Chapter 10
Technology and Fun for a Happy Old Age

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10.1 Introduction

The past 20 years have seen a rise in the development and production of technologies to support older people. These have typically focused on issues related to safety and security and to reduce the risk of hospitalization (e.g., fall detection devices). Despite their undoubted importance, it could be argued that these aspects of aging have received more attention than is warranted and as a consequence have unduly influenced the direction of technology development for the aging population. While much less attention has been paid to technology to support people to live well and experience the things that make life worth living, the evidence that is available suggests that technology can provide people with meaningful and engaging activities that are stimulating, enjoyable, and fun. This chapter provides a brief examination of this evidence for the aging population in general and then considers the application of technology for that sector of the aging population who are living with dementia. The context is provided by positive psychology, an approach to human behavior that seeks to promote the good things in life.

10.2 Positive Psychology

While most people, whatever their age, are concerned with staying safe and well, there is more to life than safety and security. In his oft-cited *Hierarchy of Needs*, Maslow (1943) identified meeting our safety needs as an important but very basic human need, second only to satisfying our physical needs such as hunger and thirst.

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However, central to Maslow's theory of human motivation was the belief that humans seek to fulfill higher level, more complex psychological needs, such as the need for satisfying relationships, achievement, and the respect of others. His *positive theory* was predicated on seeing the person as a whole within the environment in which they operate and was primarily concerned with identifying and exploring those drivers of human behavior that go beyond meeting our basic survival needs.

While the resonance and endurance of Maslow's ideas are easy to find in writings and innovation across a wide range of fields in human creativity over the past 70 years, it is more difficult to see his influence in attitudes towards aging and, specifically, in meeting people's needs for a happy and successful later life. This is particularly so in the arena of technology development, which, as indicated above, has tended to emphasize the safety of older people, with developments such as alarm pendants that people wear and should press if they have a fall or the installation of unobtrusive or passive sensors in people's homes to alert external agencies of unusual events and trigger assistance if required. While these can be seen as good-intentioned moves, they focus on only the most basic of human needs, suggesting either (1) a belief that older people do not have the same higher level psychological needs as younger people or (2) that older people do have the same higher level needs but that meeting them is either (a) less important or (b) more difficult than it is for younger people and therefore meeting the basic survival needs of older people should suffice.

The apparent ignorance or dismissal of older people's more complex needs is surprising given the efforts over the past 20 years of the positive psychology movement, which grew from and to a large extent embodies not only Maslow's work but also that of other influential writers on the broad subject of human happiness. Positive psychology is concerned with improving people's lives by nurturing them to thrive and flourish. Positive psychology developed in part as a response to a growing concern that psychology as a discipline was becoming increasingly negative, focusing too much on mental ill health and disorders of human existence (Seligman & Csikszentmihalyi, 2000). While these are a major and growing problem in society, mental disorders do not account for the majority of people's experience for the majority of their lifetime. Indeed, focusing instead on the conditions that promote *good* mental health and well-being should not only encourage people to live happier and more fulfilling lives but also help to prevent the occurrence of mental ill health, which is the goal of positive psychology.

10.3 Positive Psychology and Aging

In 1948 the Preamble to the Constitution of the World Health Organization defined health as "…a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (p. 100), a definition that has remained unchanged. Positive psychology is concerned with the aspects and qualities that promote and provide a positive and meaningful existence—essentially the things

that make life worth living. Concordant with Maslow's (1943) view, positive psychology considers the human experience from the individual to the social group, highlighting the "valued subjective experiences [of] well-being, contentment and satisfaction (in the past); hope and optimism (for the future); and Flow and happiness (in the present)" (Seligman & Csikszentmihalyi, 2000, p. 1). This approach recognizes that people do not exist and operate in isolation and thus the satisfaction of an individual's needs occurs within the social context, acknowledging the importance of interaction and relationships with others in achieving this.

There is no reason to believe that satisfying our human needs for well-being, achievement, hope, etc. lessens as we age. Additionally, there is a strong preventive argument to be made for assisting and supporting people to keep experiencing a meaningful and fulfilling life as they age for the benefits this can bring. In a study of successful aging Vaillant and Mukamal (2001) located older men on a continuum from *happy-well* to *sad-sick* based on their scores in six domains (1) objectively measured physical health (including absence of irreversible physical disability), (2) subjective physical health (completing activities of daily life), (3) length of active life, (4) objective mental health, (5) subjective life satisfaction, and (6) social supports (including relationship satisfaction). The *happy-well*, who scored highly in the six domains of successful aging, lived longer and had fewer years of disability than their counterparts who were judged to be both physically unhealthy and emotionally negative.

The need for interventions that promote positive aging and tackle negative aspects of older people's lives is further supported by the impact of depression. Although the most common mental illness, depression in older people is consistently under-diagnosed and under-treated (Age Concern, 2008), despite its links to increased disability and physical illness (Anderson, 2001). In the UK up to one in four community-dwelling older people—approximately two million people—has symptoms of depression that warrant treatment, with the risk increasing with age from one in five in the 65–69 age group to two in five in the 85+ age group (Anderson, 2001). As well as increasing vulnerability to other conditions in old age, depression can also interfere with the successful treatment of physical illness, as low mood and poor motivation make it difficult for people to engage with any kind of therapy (Salzman, 1995).

There is also a strong link between depression and suicide with figures from the United States, suggesting that older adults are disproportionately likely to die by suicide. In 2007, 14.3 per 100,000 people aged 65 and older died by suicide compared to the national average of 11.3 suicides per 100,000 people in the general population (National Institute of Mental Health, 2007). The figure was significantly higher for non-Hispanic white men age 85 or older at 47 suicide deaths per 100,000. Thus, finding ways and means to promote and support positive aging should be seen as a priority, not a luxury to be attempted only after physical and safety needs have been dealt with.

Technology can potentially assist people, young or old, to live a happy life. Indeed there are whole areas of the leisure technology industry dedicated to this, but the emphasis has tended to be on the younger generations, especially with

developments in gaming and equipment for making, playing, and enjoying music. However, this is arguably the wrong sector to focus on as increasingly the consumers of technology will be the over-50s who have higher disposable income which they are looking to spend either on themselves or their aging relatives (Coughlin, 2010).

With this in mind, what follows is a brief and necessarily selective consideration of technology that has and is being developed and used to support older people to enjoy life. The examples are confined primarily to computer technology in the areas of games and social interaction/communication to give a flavor of what can be done with technology to meet the needs of older people. The information is divided into two sections: the first concerned with the aging population generally and the second relating to meeting the needs of older people with a diagnosis of dementia. Recognizing and responding to the increasing numbers of older people with cognitive impairment presents an additional but growing challenge that must be taken into account not only by designers and developers of future technologies but also by those planning and delivering services for the aging population.

10.4 Flow Experience and Games

What makes gaming enjoyable? Why do some people enjoy computer games and other people enjoy chess, cycling, rock climbing, learning a foreign language, or playing a musical instrument? Essentially these are activities that encourage mastery and achievement and provide an opportunity for people to develop and improve a skill as well as achieving satisfaction and a sense of accomplishment. This fits well with the positive psychology notion of *Flow*, whereby one experiences immersion in an activity for its own sake with the result that one feels a sense of satisfaction and loses track of time (Csikszentmihalyi, 1990).

Csikszentmihalyi (1990) defined a Flow experience as having eight dimensions (Table 10.1), which make it reinforcing and fulfilling and which create a desire for a person to repeat the experience. Among these are clear goals and immediate feedback plus a sense of potential control. For an activity to be self-rewarding and to "…maintain a person's Flow experience, the activity needs to reach a balance between the challenges of the activity, and the abilities of the participant…If the challenge is higher than the ability, the activity becomes overwhelming and generates anxiety. If the challenge is lower than the ability, it provokes boredom" (p. 111).

Essentially, Flow can be seen as defining the conditions for positive, meaningful experience, and playing computer games provides an example of how this can be achieved using technology. This has been embodied in the Presence-Involvement-Flow Framework (Takatalo, Nyman, & Laaksonen, 2008) of game playing, which attempts to characterize the particular elements of games that make them enjoyable and that encourage people to keep playing, including the important balance between ability and challenge.

Table 10.1 Csikszentmihalyi's (1990) eight dimensions of Flow

Dimension
1. We confront tasks we have a chance of completing
2. We must be able to concentrate on what we are doing
3. The task has clear goals
4. The task provides immediate feedback
5. One acts with deep but effortless involvement that removes from awareness the worries and frustrations of everyday life
6. One exercises a sense of control over their actions
7. Concern for the self disappears, yet, paradoxically, the sense of self emerges stronger after the flow experience is over
8. The sense of duration of time is altered

10.5 Aging and Computer Games

If games are fun and playing them can make us happy, are there particular types of games or other considerations that make them more or less appealing to older people? In an early review of the literature, Whitcomb (1990) found that although only a limited number of games had been investigated at that time, it was possible to identify a range of benefits for older people from playing computer games. These included the recreational pleasures of satisfaction and accomplishment which positively influenced people's view of themselves and their abilities. Whitcomb also noted physical and cognitive benefits including enhanced motor skills, such as hand-eye coordination and manual dexterity, increased speed on the games played, plus anecdotal evidence of these skills transferring to other aspects of people's daily lives, such as driving.

Building on these findings, Ijsselsteijn, Nap, de Kort and Poels (2007) identified four potential areas for games to contribute to improving the quality of life for older people. These they characterized as (1) relaxation and entertainment, (2) socializing, (3) sharpening the mind, and (4) more natural ways of interacting. Of these, relaxation can be seen as the enjoyable, rewarding aspects of gaming that are shared by people of all ages. The second and third elements, those concerned with social interaction and cognitive stimulation, are examined further below. The final element proposed by Ijsselsteijn et al. (2007) refers to developments such as the Sony EyeToy and Nintendo Wii™ that allow for more physical ways to engage with computer games, which may encourage people to try physical activity and fitness programs.

10.6 Games and Physical Activity

A current example is Wii Fit, which comprises more than 40 activities such as yoga, strength building, aerobics, and balance games. The system has proven remarkably popular with consumers of all ages although evidence about any potential health

benefits is limited. For example, the aerobic activities were judged insufficient for maintaining target heart rate required for cardiorespiratory fitness in a study of different age groups although participants enjoyed the Wii activities more than walking or jogging on a treadmill (Graves et al., 2010). These findings suggest that presenting interactive exercise and health-related activities on a console has potential for encouraging people to engage with novel activities, even if currently available activities do not confer great health benefits.

This is supported by a case study examining the potential of the Wii Fit balance platform to contribute to rehabilitation of an older person with a history of falls (Pigford & Andrews, 2010). In this study the performance of an 87-year-old lady on balance measures improved through a traditional balance-training program combined with selective and monitored usage of the balance platform. The authors commented on specific benefits of the interactive environment, including presentation of goals and level of challenge, which motivated the player to try again, important factors in the Flow experience.

10.7 Games and Social Interaction

Alongside a potential contribution to physical health, many computer games have an intrinsic social element, being played with one or more other people. In his 1990 review, Whitcomb identified social interaction as the primary benefit that older people gain from playing games. More recent projects, such as Eldergames (Gamberini et al., 2007), have attempted to build on these early findings about the potential for games to benefit older people, coupled with increasing knowledge about neural plasticity and the capacity of the brain to compensate for age-related loss, to use games as a medium for more generally improving older people's quality of life. Using a model of user acceptance based on the theory of Flow, Eldergames examined participants' experience of their novel games table along seven key dimensions including social interaction, playability/immersion, challenge/skills, and clear goals. Participants identified social interaction, defined as the opportunity to create and maintain new relationships, as the biggest benefit in Eldergames, with 66 % endorsing the statement "The most interesting thing has been to share my time with other people while playing" (Gamberini et al., 2009, 167). The social benefits from playing computer games can also be delivered through playing remotely, such as in the Age Invaders' System, which was developed to encourage intergenerational activities online (Khoo, Merritt, & Cheok, 2009). Age Invaders was designed specifically to facilitate intergenerational family entertainment by enabling one or two different generations, for example, grandparents and grandchildren, to play games together while in different locations. This highlights not only the potential for exploiting the Internet for increased engagement and social interaction for older people but also the willingness and interest among the aging population to engage with technology. Older people's interests in technology, and their enthusiasm for adopting it, are significantly influenced by its potential for enhancing or increasing

opportunities for social contacts, putting them in touch with people with similar interests or enabling them to stay in touch with people when face-to-face interactions are not possible, perhaps through distance or illness (Ijsselsteijn et al., 2007).

10.8 Aging and Cognitive Exercise

Alongside the direct personal benefits of engaging in an enjoyable and fulfilling activity, having fun and social interaction, game playing is also becoming increasingly popular for the possible benefits it confers through cognitive stimulation. There is increasing interest in the possibility that game playing can play a preventive role in resisting cognitive decline or even the onset of dementia in the aging population. This has arisen in part as a result of growing evidence that higher levels of cognitive activity may mitigate the impact of neuropathology in the brain. Most of this evidence has come from exploration of the apparent beneficial effects of higher levels/greater years of education on people whose brains are found to contain neuropathological changes at death but in whom there were minimal signs of dementia in life (Brayne et al., 2010). This is explained most readily by the notion of brain *reserve* (Stern, Alexander, Prohovnik, & Mayeux, 1992), whereby although education does not protect against the development of neuropathological changes per se, it does enable people to compensate or overcome the impact of neuronal loss through having greater cognitive reserves to draw on.

Explanations for why education results in this buffer against neuropathology have tended to relate to either biological processes such as synaptic density, whereby greater density will hypothetically be more resistant to the synaptic loss that occurs, for example, in Alzheimer's disease (Katzman, 1993), or functional processes relating to neural networks and improved compensatory activities by those with greater reserves (Stern, 2006). This raises the increasingly important question of whether other activities besides education can influence an individual's cognitive reserve and whether these can be undertaken later in life, with a view to offering some protection against decline in older age.

In a study of 469 older people recruited to the Bronx Study of Aging, Vorghese et al. (2003) found that those who developed dementia over a 21-year period not only had lower education levels, but they also scored significantly lower on scores of current cognitive activity. In this study cognitive activity comprised six activities (reading books or newspapers, writing for pleasure, doing crossword puzzles, playing board games or cards, participating in organized group discussions, and playing musical instruments), which participants carried out with varied frequency from daily to never. One striking finding was that participants "who did crossword puzzles four days a week (four activity-days) had a risk of dementia that was 47 % lower than that among subjects who did puzzles once a week (one activity-day)" (Vorghese et al., 2003, p. 2515). These findings lead the authors to suggest that advising older people to participate in cognitive activities could become as commonplace as recommending them to undertake physical activities to reduce the risk of cardiovascular disease.

Optimism that people can increase their own reserve through cognitive exercises or other stimulating cognitive activities comes from the life course approach to cognitive reserve proposed by Richards and Deary (2005). They argue that while some abilities such as problem-solving and logical thinking (so-called *fluid intelligence*) are particularly vulnerable to neuropathology, our abilities to use skills, knowledge, and experience (*crystallized intelligence*) are not only more resistant to neuropathology but can also be extended in adulthood. Evidence from young people who have grown up playing computer games suggests that the skills they have developed, including shutting out distractions and rapidly switching attention, may equip them to better resist the onset of disorders of aging (Bialystok, 2006). Perhaps engaging in similar gaming activities could confer similar benefits to older people.

10.9 Games and Cognitive Stimulation

In their 2009 review of digital action games, Zelinksi and Reyes identified *far transfer* as a key product of cognitive training for older adults. Pointing to the potential for extended practice training, they linked this to the elements, such as presence, engagement, and other elements of Flow, that make computer game playing a positive and immersive experience. Of particular interest is their dissection of the potential benefits of different types of digital action games for different types of cognitive function (Table 10.2), although they conclude that further research is required to quantify and determine the time frame for delivering these.

One recent development that seeks to take account of and recognize the different needs of young and older players is Age Invaders. As previously described this system, designed for intergenerational game playing, is interesting in that it takes into account both differences in game playing ability due to age and experience and changes in cognitive ability associated with age (Khoo et al., 2009). For example, in

Table 10.2 Hypotheses about abilities improved by different game genres

	Game genre				
Ability	1st-person shooter	3rd-person action-adventure	Strategy	Role playing	Massive multiplayer
Eye-hand coordination	X	X	X	X	X
Memory			X	X	X
Mental rotation	X	X	X		
Reasoning			X	X	
Response speed	X	X			
Supervisory			X	X	X
Visual attention	X	Xa			
Working memory			X	X	X

x = the genre is hypothesized to produce significant improvements in performance; a = improvement expected in platformer games of this genre (Zelinksi & Reyes, 2009, p. 227)

the Space Invaders game, the system allows older players more time to react to rockets fired by younger players. This accommodation may be important for facilitating the continuation of game playing as uneven pairings of a highly skilled and practiced player with a novice may discourage the learner, especially if they lack confidence about using technology.

Game playing also offers the potential for studying cognitive function and assessing changes in players' abilities—both gains and declines. Jimison, Pavel, Bissell, and McKanna (2007) have created a suite of computer games that includes metrics to facilitate detection of change within an individual over time, providing a means of detecting early cognitive decline as well as enabling the system to adapt the user interface to the needs of the individual. While still work in progress, this approach has potential wide-scale application both in terms of detection of cognitive decline and in developing systems that can respond appropriately to user needs, a critical feature for developing novel technologies that can support people to live as well as possible as their needs change.

Thus, playing computer games, whether traditional games such as Solitaire, Scrabble, or chess or newer games developed for dedicated gaming systems, can be seen to provide potential health, social, and cognitive benefits as well as being a rewarding and fulfilling activity for people of any age. Playing games also offers some additional benefits of particular importance to the aging population in being portable, an indoors pastime that mostly does not require a large amount of physical input, thus making it a suitable activity for people with reduced mobility and limited opportunities for activities outside the home, all important when considering the potential contribution of technology to making the lives of older people worth living.

10.10 Other Potential Benefits of Technology

The potential of computer technology to help motivate and support older people to positively manage their lives and make health-related behavior change has been explored in a number of other projects. For example, Jimison and Pavel (2007) reported a new model for delivering computer-based health interventions for older people in their own homes. Their system uses key principles of health behavior change including goals, motivation, and readiness to change, addressed through specific prompts and weekly progress checks with a professional health coach via a computer. The package is tailored to each individual to meet their particular needs and help them set and meet their own goals, with regular encouragement and progress checks from the health coach. The aim is to provide enjoyable activities and the right balance of motivation, support, and encouragement to enable people to exert control over their lives. The same team is currently exploring the potential of using a more immersive interactive video environment for coaching older people in exercises (Pavel, personal communication).

10.11 Technology and Dementia

A growing number of people in the aging population have a diagnosis of dementia. Dementia is an umbrella term applied to the occurrence of progressive and irreversible cognitive decline that causes difficulties carrying out daily activities such as shopping and banking, problems recalling people's names, or difficulties planning and completing journeys. With the passage of time, the difficulties people face with dementia increase to the point where they need significant help and support to manage their daily lives, highlighting a potential role for technology.

Given that the biggest risk factor for developing a dementia is advancing age (Alzheimer's Association, 2010), technology will become increasingly important as the falling birth rate results in fewer caregivers to meet the needs of the increasing numbers of older people we can expect to be living with a dementia diagnosis. As life expectancy increases, the number of people with dementia in the world is predicted to rise from 25 million in 2000 to 63 million by 2030 and to 114 million by 2050 (Alzheimer's Association, 2010). However, dementia is a difficult disorder to deal with, as there is no single cause and no single pattern to the way it affects people. Alzheimer's disease (AD), which accounts for approximately 42 % of cases, is the most common cause although many other people have vascular dementia (23.7 %) and mixed AD and vascular dementia (21.6 %) (Brunnström, Gustafson, Passant, & Englund, 2009). Latest estimates put the current cost of providing care for people with dementia in excess of $601 billion, accounting for 1 % of the world's Gross Domestic Product with an estimated rise of 85 % by 2030 (Wimo & Prince, 2010). This demands an urgent response as the numbers affected by dementia are predicted to keep rising. While the potential of technology to support people with dementia has recently been recognized, as with developments for the rest of the aging population, the bulk of the work to date has fallen almost exclusively into the safety and security category (Astell, 2006). These include the use of automated medication prompts and electronic tagging (Bail, 2003) for people with memory difficulties, some of which raise ethical issues in relation to their application with people with dementia. Even so, it could be argued that there is even greater potential for technology to assist people with dementia to live well than for the rest of the aging population if it is approached with a positive view of enabling people to live a fulfilled and enjoyable life.

10.12 Cognitive Training and Dementia

Outside of safety and security developments, to date only a small number of studies have investigated other applications of technology for people living with dementia. Of these a number have looked at the potential of computers to deliver training either to slow cognitive decline in people with dementia (e.g., Mate-Kole et al., 2007) or enable them to keep carrying out daily activities (e.g., Hofman et al., 2003).

In their study of five females and one male with moderate dementia, aged between 64 and 93 years old, Mate-Kole et al. (2007) examined the impact of a 6-week intervention comprising Mind Aerobics (an interactive group training seminar) combined with Adaptive Computerized Cognitive Training (ACCT), a program of activities targeting a range of cognitive skills including attention, memory and problem-solving that can be modified to the individuals' needs. In this preliminary study, significant improvement is reported in global cognitive function in five of the six participants plus gains in selective remembering for all participants at the end of training. The participants' scores on measures of daily activities also improved, supported by caregiver reports of changes in behaviour including increased awareness of the environment, increased socialization and initiation of interactions. Although small scale, this study suggests that computerized activities have something to offer older people who have a dementia diagnosis, not just in terms of cognitive function but in terms of practical transfer into the rest of their lives.

10.13 Computers and Daily Activities

A number of studies by Hofman and colleagues (Hofman, Hock, Kuller, & Mûller-Spahn, 1996; Hofman, Hock, & Mûller-Spahn, 1996; Hofman et al., 2003) have explicitly examined the potential of computerized training to support people with dementia to continue to carry out everyday tasks of functional relevance such as learning a route (e.g., finding the way to the bakery or to a caregiver's apartment in the same neighbourhood) or shopping for items on a list. In these small studies of four, nine, and ten participants, respectively, the tasks were individualized to the participants, for instance, by using photographs of their real apartment and neighborhood. In all three studies, participants' performance on the trained tasks improved, with evidence of training effects being retained 3 weeks later. This highlights not just the potential but also the importance of supporting people with dementia to continue to carry out daily activities, first by reducing the burden on family and formal caregivers to take over these tasks and second to maintain the skills of people living with dementia, which would be further undermined and potentially lost quicker than needs be, if caregivers carry out activities for them (Mate-Kole et al., 2007).

Continued independence and autonomy is as important for people with dementia as it is to anyone else (Astell & Orpwood, 2010). Just as computer gaming provides the opportunity for both young and older players to enjoy a *Flow* experience, people with dementia could also benefit from the opportunity to engage in immersive and engaging activities. This requires that games and activities be designed and presented in a way that takes account of the progressive cognitive needs of people with dementia. While interactive systems such as the Nintendo Wii™ have attracted popular attention for their possible entertainment and even physical activity value for older people with dementia, such off-the-shelf systems and games are not designed to take account of the particular needs of people with dementia. Specifically,

most commercially available products assume intact cognitive function to (1) permit players to understand the relationship between a handheld controller that remotely influences activity on a screen and (2) accomplish the learning and improvement on the activities that provide the motivation to play again. Given the prominent memory difficulties of people with Alzheimer-type dementia, it is difficult for them to explicitly learn new skills and tasks by the traditional means on which these games rely.

10.14 Engaging Activities for People with Dementia

The Living in the Moment project (Astell et al., 2009) was established to explore the parameters for developing computerized activities to provide engaging and stimulating activities for people with dementia to enjoy. Working solely with people with dementia, as opposed to formal or family caregivers, the project set out to identify what sorts of activities were most enjoyable for older people with dementia and how they could best be prompted to initiate and continue to play games independently. Utilizing touch screen technology, this involved the creation and testing of more than 30 activities from a 3D tour round a botanic garden (Fig. 10.1; Astell et al., 2009) to painting a pot (Fig. 10.2) to fairground games such as duck shooting (Astell, 2010).

Over a number of years the findings revealed that people with dementia can actually learn to interact with and play computerized activities through implicit means. Participants were able to use the system and interact with the computer independently in the absence of a caregiver. There was also evidence of learning as people improved in accuracy or speed, depending on the demands of the game (Astell, 2010). The findings suggest that there is great potential for developing stimulating and absorbing activities for people with dementia. As well as providing them with rewarding and satisfying Flow experiences, independent gaming would enable people with dementia to exert some control over their environment, for which they have fewer and fewer opportunities in the rest of their lives. Additionally, the finding that people with dementia can actually learn new information and activities, just not through explicit means, has implications beyond the development of games to the broader application of creating technological solutions to the difficulties faced by people with a dementia diagnosis.

These findings support the view that it is possible to develop cognitive prostheses to leverage and extend capacities and to develop systems that fit the human and machine components together in ways that synergistically exploit their respective strengths and mitigate weaknesses (Institute for Human and Machine Cognition, 2012). For people with dementia this means taking account of their working memory difficulties, which make it difficult for them to learn new information, while maximizing their unaffected abilities. Projects such as Age Invaders demonstrate the potential for developing systems that take account of specific user needs, enabling them to be maximally useful for people with cognitive impairments.

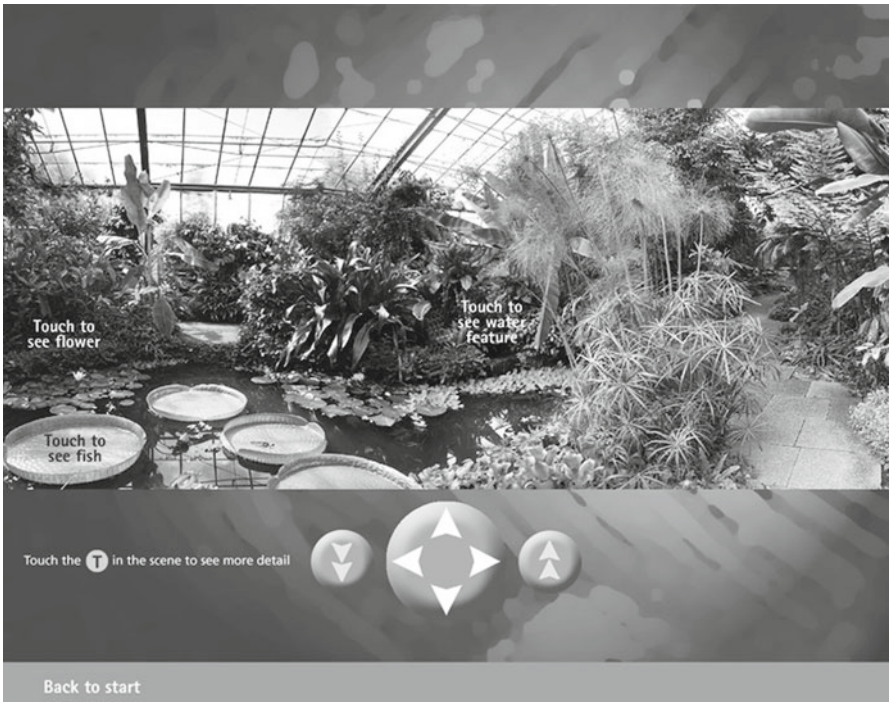

Fig. 10.1 The botanic garden

Fig. 10.2 Painting a pot

In addition to cognitive stimulation, technology has the potential to contribute to people with dementia living meaningful and enjoyable lives in a number of ways. For example, it is well established that musical memory, that is, memory for well-rehearsed music and songs, is well retained, and a number of projects have explored the potential of providing music to benefit people with dementia. The Picture Gramophone was an early small-scale project (Topo et al., 2004) to develop a music-based multimedia program to engage people with dementia. Evaluations with a small number of participants in several European countries were positive and were recently extended by Sixsmith, Orpwood, and Torrington (2010) in their development of a music player for people with dementia to access music for themselves, as opposed to having to rely on a caregiver. The preliminary results suggest that this may be of most benefit to people whose dementia has progressed to a point where they are living in nursing homes but there is further work to do.

Another small-scale pilot project explored the potential for enabling people with dementia to make music using a touch screen computer rather than just listening to it (Riley, Alm, & Newell, 2009). Typically, music groups and music therapy made available for people with dementia are conducted in groups using percussion instruments as these are most accessible for novices. In this project Riley and colleagues attempted to combine specific emotions with major and minor chords to provide an engaging experience for people with a dementia diagnosis. The initial findings suggested that the system was easy to use and engaging but requires further work to fully explore its potential.

10.15 Technology and Social Interaction in Dementia

Touch screen technology and multimedia also formed the basis of the CIRCA project (Astell et al., 2004). CIRCA is a multimedia computer designed to encourage interactions between a person with dementia and a caregiver based around reminiscing, as long-term memories tend to be well preserved in dementia. CIRCA contains a database of video clips, music, songs, and photographs, which people with dementia and a caregiver can explore together. Users choose from three categories (e.g. entertainment, sport, and schooldays) via a touch screen and then select between media (music, photographs, video) within that category. The hypermedia system allows users to move between text, sound, and graphics at will. There is no *right place* to be in the system (McKerlie & Preece, 1993), which is ideal for people with dementia who can enjoy current stimuli, such as a photograph on the screen, but have difficulty keeping topics of conversation in mind and remembering what they were previously talking about.

CIRCA was developed to take account of and respond to the profiles of spared and impaired cognitive processes of people with dementia (Astell et al., 2008). As such, CIRCA follows in the tradition of Augmented Cognition in that it aims to work with people's preserved abilities and skills while finding ways round their impaired ones. CIRCA was tested in one-to-one sessions and compared with traditional reminiscence activities, such as looking at picture cards or old artefacts.

In comparison to traditional reminiscence, which was typically a question and answer session led by caregivers, CIRCA facilitated a shared activity that both parties could enjoy together. This appears to be due to the contents being used to stimulate reminiscing being novel to both parties, which allows them to explore it together, with neither having any advantage in knowing what will happen. This has the effect of restoring people with dementia to equal partners in the interaction. Often it is the people with dementia touching the screen to make choices and lead the interaction (Astell et al., 2010).

Besides direct benefits to people with dementia from using CIRCA, they also benefit from the enjoyment and satisfaction of caregivers who find CIRCA a supportive tool for interacting with people with dementia. Caregivers particularly enjoyed the ease with which people with dementia were able to use the system and the reminiscences that are sparked. CIRCA challenges the often very low expectations that formal and family caregivers have about what people with dementia are capable of. In post-session interviews, caregivers felt that they learned more about the person with dementia after using CIRCA and often saw them in a new light, as a person with a history they had just discovered. This has obvious potential benefits for the future of their relationships, which should in turn impact on the quality of care and quality of life of people with dementia.

10.16 Potential Future Developments of Technology for Dementia

Story Table™ by the de Waag Society is another technology project for people with dementia based on reminiscence. Like Eldergames, Story Table uses a tabletop presentation and contains short video clips of 5–15 min from the 1920s to 1950s. A study of 181 older people resident in care facilities in the Netherlands identified three functions of the system: fun, promotion of social contact, and eliciting storytelling (Knipscheer, Nieuwsteeg, & Oste, 2006). The potential for promoting intergenerational storytelling and other possible applications for older people with dementia in nursing homes is still being explored.

Tabletop touch screens are also being explored for providing access to art therapy for people with dementia living in care facilities (Hoey, Leuty, Zutis, & Mihailidis, 2010). This project is attempting to use technology to enable art therapists to work with a number of clients at one time and, like the making music project described above, works with preset activities, such as collage and painting, presented by touching the screen. As with the other projects currently under way, this work recognizes that people whose dementia has reached the more advance stages also deserve to have their need for engagement in creative and engaging activities met.

To date there has been less research than with older adults generally into potential applications of technology to meet the psychological needs of people living with a diagnosis of dementia. However, the findings discussed highlight and demonstrate not only the possibilities of designing for dementia but also the benefits of this. Tackling the cognitive and social difficulties of dementia and the tendency of

caregivers and the environment to excessively disable them is to tackle a fundamental aspect of what it is to be human and to address how a disorder such as dementia challenges the very foundations of personhood.

In summary, technology can provide solutions to meeting the psychosocial needs of people with dementia, which is an aspect of care that is often overlooked in the pressure to keep people safe and secure. Projects such as LIM and CIRCA, which were designed to enhance the lives of people living with dementia and support their relationships with caregivers, also demonstrate the potential and importance of technology in responding to the ever-increasing numbers of older people affected by this progressive condition of aging.

10.17 Conclusions

To date, there has been fairly minimal exploration of technology to support people to live well as they age, beyond addressing very basic human needs. This is particularly so in respect of older people living with dementia (Sixsmith, 2006). This may reflect a lack of interest in meeting the higher-level needs of older people or, more charitably, recognition that this is a difficult task. However, as the population shifts inexorably towards a longer older age, the time for taking on this task, no matter how difficult, is at hand.

We must harness the potential of technology, not only to ensure people are safe and secure as they age but increasingly to ensure that their old age is happy and worth living. The evidence for creative applications of technology is growing, but the pace needs to increase substantially if we are to reap the benefits in the next 20 years. Positive psychology can provide a starting point and frame of reference for developing technology to bring people fun, meaning, and happiness. The challenge is to rethink our attitudes to aging and what people want as they age.

This requires detailed recognition of the complex needs of the heterogeneous population of people we class as old—that is, people over 65 years of age. Increasingly this group includes two generations of older people within one family—the old and the so-called old-old. The implications of this new but growing situation are only just being recognized but highlight the urgency of creating the next generation of novel technologies to enable people to live and age as well as possible.

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