

## CC0007 Group Proposal (1)

### *Tackling Alzheimer's Disease Among Elderly Singaporeans*

<b>Cluster</b>	C
<b>Group</b>	30
<b>Group Members</b>	Wang Jie Rui, Jerome Lim Dong Wan Ryan Tan Kai Hong Ng Hui Yi Le Minh Anh Ngoc
<b>Cluster Instructor</b>	Prof Low Chin Wui, Marc
<b>Word Count</b>	590 (excluding cover page, footnotes, figure captions, in-text citations and references)

## Introduction

With the average lifespan increasing globally, end-of-life diseases like Alzheimer's Disease (AD) have an even greater negative impact on the quality of life for the elderly. At 24 million people, AD is very much prevalent globally amongst the elderly (Mayeux et al., 2012), similarly affecting a sizable amount of the elderly in Singapore alone (Figure 1). Unlike other diseases, AD is unique in that it is mostly silent (Rana et al., 2018) despite its prevalence. This might be due to the societal stigma against dementia<sup>1</sup> (Alzheimer Society, n.d.). Consequently, those affected by AD may refuse to speak up and seek treatment (Fowler et al., 2015)<sup>2</sup>, either due to fears of their condition being downplayed<sup>3</sup> by other people, or that they may not even be aware of their condition given its silent nature. Additionally, the patient's financial status also plays a huge role in seeking treatment, with the less financially-abled less likely to seek treatment (Hsu & Willis, 2013).

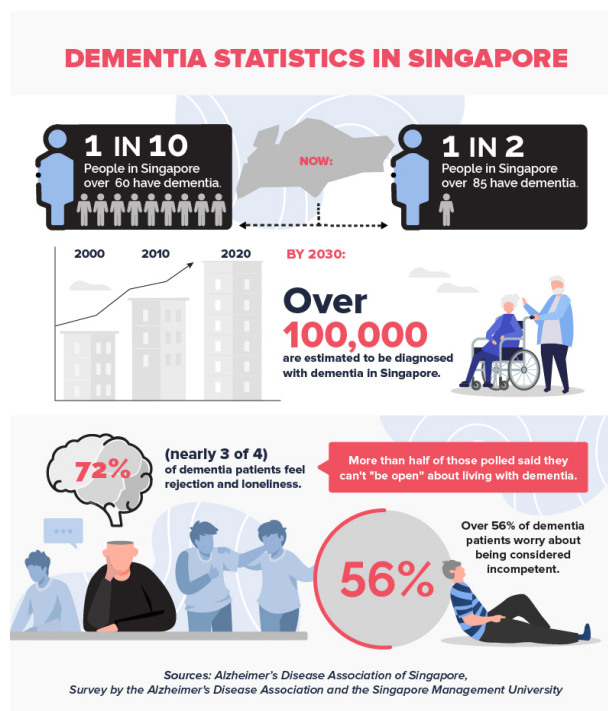


Figure 1: Dementia Statistics in Singapore (POSB, 2020)

Hence, our proposed solution, the **Cogni+** app (Figure 2), seeks to bridge this gap in access to treatment by rethinking the very nature of diagnosis and treatment in Singapore's context.

<sup>1</sup> Dementia is a direct consequence of AD (Mayo Clinic, 2022).

<sup>2</sup> Research has shown that amongst the factors for refusing diagnosis and treatment, a "negative attitude" towards cognitive tests and possibly shame relating to their cognitive decline have the largest impact on their decision (Fowler et al., 2015).

<sup>3</sup> Societal ignorance and stigma has even resulted in some doctors holding a laissez-faire (allow-to-do) attitude towards AD (Fowler et al., 2015), prioritising other more acute diseases over it.

## Proposed Innovation



*Figure 2: Cogni+ Splashscreen*

Cogni+ is an Artificial Intelligence (AI)-enabled application that repackages traditional diagnostic tests and therapy into cognitive games. The AI embedded within will conduct continual testing and therapy through the games, by tracking the cognitive performance of the elderly and targeting identified areas of weakness by customising the games offered.

Through gamification, our solution aims to sidestep the stigma of AD, by reimagining the way tests and therapy are conducted and incorporating the principles of Cognitive Stimulation Therapy (CST<sup>4</sup>) (DementiaHubSG, n.d.) within the games.

---

<sup>4</sup> CST is a form of evidence-based, Non-Pharmacological Intervention (NPI), formed by a combination of various effective elements of non-pharmacological therapies for people experiencing “mild to moderate dementia” (DementiaHubSG, n.d.).

## Features

Feature	Benefit	Feasibility
<b>Games (similar to the online Human Benchmark tests)<sup>5</sup> (Figures 3 &amp; 4)</b>	<ol style="list-style-type: none"> <li>1) Addresses the gap in testing brought about by tedious processes, by reducing the boredom and frustration that the elderly may face.</li> <li>2) Reduces risk of “new-onset mild cognitive impairment” by up to 22% (Rapaport, 2017).</li> <li>3) Allows the elderly to conduct self-paced private therapy (through the series of cognitive games in Cogni+)<sup>6</sup> in the comfort of their homes.</li> </ol>	Games have been proven to foster positive outcomes in Education (Satrio et. al., 2021).
<b>Artificial Intelligence</b>	<ol style="list-style-type: none"> <li>1) Projected to offer higher diagnostic accuracy than humans, since it will be trained on copious datasets of AD symptoms.</li> <li>2) Addresses the existing accuracy issue that questionnaires face<sup>7</sup> (Rosen et. al., 2016).</li> </ol>	AI outperformed medical specialists in many instances, such as in the diagnosis of breast cancer (Walsh, 2020) and diabetes (Tallam et al., 2022).
<b>Rankings (Figure 5) &amp; Voucher Incentive Program (Figure 6)</b>	Encourages greater participation among the elderly by tapping into Singapore’s ‘kiasu’ <sup>8</sup> culture.	Case in point
<b>Continuous Assessment<sup>9</sup></b>	Difficulty level of games will be adjusted based on users’ performance.	Mechanism is also used in duolingo and is proved to be efficient for users.

<sup>5</sup> Some of the popular online Human Benchmark tests range from memory, language, attention, reasoning, perception to problem solving (i.e. clock drawing, animal naming, quick words reminder etc.).

<sup>6</sup> Research has shown that amongst the factors for refusing diagnosis and treatment, a “negative attitude” towards cognitive tests and possibly shame relating to their cognitive decline have the largest impact on their decision (Fowler et al., 2015).

<sup>7</sup> Questionnaire accuracy declines with age due to cognitive decline.

<sup>8</sup> A colloquial term, used by Singaporeans, for one’s fear of losing out.

<sup>9</sup> Our diagnostic tests embedded within the games are modelled off those currently used by doctors, such as the Self-Administered Gerocognitive Exam (SAGE), Montreal Cognitive Assessment (MoCA) and Mini-Mental State Examination (MMSE).

<b>Financially Acceptable Pricing</b>	Addresses the financial barrier with lower pricing compared to most dementia tests and therapy packages (Samuels, 2021).	Case in point
---------------------------------------	--	---------------



Figure 3: Example of a game

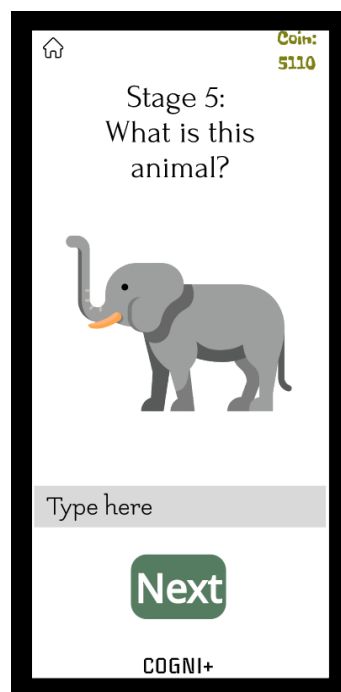


Figure 4: Example of a game

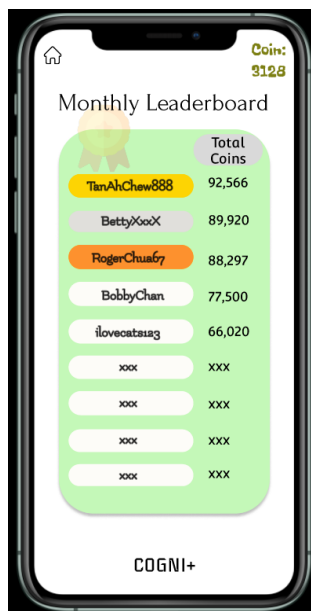


Figure 5: Scoreboard

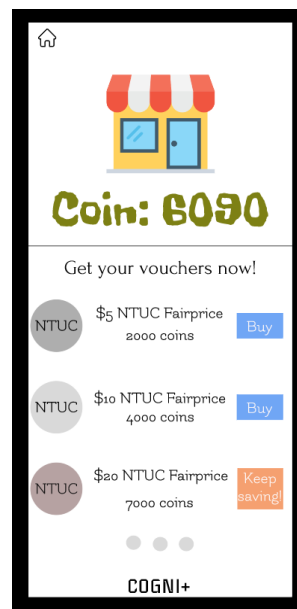


Figure 6: Redemption page

## Considerations

### *Accessibility*

The font size in Cogni+ will be large enough for the benefit of the elderly struggling with eyesight problems, coupled with narrations in all dialects and the 4 official languages of Singapore (Figure 7) to accommodate those with presbyopia (Mayo Clinic, 2021) and hearing issues.



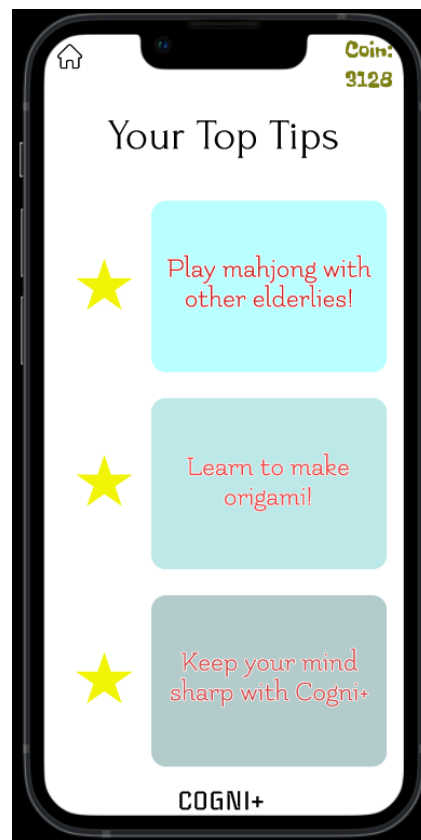
*Figure 7: Preferred language selection page*

Additionally, we will direct our marketing efforts toward the younger generation despite our app's target audience being the elderly. As the learning curve of technology will be steeper for the elderly, the younger generation can assist them in understanding the various functions of the app so as to overcome this challenge faced by the elderly, thereby increasing its adoption rate.

### ***Extensible Treatment***

Although Cogni+ is developed as a low-cost alternative solution to the traditional testing and treatment pathway, the personalised results gleaned from the activities completed in the app can be used to seek professional advice from doctors.

Moreover, relevant lifestyle recommendations will be made according to their game performance<sup>10</sup> (Figure 8).



*Figure 8: Personalised tips for the user*

---

<sup>10</sup> e.g. users underperforming in the area of language cognition will be recommended to meet up with friends.



## References

- Alzheimer Society of Canada. (n.d.). *Stigma Against Dementia*. Retrieved September 7, 2022, from <https://alzheimer.ca/en/about-dementia/stigma-against-dementia>
- Boyle & Velasquez (2022, May 27). *Top 25 Developed and Developing Countries*. Retrieved September 6, 2022, from <https://www.investopedia.com/updates/top-developing-countries/>
- Care.com. (2022, February 28). *How to Improve Cognitive Health in Old Age*. Retrieved September 8, 2022, from <https://www.care.com/c/en-nz/how-to-improve-cognitive-health-in-old-age/>
- DementiaHubSG (n.d.). *Cognitive Stimulation Therapy*. Retrieved September 6, 2022, from <https://www.dementiahub.sg/care-professional/cognitive-stimulation-therapy/>
- Fowler et al. (2015, June). *Traits of Patients Who Screen Positive for Dementia and Refuse Diagnostic Assessment*. National Library of Medicine. Retrieved September 6, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4527161/>
- Home Instead. (2021, July 7). *Singapore Dementia Statistics and Facts*. Retrieved September 7, 2022, from <https://homeinstead.sg/dementia-singapore-statistics/>
- Hsu J. W. & Willis R. (2013, Apr 1). *Dementia Risk and Financial Decision Making by Older Households: The Impact of Information*. National Library of Medicine. Retrieved September 6, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4267321/>
- Husami. (2022, April 27). *What are the Benefits of AI in Medical Diagnosis?* Insidetelecom. Retrieved September 6, 2022, from <https://insidetelecom.com/what-are-the-benefits-of-ai-in-medical-diagnosis/>
- Institute on Aging. (2017, July 18). *Free Cognitive Tests for Older Adults and Caregivers to Assess Memory*. Retrieved September 9, 2022, from <https://blog.ioaging.org/mental-illness/free-cognitive-tests-older-adults-caregivers-assess-memory/>
- Kapok Aging and Caregiver Resources. (2022, May 29). *Resources for Senior Citizens & Elderly Care: Kapok*. Retrieved September 9, 2022, from <https://multiculturalcaregiving.net/>

- Mayeux et al. (2012, August). *Epidemiology of Alzheimer Disease*. National Library of Medicine. Retrieved September 6, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3405821/>
- Mayo Clinic. (2021, November 20). *Presbyopia*. Retrieved September 9, 2022, from <https://www.mayoclinic.org/diseases-conditions/presbyopia/symptoms-causes/syc-20363328#:~:text=Presbyopia%20is%20the%20gradual%20loss,worsen%20until%20around%20age%2065>
- Mayo Clinic. (2022, February 19). *Alzheimer's Disease*. Retrieved September 6, 2022, from <https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/symptoms-causes/syc-20350447#:~:text=Overview,person's%20ability%20to%20function%20independently>
- Ministry Of Health. (2022, February 14). *Measures To Alleviate Healthcare Manpower Crunch From Recent Surge Of Covid-19 Omicron Variant Cases And Resignation Rates Of Healthcare Workers In 2021*. Retrieved September 6, 2022, from <https://www.moh.gov.sg/news-highlights/details/measures-to-alleviate-healthcare-manpower-crunch-from-recent-surge-of-covid-19-omicron-variant-cases-and-resignation-rates-of-healthcare-workers-in-2021>
- National Institute on Aging. (n.d.). *Assessing Cognitive Impairment in Older Patients*. Retrieved September 9, 2022, from <https://www.nia.nih.gov/health/assessing-cognitive-impairment-older-patients>
- POSB. (2020, Feb 5). *How to Care for Someone with Dementia in Singapore*. Retrieved September 6, 2022, from <https://www.posb.com.sg/personal/articles/my-family/care-for-someone-with-dementia>
- Practice Aptitude Tests. (2021, August 5). *Aptitude Test: 1000s of Free Practice Aptitude Test Questions*. Retrieved September 8, 2022, from <https://www.practiceaptitudetests.com/>
- Rana A. et al. (2018, Dec 3). *Alzheimer's Disease Silent Killer of Memory: A Review on Pathological Mechanisms*. HERALD Scholarly Open Access. Retrieved September 6, 2022, from

<https://www.heraldopenaccess.us/openaccess/alzheimer-s-disease-silent-killer-of-memory-a-review-on-pathological-mechanisms>

- Rapaport, L. (2017, January 31). *Brain Games Linked to Delayed Cognitive Decline in Elderly*. Reuters. Retrieved September 8, 2022, from <https://www.reuters.com/article/us-health-aging-mental-stimulation-idUSKBN15F2PA>
- Rosen et al. (2016, June). *How Aging Affects Self-Reports*. National Library of Medicine. Retrieved September 6, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5550601/>
- Samuels, C. (2021, Mar 30). *Understanding the Surprising Costs of Dementia Care*. aPlaceforMom. Retrieved September 6, 2022, from <https://www.aplaceformom.com/caregiver-resources/articles/cost-of-dementia-care>
- Satrio et. al. (2021, Jul 14). *The Effectiveness of Educational Games on Post-Pandemic Learning*. Knowledge E. Retrieved September 6, 2022, from <https://knepublishing.com/index.php/KnE-Social/article/view/9388>
- Tallam et al. (2022, April 5). *Artificial Intelligence May Improve Diabetes Diagnosis - Novel Deep Learning Approach Analyzes Pancreatic, Extra-Pancreatic Ct Features*. RSNA. Retrieved September 6, 2022, from <https://www.rsna.org/news/2022/april/AI-Improve-Diabetes-Diagnosis#:~:text=Using%20a%20fully%20automated%20AI,meet%20the%20criteria%20for%20prediabetes>
- Walsh, F. (2020, Jan 2). *AI ‘outperforms’ Doctors Diagnosing Breast Cancer*. BBC. Retrieved September 6, 2022, from <https://www.bbc.com/news/health-50857759>