Abstract: Dementia is an illness that affects the brain’s functionality and one’s mental capacity; it is not a normal process of ageing.

‘Dementia’ is a collective name for progressive degenerative brain syndromes that affect one’s memory, thinking ability, behaviour and emotion. Alzheimer’s disease is the most common cause of dementia.

The number of people with Alzheimer’s and other dementias increase every year because of the steady growth of the older population. In Singapore, about 5.2% of elderly, age 65 or older, suffer from dementia. In view of this, Singapore’s National Design Centre for Ageing, >60 Design Centre collaborated with Alzheimer’s Disease Association (Singapore) to design a series of card games for active brain stimulation.

This paper will address the results of our focus group activities and how they lead to the design of a non-language biased, and internationally-friendly card game known as ‘A-HAH!’. This card game was officially launched on an international platform at the 24th Conference of Alzheimer’s Disease International (ADI) with more than a thousand delegates from 65 countries.

Keywords: Dementia, Elderly, Card Games
As Hateley and Tan aptly states in The Greying Asia, “the two main causes of rapid ageing are attributed to successful economic development and effective implementation of family planning programs.”3 The rapid economic growth and development since the 1960s has raised per capita income, reduced infant mortality, raised standards of living, increased levels of education, accelerated urbanization, encouraged nuclear families, and weakened traditional morals; as people become more affluent with higher standards of living, more have survived to adulthood and live in urban settings. They tend to get married at a later age (if at all), and have fewer children; these factors had also contributed to the reduced fertility. Furthermore, with higher living standards, improved public health, and better healthcare, people in more developed countries tend to live longer.

Since the 1980s, Singapore’s Government has been working to address the ageing issues and the implications of how demographic shift would affect the overall society and economy. “Singapore’s response to these challenges identifies a need for a centre of design research and development that specifically addresses the needs of the ageing sector.” In January 2008, “Singapore opened its first and only National Design Centre for Ageing, called the >60 Design Centre (>60 is pronounced as “Greater Than Sixty”)”4.

1.2 >60 Design Centre

To address the challenges of an ageing society, the >60 Design Centre was established as the National Design Centre for Ageing to explore and study the ageing process and related issues, to provide design ideas and solutions that will make the ageing lifestyle a creative and an exciting one. Supported by the Ministry of Community Development, Youth and Sports (MCYS), the Centre aims to generate products and services that will enhance and improve the quality of life of the baby boomers and the emerging ageing population. It also provides design consultation to industry to develop products for the international silver market. The Centre also holds local and international workshops, conferences and seminars to generate public and industry interest in designing for the ageing as part of its movement to raise national preparedness for the ageing population.

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2 Ministry of Community Development, Youth and Sports (2009), Adding Life to Years: Happy, Healthy, Active Seniors, p. 4
3 Hateley, Louise and Tan, Gerald (2003), The Greying of Asia: Causes and Consequences of Rapid Ageing in Asia, pp. 1-2.
>60 adopts a multi-disciplinary approach to designing elderly-friendly and commercially viable solutions. The team, which comprises of individuals from different disciplinary backgrounds, explores all possible angles and ensures that the final solutions are able to accommodate a wide range of the population’s preferences and abilities.

The Centre’s design and research team applies inclusive design principles, engaging the users in the design process and taking a wide range of individual preferences and abilities into consideration. The Centre also upholds the ethos of inclusive design, which is user-centred, population aware and business focused. Our Design Process will include market study and research, concept generation and development, testing of concepts, prototyping, user studies and final review by relevant authorities such as medical experts to ensure accountability and quality.

1.3 Universal Design

The concept of accommodating the needs of all people, regardless of their age, gender stature, abilities or social status, started to gain attention and importance as the demographic change took place worldwide.

There is a rapid growth in the ageing population as people are living longer today. Modern medicine has also increased the survival rate of those with significant injuries, illnesses and birth defects. Therefore, there is a growing interest in universal design. In 2005, the proportion of the elderly population aged 60 years old or over was 10 percent and the figure is expected to reach 22 percent in 2050 (UN, 2007) (Table 1).

<table>
<thead>
<tr>
<th>Years old</th>
<th>0-14</th>
<th>15-59</th>
<th>60+</th>
<th>80+</th>
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<td>2005</td>
<td>28.3</td>
<td>61.4</td>
<td>10.3</td>
<td>1.3</td>
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<tr>
<td>2050</td>
<td>29.8</td>
<td>58.3</td>
<td>21.8</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Table 1: Percentage distribution of the world population by Board Age Group in 2005 and 20505

The idea of Universal Design was introduced by American architect Ronald L. Mace, the “designing of things that almost anybody, including the mobility-impaired and the elderly could use”.6 It simply means to design for all people to the greatest extent possible. Universal design is not a design style, but an orientation to design. Therefore, if a design works well for older adults or people with disabilities, it works better for everyone. “Design for all” benefits people of all ages and abilities.

It is hard to imagine what life will be like when we grow much older. We may neither be able to read small typefaces, walk long distances nor hear the other person on the line. As people age, simple daily tasks that used to be easy will become difficult, time consuming or even impossible.

The Universal Design Philosophy of “Simple and Intuitive use” was adopted in our design and research approach. The use of the design must be easy to understand, and must accommodate a wide range of literacy and

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language skills, particularly in the context of Singapore where there is a diversity of different ethnicity and languages and dialects i.e. English, Malay, Tamil, Chinese - Mandarin, Cantonese, Hokkien.

2. Our research approach

2.1 Project Objective
The objective was to design an economical and simple game solution that is easily played and comprehended by the players of all ages. In consultation with the resource panel, card games were indentified as the design brief. Card games are portable, economical, and can be played in various ways, whether in groups or individual.

Although designed for people with dementia in mind, the game must be universal in nature, be it for Alzheimer’s disease patients, elderly in general or even young children developing cognitive skills. The card game is designed to keep players mentally engaged, for them to have fun, while at the same time, improving their overall emotional and mental heath.

2.2 Resource Panel
A resource panel consisting of medical experts, occupational therapists, and caregivers was formed as the consultant for this project. Specialist information was shared amongst the design and research team, particularly the behaviour and characteristics of people with dementia, our primary target user.

Dementia is an illness that affects the brain’s functionality and one’s mental capacity; it is not a normal process of ageing (Figure 2). ‘Dementia’ is a collective name for progressive degenerative brain syndromes that affect one’s memory, thinking ability, behaviour and emotion. Alzheimer’s disease is the most common cause of dementia. In the absence of a cure, current therapies are focused on providing symptomatic benefits and improving patient’s and caregiver’s quality of life. More importantly, disease progression can be significantly delayed if treated early.

Figure 2:
The difference between someone with Alzheimer symptoms than normal age-related memory changes

7 Alzheimer’s Association (2005), Basics of Alzheimer’s disease, p. 5
“The greatest known risk factor for Alzheimer’s is increasing age. Most individuals with the illness are 65 and older. The likelihood of developing Alzheimer’s approximately doubles every five years after age 65. After age 85, the risk reaches nearly 50 percent.”

Alzheimer’s disease worsens over time, and symptoms vary greatly for each individual. Generally, the stages of the disease are determined by the Mini-Mental State Exam (MMSE). (Figure 4) The Mini-Mental State Exam (MMSE) is a brief test of cognitive impairment used widely to screen for dementia. “The original test, developed by Folstein et al (1975), includes questions about orientation, attention, recall and language.”

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8 Source: Alzheimer’s Association (2005), Basics of Alzheimer’s disease, p. 11  
9 Alzheimer’s Association (2005), Basics of Alzheimer’s disease, p. 12  
10 The First Steps in Alzheimer’s Disease Care: Assessments and Diagnosis. http://www2f.biglobe.ne.jp/~boke/improvingad.htm  
11 The First Steps in Alzheimer’s Disease Care: Assessments and Diagnosis. http://www2f.biglobe.ne.jp/~boke/improvingad.htm
Doctors traditionally divide the stages of dementia into three—Mild, Moderate and Severe with considerable overlapping. Generally, people with mild dementia can live independently with adequate personal hygiene and relatively intact judgment; however, their social activities and employability are both significantly impaired. Formal employment and living independently is no longer possible for people with moderate dementia. For severe cases, there is severe impairment of daily activities and continual supervision is required.

Dr Ng Li Ling (Vice President, Alzheimer’s Disease Association (Singapore)) (pers. comm. 23 March 2009) from the resource panel expressed the view that reminiscence therapy is one of the most popular psychosocial interventions in dementia care, and is highly rated by staff and participants. Reminiscence therapy generally involves exchanging memories with the elderly and youth, friends and relatives, caregivers and professionals, and passing on information, wisdom and skills. There is some evidence to suggest it is effective in improving the moods of elderly people with or without dementia.

The resource panel identified card games as the design brief and set out various research directions for the team. Such as, the appropriate size of cards, trans-language for contents, objects of reminiscence to be used and the incorporation of multiple game plays.

3. Data Collection

3.1 Initial Visits and Observations

Out of twelve dementia day-care centres in Singapore, the team initiated visits to six. The research team observed and studied the groups, from their daily activities to the games they played.

![Figure 5: Elderly and their daily activities and games in senior activity centres.](image-url)

Playing games help to develop a wide range of skills and abilities that translate into other areas of life. The challenges of games stimulate physical and mental skills. Some forms of play stimulate the senses and
emphasize motor abilities. The elderly enjoy probability games such as ‘Three Card Poker’ and ‘Bingo’ in particular, based on our research. The benefits through such game playing, like Bingo, can advance the speed and precision of short-term memory and actually aids in countering some ageing effects. Through games, the elderly maintain memory skills, improves concentration. The group games also serve as a good platform for social interaction. Most importantly, games for elderly must allow the player to have a feeling of success and accomplishment, consequently, increasing their self-esteem.

3.2 User Testing

Groups of respondents ranging from 25-97 years old were selected from schools, senior activity centres and dementia daycare centres to take part in the user testing. The research methodology used for this project was qualitative in nature. With a sample size of sixty respondents, our team carried out in-depth interviews and user testing through video and photo documentation. The concept validation process was conducted on a wide cross-section of people by testing the playing of the specially designed cards in small groups.

Stage 1

Figure 6: Images of familiarity and most elderly friendly size of card

Objects of reminiscence were shown to our primary target group, unrecognisable images were eliminated. Some of the images of Asian objects were too foreign for the 6 percent of western elderly surveyed (Figure 7).
The groups of respondents from different stages of dementia were chosen for the user testing ranging from Early, Early Moderate and Moderate dementia, as well as a group of healthy elderly (Figure 9). People with mild dementia are generally active and sociable, and games that encourage cognitive stimulation and social interaction will be beneficial to them. Based on our observations and interviews, people with mild dementia are able to learn new games and follow simple instructions. Respondents in the Moderate stage of dementia find the games too challenging and unable to follow simple rules, thus individual games are more suitable for this group.

The majority of the groups recognise the objects of reminiscence shown (Figure 10), but some respondents were unable to respond to the image due to poor vision. Vision changes as people age, where certain parts of the eye become less elastic, which impacts how well a person can see. The loss of being able to see minute and clustered objects is a normal process of ageing.
During the user testing, four different sizes of cards were shown to each respondent (Figure 11). They were asked which of the four samples ranging from standard poker cards (87 X 62 mm) to the largest card (172 X 120 mm) is most comfortable for the eyes. The respondents were then asked to hold ten differently sized cards and to pull out the cards one by one and dropping it into a pile. Based on our observations, the user naturally chooses the biggest card available, however as observed, the bigger the card, the more difficult it is for the user to hold and maneuver. At the end of the testing, 55 percent of the respondents chose C (110 X 145 mm) as their preference based on the balance between visibility of graphics and the ease of holding.

Stage 2
Testing of Game Set A and B

Two sets of card games were derived from stage one based on the gathered observations and feedback. The new game cards incorporated the use of numbers and images of nostalgic objects, as well as selective images of fruits. Both game sets can be played in multiple ways, ranging from easy to challenging depending on the cognitive level of each individual. Respondents were asked to play the games available on the two sets of card games.

![Figure 11: The most elderly friendly size of game cards](image)

During the user testing, four different sizes of cards were shown to each respondent (Figure 11). They were asked which of the four samples ranging from standard poker cards (87 X 62 mm) to the largest card (172 X 120 mm) is most comfortable for the eyes. The respondents were then asked to hold ten differently sized cards and to pull out the cards one by one and dropping it into a pile. Based on our observations, the user naturally chooses the biggest card available, however as observed, the bigger the card, the more difficult it is for the user to hold and maneuver. At the end of the testing, 55 percent of the respondents chose C (110 X 145 mm) as their preference based on the balance between visibility of graphics and the ease of holding.

![Figure 12: Set A User Testing](image)
**Set A:** Forty cards consisting of numbers from zero to nine and twenty image pairs of nostalgic objects in sets of four different colours.

Players were asked to play varied games: (Figure 12)
1) The pairing game: 95 percent of the players were able to pick out pairs from the pile.
2) The memory game: Slightly challenging, with 79 percent of the players able to remember the positions of the cards.
3) Simple Mathematics: 85 percent of the players were able to pick up the correct cards that add up to the respective number given.

**Set B:** Forty cards consisting of ten sets of fruits, each fruit formed by four cards. Each card is colour-coded to differentiate the fruits.

Players were asked to play varied games: (Figure 13)
1) Picture puzzle: 79 percent of the players were able to form a complete picture.
2) Image recognition (fruit images): 94 percent of the players were able to recognise the fruit image.
3) Grouping: 55 percent of the players were able to collect and group the puzzle sets by asking other players for their desired cards. This game involves social interaction between the players; therefore, those who are at the Moderate stage of dementia found this game challenging.
Stage 3

Figure 14: Game testing beyond the primary target user group

Game testing was conducted beyond the primary target user group (Figure 14). Twenty-seven respondents age ranging from 25-59 played the game. Feedbacks were gathered for further design refinement.

4. Our Findings and Design Solution

The team observed that people with dementia tends to be less willing to learn new games or tasks. They did not enjoy being treated like children as most of their existing tools such as puzzles and colouring books are meant for children. The game design needed to incorporate a set of progressively challenging games with easy-to-follow rules and repetitive game plays that would facilitate the game play process for people at different levels of cognitive ability.

The design was inspired by the research studies that hinted at physical, leisure and cognitively stimulating activities having combined effects of reducing the onset of dementia. According to the resource panel’s advice, their dementia patients play with cards frequently and are very familiar with the game play. There is also more versatility as the card games can be played in multiple ways, in numerical order, in family order, in matching order and more for mental and memory exercise.

The card game encourages social interaction and promotes cognitive training such as memory stimulation, visual recognition of everyday objects, mind processing of simple information and logic and reasoning for problem-solving. It is specially designed for people with dementia, and entertainment for all ages.
A-HAH! MEMORITZ (Figure 15)
MEMORITZ is a set of forty cards consisting of numbers from zero to nine and twenty image pairs of nostalgic objects in sets of four different colours.
Games to play: Quick Match, The Memory Game, 1-2-3, What's this?, A-Hah!

A-HAH! FRUITO (Figure 16)
FRUITO is a set of forty cards consisting of ten sets of fruits, each fruit formed by four cards. Each card is colour-coded to differentiate the fruits.
Games to play: Picture Puzzle, Guessing Game, Hello!

The game can be played with grandparents and grandchildren, amongst family members or be used in care centres as an everyday tool for caregivers. The team went through observation, conceptualization, user testing, and refinement of design ideas and the final prototype and design was endorsed by Alzheimer’s Disease Association (Singapore).

5. Conclusion
A-HAH! is a non-language biased, cross boundary card game specially designed for people with dementia and as an everyday tool for their caregivers at home and in elderly centres. Developed by >60 Design Centre in close collaboration with Alzheimer's Disease Association (Singapore) and The Ad Planet Group, the A-HAH! card games encourage active brain stimulation, social interaction and intergenerational bonding, which could lead to the reduction of the risk of dementia in seniors.

Universal design was the key in >60 Design Centre's design conceptualisation process. Inspiration for this project came from previous and ongoing research studies that hinted at physical, leisure and cognitively stimulating activities having a combined effect of reducing the onset of dementia.

"One of our goals is to contribute to research and development of products and services that will make a difference in the lives of those affected by Alzheimer's and dementia now and for future generations. ADA is glad to have contributed to the making of A-HAH! card games, and this will be a great tool for caregivers all over the world," said Dr Ng Li Ling, Vice President of Alzheimer's Disease Association (Singapore) (pers. comm. 23 March 2009). A-HAH! was launched on an international platform at the 24th Conference of Alzheimer's Disease International on 25-28 March 2009, with more than a thousand delegates from 65 countries. The A-HAH! game packs were proudly distributed to all conference delegates. Due to the wide dissemination of game packs during ADI 2009, A-HAH! has made its way to the United Kingdom, India, China, Hong Kong SAR, Nigeria, and many countries around the world. If A-HAH! is proven to be effective and well received by the users, variations of the design will be further developed and manufactured to help a greater number of elderly internationally.
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