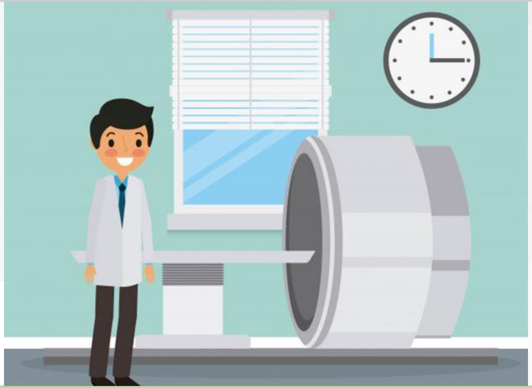
Group 8

Mapping the reading circuitry for skilled pre- and post-lingual deaf Chinese readers:

An fMRI study of semantic and phonological processing



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Introduction

Phonological processing for deaf people?

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ERP Studies? How about fMRI studies?

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Mapping the reading circuitry for skilled deaf readers:
An fMRI study of semantic and phonological processing (Emmorey et al. ,2013)

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Research Question: **Chinese**? **Time of deafness**?

Hypothesis

Overall Degree of Activation	Normal Hearing Control	>	Post-lingual Hearing Impaired	>	Pre-lingual Hearing Impaired
Degree of Activation in ***Semantic Processing***	Normal Hearing Control	≈	Post-lingual Hearing Impaired	≈	Pre-lingual Hearing Impaired
Degree of Activation in ***Phonological Processing***	Normal Hearing Control	≠	Post-lingual Hearing Impaired	≠	Pre-lingual Hearing Impaired

Region Involved in ***Phonological Processing***

- Normal Hearing Control: Similar to previous study
- Post-lingual Hearing Impaired: Auditory remain
- Pre-lingual Hearing Impaired: No auditory region involved

Participants - Selection Criteria

Pre-lingual Hearing Impaired

Deaf ***BEFORE*** speech and language development

Post-lingual Hearing Impaired

Deaf ***AFTER*** speech and language development

Severe to Profound Hearing Loss (more than 70dBHL)

Without Any Hearing Device

Consistent in the way of daily communication

Normal Hearing Control

No Hearing Loss

Participants - Selection Criteria

Pre-lingual Hearing Impaired	Post-lingual Hearing Impaired	Normal Hearing Control

Right-handed

No other mental or emotional disorders and/or biological disabilities

Normal or corrected-to-normal vision

Participants - Test

Pre-lingual Hearing Impaired

Post-lingual Hearing Impaired

Normal Hearing Control

Questionnaire on Reading Preference and Habits (Emmorey et al. ,2013)

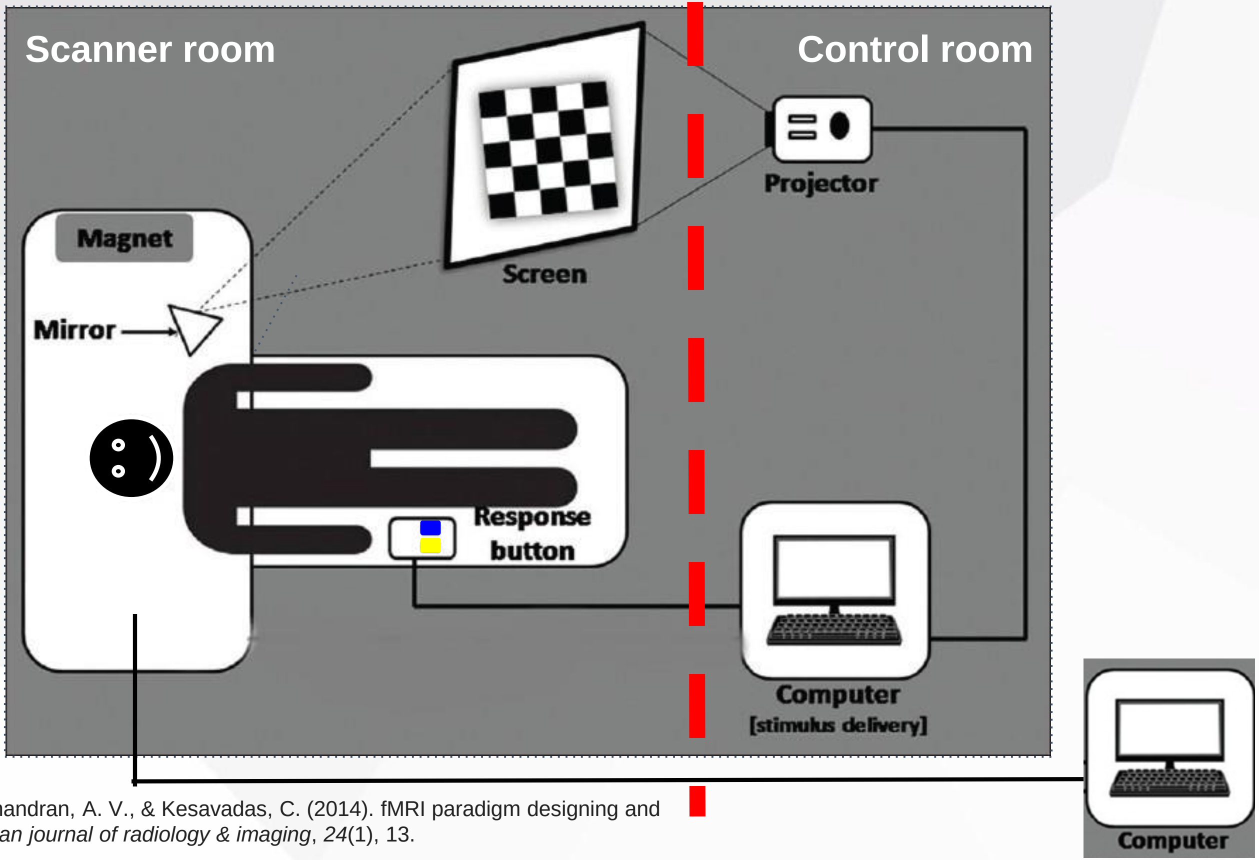
IQ Test - Raven's Progressive Matrices (Raven’ s) (Yeung, Ho, Wong, Chan, Chung, & Lo, 2012)

Reading Ability Test - Standardized Graded Character Naming Test (GCNT) (Leung, Chang, & Kwan, 2007)

Vocabulary Test - The Hong Kong Cantonese Receptive Vocabulary Test (Wong, Ciocca, & Yung, 2009)

Phonological Awareness Test - Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD; Ho, Chan, Tsang, & Lee, 2000)

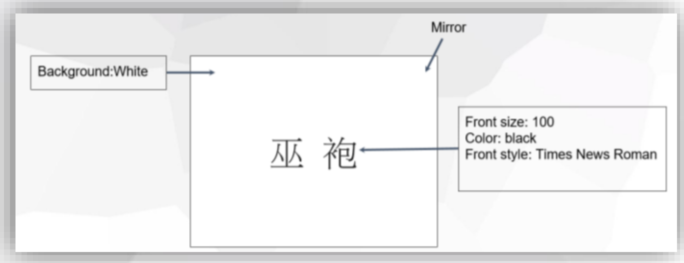
Experimental design - Setting



James, J. S., Rajesh, P. G., Chandran, A. V., & Kesavadas, C. (2014). fMRI paradigm designing and post-processing tools. *The Indian journal of radiology & imaging*, *24*(1), 13.

Experimental design - Materials

Task 1. The rhyme judgement task(Sergent et al., 1992) -- phonological processing



- To judge whether two words are rhyme or not
- 112 pairs (half rhyme and half non-rhyme)
- Number of strokes : 5-15 strokes per each word
- Frequency and age of acquisition (*Hong Kong Chinese Lexical Lists for Primary Learning*)
- Consonants vary
- Examples:

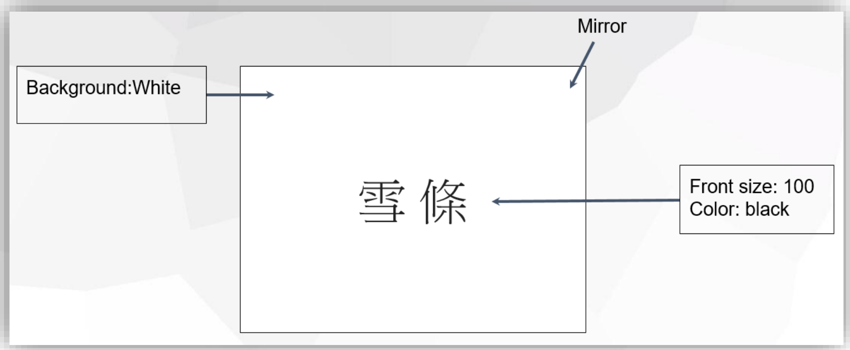
巫 (witch)	/mou21/	袍 (robe)	/p^{h}ou21/	Rhyme
沙 (sand)	/sa:55/	花 (flower)	/fa:55/	Rhyme
雨 (rain)	/jy:23/	柱 (pillar)	/ts^{h}y:23/	Rhyme
弟 (brothers)	/t ɐ i33/	包 (bun)	/pa:u55/	Not rhyme
符 (symbol)	/fu:21/	書 (book)	/sy:55/	Not rhyme

Experimental design - Materials

Task 2. The category decision task (living or non-living) (Wagner et al., 1997) -- semantic processing

- 112 disyllabic vocabularies (half are living things, half are non-living
- Number of strokes : 5-15 strokes per each word
- Frequency and age of aquisition (*Hong Kong Chinese Lexical Lists for Primary Learning*)
- Examples:

雪條 (ice-cream)	/sy:t2 t^hi:u25/	Non-living
青蛙 (frog)	/ts^h ɛ : ŋ 55 wa:55/	Living
狐狸 (fox)	/wu:21 lei21/	Living
恤衫 (shirt)	/s ɵ t55 sa:m55/	Non-living
氣球 (ballon)	/hei3 k^h ɐ u21/	Non-living

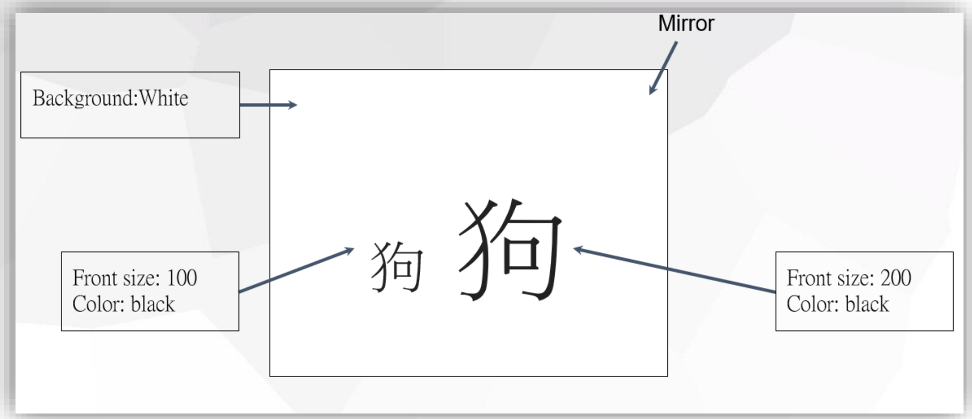


Experimental design - Materials

Task 3. Baseline Task-- control

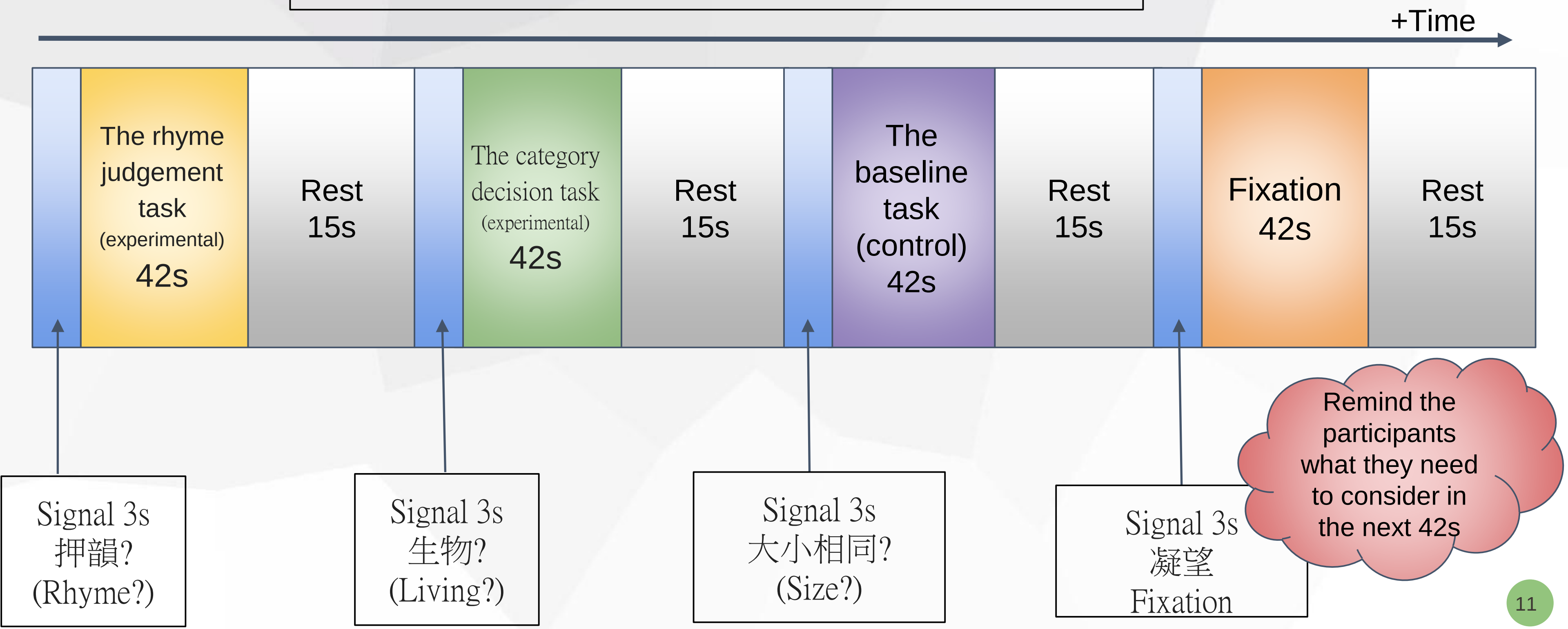
- 112 pairs (half are same size, half are different size)
- Number of strokes : 5-15 strokes per each word
- Frequency and age of aquisition (「香港小學學習字詞研究」)
- Examples:

狗 狗 ; 桌 桌



Experimental design - Procedure

Experimental design : Block design



Experimental design - Procedure

The rhyme judgement task 42s

Reponse must be given in 3s in each stimulus

1 s	2s	1 s	2s	1 s	2s	1 s	2s	1 s	2s	…	1 s	2s

fMRI images are also captured

1 s

Experimental materials of first stimulus appear on the screen and participants can give response

巫　袍

2s

A question mark appears, remind the participants to give response within 2s

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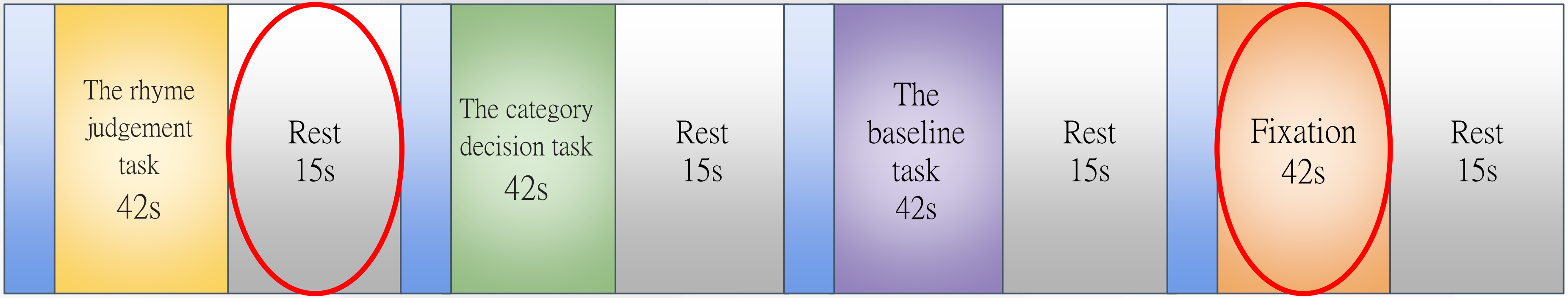
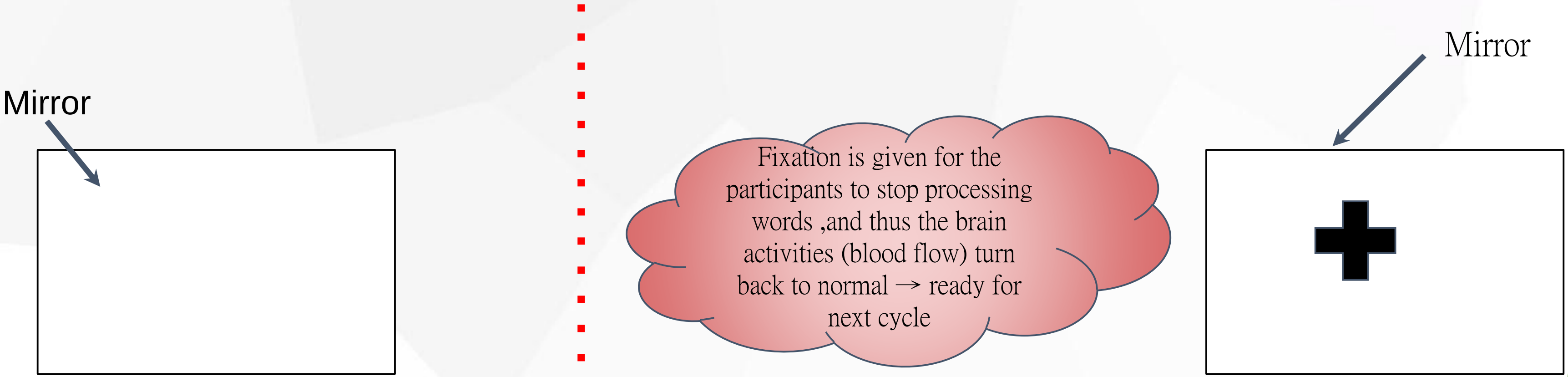
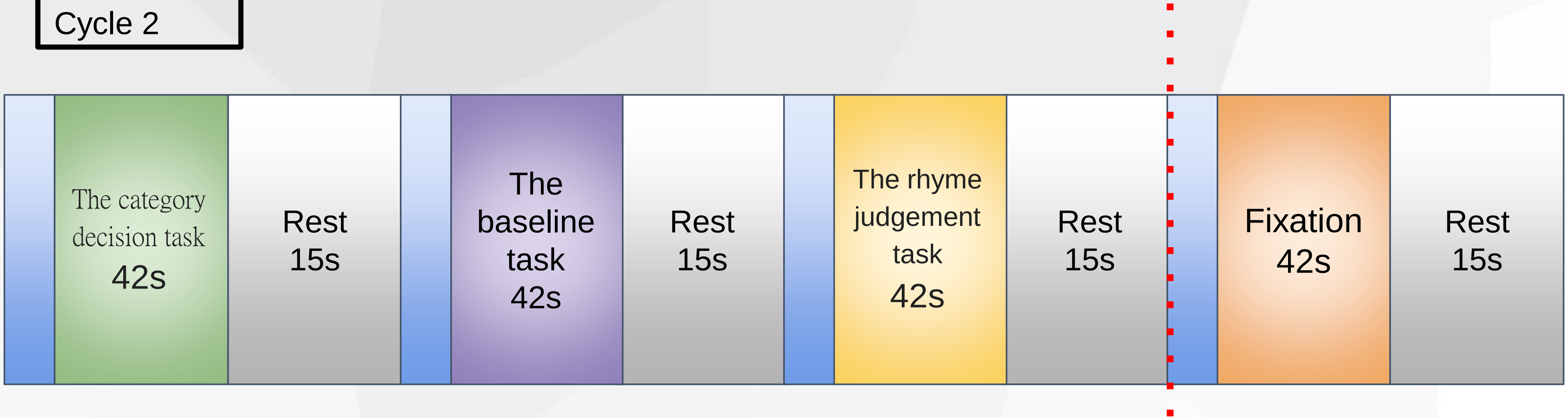
Experimental design - Procedure





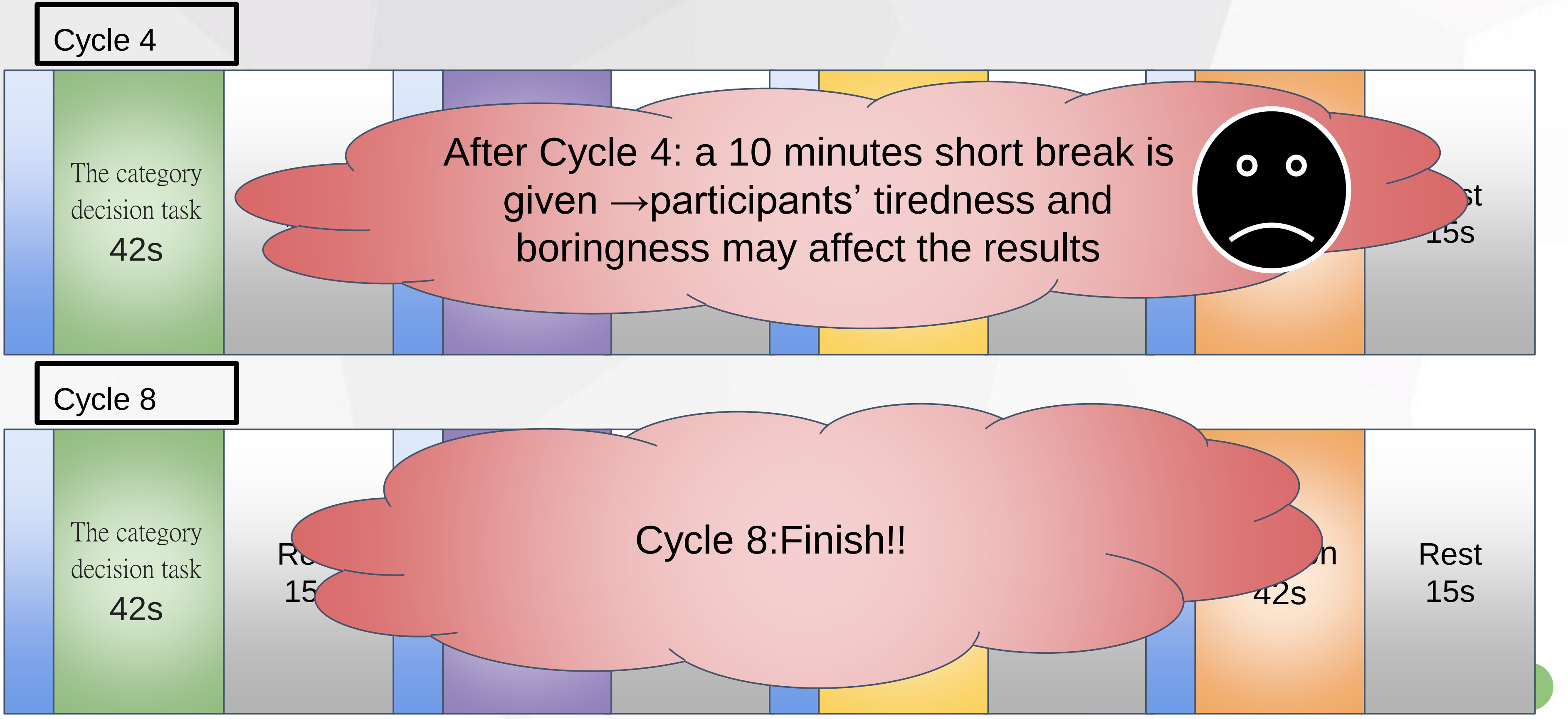
Experimental design - Procedure

Cycle 2



Two experimental conditions and the control block will be reordered in the next cycle (the order in the previous cycle is different from that in the current cycle
→Avoid participant's prediction and habitual response!!

Experimental design - Procedure



Experimental design - Trial

Video link :
https://drive.google.com/file/d/1ARjMTKn_BtCd_pfxSTjifTZBoPOpoOU9/view?usp=sharing

Trials

	The rhyme judgement task 42s	Rest 15s		The category decision task 42s	Rest 15s		The baseline task 42s	Rest 15s		Fixation 42s	Rest 15s

- Trial(s) will be given before the experimental materials present
- Accuracy is monitored. If three wrong responses are given, the whole set of trials will be repeated.
- fMRI images are not captured
- Similar to experimental cycle but the materials used in trials will not be reused as experimental stimuli.
  - Make sure the participants know what they should do in the experiment

Measurement

The baseline data − Fixation = Non-linguistic processing

The rhyme judgement data − Fixation − Non-linguistic processing = Phonological processing

The category decision data − Fixation − Non-linguistic processing = Semantic processing

Measurement

Degree of activation

Activation **Regions**

Reaction Time

Accuracy

Implication

1. **Mapping** processing with brain region, espeically in **hearing impaired**

2. If ***post-lingual*** hearing-impaired had the similar activation as ***normal hearing***
   - Audio input does help reading
     - Practicality of hearing device in reading

Limitation

Participants
- Large range of age
- Hard to find participants

Stimuli
- Orthographic structure
- Number of strokes

Brain Regions
- Unclear boundaries between regions
- “Suggested” functions of regions

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