



White Paper

The Effects of Computerised Cognitive Training on Cognitive Function, Gait and Balance in Community-Dwelling Older People: A Randomised Controlled Trial

Dr Alvin Chan, CEO & Co-Founder

October 2018



Contents

Executive Summary	Slide 3
Background	Slide 4
The Facts	Slide 5
Research Objectives	Slide 6
Research Protocol	Slides 7 - 9
Assessments	Slides 10 - 11
Neeuro Cognitive Training Solution	Slides 12 - 14
Research Results	Slide 15
Conclusion	Slide 16

Executive Summary

Talk about the results and its publication at Singapore Health & Biomedical Congress (SHBC) 2018 in Singapore held on the 25th to 27th October 2018 at MAX Atria, Singapore EXPO, is the largest medical congress in Singapore with an expected 4,000 delegates.

Neeuro Technology and programme

Working with GERI, to assess and see results.

Positive results showing proof and promise to help with lowering the risk of dementia in seniors.

Background

Older adults are estimated to constitute 22% of the world's total population by year 2050. Global economic burden on caregivers and social healthcare systems is likely to grow in tandem with the rise in rates of neurocognitive decline. The estimated total worldwide cost of dementia was reported to be a whopping US\$818 billion in year 2015. By 2018, the global cost of dementia will rise above a US\$ trillion.

At present, there is no cure for major neurocognitive disorders. Current treatment options for patients with dementia are management-based and multi-pronged depending on stages of dementia in question. Dealing with major neurocognitive disorders is expensive and troublesome yet potentially futile. In view of these, alternative early and personalized interventions can serve as a means to delay onset of irreversible neurocognitive disorders and preserve or even enhance neurocognition.

Prevention or delay is cheaper than management of neurocognitive disorders such as dementia, which is chronic in nature.

The Facts

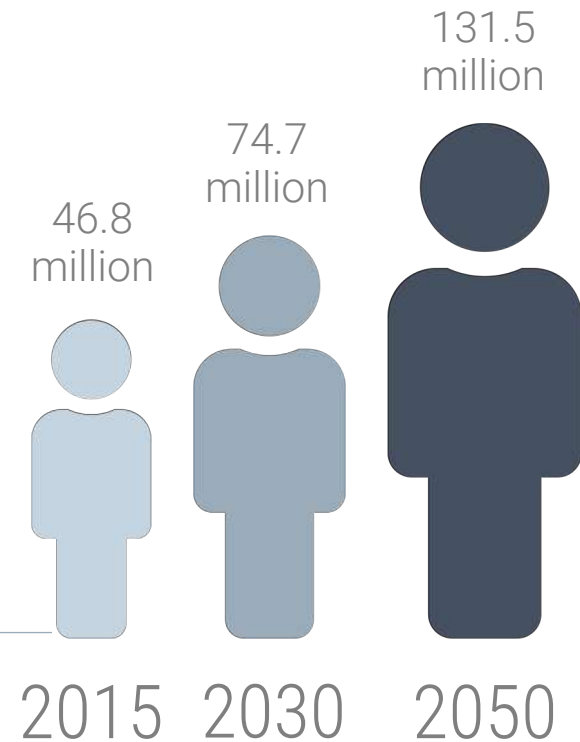


Around the world, there were 9.9 million new cases of dementia in 2015

One every 3 seconds

46.8 million people worldwide were living with dementia in 2015

This number will almost double every 20 years



Research Objectives

Determine the effects of Computerised Cognitive Training Programme for improving memory, attention, executive functions, processing speed, spatial skills and overall cognitive functions in healthy elderly.

Additionally to evaluate the effects of improving physical performance: gait speed, gait speed under dual tasks condition and balance in the healthy elderly.



Research Protocol

Research Subjects

Community dwelling healthy elderly, with no significant cognitive impairment, no depression, no vertigo, no colour blindness and no walking or balance impairments. Not using psychotropic medications.

Location

The research was based in a community centre where the elderly typically gathered for activities.

Duration

6 months

Training Programme

NeeuroFIT for Seniors

Technology

- Neeuro SenzeBand
- Neeuro Memorie App

Cognitive Assessments

- Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)
- Color Trails Test Part 2 (CCT)

Physical Assessments

- GaitRite: gait speed single & dual task gait speed, dual task cost, gait variability index (GVI)
- Berg Balance Scale (BBS)

Research Protocol

Participants

52 healthy community dwelling seniors randomised into the intervention or waitlist control group

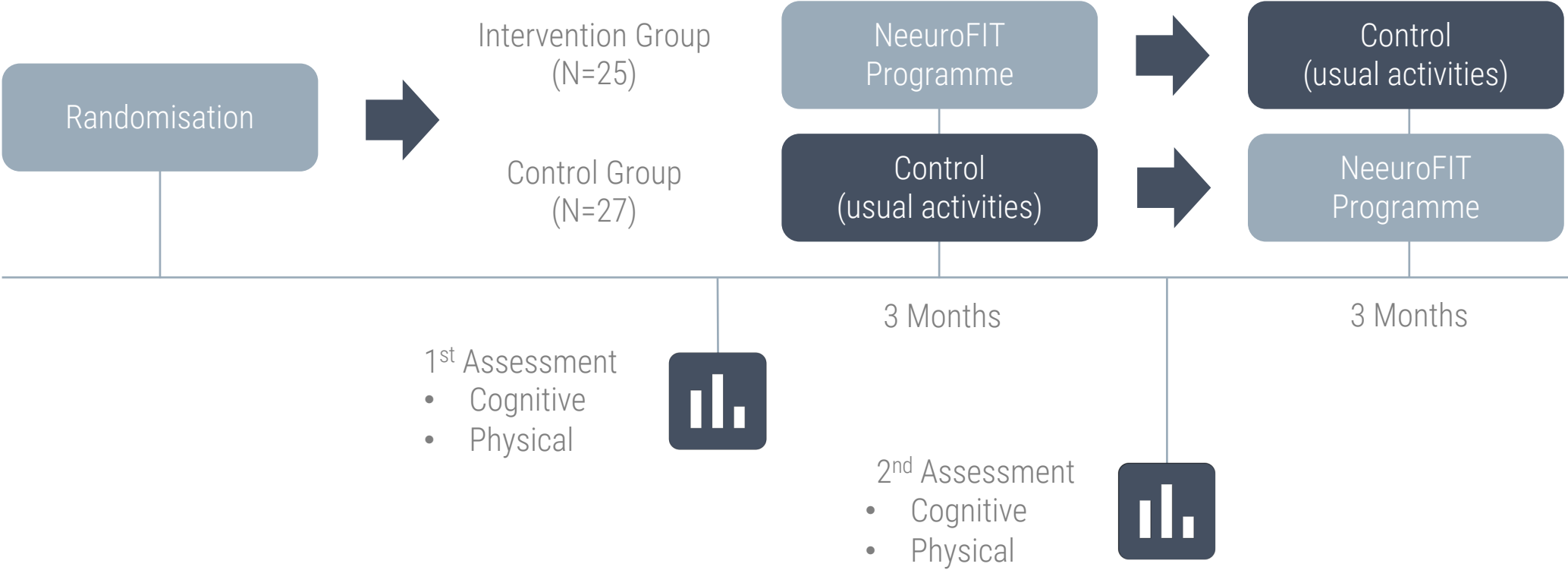
- ≥ 55 years old
- English / Chinese speaking
- Mini-Mental State Examination (MMSE) ≥ 24
- Geriatric Depression Scale (GDS) ≤ 8
- No neuropsychiatric disorders or severe walking/balance impairments

NeeuroFIT Programme

- Twenty 2-hour instructor-led training sessions conducted 2 times per week over 3 months
- Use of brain training application, “Memorie” paired with an EEG headband “SenzeBand”
- Play cognitively stimulating games targeted at attention, memory, decision-making, spatial ability and cognitive flexibility



Research Protocol



Cognitive Assessments

Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)

RBANS is a neuropsychological assessment that consists of ten subtests which give five scores, one for each of the given domains tested (immediate memory, visuospatial/constructional, language, attention, delayed memory). It takes about half an hour to administer and was originally introduced in the screening for dementia.

This instrument is used by clinicians and neuropsychologists to help: (1) screen for deficits in acute-care settings, (2) track recovery during rehabilitation, (3) track progression of neurological disorders and (4) screen for neurocognitive status in adolescents.

In summary, RBANS measure cognitive decline or improvement across these domains: (a) immediate memory, (b) visuospatial/constructional, (c) language and (d) delayed memory.

Colour Trails Test Part 2 (CTT)

CCT uses numbered coloured circles and universal sign language symbols. The circles are printed with vivid pink or yellow backgrounds that are perceptible to colour blind individuals. For the Colour Trails Part 2 trial, the respondent rapidly connects numbered circles in sequence, but alternates between pink and yellow colours. A stopwatch is used to record the time taken to complete each trial along with qualitative features of performance indicative of brain dysfunction, such as near-misses, prompts, number of sequence errors, and colour sequence errors.

Physical Assessments

GAITRite

Gait analysis provides information about functional walking for people of all ages. Clinically, gait assessment measures progress before and after interventions. This is done by using GAITRite which is a portable single layer pressure sensitive walkway measuring temporal spatial parameters, providing easy identification of gait anomalies.

The Gait Variability Index (GVI) quantifies gait variability in spatiotemporal variables where a score ≥ 100 indicates a similar level of gait variability as the control group and lower scores denote increased gait variability.

- Velocity – Gait velocity measures in cm/sec
- Average Gait Variability Index (GVI) – Decrease with ageing; so higher score is better

Berg Balance Scale (BBS)

BBS is used to objectively determine a person's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14-item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function and takes approximately 20 minutes to complete.

- Berg Balance Scale – ≥ 20 : wheel chair user, $> 20 \leq 40$: walking with assistance, $> 40 \leq 50$: independent

The NeeuroFIT Course

The NeeuroFIT course is a trainer-led cognitive training programme conducted in a classroom. During each session, participants go through an introduction on cognitive functions, instructions on the SenzeBand setup and Memorie game play. Trainers assist participants in the various computerised brain training games within Memorie, providing motivation and support for participants.

Trainers provide the necessary education and structure for cognitive, relaxation and mindfulness training.

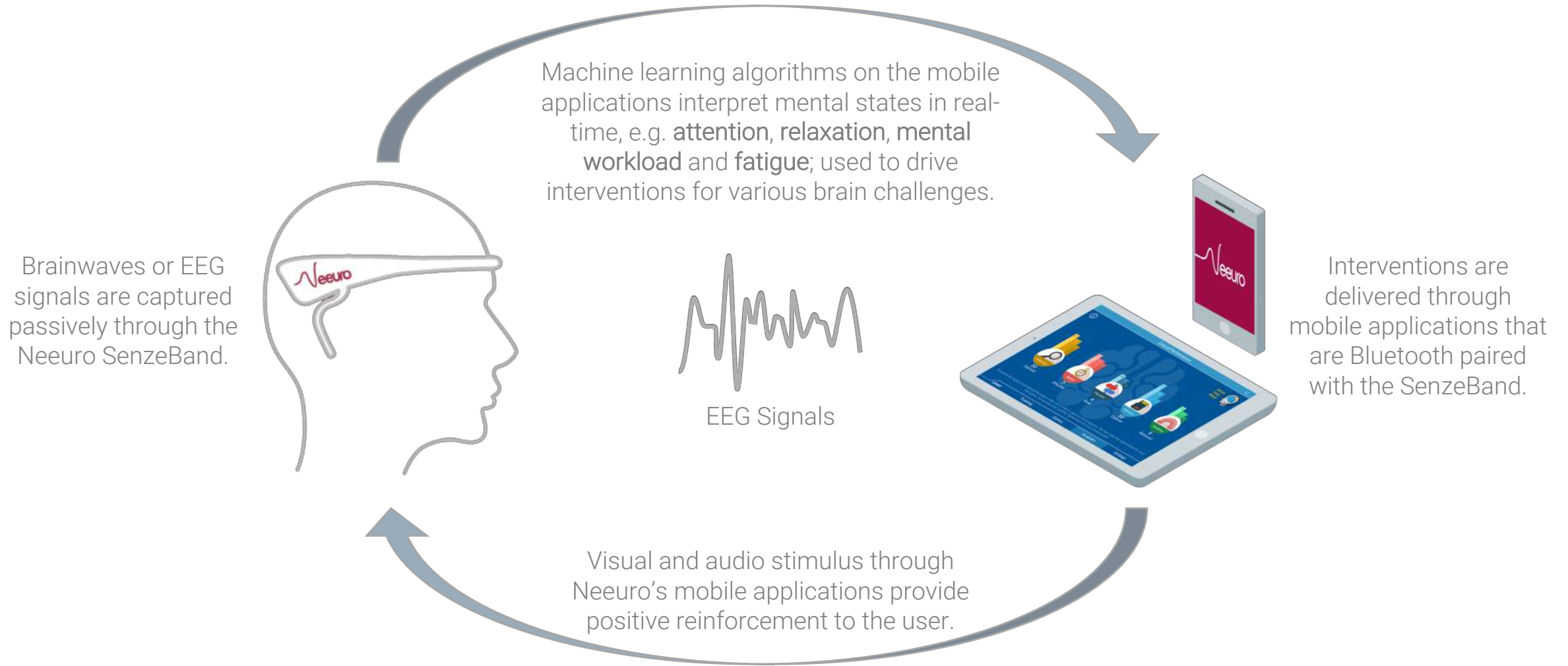




NeeuroFIT Classes conducted with seniors and led by trainers



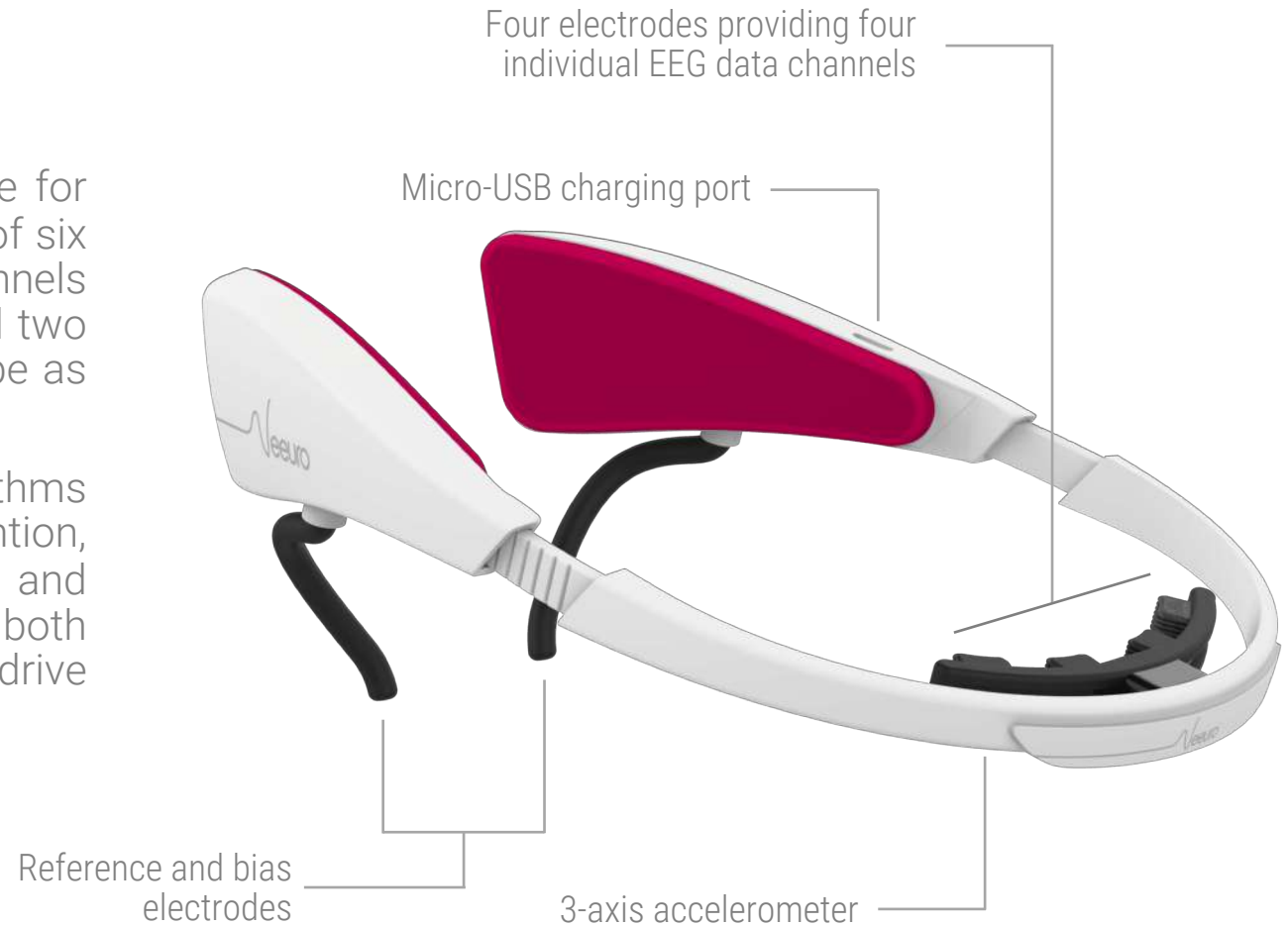
How It Works?



Neeuro SenzeBand

The Neeuro SenzeBand is a non-invasive device for capturing EEG (brainwaves) signals. It consists of six dry electrodes with four individual data channels located on the prefrontal cortex or forehead and two that are wrapped around the back of the ear lobe as reference and bias.

Together with Neeuro's machine learning algorithms it interprets various mental states like attention, relaxation, mental workloads, fatigue, stress and many more; providing insightful biofeedback for both measurement and used in real-time to drive interventions for various brain challenges.



Memorie Games



Memory

Memory is important for storing and retrieving information. This comes in both short and long term memory. Training lets us improve aspects such as working memory. Working memory can be thought of as mental sticky note that helps us keep tabs on information until we need to use it for thinking, comprehending and problem solving.



Decision Making

In decision making, we gather information and assess the right choices. By training logic and reasoning skills, we can make more mindful decision by organising relevant information and outlining alternatives.



Cognitive Flexibility

Training cognitive flexibility lets you efficiently shift your attention between one task and another. One example is switching between reading instructions from a cook-book and preparing a meal.



Spatial Ability

Spatial ability refers to the ability to understand, reason and remember the spatial relations among objects or space. Spatial training is relevant for daily tasks like driving, using maps and even exercising or playing sports.



Attention

Attention is the ability to concentrate on important things that matter at any given time. Our attention training games encourage players to gain a higher attention span to process new concepts and complete daily tasks with more ease.

Psychic Cyclist

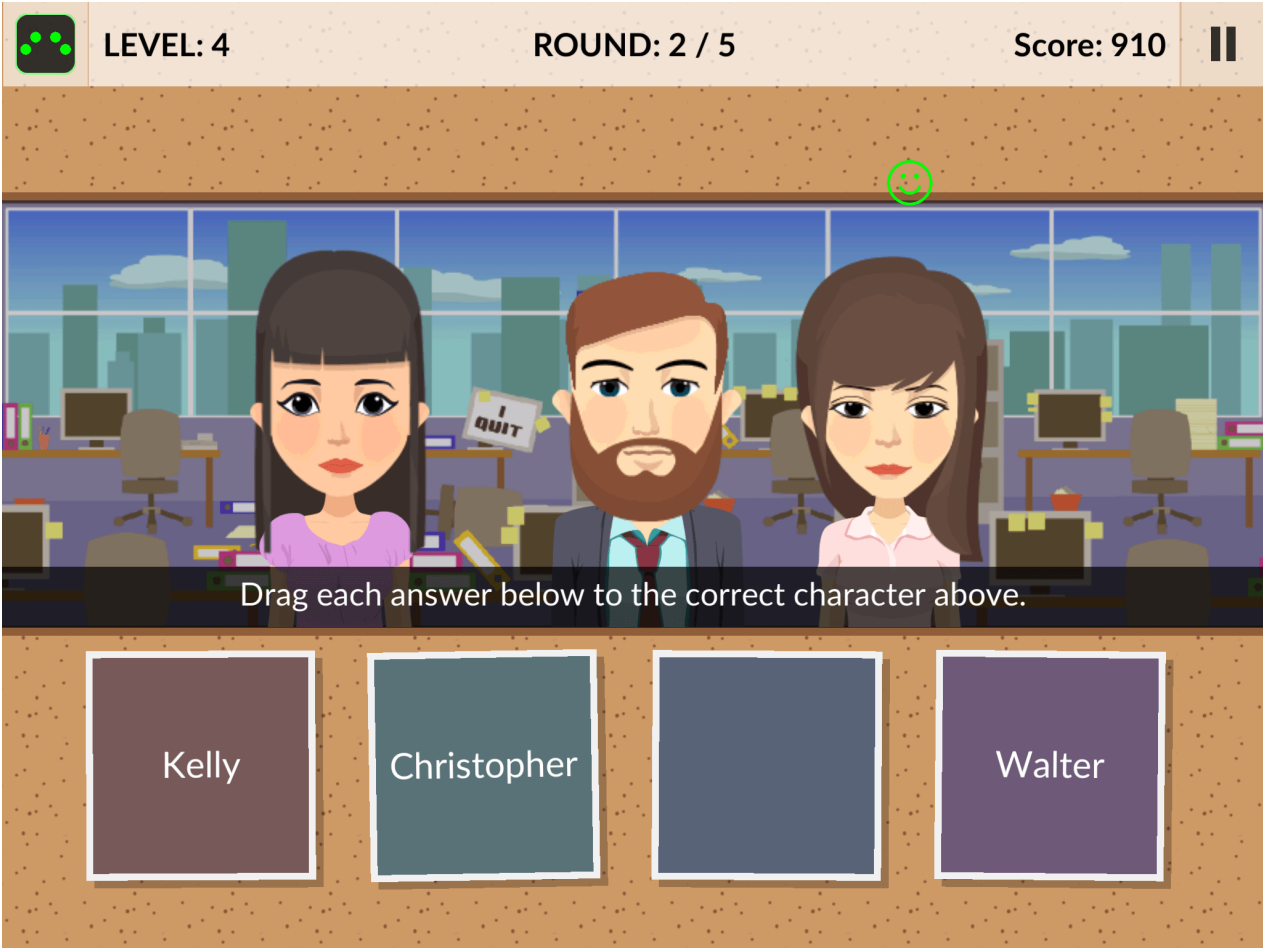


The Psychic Cyclist game in Memorie trains the user on attention and inhibition.

Attention levels from the user through EEG signals drives the cyclist to move ahead. This provides real time feedback if the user is focused, conditioning him to learn to focus.



Who's Who



Research Results

The intervention group attended ≥ 12 NeeuroFIT training sessions. No significant group differences for all baseline demographics and variables.



Total RBANS score ($p = 0.039$) and figure recall score ($p = 0.007$) increased in the intervention group but remained unchanged in the control group.

Picture naming remained unchanged in the intervention group but decreased in the control group ($p = 0.032$).

Intervention group required fewer prompts during CTT ($p = 0.045$).

BBS scores dropped in the control group ($p = 0.048$) but was maintained in the intervention group.

Conclusion

Team

- Peishi Yeo
- Tan Si Min Lynn
- Philip Yap
- Tze Pin Ng
- Shiou Liang Wee



**Geriatric Education &
Research Institute**



References

<https://shbc.com.sg>



Contact Us



+65 6397 5153



contact@neeuro.com



www.neeuro.com



Neeuro Pte. Ltd.
(Company Registration: 201302274H)

79 Ayer Rajah Crescent
#02-19 LaunchPad @ One-North
Singapore 139955

Notes

We are pleased to share that the final data collection for the study was conducted on 7 – 9 Nov 2018. A total of 36 participants completed 3rd assessments

- 3 participants completed assessments on 29 Oct and 1 Nov as they were not available during the above dates
- 33 completed assessments on 7 – 9 Nov
- Excluding those who dropped out before the start of assessments, 2 participants did not show up for their scheduled slot as they were busy/having blurry vision after a cataract surgery. Please see the attached excel sheet for more information.

An overview of the project timeline and dropout rates can be seen below:

Many thanks for working with us all this while and for making this project possible!

As discussed, we will

- Finish scoring, data entry, and data analyses for Batch 1/Bukit Batok CC by the end of this year
- Meet in late Dec to go over the above findings and Neeuro's white paper that would feature the study
- Thereafter, we will continue to score and analyse data for Batch 2/Keat Hong CC.

Project Timeline

Screening

- Batch 1: 20 Sept 2017
- Batch 2: 7 May 2018

2nd Assessment

- Batch 1: 10 – 12 Jan 2018
- Batch 2: 16, 17, 20, 21 Aug 2018

1st Assessment

- Batch 1: 2 – 6 Oct 2017
- Batch 2: 17, 18, 21 May 2018

3rd Assessment

- Batch 1: 12 – 13 Apr 2018
- Batch 2: 7 – 9 Nov 2018

	Total	Intervention	Control
Screening	147	–	–
1 st Assessment	125	65	60
2 nd Assessment	94	52	42
3 rd Assessment	77	45	32
Drop Outs (%)	48 (38.40%)	20 (30.77%)	28 (46.67%)

By Batch

Batch 1 (Bukit Batok CC)	Total	Intervention	Control
Screening	78	–	–
1 st Assessment	64	31	33
2 nd Assessment	52	25	27
3 rd Assessment	41	22	19
Drop Outs (%)	23 (35.94%)	9 (29.03%)	14 (42.4%)

Batch 2 (Keat Hong CC)	Total	Intervention	Control
Screening	69	–	–
1 st Assessment	61	34	27
2 nd Assessment	42	27	15
3 rd Assessment	36	23	13
Drop Outs (%)	25 (40.98%)	11 (32.35%)	14 (51.85%)