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# The Influence of Bilingualism and Hearing Loss on Cognition in Older Adults

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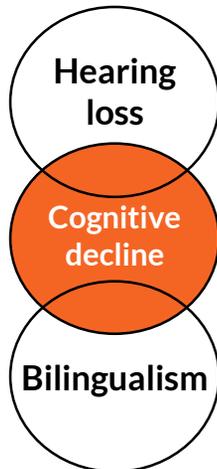
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## Introduction

- ❖ Cognitive decline can consist of many well-known diseases and disorders impairing the mind as one gets older (Craik & Bialystok, 2010; Marian & Shook, 2012)
- ❖ Age-related hearing loss has been linked to cognitive decline in older adults
  - Lin (2011) concluded that a greater hearing loss was associated with poorer cognitive functioning



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## Introduction, continued

- ❖ Existing research has shown that bilingualism improves executive control abilities in children (van den Noort et al., 2019).
- ❖ Bilingualism can also affect the rate of cognitive decline in older adults (Craik & Bialystok, 2010)
- ❖ Whether bilingualism protects older adults against the negative effects of hearing loss on cognition is unclear

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3

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## Purpose

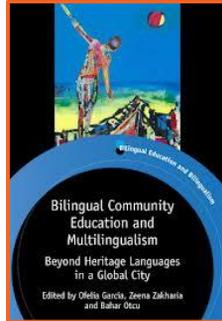
- ❖ The purpose of this pilot study is to explore the relationship between hearing impairment and bilingualism in relation to cognitive decline.
- ❖ Does bilingualism offer a protective effect on older individuals with cognitive decline associated with hearing impairment?

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4

## Significance: Language Other than English in NY

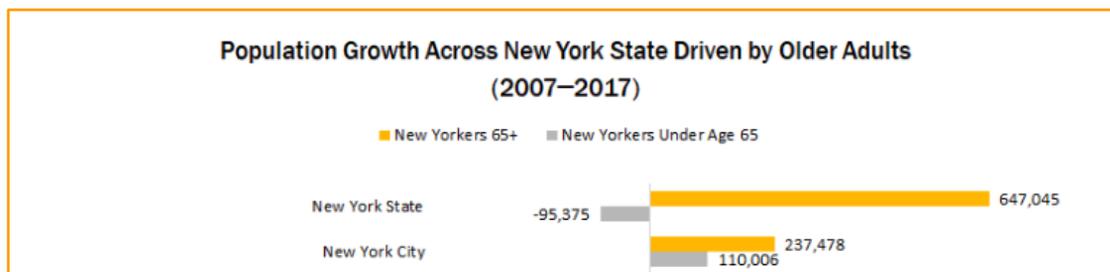
1. Spanish
2. Chinese
3. Russian
4. Haitian (Creole)
5. Italian
6. French
7. Yiddish
8. Korean
9. African Languages
10. Polish
11. Tagalog
12. Greek



13. Arabic
14. Hebrew
15. (Bengali)
16. Urdu
17. Hindi
18. German
19. Japanese
20. Serbo-croatian
21. Portuguese
22. Persian
23. Vietnamese
24. Hungarian
25. Gujarati

*Languages Other Than English (LOTE) spoken by New Yorkers over 5 years of age, US Census Bureau (2009) American Community Survey Table B160001 in Garcia, Zakharia & Ota, 2013, p13.*

## Significance: Growing Older Population



- ❖ With the growing older population comes a growing hearing-impaired population

# Methodology: Participants

- ❖ Two groups of older adults were compared at Long Island University, Brooklyn
  - > Group A was monolingual (English)
  - > Group B was bilingual (Spanish - English)
- ❖ A group of individuals aged 21 to 26 years old with normal hearing
  - > 39 participants

# Methodology: Test 1

**MONTREAL COGNITIVE ASSESSMENT (MOCA)**  
Version 7.1 Original Version

NAME: \_\_\_\_\_ Education: \_\_\_\_\_ Date of birth: \_\_\_\_\_  
Sex: \_\_\_\_\_ DATE: \_\_\_\_\_

<b>VISUOSPATIAL / EXECUTIVE</b>		Copy cube	Draw CLOCK (Ten past eleven) (3 points)	POINTS			
		<input type="checkbox"/> Contour <input type="checkbox"/> Numbers <input type="checkbox"/> Hands	___/5				
<b>NAMING</b>							
		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	___/3				
<b>MEMORY</b>							
Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.		FACE	VELVET	CHURCH	DAISY	RED	No points
1st trial							
2nd trial							
<b>ATTENTION</b>							
Read list of digits (1 digit/sec).		Subject has to repeat them in the forward order [ ] 2 1 8 5 4			___/2		
		Subject has to repeat them in the backward order [ ] 7 4 2					
Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors		[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B			___/1		
Serial 7 subtraction starting at 100		[ ] 93	[ ] 86	[ ] 79	[ ] 72	[ ] 65	___/3
		4 or 3 correct subtractions: 3 pts, 2 or 1 correct: 2 pts, 1 correct: 1 pt, 0 correct: 0 pt					
<b>LANGUAGE</b>							
Repeat: I only know that John is the one to help today. [ ] The cat always hid under the couch when dogs were in the room. [ ]		Fluency / Name maximum number of words in one minute that begins with the letter F [ ] _____ (N ≥ 11 words)			___/2		
<b>ABSTRACTION</b>							
Similarity between e.g. banana - orange = fruit [ ] train - bicycle [ ] watch - ruler [ ]					___/1		
<b>DELAYED RECALL</b>							
Has to recall words WITH NO CUE		FACE	VELVET	CHURCH	DAISY	RED	Points for UNCUED recall only
Multiple choice cue		[ ]	[ ]	[ ]	[ ]	[ ]	
Optional					___/5		
<b>ORIENTATION</b>							
[ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City					___/6		
© Z. Nasreddine MD		www.mocatest.org		Normal: ≥ 26 / 30	TOTAL	___/30	
Administered by: _____					Add 1 point if ≤ 12 yr edu		

Nasreddine et al., 2005

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## Methodology: Test 2

- ❖ The Adapted Reading Span Test (RST)
  - Span test commonly used to gauge efficiency of working memory
  - The participants read groups of 2-6 simple sentences aloud and are asked to recall the last word of each of them in no specific order.
  - There are 100 sentences in the whole test, and there are 4 different versions of the test, distributed randomly.

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9

Of course it was expensive, but he was very happy with his beautiful new car.

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Five minutes before the end of the match, the referee gave the deciding penalty.

11

RECALL

12

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## Adaptations to the Original RST

- ❖ A new software package has been produced to conduct the RST variant developed by van den Noort et al. (2008).
  - ❖ In the new RST, presentation time is not restricted as in the original RST, therefore participants have more time to read the sentence out loud.
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## Adaptations (cont.)

- ❖ Two sentences were deemed slightly (in)sensitive and were changed keeping all strict methodological criteria intact

Sentences that were changed	
van den Noort et al. (2008)	Current Study
Ex 0.2c. The only way the police could stop the bank robbery was by <b>killing</b> the two men.	Ex 0.2c. The only way the police could stop the bank robbery was by <b>shooting</b> the two men.
Ex 3.2. The attack of the <b>Israelis</b> on the <b>Palestinians</b> puts peace in great danger.	Ex 3.2. The attack of the <b>aliens</b> on the <b>civilization</b> puts peace in great danger.

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## Key Findings

- ❖ Statistical analysis was conducted to:
  - Determine whether our adapted RST is an adequate replacement to the original van den Noort (2008).
  - Determine whether bilingualism offers a protective effect on older individuals with cognitive decline associated with hearing loss.

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 15

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## Comparison of van den Noort et al. (2008) RST and revised RST

Participant Background	
van den Noort et al. (2008)	Current study
40 participants total	39 participants total
Age range: 19 to 28 years old Mean: 22.4 SD: 2.3	Age range: 21 to 26 years old Mean: 23.6 SD: 1.5

- ❖ In both studies, participants had a high school level education or higher.

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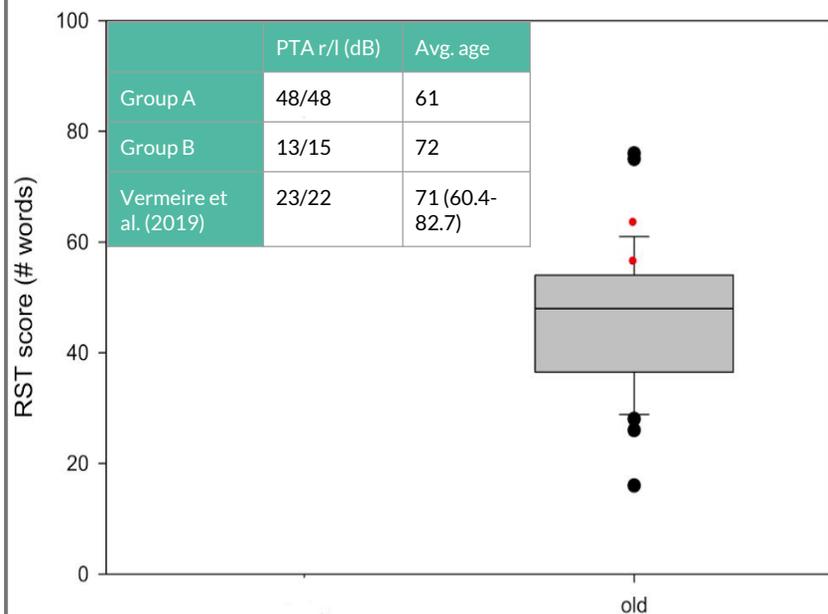
 16

## Comparison of van den Noort et al. (2008) RST and revised RST

Reading Span			
	van den Noort et al. (2008)	Current study	Significance
Series 1	13.2 (SD 1.4)	13.3 (SD 3)	$p = 0.877$
Series 2	12.9 (SD 1.4)	13.2 (SD 3.3)	$p = 0.692$
Series 3	13 (SD 1.3)	13.5 (SD 3)	$p = 0.325$
Series 4	13.3 (SD 1.9)	13.4 (SD 3.1)	$p = 0.388$
Series 5	13.1 (SD 1.9)	14.2 (SD 3.1)	$p = 0.078$
<b>Total</b>	<b>65.6 (SD 5.8)</b>	<b>67.5 (SD 13.2)</b>	<b><math>p = 0.428</math></b>

17

## Older Participants RST results compared to Vermeire et al. (2019)



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## Conclusion

- ❖ The adapted RST is an adequate replacement to the older van den Noort (2008) version.
- ❖ The older bilingual group (Group B) scored slightly better in the RST than its monolingual counterpart (Group A)
  - The Group B score is above normal range, but it could be an outlier
- ❖ We cannot undeniably conclude that bilingualism has a positive effect.

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19

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## Limitations and Further Research

- ❖ Limitations
  - Small sample size
    - Using a larger sample size could explain whether the Group B score is an outlier or not
  - Study focused on solely Spanish-English bilinguals
    - More comprehensive results with more language groups
- ❖ The results of this study can be used to encourage further research on possible correlating variables of cognitive decline - such as hearing loss and bilingualism - in older adults

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20

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- ❖ I would like to thank:
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    - The NSF REU program mentors
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21

## Revised RST: Participant Profile

Reading Span			
	Current study		Significance
	Monolingual	Bilingual	
Series 1	13.26 (SD 2.16)	13.30 (SD 3.70)	p = 0.970
Series 2	13.26 (SD 2.88)	13.10 (SD 3.74)	p = 0.880
Series 3	14.21 (SD 2.57)	12.85 (SD 3.20)	p = 0.153
Series 4	13.68 (SD 2.16)	13.05 (SD 3.79)	p = 0.523
Series 5	14.79 (SD 2.84)	13.55 (SD 3.27)	p = 0.215
<b>Total</b>	<b>69.21 (SD 10)</b>	<b>65.85 (SD 15.67)</b>	<b>p = 0.430</b>

22