

Designing Video Games for Older Adults and Caregivers

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### Abstract

Providing care for older adults is a challenging task, particularly when close family members are involved: instead of spending quality time with the other person, caregiving relationships often focus on daily needs of the older adult, leaving little room for persons to communicate outside the caregiving context. In this paper, we examine the design of interactive technologies to support caregiving relationships through play. We present an exploratory study where ten caregiving dyads played cooperative motion-based video games, and follow up with two case studies to analyze how video game play affects older adults and family caregivers. Our results show that playing games generally represents an enjoyable activity for older adults and caregivers that can be integrated into the caregiving context. Based on our findings, we highlight design opportunities, and outline core challenges that need to be addressed to design accessible games that provide positive shared experiences for a wide range of caregiving dyads.

*Keywords:* Caregiving, games, older adults, relationships.

### Designing Video Games for Older Adults and Caregivers

Older adults who experience increasing levels of age-related changes and impairments often struggle to take care of their daily needs, and may at some point have to rely on others for care. Often, close relatives are involved in providing in-home care for older adult family members (Johnson and Wiener, 2013), causing a shift from a usually reciprocal relationship to asymmetry. This creates challenges for both members of this caregiving dyad: older adults have to adapt to depending on others to take care of personal needs, and this affects the way they perceive themselves (Lindley et al., 2008). At the same time, caregivers often struggle with a lack of personal freedom as the result of spending significant time towards caring for their family member. These challenges often put stress on the relationship, which can lead to fragility and isolation in the dyad. These negative outcomes then put further pressure on the emotional and physical well-being of older adults and caregivers, weakening, rather than strengthening their relationship over time (Fried et al., 2005; Yamashita et al., 2013).

To improve the situation of caregiving dyads, human-computer interaction researchers have designed interventions that facilitate the caregiving process. Current work aims to provide support for the tasks of caregiving (e.g., reducing caregiver burden through applications that enable caregivers to communicate with healthcare professionals (Liu et al., 2011)), or to assist older adults to live independently (e.g., applications to help them keep track of medication (Khan et al., 2010)). Although relieving the burden of the caregiver is essential for managing the caregiving relationship, the potential of interactive technologies to address the quality of the relationship in a caregiving dyad has been largely unexplored. Alongside the need to facilitate the giving and receiving of care, interactive technologies have the potential to support relationships by creating experiences that foster affection and closeness (Townsend and Franks, 1995).

In our work, we explore the potential of motion-based video games to connect persons in caregiving relationships. It has been shown that these games have a positive impact on the emotional well-being of older adults (Jung et al., 2009), and that their physical dimension may be leveraged to increase the satisfaction of relatedness (Hassenzahl et al., 2012), and they offer the opportunity of contributing to the relationship between players by fostering social interaction through play (De Kort and IJsselsteijn, 2009). In addition, games have been shown to be a way of importing affect through experienced competence in a risk-free environment (Ryan et al., 2006),

and provide an enjoyable activity for players to focus on, thus binding the players' attention and cognition, leaving few resources to ruminate on the cares and worries of daily life (Knoblock-Westerwick, 2006).

We apply principles from casual and intergenerational game design as well as a set of considerations specifically addressing the needs of caregiving dyads to create two multiplayer games suited for older adults and caregivers. Results of an exploratory study where ten dyads played our games and a detailed analysis of the experience of two dyads show that caregiving dyads enjoy playing games, but that special dynamics of the relationship require careful design considerations. Our work makes three contributions: (1) We provide a first example of how interactive technologies can be applied to engage caregiving dyads in joint activity. (2) We show that motion-based games have the potential of fostering communication between older adults and caregivers. (3) We identify challenges and opportunities in game design for the caregiving context, and outline strategies to support designers wishing to create games for caregivers and older adults.

Connecting caregiving dyads through shared experiences is an important step toward increasing the emotional and physical well-being of older adults and caregivers. Interactive interventions such as video games that connect people have the potential of supporting this goal by providing a joint leisure activity, fostering the development of positive relationships through communication and shared experiences, and may contribute to the quality of life of older adults and caregivers.

### **Literature Review**

In this section, we outline the importance of meaningful relationships in caregiving, and show how interactive technologies have been applied to support this goal.

#### **Relatedness and Caregiving**

Baumeister and Leary (1995) define the *need to belong* or *relatedness* as a “need to form and maintain at least a minimum quantity of interpersonal relationships”, and they identify two main aspects that help fulfill that need: people require repeated interaction with the same person to develop a relationship; that relationship can only be meaningful if both people care about the other. Literature reports various negative effects of a lack of meaningful relationships, ranging

from decreased emotional well-being to negative effects on health (Uchino et al., 1996). In their work, Baumeister and Leary (1995) provide a detailed discussion of potential consequences of the deprivation of meaningful relationships on the individual. In caregiving, two situations can potentially bring up this issue. First, age-related changes may limit older adults' opportunities of social participation. Second, if people with a previously established bond of caring become involved in caregiving – e.g., if an adult child takes care of their elderly parent – the act of caring may take up time that was once reserved for social interaction (Fried et al., 2005), reducing the relationship to its practical aspects. Additionally, the shift from reciprocal relationships to asymmetry in late life influences the way older adults perceive themselves, having a negative impact on their emotional well-being (Lindley et al., 2008). In this context, fulfilling the *need to belong* can contribute to well-being of the older adult and increase the overall quality of care.

### **Technology to Support Relationships**

Interactive technologies have previously been applied to increase *relatedness* among different groups, e.g., persons in romantic relationships, among families, and close friends. Much work in this field has focused on intimate relationships. In a 2012 review, Hassenzahl et al. (2012) examined 143 artifacts designed to support romantic relationships. Examples of technologies to support romantic relationships are applications such as Hug over a Distance by Vetere et al. (2005) that aims to facilitate physical intimacy over a distance, or the application of video chat to connect persons in long-distance relationships (Neustaedter and Greenberg, 2012). Additionally, research exploring the potential of technology to support relationships has increasingly started to focus on connecting families. Research by Kirk et al. (2010) suggests that families apply video chat to connect to members in remote locations; Forghani et al. (2013) discuss how the technology is applied to connect grandparents and grandchildren. Along these lines, Davis et al. (2007) present Virtual Box, an application to connect children and grandparents in play to help mediate family intimacy, highlighting the potential of engaging persons in playful interaction.

### **Interactive Technologies in Caregiving**

*Interactive technologies for caregivers or patients.* Various technologies have been designed to support the caregiving process. Chen et al. (2012) review main challenges that need to be addressed to reduce caregiver burden, and identify the design opportunities of applications

that support caregivers that help cope with emotional stress and management of caregiving as core design opportunities. In this context, Yamashita et al. (2013) highlight the importance of social networks, and Liu et al. (2011) show that mobile technologies can help connect caregivers with other family members and healthcare professionals to facilitate caregiving, and applications have been developed to help caregivers manage the caregiving process, e.g., task scheduling (Lee and Dey, 2011). Likewise, research has addressed supporting the needs of patients, e.g., by providing applications to help older adults keep track of medication (Khan et al., 2010). There has also been significant work done to facilitate older adults' 'aging in place' – an area related to caregiving. Benefield and Beck (2007) suggest the implementation of different technologies to facilitate aging in place, e.g., allowing family caregivers to remotely monitor the health status of the older adult patient, whereas the Aware Home Initiative at Georgia Tech (Kientz et al., 2008) focuses on supporting the needs of older adults aging in place and the peace of mind of their family members. For the most part, current approaches integrating technology in caregiving aim to resolve practical problems (e.g., scheduling and monitoring) rather than focusing on the emotional well-being of individuals involved in caregiving.

*Games for health.* Games for Health are an area of game design concerned with the development of video games to increase the physical and emotional well-being of players. Initial design efforts have been made to facilitate the caregiving process through video games. Patel and Salata (2006) applied video games to improve communication between children with dysarthria and their caregivers by increasing the verbal abilities of patients through play. Gerling et al. (2011) showed that caregivers of children with cancer regarded video games as a means of initiating communications between patients, parents, and medical staff, a factor that is crucial to increase social support for patients (Lieberman, 2001). However, none of these games directly connect patients and caregivers through play; in all cases, patients engage with the game and benefits are expected to carry over into the relationship with their caregivers.

Despite these design efforts addressing the challenges of caregiving from different perspectives, no applications are available that specifically address the idea of directly connecting patients and caregivers. In our work, we investigate whether interactive technologies can be applied to support older adult-caregiver relationships. We believe that connecting older adults and caregivers through video games can have a positive impact on relationships by leveraging the

fact that play often is symmetrical and reciprocal (Lindley et al., 2008). This would allow caregiving dyads to have joint experiences on common ground, and could help family caregivers and older adults engage in a new shared activity.

### **Designing Video Games for Caregiving Dyads**

In this section, we present the design rationale for our two motion-based games *Prairie Hunter* and *Candy Kids*. Furthermore, we present design probes and discuss how different caregiving dyads engage in play, and how the characteristics of each dyad influence their experience playing our games.

#### **Design Rationale**

To adapt our games to the needs of older adults, caregivers, and the caregiving context, we built on prior work addressing casual game design and intergenerational play.

#### **Existing Design Guidelines**

Research on casual exergames (Gao and Mandryk, 2012) and casual games for health (Gerling et al., 2012) has shown that simplistic, easily accessible game concepts are particularly suited for audiences with little gaming experience and in gaming situations where players cannot engage with games over a longer period of time, aspects that are also relevant in a caregiving context. This goes along with considerations for the design of motion-based games for older adults (Gerling et al., 2012), highlighting the importance of accounting for age-related changes. Additionally, caregiving often involves cross-generational dyads, e.g., if adults care for older adult parents. Work in the field of intergenerational play has shown that video games are a means of creating common ground in asymmetrical relationships (Lindley et al., 2008), and can connect people across generations (Volda and Greenberg, 2009). Furthermore, Vanden Abeele and De Schutter (2010) outline the importance of creating games that relate to experiences from daily life, and recommend the integration of competition in games to foster social interaction. Likewise, Rice et al. (2013) suggest that intergenerational play can support interaction between different groups of players, and they highlight that moderate physical effort yields additional health benefits for players. Furthermore, we aim to integrate design considerations for technologies to increase relatedness that were identified by Hassenzahl et al. (2012). Their work suggests that the integration of physicality as well as joint actions can increase relatedness. Both

aspects are inherent to cooperative motion-based game play. Thereby, we aim to provide an opportunity for shared activity to facilitate social interaction between older adults and caregivers.

### **Challenges Specific to Caregiving Dyads**

The special nature of the caregiving relationship in late life poses unique design challenges. In this section, we identify three core challenges that need to be addressed when designing video games for the caregiving context.

*Challenge 1: Supporting a wide range of caregiving dyads.* Research on motion-based games for older adults shows that older adults in long-term care are a heterogeneous target audience, and that it is important to accommodate a wide range of physical and cognitive abilities (Gerling et al., 2012). Additionally, a challenge specific to game design to connect caregivers and older adults is the likelihood of the composition of the caregiving dyad influencing game interaction: when younger caregivers (e.g., adult children) are involved, they can be expected to have prior computer experience. In contrast, in dyads where members do not have extensive computer and/or gaming experience (e.g., if spouses are involved in caregiving), we expect it to be more difficult for dyads to gain access to video games. Particularly when designing for caregiving dyads with limited technology literacy, or dyads where one member has extensive prior gaming experience, *creating enjoyable games that offer an adequate level of challenge* is important. Besides offering tutorials and other supportive materials (Gerling et al., 2012), striking the right balance between challenge and player skills for players of different ability and experience is crucial.

*Challenge 2: Preventing the caregiving relationship from being affected by poor playing performances.* Research on player balancing in multiplayer exergames has demonstrated that poor player performance can have an impact on self-esteem and the relationship between players (Gerling et al., 2014). This is a challenge for motion-based video games for the caregiving context as negative emotions associated with poor playing performances could carry over into the caregiving relationship; particularly affecting older adult players who are more likely to experience gameplay problems due to the impact of age-related changes and impairments. To overcome this challenge, designers have to *move the player focus from individual in-game performances to the joint experience*. In terms of game design, this could be accomplished by putting a bigger emphasis on joint efforts, e.g., by rewarding joint actions rather than the result of



one single player action. Furthermore, individual player scores should be avoided and integrated into team scores to emphasize the importance of the performance of the caregiving dyad.

*Challenge 3: Facilitate shared ownership of games to avoid reinforcement of existing roles.* To avoid the reinforcement of existing roles within the caregiving dyad (e.g., the caregiver being responsible for daily needs of the older adult), it is important for video games for caregiving dyads to *encourage shared ownership*, offering common ground for older adults and caregivers, and creating a space where older adults can actively contribute to the success of the dyad. This can be accomplished in two ways. First, in-game skill balancing can be applied to assist weaker players. Second, games can be designed to build on the strengths of older adults, allowing them to be independent players and offering them the opportunity of assisting their caregivers. This can either be done by integrating challenges that appeal to their age group (e.g., specifically integrating game content that relates to their past), or by offering asymmetric player roles to allow older adults to choose an interaction paradigm and/or in-game role that suits their needs. Applying both strategies would allow older adults to make an independent contribution to the game, potentially increasing their confidence in their abilities of participating in the game.

### **Game Concepts**

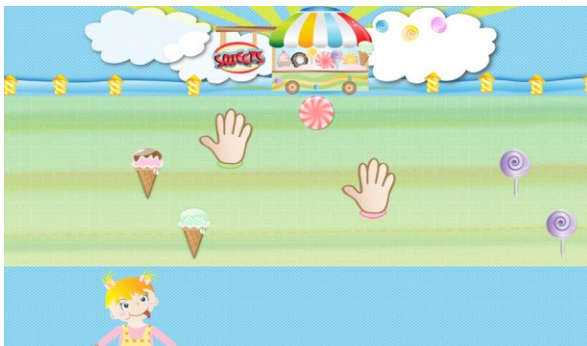
Based on these considerations, we developed *Candy Kids* and *Prairie Hunter*, two motion-based casual games that provide easily accessible game controls, simple game mechanics, and short chunks of play. In *Candy Kids*, players collaborate to feed a child different types of candy and vegetables: items moves across the upper area of the screen and can be fed to the child by moving both player avatars (represented by virtual hands) overtop of the food at the same time. Challenge is created by switching the location of the child, and by including items of different value.

*Prairie Hunter* allows players to support each other when hunting wild animals. In order to increase their score, they have to hunt as many animals as possible. This is achieved by moving the avatar (represented by a crosshair and controlled by one player) overtop of the animal. Once the avatar is in the right position, the other player has to perform a pushing gesture to fire the gun. Challenge is created as animals appear in different locations and at different times: bigger animals result in a greater score, but they appear less frequently, while smaller animals appear repeatedly for a short time. Both games are played using the Microsoft Kinect.

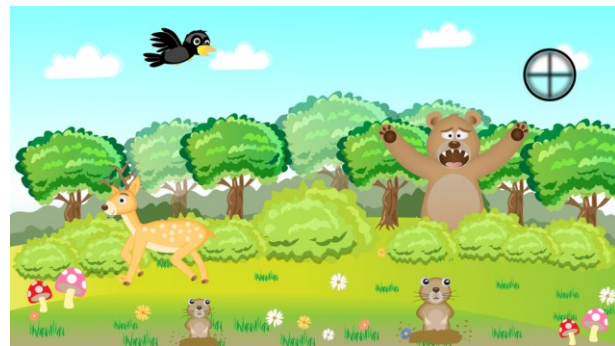
Our implementation invites players to use their strong hand to perform gestures and pointing actions to control the avatar.

Both games pick up topics that we expect players to be familiar with to facilitate older adults' entry into play; furthermore, the games encourage joint interaction and rate player success based on collaborative goals. To further explore how older adults and caregivers interact with motion based games, we implemented different interaction paradigms: although both games are cooperative, *Candy Kids* requires symmetric input (both players perform the same action – moving their hand overtop candy), whereas *Prairie Hunter* is asymmetric (players have different roles – one player aims, the other player controls the trigger).

The games were implemented in C# using Microsoft XNA Game Studio 4.0, and use Microsoft Kinect to track user input inviting players to use their strong hand to perform gestures.



**Figure 1. Candy Kids.**



**Figure 2. Prairie Hunter.**

### **Exploring How Caregiving Dyads Engage in Play**

In this part of our work, we explore how caregiving dyads approach *Candy Kids* and *Prairie Hunter* through case studies with a focus on how different characteristics of caregivers and older adults influence the way they engage in play.

### **Participants and Procedure**

Ten pairs of caregivers and older adults participated in the evaluation. All caregiving dyads included older adults and a family caregiver (e.g., adult daughter or son, or a spouse). The average age of older adults (7 female, 3 male) was 81.50 (SD=6.36); caregivers (8 female, 2 male) had an average age of 58.70 (SD=10.89). Only one older adult had prior computer experience (that person had also played video games before); all caregivers had used a computer, and three of them were familiar with video games. Regarding age-related changes and

impairments, four older adults reported age-related mobility impairments that restricted their independence, and one participant was diagnosed with dementia. None of the older adults lived in residential care; six older adults lived in their own apartment and were visited regularly (at least two times per week) by their caregiver. Four participants reported that they lived with their caregiver. We assessed caregiver burden using the Caregiver Burden Scale (Montgomery et al., 1985). Results show that objective caregiver burden was within a normal range (average score: 19; scores above 23 are considered high).

The case studies were carried out in the home of the older adult to allow participants to remain in a familiar environment. At the beginning, written consent (caregivers) and oral assent (older adults) was obtained. To better understand the background of the dyads, participants were asked to provide demographic information including questions about their relationship with the other person. Additionally, caregivers answered a questionnaire on caregiver burden (Montgomery et al., 1985). Participants then received an introduction to the games and played two rounds using each of them. Afterwards, they answered a questionnaire on their player experience (PX) (Rice et al., 2013) that examines joint video game play on the dimensions *Cooperation, Communication, Partner Preference, Ease of Use, and Competence*. The questionnaire consists of 22 statements (e.g., “*It was difficult to communicate with my partner*”, “*I was good at playing the game*”) which are rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Additionally, caregiving dyads participated in a structured interview that further explored their perceptions of motion-based games as a shared activity. Each session lasted about 90 minutes.

### **Quantitative Results**

Between-group comparisons for player experience were made using one-way ANOVA. Pre- and post-play affect were compared using Wilcoxon Signed Rank Test. Qualitative data was coded with a focus on the research questions.

*Are motion-based games accessible and usable for caregiving dyads?* Our results show that both games were playable by caregiving dyads. On average, caregiving dyads scored 30.44 points (SD=15.97) in *Prairie Hunter*, and 11.71 points (SD=10.88) in *Candy Kids*; large standard deviations outline performance differences between dyads. Questionnaire results for PX metrics for ease of use (Figure 3) show that both older adults and caregivers found the game usable and

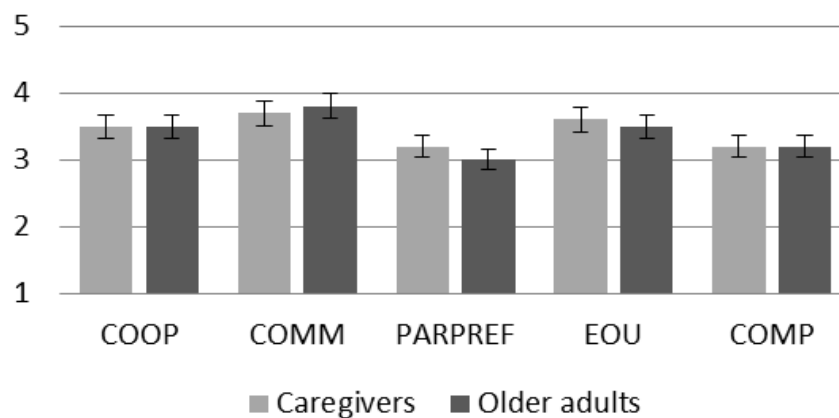
accessible. A one-sample t-test showed that the ratings for ease of use were significantly higher than neutral ( $t_{17}=3.5$ ,  $p=.003$ ). We also found no significant differences in the ease of use ratings between groups (older adults and caregivers) ( $F_{1,16}=0.03$ ,  $p=.866$ ). In addition, both older adults and their caregivers expressed their competence with the game and we did not find any difference between the groups ( $M_{OA}=3.16$ ,  $SD_{OA}=0.55$ ;  $M_{CG}=3.18$ ,  $SD_{CG}=0.70$ ;  $F_{1,18}=0.01$ ,  $p=.944$ ). These results show that the games were generally accessible to caregivers and older adults.

Observations during gameplay back up these findings and provide a greater insight into how caregiving dyads approached our games. Generally, caregivers had a higher level of computer and video game experience and were more comfortable with the idea of playing video games. Often, this caused caregivers to take the lead during the first moments of play, and instruct the older adult on how to complete in-game challenges. Except for one caregiving dyad, this behaviour diminished as the gaming session progressed. Generally, caregivers with gaming experience seemed to be more enthusiastic about playing games with their loved one, and needed less help when learning how to play. Observations and quotes show that caregiving dyads consisting of two older adults (e.g., if the caregiver was a spouse) found it more difficult to learn how to play the games, e.g., “*we are too old to learn this*” (caregiver, D5). Despite these comments on a lack of experience, ratings for ease of use and competence suggest that older adults were generally able to play the games with motion-based input.

*How do caregiving dyads feel about playing motion-based games together?*

Questionnaire results for PX show that caregiving dyads generally had a positive experience, and that they collaborated well. Ratings for both cooperation and communication were significantly higher than neutral (Coop:  $t_{17}=2.4$ ,  $p=.027$ ; Comm:  $t_{18}=4.0$ ,  $p=.001$ ). This is backed by interview results showing that both members of the dyad generally enjoyed playing motion-based games with the other person, stating that “*playing games is a great joint activity*” (older adult, D3) and that “*it is nice to be able to play together*” (caregiver, D2). There were no significant differences in the ratings between the groups (Cooperation:  $F_{(1,16)}=0.04$ ,  $p=0.848$ ; Communication:  $F_{(1,17)}=0.02$ ,  $p=0.895$ , Partner Preference:  $F_{(1,16)}=0.25$ ,  $p=0.626$ ), suggesting that older adults and caregivers had similar experiences. In some cases, interviews revealed comments regarding partner preference that had a negative connotation, e.g., “*my partner \*tried\* their best*” (caregiver, D5).

When questioned about the value of joint video game play, nine out of the ten caregiving dyads highlighted that they were able to help each other in the games, and that they felt that the other person contributed to their success. In contrast, one dyad outlined that they did not enjoy playing games together (D5; caregiver was unhappy with his partner's contribution), and that their engagement with our games confirmed this perception. The physical dimension of the games was perceived as a means of providing mental and physical stimulation; as one participant highlighted, “*you spend time together, you get a little bit of exercise, [and] you can train your hand-eye coordination*” (older adult, D3). Additionally, observations show that the physicality of the games caused caregiving dyads to coordinate their actions (e.g., instructing the other person where to place their hand), and sometimes led to affectionate touch where one player would gently squeeze another player's hand or arm during the course of the game, or hug the other person after finishing a round of playing. Finally, participants commented on the potential of the games to initiate discussions, with one dyad stating that “*games are good to foster communication*” (caregiver, D2) and can help “*bring up memories*” (older adult, D2).



**Figure 3. Player experience results (COOP = Cooperation, COMM = Communication, PARPREF = partner preference, EOU = Ease of Use, COMP = Competence). Results were provided on a 5-point Likert scale (higher = better; CI=5%).**

When interpreting these results, two main areas should be discussed regarding their potential of supporting caregiving relationships: (1) The application of games to foster communication between older adults and caregivers, and (2) potential benefits of joint interaction with a physical dimension. However, the results also suggest challenging aspects in the sense that

the experience of playing video games greatly differed for individual caregiving dyads (e.g., results regarding partner preference, Figure 3 and Figure 4). In this context, it is important to acknowledge design requirements that emerge from the individual characteristics of caregiving dyads; for the successful deployment of games, it is not only important to create positive experiences for the majority of dyads, but also to ensure that shared video game play does not harm individual relationships.

### **Qualitative Inquiry: Case Studies**

In this section, we analyze the individual experiences of two caregiving dyads with different backgrounds to expose factors that may either hinder or facilitate the perception of shared video game play as a positive experience.

#### **Emma and Andrew: Effects of Cognitive Impairments on Joint Play**

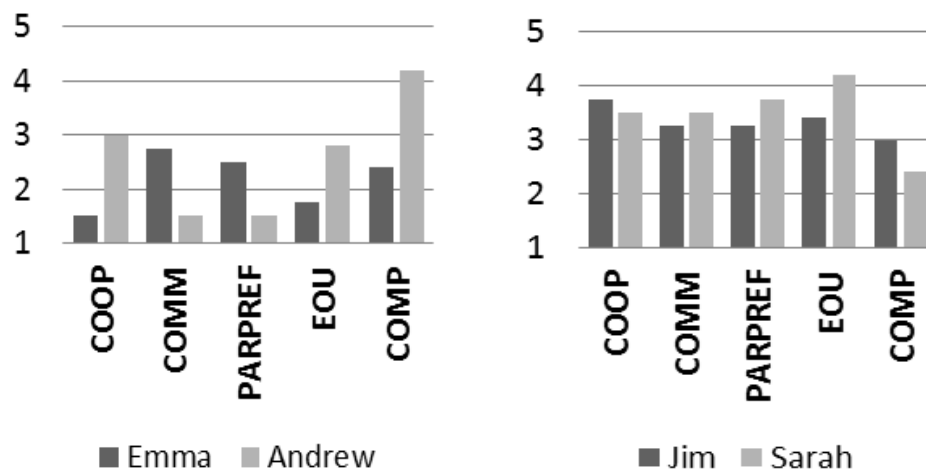
Emma and Andrew (both 83 years old) are married and have lived together for almost 60 years. Before retiring, Andrew worked an office job with managerial responsibilities; Emma was a housewife and took care of their children. Recently, Emma was diagnosed with early stage dementia, which increasingly limits her independence. While she still takes care of some of the household chores, Andrew faces the growing responsibility of organizing her daily life; however, when questioned about caregiver burden, he reported low objective burden (score: 14) suggesting that his personal life is not severely affected by caring for his wife. Regarding joint leisure activities, Emma and Andrew report traveling together, as well as reading and listening to music, but do not play card- or board games regularly. Additionally, they do not have extensive experience using computers, and they have never played video games before.

*Playing video games as shared leisure activity.* Since Emma and Andrew had not played video games before, we were interested in how they approached our games, and whether Emma's cognitive abilities would influence their experience. Generally, our observations show that Andrew found quick access to the games, whereas Emma found the concept of motion-based game interaction difficult to understand. While playing our games, she was continuously instructed by Andrew, who was very focused on success. Instead of addressing Emma's needs (e.g., answering her questions about the goal of the game), we observed that Andrew tried to push her to simply complete actions required for them to be successful within the game. Over the course of the games, comments show that Andrew got increasingly frustrated with Emma,

exclaiming that there was “*no point in trying this with you [Emma]*” after she had repeatedly asked similar questions about the game. When asked about the contribution of his partner in the follow-up interview, he reflected on their score and pointed out that Emma “*tried her best*”, but that her help was “*not enough to be successful*”. In contrast, Emma pointed out that she appreciated Andrew’s help, and that she thought they worked well together as a team. This is also reflected by their questionnaire responses investigating game experience (Figure 4, left).

Regarding synchronous and asynchronous input, Emma stated that she found it easier to play Candy Kids (using synchronous input), because it allowed her to imitate Andrew’s actions.

Regarding their general perception of joint motion-based play, Emma and Andrew agreed that “*it is positive to work together*”, but that they do not consider playing video games an interesting leisure activity.



**Figure 4. Player experience results for Emma and Andrew (left) and Jim and Sarah (right). COOP = Cooperation, COMM = Communication, PARPREF = partner preference, EOU = Ease of Use, COMP = Competence. Results were provided on a 5-point Likert scale (higher = better).**

*The impact of their individual characteristics on their gaming experience.* Emma and Andrew are an example of an older adult-older adult caregiving dyad where one member experiences cognitive impairments, and the spouse is transitioning into the role of the caregiver. This comes with a set of unique challenges (e.g., the loss of reciprocity in a formerly symmetric relationship) that influenced the way Emma and Andrew experienced joint motion-based play:

while the games were generally accessible to Andrew, our results show that additional considerations are necessary to allow persons with Emma's background to engage in play, which includes designing games in a way that would give the caregiver enough space to help their family member accomplish in-game goals while still being able to succeed in the game on a personal level.

### **Jim and Sarah: Connecting Gamers Through Shared Motion-Based Play**

Jim (80 years old) was diagnosed with polyneuropathy, a condition that affects the nervous system and has a negative impact on his mobility. He experiences problems walking and relies on a walker as a mobility aid. Before retiring, he worked as firefighter. His daughter, Sarah (50 years old), is a professional caregiver and assists Jim in his daily life, taking care of many household chores (e.g., laundry and grocery shopping). They do not share the same home, but see each other multiple times a day; Sarah gradually transitioned into the role of Jim's caregiver after his wife died three years ago. Interview results show that Jim is thankful for his daughter's help, and that Sarah appreciates being able to support her father. Both of them have previous experience using computers and playing video games, with Jim being an avid gamer pointing out that he "*plays video games every morning after breakfast*". They play card and board games with friends and family, and they have also played movement-based games such as Wii Sports Bowling.

*Playing video games as shared leisure activity.* Observations showed that Jim and Sarah could build on previous experience when approaching our games, and quickly developed an encouraging, reciprocal approach to play where both players occasionally instructed the other person and gave feedback on their performance. Sarah pointed out that she "*dominated in the beginning but he [Jim] quickly figured out how to play*". In this context, observations showed that Sarah was patient and gave Jim room to learn how to play our games. Regarding joint play, Jim pointed out that "*[...] it wasn't bad at all to be able to help Sarah [...]*" and that he enjoyed working together with his daughter, stating that he would like one of his friends to try the games with him. They generally found the asymmetric interaction in Prairie Hunter more interesting, but pointed out that both games were fun to play. When comparing our games to card- and board games they had played before, they pointed out that being able to observe the other person's facial expression was a dimension not included in video games as both players generally focus on



the screen, which they thought might have contributed to their experience. In general, both Jim and Sarah agreed that playing games together was an interesting joint activity where “*everybody had to contribute their share*” (Sarah). This perception is also reflected by their questionnaire results (Figure 4, right), which show very balanced, above-average results for both members of the caregiving dyad on all scales investigating joint play.

*The impact of their individual characteristics on their gaming experience.* Jim and Sarah are an example of a daughter-father caregiving dyad where both members have computer experience, and the older adult is enthusiastic about playing video games. Interview results shows that both Jim and Sarah had detailed perception of the games and were able to communicate preferences regarding interaction paradigms and game mechanics. This creates interesting opportunities for game designers wishing to follow a participatory design approach where caregiving dyads with previous gaming experience could provide detailed feedback on game concepts beyond high-level personal preferences and accessibility considerations. However, the experience of Jim and Sarah also shows that it may be necessary to develop more complex, challenging gaming experiences to keep caregiving dyads with gaming experience engaged over a longer period of time, adding another layer of complexity to the development process as these games may not be suitable for caregiving dyads with lower levels of technology literacy.

### **Comparing the Results**

The differences in the experience of Jim and Sarah and that of Emma and Andrew expose characteristics of caregiving dyads that may contribute to the adoption of games as a positive shared activity. When comparing the case studies, we observed large differences in experience (see different player experience results, Figure 4), and we identified characteristics that might have affected the adoption of games and should be investigated by future work.

*Status and type of the caregiving dyad.* Jim and Sarah are a well-established caregiving dyad with clearly defined roles that are accepted by both members. In contrast, Emma and Andrew are transitioning into caregiving; issues associated with this process (e.g., accepting that a family member can no longer take care of her own needs) may have carried over into their gaming experience. Additionally, Emma and Andrew are a caregiving dyad where a spouse takes care of his partner – a relationship that is usually symmetric and highly reciprocal, which may

further complicate transitioning into caregiving. Along these lines, the differences in age-related changes (cognitive vs. mobility impairments) had a different impact as Jim could easily access our games, whereas the visibility of Emma's cognitive impairments was increased by the gaming situation. In this context, having to approach a new activity (e.g., video games) may reinforce existing issues within the caregiving dyad instead of providing an enjoyable leisure activity.

*Previous gaming experience and player personalities.* In contrast to Emma and Andrew, Jim and Sarah had a positive perception of games, and could build on previous experience playing video games when interacting with our games. This facilitated their access to our games and allowed them to focus on playing games together instead of solely coordinating their own actions. In this context, comments during play showed that Sarah was more concerned with their shared experience than the overall outcome of the game, whereas Andrew was highly ambitious (e.g., commenting on their scores) and therefore perceived Emma's problems in learning how to play the games as hindrance to being successful in the game. In this context, providing combined scores for caregivers and older adults may have been a disadvantage, showing the importance of arriving at a better understanding at how game designers can create enjoyable shared experiences that allow both caregivers and older adults to experience success regardless of their player personalities.

These considerations suggest that research should explore a third area when addressing game design for caregiving dyads: focusing on design challenges that arise from individual characteristics of caregiving dyads (e.g., the nature of the caregiving dyad or previous gaming experience among older adults) is not only an important step toward creating enjoyable games, but also crucial to ensure that shared play does not harm burdened relationships.

### **Discussion**

This paper looks at how motion-based video games can be designed to connect caregivers and older adults. We present design considerations that can be applied to ensure that motion-based games are generally accessible and enjoyable for caregivers and older adults, and we discuss individual characteristics that may influence the shared experience of playing games. In this section, we discuss our findings with a focus on design opportunities and challenges for future work in this area.

### **Shared Play as an Opportunity to Connect Caregiving Dyads**

There are various opportunities for interactive technologies to support relationships. In this section, we outline how our findings regarding video games for caregiving dyads can be leveraged to connect caregiving dyads.

#### **Fostering Communication Through Play**

Games are a potential means of scaffolding conversation among older adults and caregivers. While participants were generally focused on in-game events during gameplay, many dyads reflected upon their gaming session once they finished playing. Interestingly, even participant pairs who did not consider themselves avid video game players trailed off into discussions of other topics related to the games (e.g., one older adult commented on how they would offer their grandchildren candy to make them eat their meals, which initiated more storytelling about the past among older adult and caregiver). This aspect could be leveraged in the context of mini games that can serve as conversation starters between persons in caregiving relationships. Drawing from positive memories of both members of caregiving dyads would be an interesting design opportunity to connect older adults and their caregivers; design efforts in this field could draw from previous work that investigated game topics suitable for older adults (Vanden Abeele and De Schutter, 2010). Additionally, this concept easily extends beyond caregiving for older adults and could be applied for other people in difficult situations as demonstrated by Gerling et al. (2012).

#### **Interaction with a Physical Dimension**

Our study shows that the physical dimension of co-located play connects older adults and caregivers, and findings suggest two aspects of joint interaction that could be leveraged to foster closeness. First, joint interaction naturally encourages verbal coordination; this can serve as a vehicle to connect players through conversation, and giving purpose to communication through the means of in-game challenge. In our study, we observed that discussing how to interact with the game and helping each other often served as an ‘icebreaker’ that allowed both members to get familiar with the game and negotiate their in-game roles. Second, we observed that the physical dimension of the game sometimes led to affectionate touch between players, e.g., one player would gently squeeze another player’s hand or arm during the course of the game, actions which may further contribute to increased levels of relatedness between players. This aspect could be

strengthened through interaction design: while our games only required joint interaction within the game (e.g., connecting avatars in the game), a carefully designed physical dimension – e.g., using player proximity as input, or encouraging players to join or clap hands – might be an interesting means of fostering closeness.

### **Risks and Challenges of Shared Play Within Burdened Relationships**

Our work exposes risks and challenges that need to be addressed when engaging caregiving dyads in shared motion-based video game play. Our analysis of two case studies – the experiences of Emma and Andrew as well as Jim and Sarah – shows that both status and type of the caregiving dyad as well as their general approach to video games greatly influences the perception of games as a shared experience. Particularly when looking at the experience of Emma and Andrew, it becomes clear that further design considerations are necessary to avoid games harming caregiving dyads by reinforcing existing challenges within the caregiving relationship. In this context, it is important to recognize the vulnerability of caregivers: our initial design considerations strongly focused on the needs of the older adult to ensure their access to our games. However, results of the case studies suggest that shared activities may also burden the caregiver if they expose the impact of age-related changes on the older adult, e.g., if shared in-game goals put pressure on the caregiver and faces them with the conflict of consolidating their own ambitions within the game with their task of supporting their loved one. Therefore, future work should explore ways of mitigating the risk of increasing the vulnerability of caregiving dyads through shared play, and provide recommendations that can help inform the work of designers wishing to create video games for caregivers and older adults experiencing high levels of age-related changes, burden and stress – dyads that could benefit the most from enjoyable shared leisure activities.

### **Limitations**

Our results show that motion-based games are generally accessible for caregiving dyads and that they enjoy shared play; however, there are certain limitations that need to be discussed. On a general level, caregiving is a sensitive topic: some dyads seemed to be afraid of giving off a wrong impression, or hurting the other person with their statements. We observed that older adults and caregivers in our study would seek affirmation of the other person on answers regarding their relationship. Also, some caregivers tried to influence the way older adults

responded to questions. The setup of our study – inviting caregivers and older adults to participate at the same time in their own homes – was not ideal, and future work investigating this topic should consider interviewing caregivers and older adults separately. Additionally, future work should investigate long-term effects of video games on caregiving dyad; while the work presented in this paper provides first insights into challenges and opportunities, it is important to understand how repeated video game play affects caregivers and older adults, and whether positive effects of games prevail over a longer period of time.

### **Conclusion**

Caregiving for older adult family members is a challenging task that changes the nature of relationships, and may expose the caregiving dyad to high levels of stress. Our work is a first step towards the application of interactive technologies to directly connect caregivers and older adults instead of focusing on one member of the caregiving dyad, and it exposes both design opportunities as well as challenges that need to be addressed by researchers and designers. Our findings highlight that caregivers and older adults enjoy engaging with motion-based video games as a shared activity, and that games encourage communication, potentially fostering closeness within the caregiving dyad. This highlights the potential of video games to support positive relationships among caregiving dyads: integrating interactive technologies into the caregiving process may not only provide an enjoyable leisure activity for caregiving dyads, but also offer a novel way of promoting positive relationships in difficult situations, thereby contributing to the quality of life of older adults and caregivers.

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