physical capability) or to personal skills with new technologies or games. Technical quality related more to how well the game functioned. If the experience was injury or hurt related, this was the main reason, but could also be related to physical (in)capability.

Overall, such negative experiences naturally lead to negative feelings. Most occurring feelings resulting from the described negative experiences were the feelings of disappointment, frustration, and bad mood. Same as satisfaction, disappointment could be related to the user him/herself or towards the game. Frustration could be related to either the game and technical issues or to oneself when not being able to play the game at a sufficient level. Bad mood was related to general bad feelings resulting from the experience.

5 Conclusion

The purpose of this study was to increase the understanding on how older adults perceive and experience exergaming. Specific focus was on examining older adults' most meaningful exergaming experiences, i.e., critical incidents. The main research question was: What kinds of exergaming experiences older adults perceive as the most meaningful ones and how are the resulting feelings? The study followed an exploratory qualitative approach and was based on a thematic analysis of older adults' actual critical exergaming experiences.

According to the results, the most meaningful experiences older adults have with exergaming typically occur while they are personally playing exergames, be it alone or together with others. The most meaningful positive experiences seem to be due to fun and enjoyment, sense of getting physical activity, achieving something in the game, or socializing with other people. These kinds of experiences were likely to lead to feelings of joy, satisfaction, and good mood. The most meaningful negative experiences seem to be due to technical issues (i.e., the game freezing or not working properly), not being physically able to conduct all the movements required by the game, or hurting oneself or another player while playing. These kinds of experiences were likely to lead to feelings of disappointment, frustration, and bad mood.

In general, the findings suggest that for older adults, the most meaningful positive experiences of exergaming are more due to hedonic and social aspects than utilitarian aspects, although also utilitarian physical activity benefits are valued. Thus, in designing and marketing exergames targeted either for older adults directly or for older adults as one of the target groups, it would be sensible to highlight the enjoyment and social aspects, while also implying about the games potential to provide physical activity and related benefits. To promote meaningful exergaming experiences of older adults, games should provide good entertainment, possibilities to play and socialize with others, and an adequate amount of physical activity and manageable goals which can be achieved by the players. Considering the value of social aspects, exergames could also be used to promote intergenerational gaming.

The most meaningful negative experiences of exergaming among older adults are mostly due to technological issues with technology/game or personal physical limitations or incapability to conduct the movements required by the game. Thus, the characteristics of this user group of older adults should be considered when designing the games. For example, the issues with technology or games may not be solely due to the games and devices themselves, but could also be due to the novel user interfaces of exergames, which might not be familiar to this user group. To overcome this, a clear and enjoyable onboarding would be beneficial. And should the onboarding already be able to offer some forms of achievements, that would be even better.

Considering the issues related to physical incapability, the games should be designed bearing in mind that there are most likely certain movements that are not completed as fluently in this age group as among younger people. Thus, the games should be implemented not just with different in-game difficulty levels but also with optional levels of physical difficulty, and the controlling of the game should be modified accordingly. A step further would be if the user would be able to inform the game if not wanting to use certain limbs or certain movements for the game play. Finally, to prevent injuries or hurting oneself, the games and especially how they are controlled should be designed in a way that does not require extreme movements. It would also be sensible to inform the players before the gaming starts that how much space should be reserved for safe gaming experience to avoid hitting furniture or alike. Furthermore, some sort of digital coaching (cf., Kari & Rinne, 2018; Kettunen & Kari, 2018) features could be implemented that remind about the importance of warming up before setting into a more intense session of exergaming. This warming up could of course be built into the game, so that the first ten minutes or so of the gaming would be physically less demanding and include some easy stretching.

To summarize the contribution, from a theoretical perspective this study increases the understanding on a growing but limitedly researched player group that is older adults and on their exergaming use experiences by uncovering their most meaningful exergaming experiences. At the same time, it also answers the calls by Liu et al. (2013) to conduct more IS research on digital games and Loos (2016) to conduct more qualitative studies giving voice to the experiences of older adults playing exergames in natural settings. From a practical standpoint,

the findings are used to contribute practical implications that can be utilized by the different actors in the industry and society working with exergaming.

6 Limitations and Future Research

This study has some limitations to be noted. First, since the time of the data collection, some novel exergaming concepts have become better known and more popular, such as augmented reality and virtual reality exergames. Thus, the collected experiences in this study are limited to those exergames that were available during the time the data collection took place. However, as the thematic analysis focused on general themes instead of game-specific nuances, the findings can also inform about the use and design considerations for more novel exergames. Second, all the respondents were under 70 years of age with most being between 50 and 60 years of age. Whilst this can be seen as its own segment, the critical experiences of even older people might be different. Third, although providing important insights about older adults' exergaming incidents, this study did not examine the effects of those incidents to the users' behavioral outcomes, such as use continuance. This type of investigation would be important as well.

The study also provides avenues for future research. Future studies could investigate how critical exergaming incidents affect the users' future exergaming behavior and use of exergames. Future studies could also focus on the experiences of even older adults, a group still very much under-researched. Further, other data collection methods, such as interviews could also be utilized to investigate different aspect of critical incidents in this age group. Furthermore, future studies could draw from the insights and methodology of this study in investigating different aspects of older adults' technology and digital gaming experiences. It would also be valuable to repeat this study to accumulate knowledge on the experiences with the very latest technology. A different kind of, yet highly interesting research avenue would be to investigate the ability of exergames to promote intergenerational gaming. Overall, it would be important to conduct more studies on the actual exergaming experiences of the older age groups.

References

- Andersson, B., & Nilsson, S. (1964). Studies in the reliability and validity of the critical incident technique. *Journal of Applied Psychology*, 48(6), 398-403.
- Bitner, M. J., Booms, B. H., & Tetreault, M.S. (1990). The service encounter: diagnosing favorable and unfavorable incidents. *The Journal of Marketing*, 54(1), 71-84.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Butterfield, L. D., Borgen, W. A., Amundson, N. E., & Maglio, A. T. (2005). Fifty years of the critical incident technique: 1954-2004 and beyond. *Qualitative Research* 5(4), 475-497.
- Carlsson, C., & Walden, P. (2017). Digital Coaching to Build Sustainable Wellness Routines for Young Elderly. In *The 30th Bled eConference "Digital Transformation – From Connecting Things to Transforming Our Lives"* Research Volume, 18.-21.6.2017 (pp. 57-70). Bled, Slovenia: University of Maribor.
- Cenfetelli, R. T. (2004). Inhibitors and enablers as dual factor concepts in technology usage. *Journal of the Association for Information Systems*, 5(11-12), 472-492.
- Chamberlin, B., & Maloney, A. (2013). Active video games: Impacts and research. In K. E. Dill (Ed.), *The Oxford handbook of media psychology* (pp. 316-333). New York, NY: Oxford University Press.
- De Schutter, B., & Brown, J. A. (2016). Digital Games as a Source of Enjoyment in Later Life. *Games and Culture*, 11(1-2), 28-52.
- Edvardsson, B., & Strandvik, T. (2000). Is a critical incident critical for a customer relationship?. *Managing Service Quality*, 10(2), 82-91.
- Edvardsson, B., & Roos, I. (2001). Critical incident techniques: Towards a framework for analysing the criticality of critical incidents. *International Journal of Service Industry Management*, 12(3), 251-268.
- Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin*, 51(4), 327-358.
- Gabbott, M., & Hogg, G. (1996). The glory of stories: Using critical incidents to understand service evaluation in the primary healthcare context. *Journal of Marketing Management*, 12(6), 493-503.
- Gogan, J., McLaughlin, M. D., & Thomas, D. (2014). Critical incident technique in the basket. *Proceedings of the 35th International Conference on Information Systems (ICIS) 2014*. AIS.
- Gremler, D. D. (2004). The critical incident technique in service research. *Journal of Service Research*, 7(1), 65-89.
- Grove, S. J., & Fisk, R. P. (1997). The impact of other customers on service experiences: A critical incident examination of "getting along". *Journal of Retailing*, 73(1), 63-85.
- Guest, G., MacQueen, K. M., & Namey, E. E. (2012). *Applied thematic analysis*. Los Angeles, CA: SAGE.
- Gummerus, J., & Pihlström, M. (2011). Context and mobile services' value-in-use. *Journal of Retailing and Consumer Services*, 18(6), 521-533.
- Holloway, B. B., & Beatty, S. E. (2008). Satisfiers and dissatisfiers in the online environment: A critical incident assessment. *Journal of Service Research*, 10(4), 347-364.

- Kajastila, R., Holsti, L., & Hämäläinen, P. (2014). Empowering the exercise: A body-controlled trampoline training game. *International Journal of Computer Science in Sport*, 13(1), 6-23.
- Kajastila, R., & Hämäläinen, P. (2014). Augmented climbing: interacting with projected graphics on a climbing wall. In *Proceedings of the Extended Abstracts of the 32nd Annual ACM Conference on Human Factors in Computing Systems* (pp. 1279-1284). ACM.
- Kappen, D. L., Mirza-Babaei, P., & Nacke, L. E. (2019). Older adults' physical activity and exergames: A systematic review. *International Journal of Human-Computer Interaction*, 35(2), 140-167.
- Kari, T. (2014). Can exergaming promote physical fitness and physical activity?: A systematic review of systematic reviews. *International Journal of Gaming and Computer-Mediated Simulations*, 6(4), 59-77.
- Kari, T. (2016). Pokémon GO 2016: Exploring Situational Contexts of Critical Incidents in Augmented Reality. *Journal of Virtual Worlds Research*, 9(3), 1-12.
- Kari, T., & Makkonen, M. (2014). Explaining the usage intentions of exergames. In *Proceedings of the 35th International Conference on Information Systems* (18 pages). Auckland, New Zealand: AIS.
- Kari, T., Makkonen, M., Moilanen, P., & Frank, L. (2013). The habits of playing and the reasons for not playing exergames: Age differences in Finland. *International Journal on WWW/Internet*, 11(1), 30-42.
- Kari, T. (2017). Exergaming usage: Hedonic and utilitarian aspects. *Jyväskylä studies in computing* 260. (Doctoral dissertation).
- Kari, T., & Rinne, P. (2018). Influence of Digital Coaching on Physical Activity: Motivation and Behaviour of Physically Inactive Individuals. In *Proceedings of the 31st Bled eConference "Digital Transformation – Meeting the Challenges"* (pp. 127-145). Bled, Slovenia: University of Maribor Press.
- Kettunen, E., & Kari, T. (2018). Can Sport and Wellness Technology be My Personal Trainer?: Teenagers and Digital Coaching. In *Proceedings of the 31st Bled eConference "Digital Transformation – Meeting the Challenges"* (pp. 463-476). Bled, Slovenia: University of Maribor press.
- Kinnunen, J., Lilja, P., & Mäyrä, F. (2018). Finnish Player Barometer 2018 [Pelaajabarometri 2018], (Report). Tampere, Finland: University of Tampere.
- Lieberman, D. A., Chamberlin, B., Medina, E., Franklin, B. A., Sanner, B. M., & Vafiadis, D. K. (2011). The power of play: innovations in getting active summit 2011. *Circulation*, 123(21), 2507-2516.
- Liu, D., Li, X., & Santhanam, R. (2013). Digital games and beyond: What happens when players compete. *MIS Quarterly*, 37(1), 111-124.
- Loos, E. (2016). The impact of exergames: A panacea for older adults' wellbeing? Using narrative literature reviews to make sense of exergaming in later life. (Report).
- Loos, E. (2017). Exergaming: Meaningful play for older adults?. In *Proceedings of the International Conference on Human Aspects of IT for the Aged Population* (pp. 254–265). Vancouver, Canada: Springer.
- Maddison, R., Simons, M., Straker, L., Witherspoon, L., Palmeira, A., & Thin, A. (2013). Active video games: An opportunity for enhanced learning and positive health effects?. *Cognitive Technology*, 18(1), 6-13.
- Meuter, M. L., Ostrom, A. L., Roundtree, R. I., & Bitner, M. J. (2000). Self-service technologies: understanding customer satisfaction with technology-based service

- encounters. *Journal of Marketing*, 64(3), 50-64.
- Mueller, F., Khot, R. A., Gerling, K., & Mandryk, R. (2016). Exertion Games. *Foundations and Trends in Human-Computer Interaction*, 10(1), 1–84.
- Myers, M. D. (2013). *Qualitative research in business and management* (2nd edition). Los Angeles, CA: SAGE.
- Nguyen, T. T. H., Ishmatova, D., Tapanainen, T., Liukkonen, T. N., Katajapuu, N., Makila, T., & Luimula, M. (2017). Impact of serious games on health and well-being of elderly: a systematic review. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 3695-3704). Hawaii.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd edition). Thousand Oaks, CA: SAGE.
- Payne, A., Storbacka, K., & Frow, P. (2008). Managing the co-creation of value. *Journal of the Academy of Marketing Science*, 36(1), 83-96.
- Pearce, C. (2008). The Truth About Baby Boomer Gamers: A Study of Over-Forty Computer Game Players. *Games and Culture*, 3(2), 142-174.
- Pyae, A., Raitoharju, R., Luimula, M., Pitkäkangas, P., & Smed, J. (2016). Serious games and active healthy ageing: a pilot usability testing of existing games. *International Journal of Networking and Virtual Organisations*, 16(1), 103-120.
- Saint-Maurice, P. F., Coughlan, D., Kelly, S. P., Keadle, S. K., Cook, M. B., Carlson, S. A., ... & Matthews, C. E. (2019). Association of Leisure-Time Physical Activity Across the Adult Life Course With All-Cause and Cause-Specific Mortality. *JAMA network open*, 2(3), e190355-e190355.
- Salo, M., & Frank, L. (2017). User behaviors after critical mobile application incidents: The relationship with situational context. *Information Systems Journal*, 27(1), 5–30.
- Salo, M., Olsson, T., Makkonen, M., Hautamäki, A., & Frank, L. (2013). Consumer value of camera-based mobile interaction with the real world. *Pervasive and Mobile Computing*, 9(2), 258-268.
- Valo Motion. (2019a). ValoClimb. Retrieved 14.3.2019 from <https://valomotion.com/valoclimb/>
- Valo Motion. (2019b). ValoJump. Retrieved 14.3.2019 from <https://valomotion.com/valojump/>
- Zero Latency. (2019). Retrieved 14.3.2019 from <https://zerolatencyvr.com/>