

# CLSA Webinar Series



## Combined Vision and Hearing Loss in the CLSA: Prevalence, Severity and Relationships to Cognitive and Social Variables

Dr. Walter Wittich, University of Montréal

12 pm to 1 pm ET | May 21, 2019

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# Disclosures

- Funding in past 5 years – peer-reviewed:



- Other funding - industry:



- Conflicts of interest: none

# CLSA & Networking Resources

- Study Funding:
  - Canadian Institutes of Health Research (CIHR) Catalyst grant ACD 373228
  - Quebec Research Network on Aging (RQRV) Supplement
- Infrastructure: Canadian Consortium on Neurodegeneration and Aging (CCNA) Team 17 - *Interventions at the Sensory-Cognitive Interface*
- Funding for CLSA is provided by CIHR (grant LSA 9447) and the Canada Foundation for Innovation.
- Collaborative Data Access: interRAI & CIHI



# Meet the team – CCNA Team 17

## Interventions at the Sensory and Cognitive Interface.



Our Post-docs  
**Anni Hämäläinen**  
Andrea Urqueta Alfaro  
Nathalie Giroud

Our Trainees  
Sana Rehan  
Maksim Parfyonov  
Samantha Layson  
Faisal Al-Yawer  
Lebo Kolisang

Our Staff  
Samantha Bishundayal  
Karine Elalouf

# Sensory-Cognitive Aging

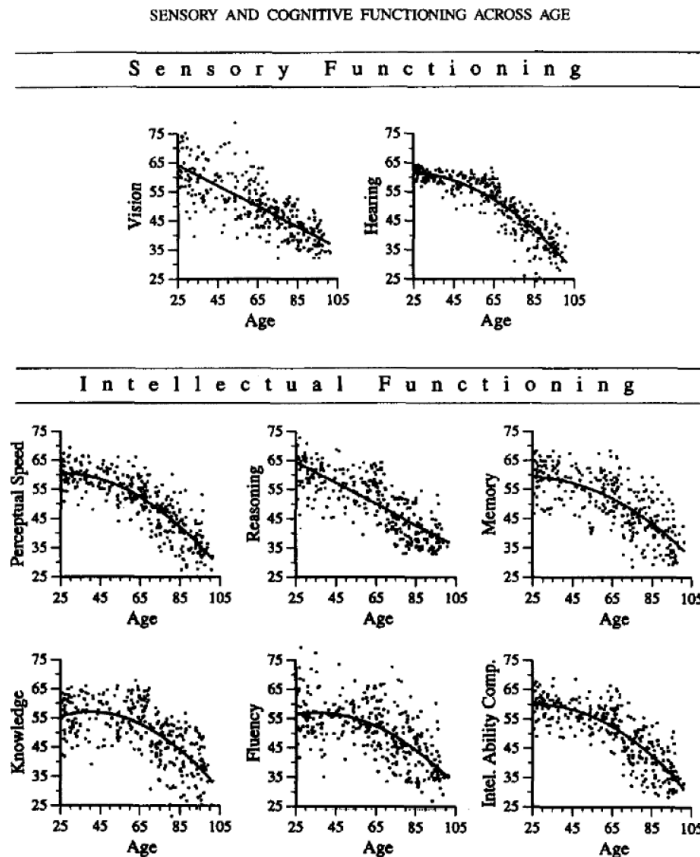


Figure 1. Cross-sectional age gradients for vision, hearing, five intellectual abilities, and the intellectual ability composite ( $N = 315$ , age range = 25–101 years). Linear and quadratic age trends are reported in the top rows of Table 1. With respect to vision and reasoning, quadratic age trends did not differ significantly from zero ( $p > .01$ ). Intel. Ability Comp. = intellectual ability composite.

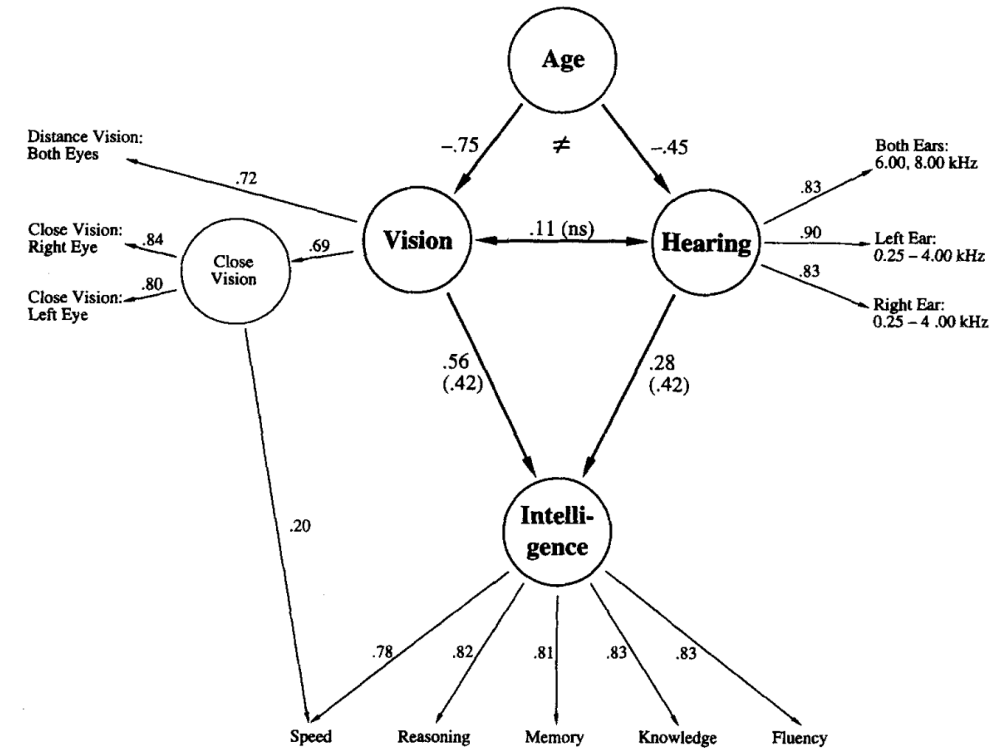


Figure 4. The structural model of the relationship between age, visual acuity, auditory acuity, and intellectual functioning; for fit statistics, see Table 4. The path coefficient from age to vision was significantly higher than the path coefficient from age to hearing ( $\neq$ ). The correlation between vision and hearing did not differ significantly from zero ( $ns$ ). The path coefficients from vision to intelligence and from hearing to intelligence did not differ significantly from each other; the magnitude of the constrained estimate was  $\beta = .42$ .

Lindenberger & Baltes, 1994, *Psychol. Aging*  
 Baltes & Lindenberger, 1997, *Psychol. Aging*

# Perceptual & Cognitive Decline in Aging

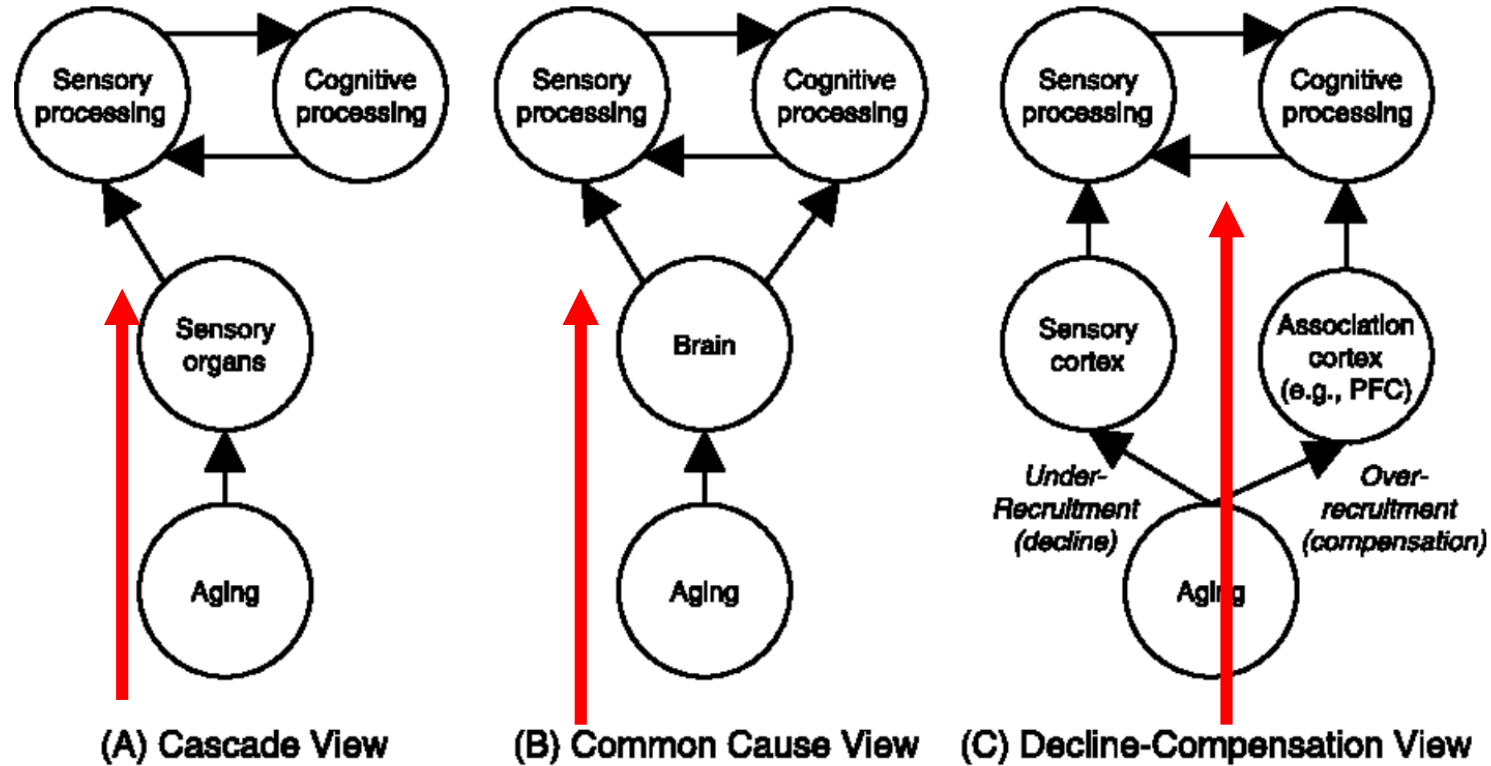


FIG. 1.3. Three views of perceptual and cognitive decline in aging.

# Some Vocabulary

- Combined vision and hearing loss
- Dual sensory impairment
- Acquired deafblindness
  
- Deafblindness – umbrella term in clinic
- Dual sensory impairment - researchers

# Why Dual Sensory Impairment?

- Deaf-blind, or deafblind, is a combination of hearing and vision loss of any varying degrees that affects a person's ability to **communicate**, get environmental **information**, **participate** in the community, obtain and keep a **job**, and maintain **independence**.

American Association of the Deaf-Blind, 2010

- Deafblindness is a combined vision and hearing impairment of such severity that it is hard for the impaired senses to compensate for each other. Thus, deafblindness is a **distinct disability**.

New Nordic Definition of Deafblindness, 2016

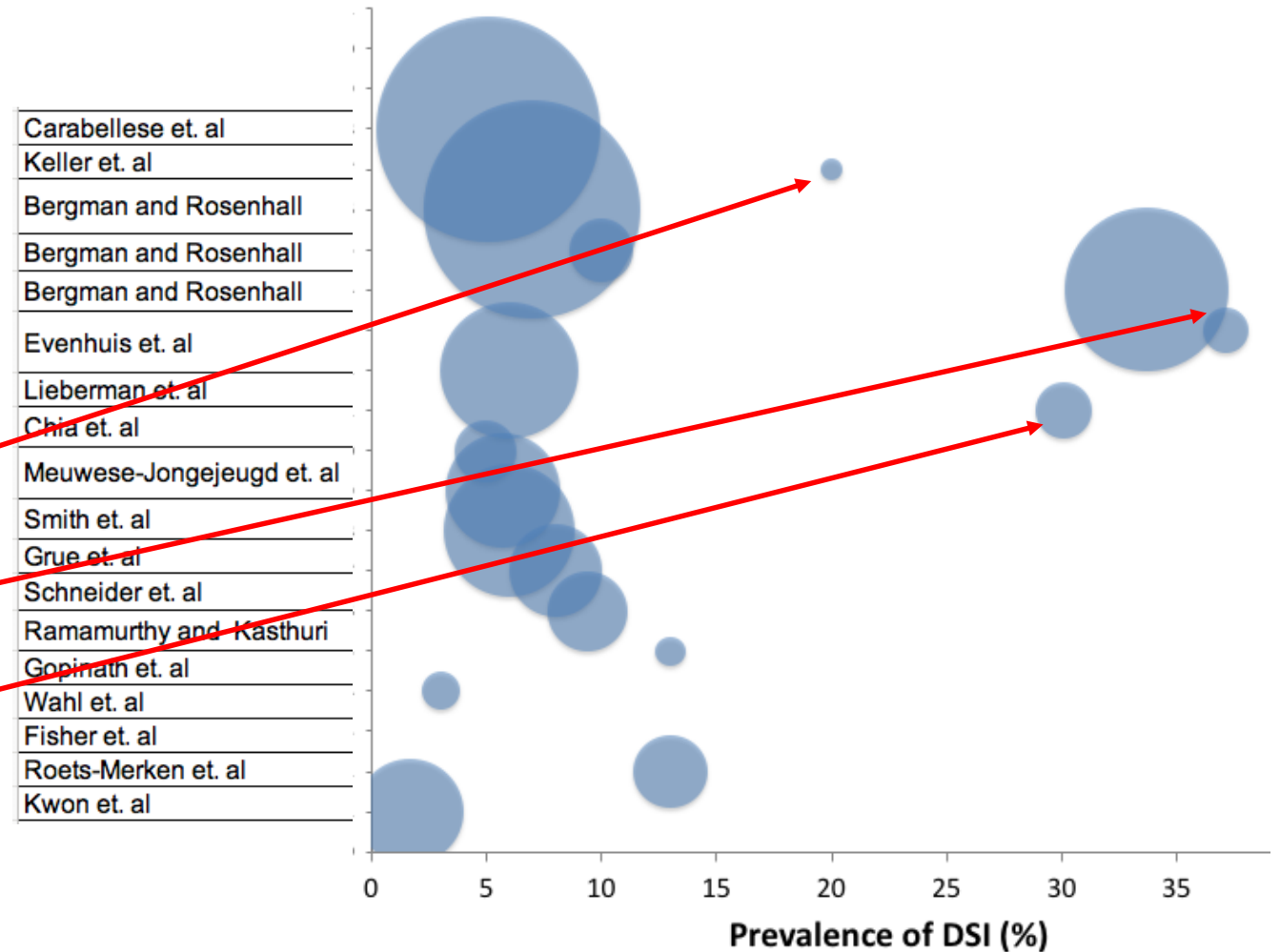


# Why study Dual Sensory Impairment & Aging?

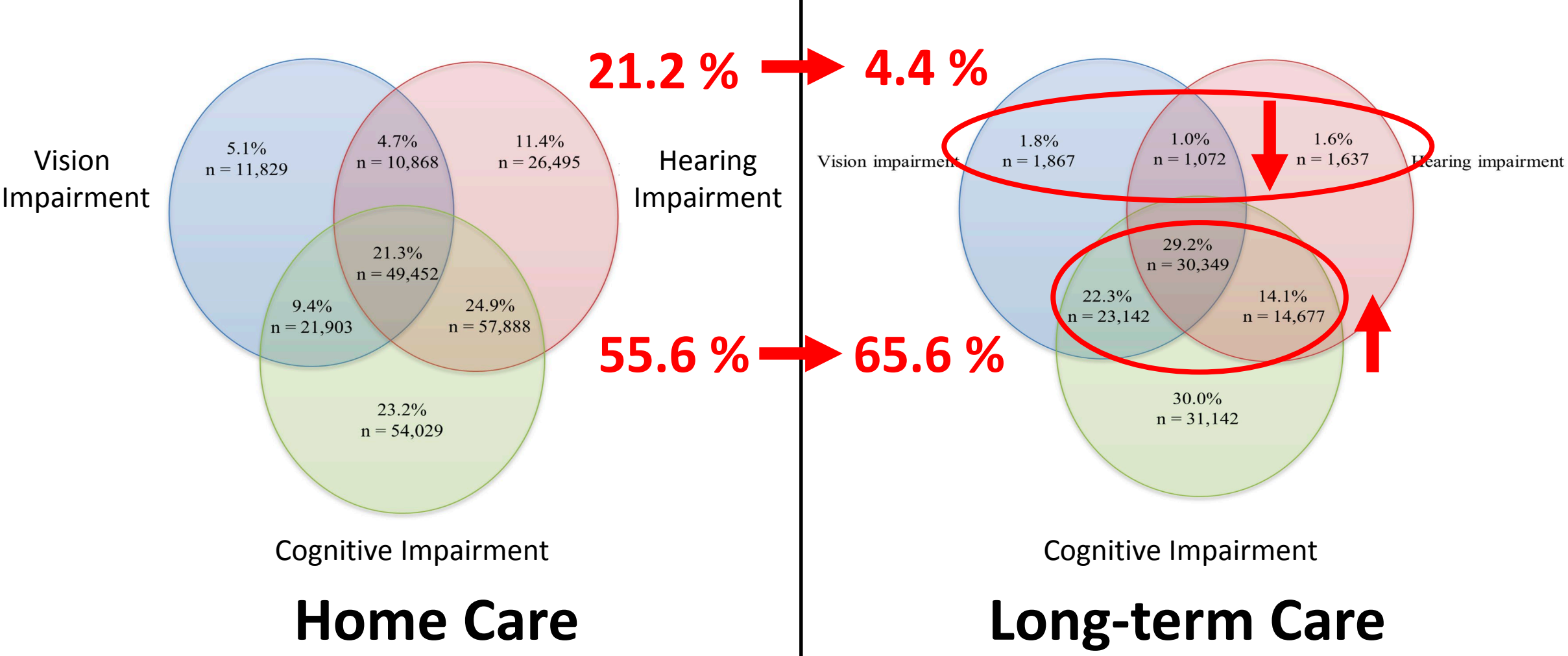
- 1+1 does NOT equal 2
- DSI & Cognition
- DSI & Social Isolation
- DSI & Rehabilitation
- DSI & Policy
- DSI & ...

# DSI Prevalence

- Population stats 0.2% to 2% depending on development stats of country
- Aging stats: Age 50+ around 5%
  - Using VA and dB HL
- Higher in sub-populations
  - Residential care
  - Rural populations
  - Those with hip fractures



# DSI and Cognition



Guthrie, et al. (2018), *Plos One*, 13(2), e0192971. <https://doi.org/10.1371/journal.pone.0192971>

# And it matters

Age and Ageing 2014; 43: 69–76  
doi: 10.1093/ageing/aft122

Published by Oxford University Press on behalf of the British Geriatrics Society 2013.  
This work is written by (a) US Government employee(s) and is in the public domain in the US.

## Impairments in hearing and vision impact on mortality in older people: the AGES-Reykjavik Study

DIANA FISHER<sup>1</sup>, CHUAN-MING LI<sup>2</sup>, MAY S. CHIU<sup>2</sup>, CHRISTA L. THEMANN<sup>3</sup>, HANNES PETERSEN<sup>4,5</sup>,  
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TAMARA B. HARRIS<sup>9</sup>, LENORE J. LAUNER<sup>9</sup>, GUDNY EIRIKSDÓTTIR<sup>8</sup>, VILMUNDUR GUDNASON<sup>4,8</sup>,  
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 **frontiers**  
in Aging Neuroscience

ORIGINAL RESEARCH  
published: 22 March 2019  
doi: 10.3389/fnagi.2019.00065

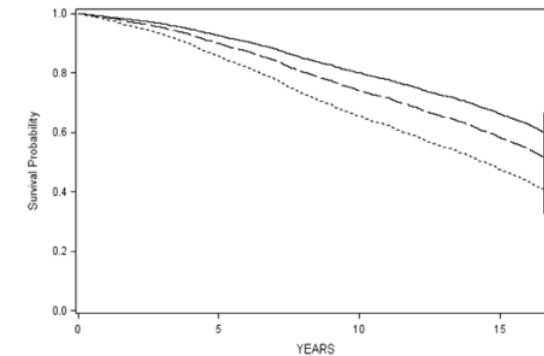


## Cognitive Performance Concomitant With Vision Acuity Predicts 13-Year Risk for Mortality

Huan Liao<sup>1,2†</sup>, Zhuoting Zhu<sup>3†\*</sup>, Hongxuan Wang<sup>1,2</sup>, Xiaoming Rong<sup>1,2</sup>,  
Charlotte Aimee Young<sup>4</sup> and Ying Peng<sup>1,2\*</sup>

...but does not always replicate.

## Number of sensory impairments & mortality USA, N=2,418, age: 57-97 years, 45.4% died in 15-year period starting in 2000

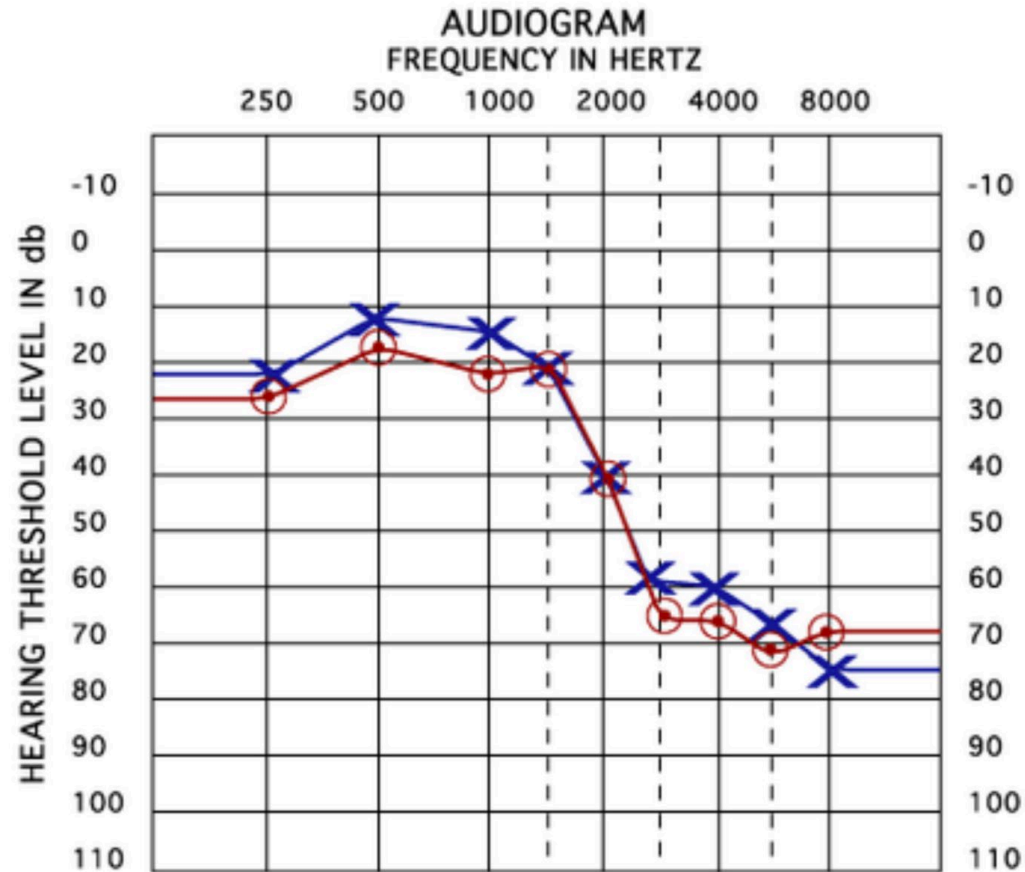


Hazard ratios adjusting for age & sex  
One impairment: 1.40  
Two or more impairments: 2.12  
**But only olfaction was significantly related to mortality after adjusting for subclinical atherosclerosis and Inflammation.**

Figure 1. Age- and sex-adjusted probability of survival by number of sensory impairments in the Epidemiology of Hearing Loss Study. Solid line = no sensory impairment; dashed line = one sensory impairment; dotted line = two or more sensory impairments.

Schubert, C.R., Fisher, M.E., Rinto, A.A., Klein, B.E.K., Klein, R., Tweed, T.S., & Cruickshanks (2017).  
*Journal of Gerontology Medical Sciences*, 72(5), 710-715.

# Vision and Hearing in the CLSA



- **Hearing - performance-based**

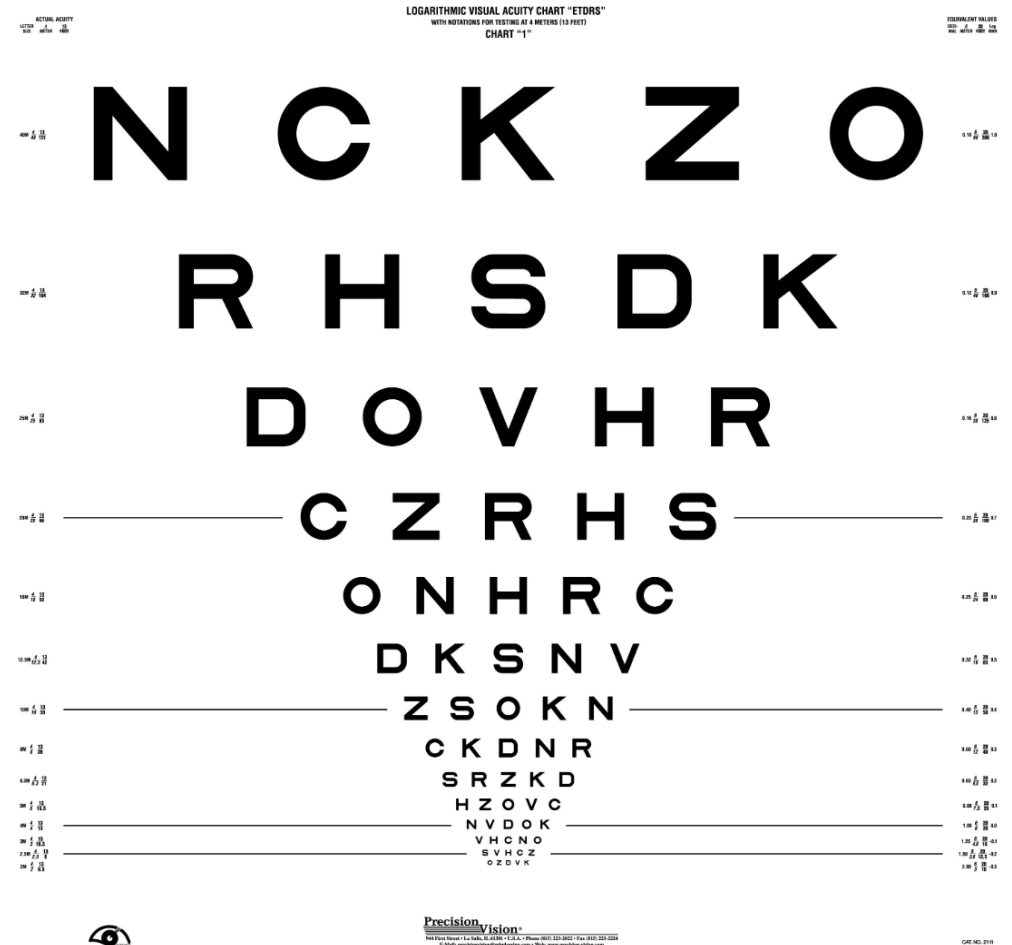
- Automated pure tone audiometry in quiet room at frequencies 500, 1000, 2000, 3000, 4000, 6000, 8000 Hz

- **Hearing – self-report**

- Is your hearing, using a hearing aid if you use one...
- Excellent, Very good, Good, Fair, Poor
- Do you find it difficult to follow a conversation if there is background noise, such as TV, radio or children playing, even if using a hearing aid as usual?
- Yes, No

# Vision and Hearing in the CLSA

- **Vision - performance-based**
  - **Habitual** correction visual acuity, ETDRS @ 2 meters
  - **Pinhole**-correction visual acuity, ETDRS @ 2 meters
- **Vision - self-report**
  - Is your eyesight, using glasses or corrective lenses if you use them...
  - Excellent, Very good, Good, Fair, Poor



# CLSA and Vision Loss

- **Definitions:** Binocular acuity worse than 20/40 (0.301 logMAR) with prescribed glasses or contact lenses for distance vision, if any.
  - Binocular – **monocular in better eye**
  - **Pin-hole corrected**, habitual correction
- **Prevalence:** Already reported in the CLSA
  - 5.7% (95% CI 5.4–6.0) had visual impairment.
  - Wide variation across provinces
    - low of 2.4% (95% CI 2.0–3.0) in Manitoba
    - high of 10.9% (95% CI 9.6–12.2) in Newfoundland and Labrador

## [Visual impairment and eye care utilization in the Canadian Longitudinal](#)

### [Study on Aging](#)

Date: December 12, 2017

Speaker: Dr. Ellen Freeman

[Presentation slides](#)

Aljied, R., Aubin, M. J., Buhrmann, R., Sabeti, S., & Freeman, E. E. (2018a). Eye care utilization and its determinants in Canada. *Canadian Journal of Ophthalmology*, 1–7. Elsevier Inc.

Aljied, R., Aubin, M. J., Buhrmann, R., Sabeti, S., & Freeman, E. E. (2018b). Prevalence and determinants of visual impairment in Canada: Cross-sectional data from the Canadian Longitudinal Study on Aging. *Canadian Journal of Ophthalmology*, 53(3), 291–297.



# CLSA & Hearing loss

- **Definitions:** Audiogram pure-tone average in the better ear across 4 frequencies (1, 2, 3 and 4 kHz)

*Hearing loss and healthy aging:  
The association between sensory and social measures  
in the CLSA Tracking cohort*

Dr. Paul Mick, MD  
Dr. Kathy Pichora-Fuller, PhD

May 19, 2016



Kathy Pichora-Fuller



Paul Mick



[www.clsa-elcv.ca](http://www.clsa-elcv.ca)



Mick, P., Parfyonov, M., Wittich, W., Phillips, N., & Pichora-Fuller, M. (2018). Associations between sensory loss and social networks, participation, support, and loneliness. *Canadian Family Physician*, 64(1), 33–41.

<https://www.youtube.com/watch?v=N-5sYCbJFg>



# Our definitions of behavioural VI, HI, DSI

- Vision impairment (**binocular/habitual correction**):
  - $\geq 0.2$  logMAR – mild VI (clinical interest) – 20/32 or 6/10
  - $> 0.3$  logMAR – common in epidemiology – 20/40 or 6/12
  - $> 0.48$  logMAR – WHO for moderate VI – 20/60 or 6/18
- Hearing impairment (**unaided**):
  - 25.1-40 dB HL – WHO mild HI
  - 40.1-59.9 dB HL – WHO moderate HI
  - $\geq 60$  dB HL – WHO severe HI
- Dual Sensory Impairment:
  - $>25$  dB HL (0.5, 1, 2, and 4 kHz) and  $\geq 0.2$  logMAR; Mild/Mild
  - $>25$  dB HL (0.5, 1, 2, and 4 kHz) and  $> 0.3$  logMAR; Mild/Common
  - $>40$  dB HL (0.5, 1, 2, and 4 kHz) and  $> 0.3$  logMAR; Moderate/Common
  - [  $>40$  dB HL (1, 2, 3 and 4 kHz) and  $> 0.48$  logMAR  $\Rightarrow$  n = 89 ] Moderate/Moderate

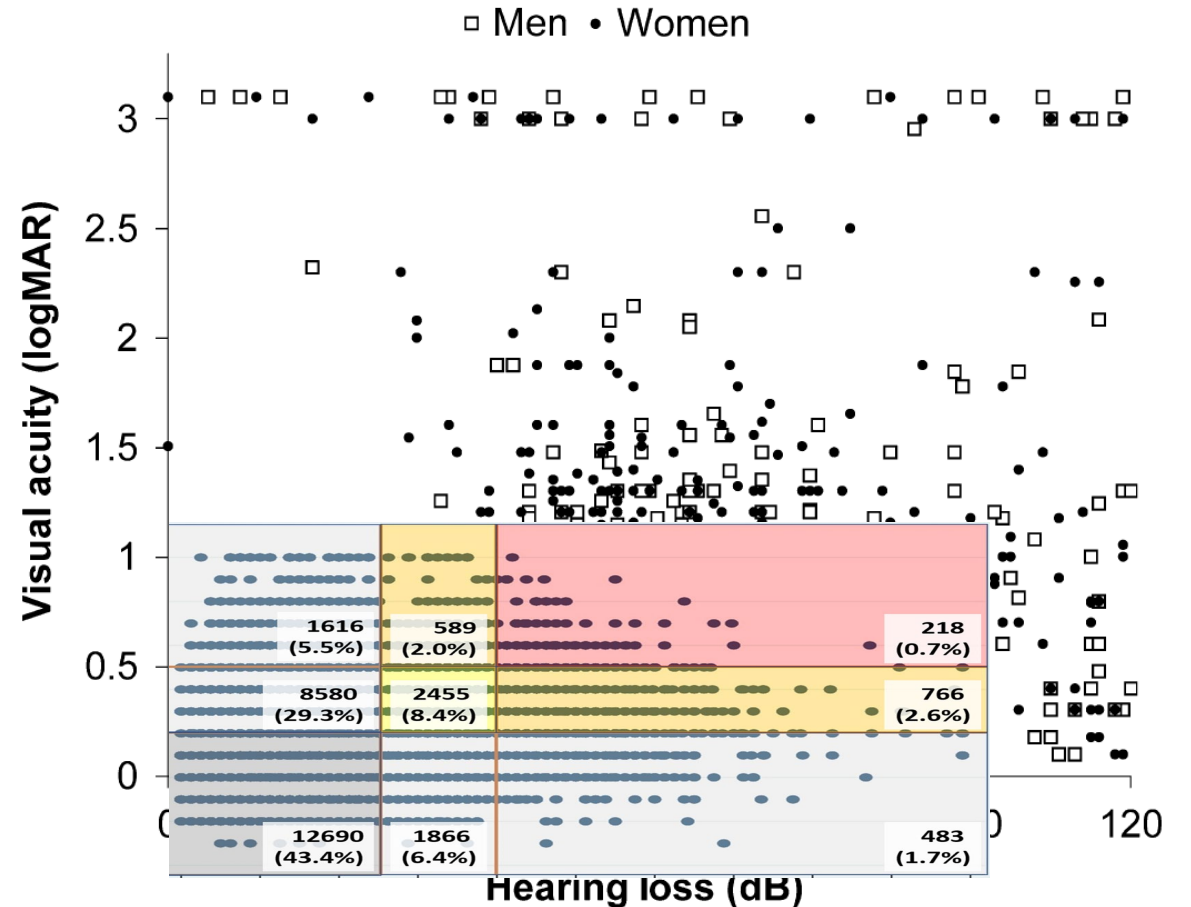
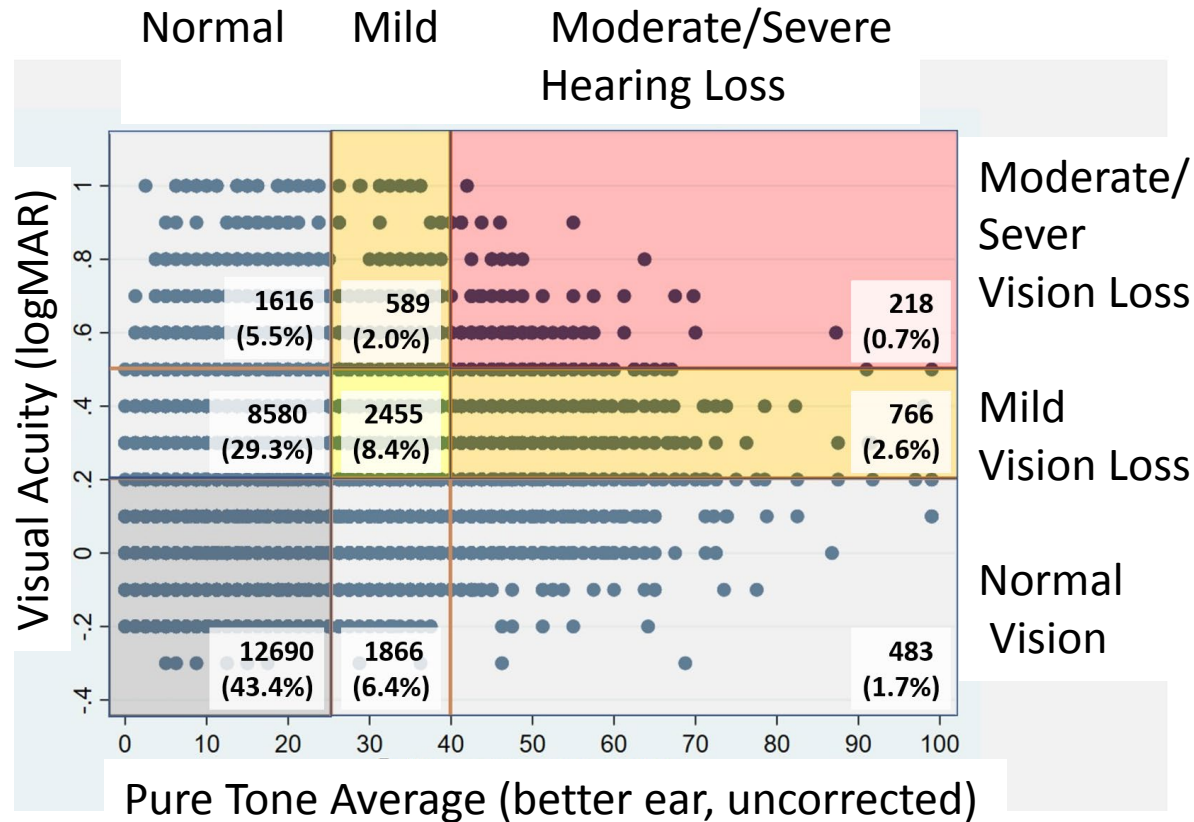
# CLSA baseline data (collection finished 2015)

- Comprehensive cohort
  - ~ 30 000 participants (English- & French-speakers)
  - Home visit, data collection site visit (interviews + functional testing)
  - >4000 variables recorded
  - Age @ baseline 45-85 years
  - Representative sample around 11 data collection sites
- Provide BOTH
  - performance/behaviour-based and self-report
  - vision & hearing data  
n = 29,002 (96.4%)

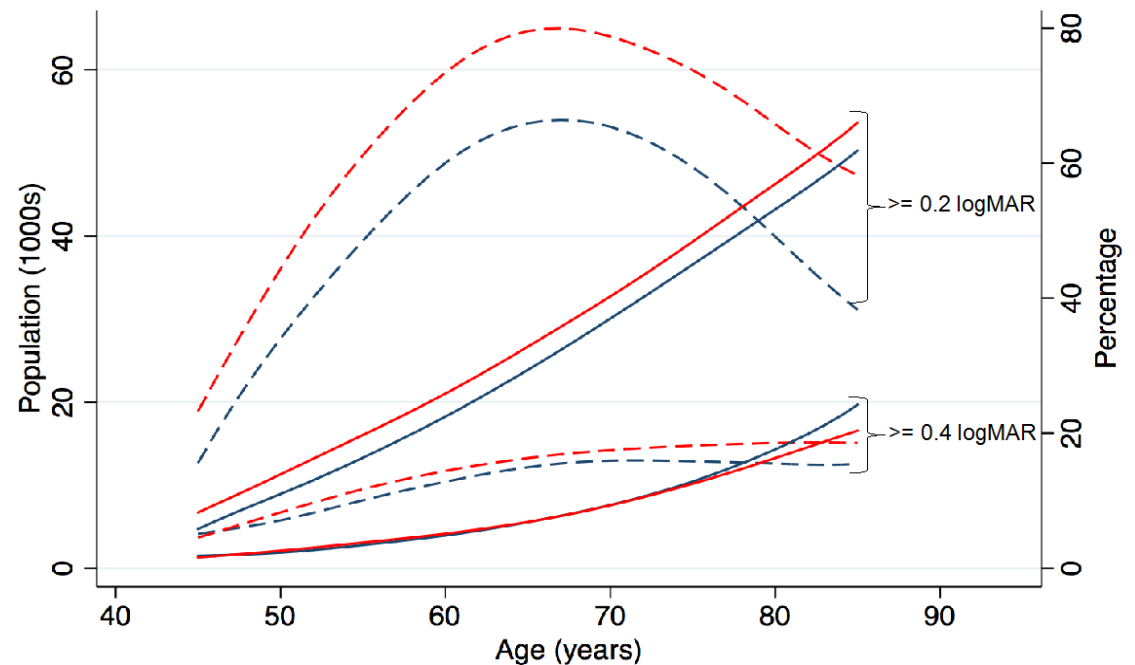
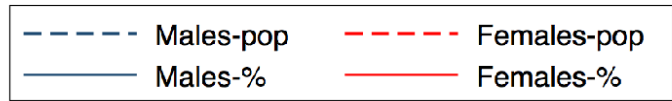
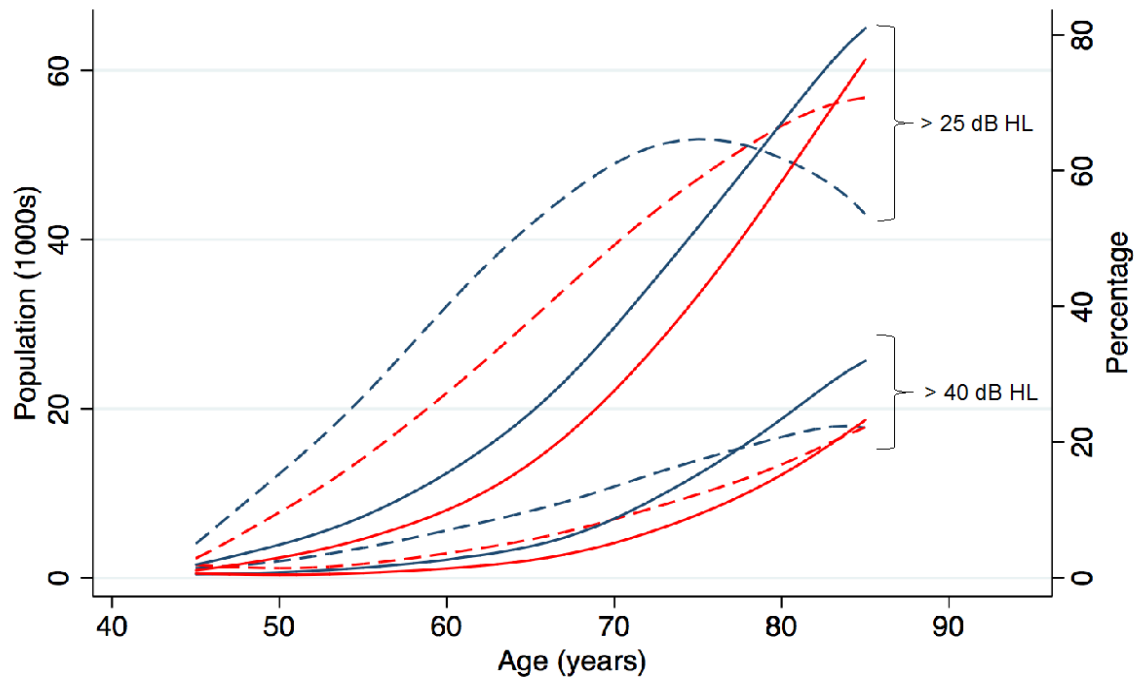
# Results

- Data distribution & prevalence
- Subjective reports versus behavioural measures
  - Vision
  - Hearing
  - DSI
- Why it is important to use both in combination !
- Quick link to congition

# How prevalent is vision, hearing, and dual sensory loss (DSL)?

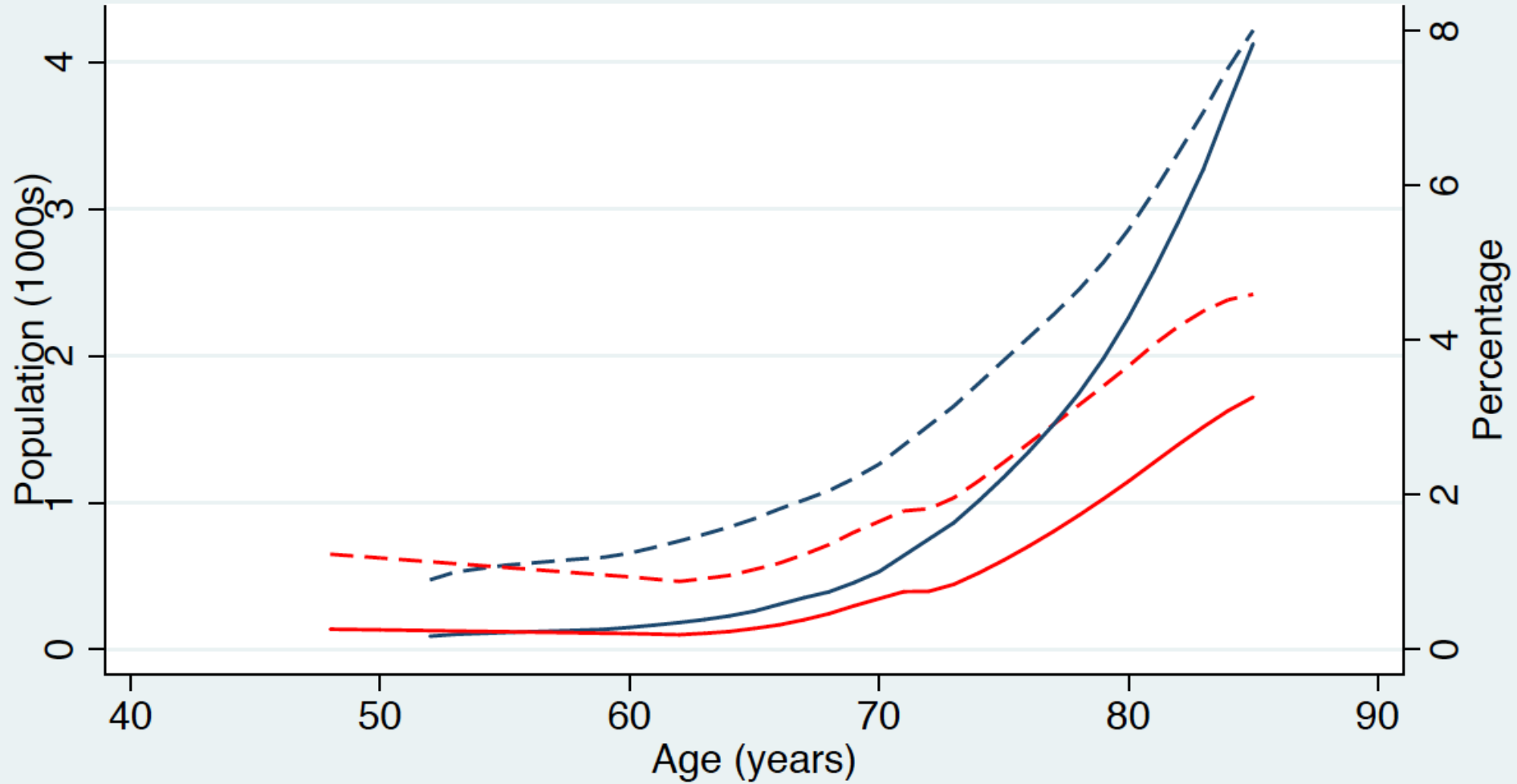


# Prevalence of hearing and vision loss according to age and sex



- Dashed lines: prevalence **COUNT** (left axis)
- Solid lines: prevalence **PROPORTION** (right axis)
- **Red:** Females; **Blue:** Males

# Prevalence of dual sensory loss (>40 dB, $\geq 0.4$ logMAR)



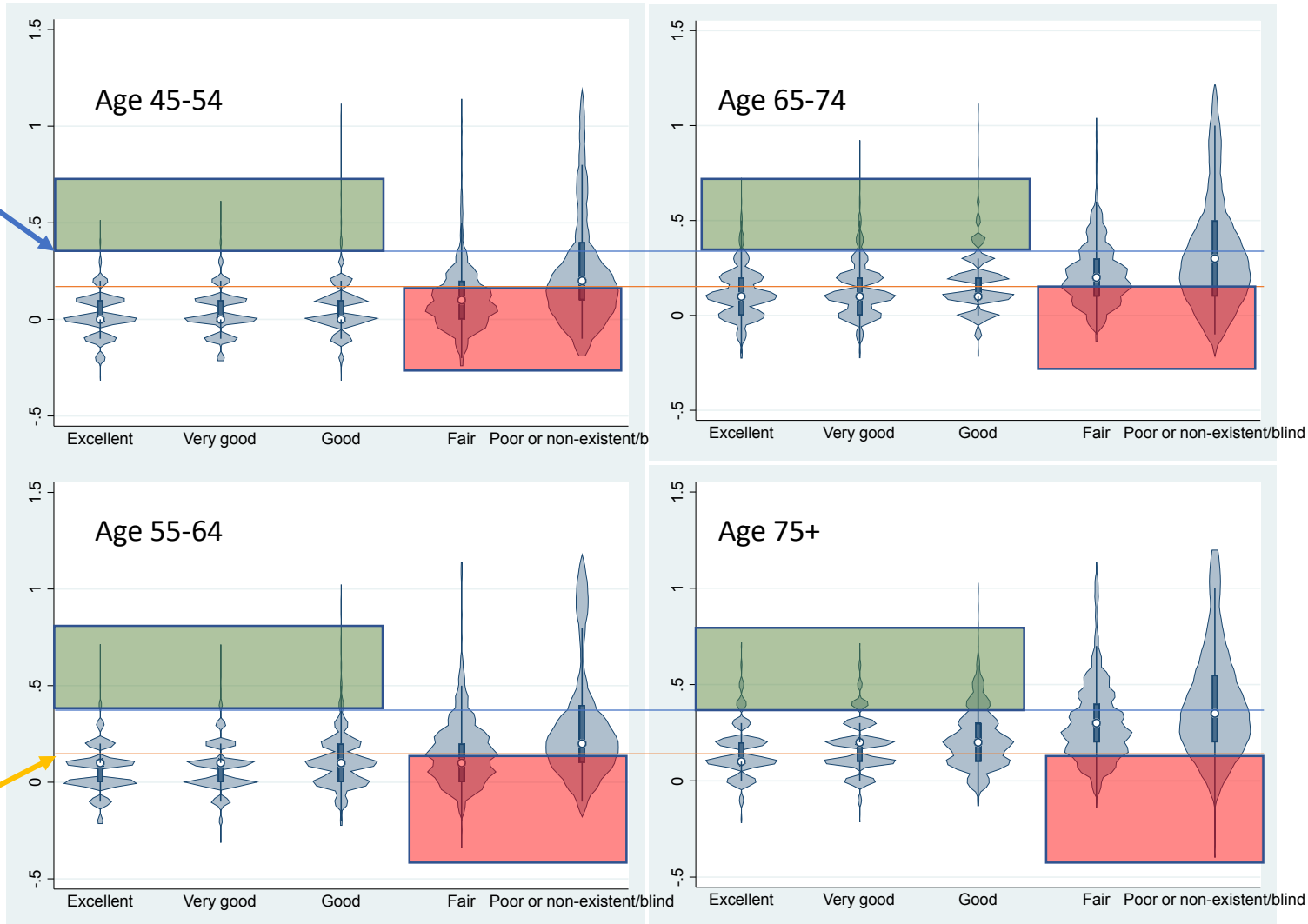
- Dashed lines: prevalence **COUNT** (left axis)
- Solid lines: prevalence **PROPORTION** (right axis)
- **Red:** Females; **Blue:** Males

# Behavioural vs. Subjective Vision Measures

Is your eyesight, using glasses or corrective lens if you use them...

Blue Line =  
Moderate VA loss

Visual Acuity (logMAR)



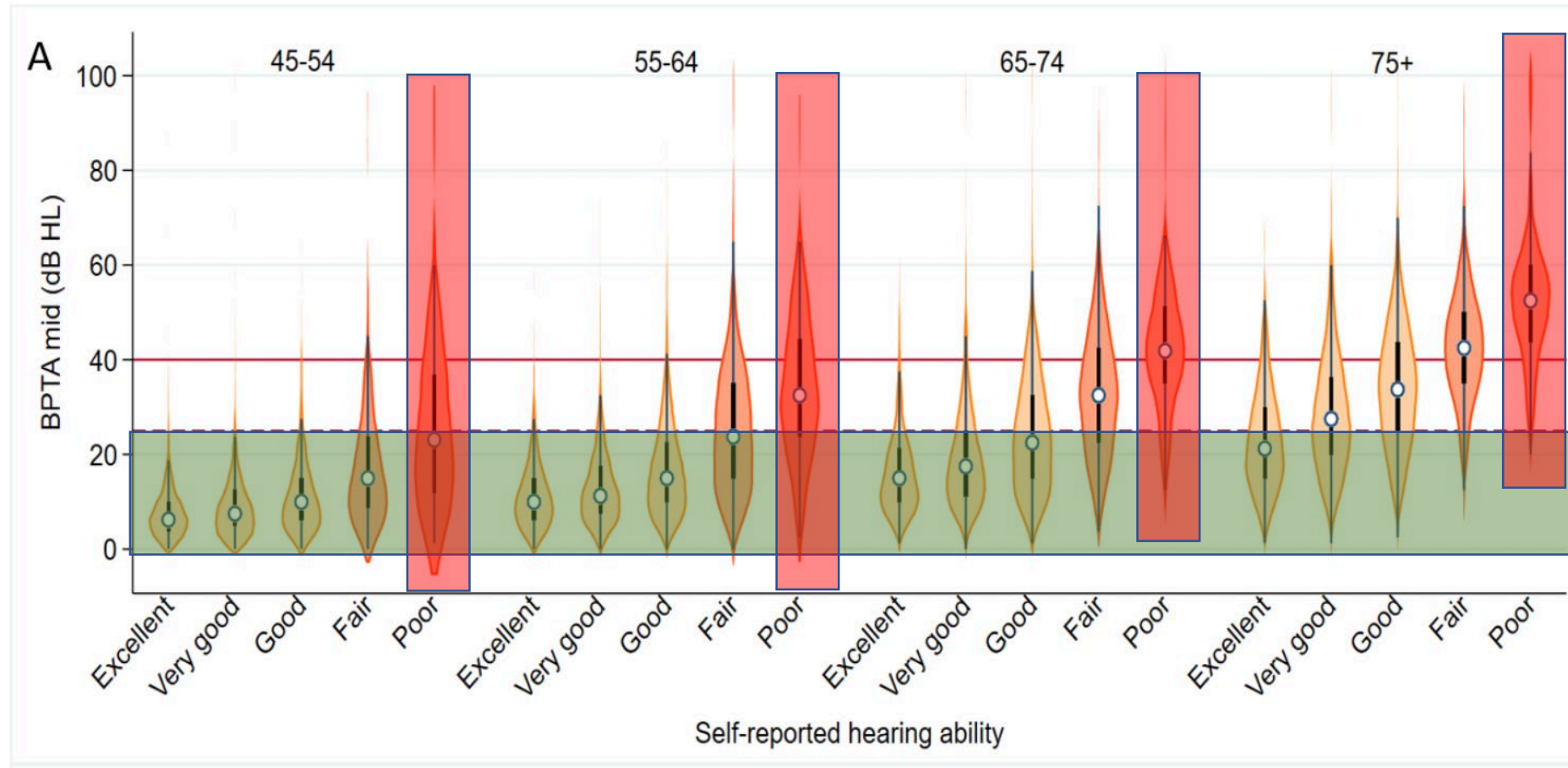
With “normal” acuity,  
you can perceive your  
vision as fair or poor

With “poor” acuity,  
you can perceive your  
vision as excellent,  
very good, or good

Orange Line =  
Mild VA loss

# Behavioural vs. Subjective Hearing Measures

Is your hearing, using a hearing aid if you use one...

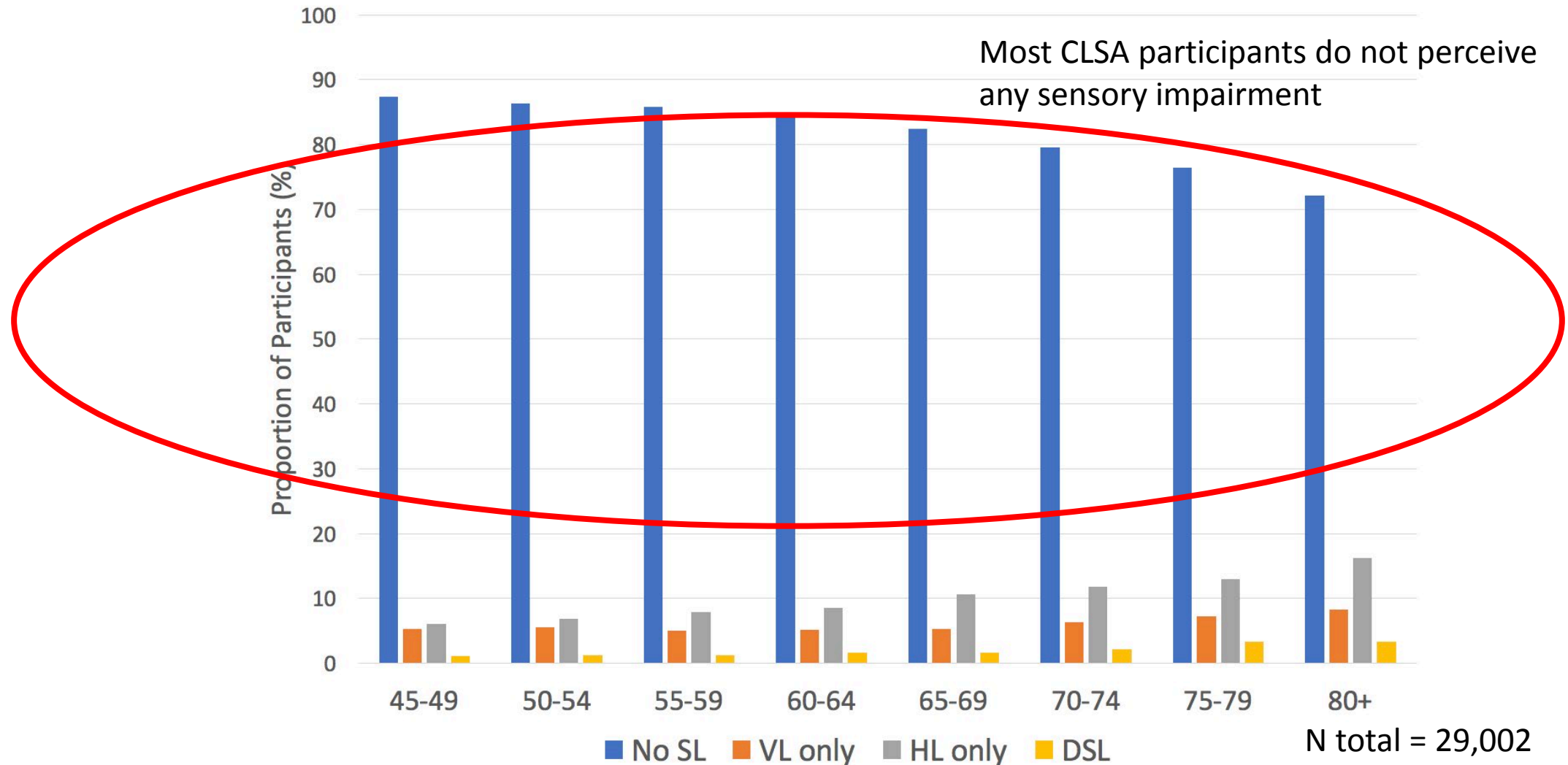


Within a normal audiogram range, participants can provide any functional answer

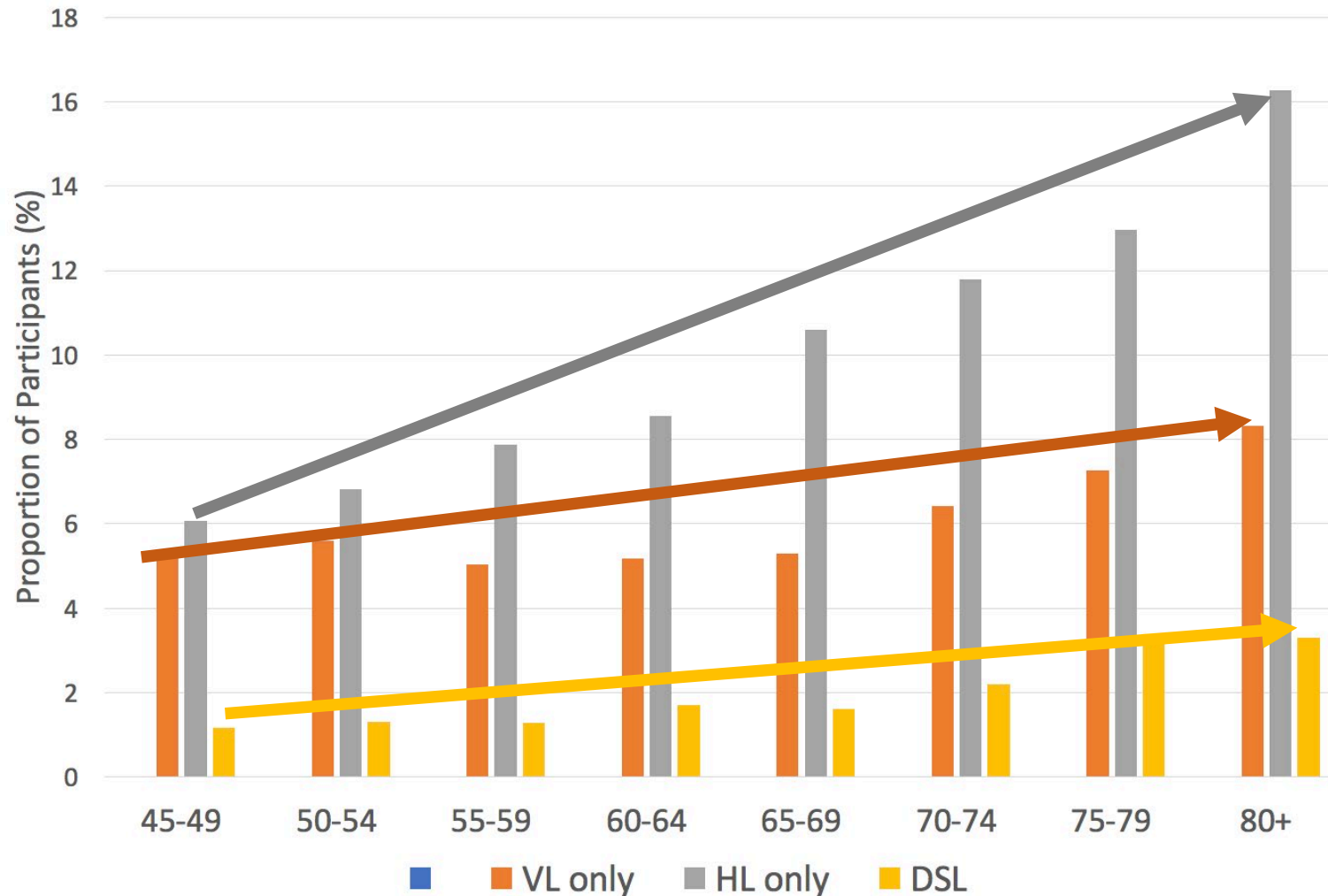
Participants perceiving their hearing as poor may have almost any pure-tone average on an audiogram



# The proportion of people self-reporting their sensory status



# The proportion of people self-reporting their sensory loss



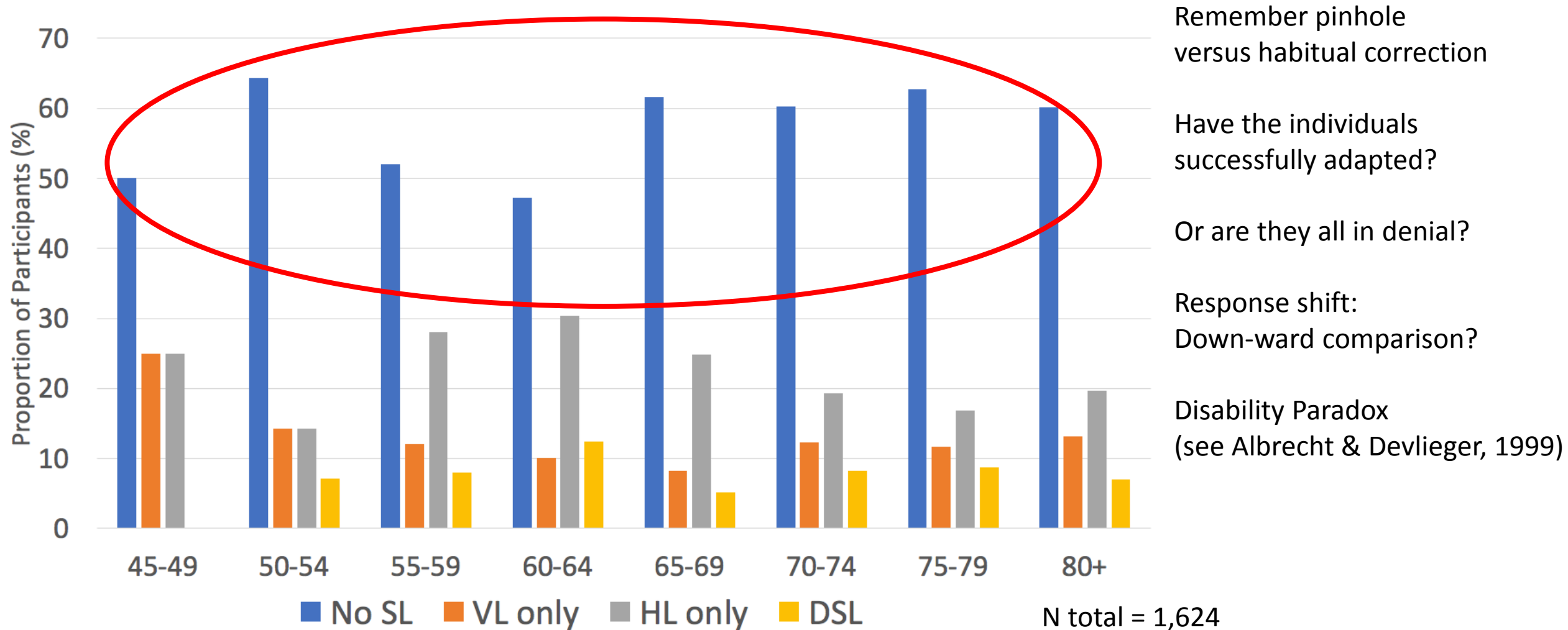
Larger increase in Perceived HI with age

Slight increase in Perceived VI with age

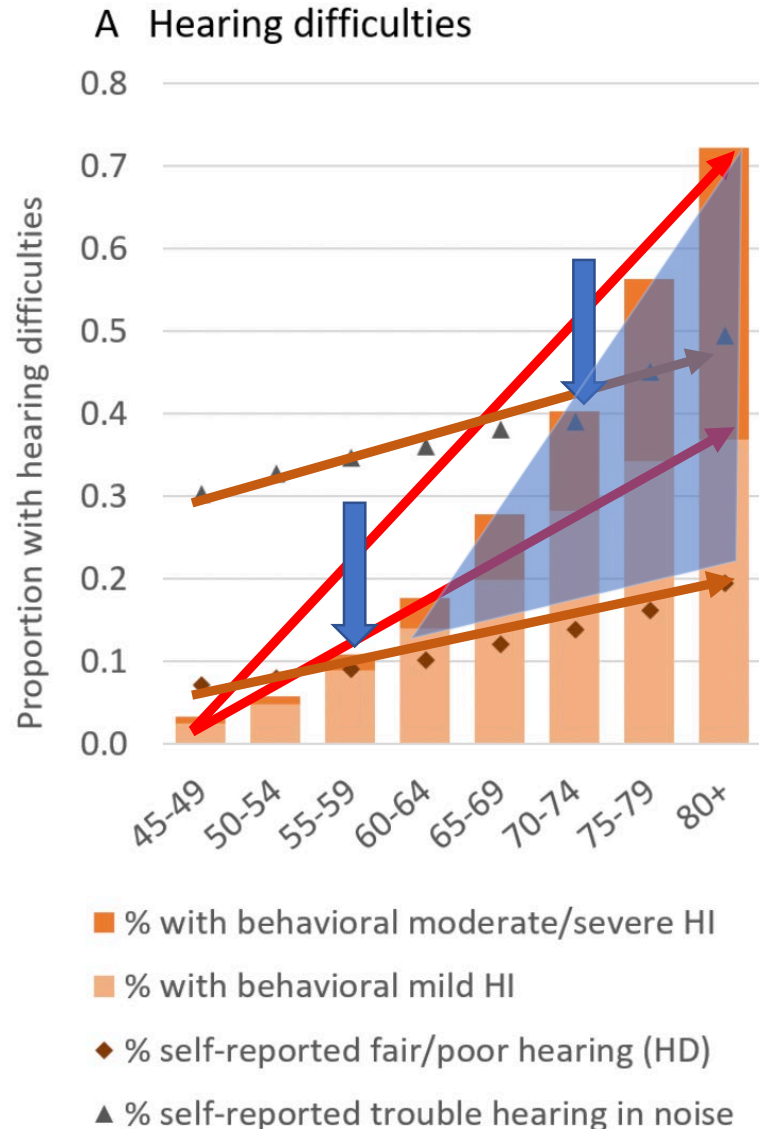
Slight increase in Perceived DSL with age

N total = 29,002

# The proportion of people with behavioral DSI self-reporting their sensory loss



# Comparing Behavioural vs. Subjective Measures



- Both mild and moderate/severe deficits on audiogram increase with age
- Self-reported fair/poor hearing increases with age
- But Self-reported trouble hearing in noise is larger issue, for all ages
- At younger ages (< 60), perceived difficulties hearing are not captured by audiogram
- At younger ages (< 75), perceived difficulties hearing in noise are not captured by audiogram
- At older ages (> 60), audiogram over-“estimates” perceived difficulties
- At older ages (> 75), audiogram over-“estimates” perceived trouble hearing in noise
- Audiogram alone may not tell you what you need to know!

# Comparing Behavioural vs. Subjective Measures

Behavioral visual impairment increases with age both

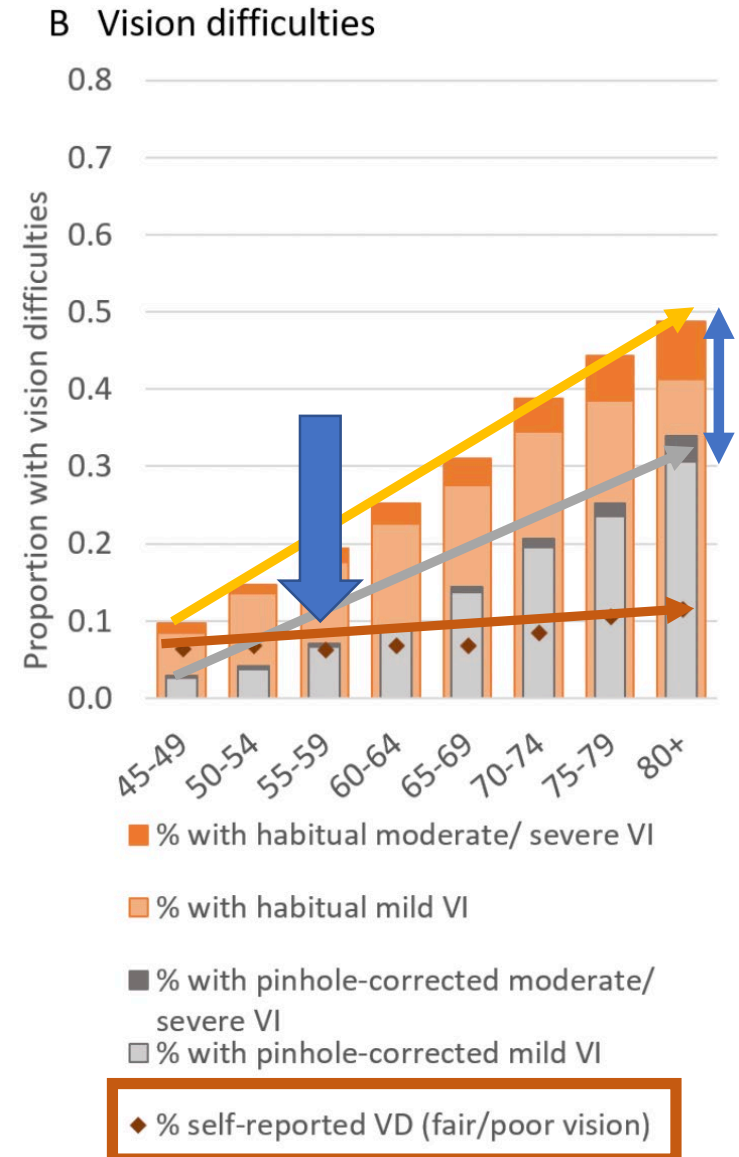
- with best correction (pinhole - GREY)
- and with habitual correction (ORANGE)

Difference is correctable (BLUE)! (also see Aljied et al. 2018)

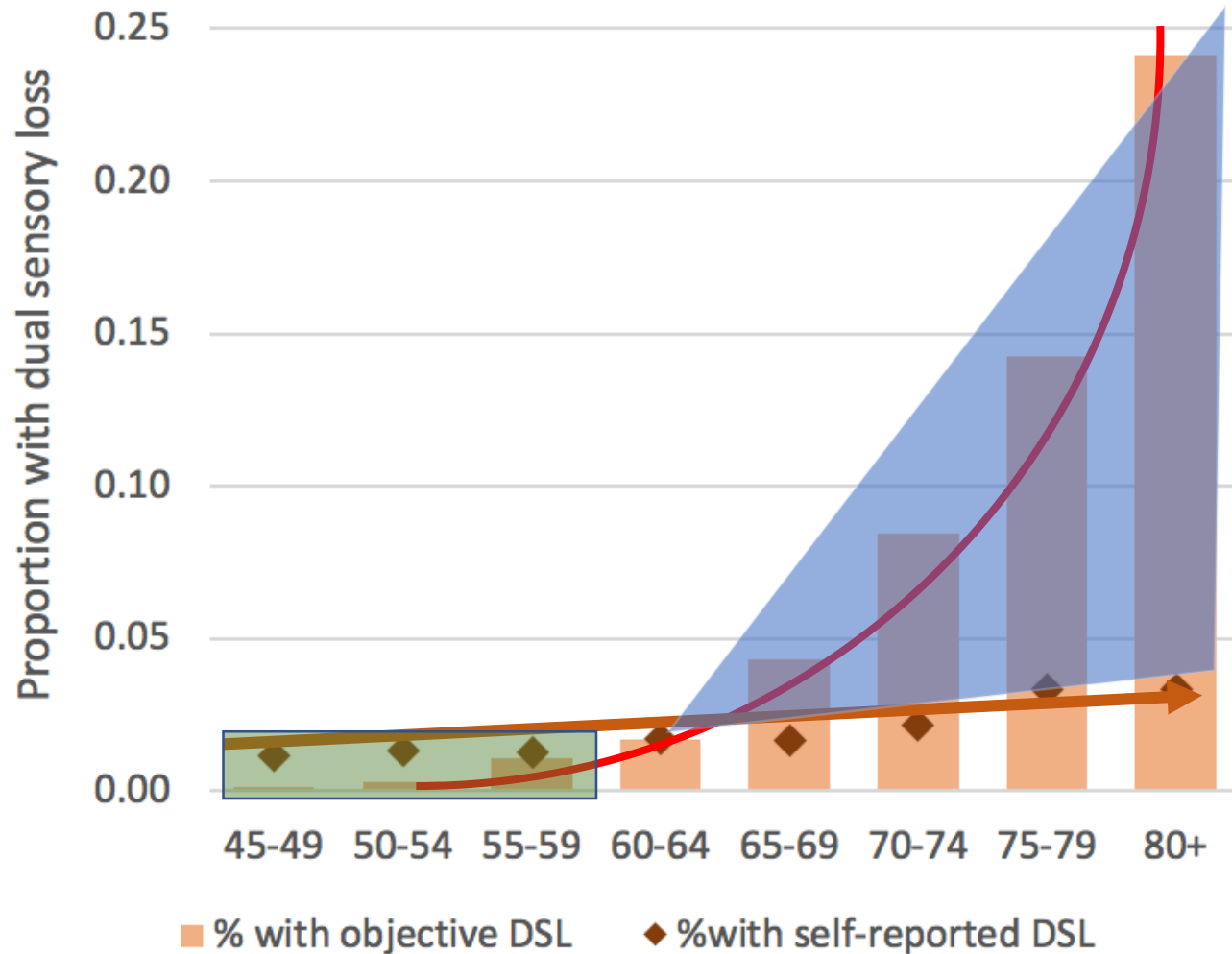
Across all ages, self-reported fair/poor vision remains below/around 10%

Under the age of 60, pinhole acuity “UNDER”-estimates self-reported problems

Over the age of 60, pinhole acuity “OVER”-estimates self-reported problems




# Comparing Behavioural vs. Subjective Measures

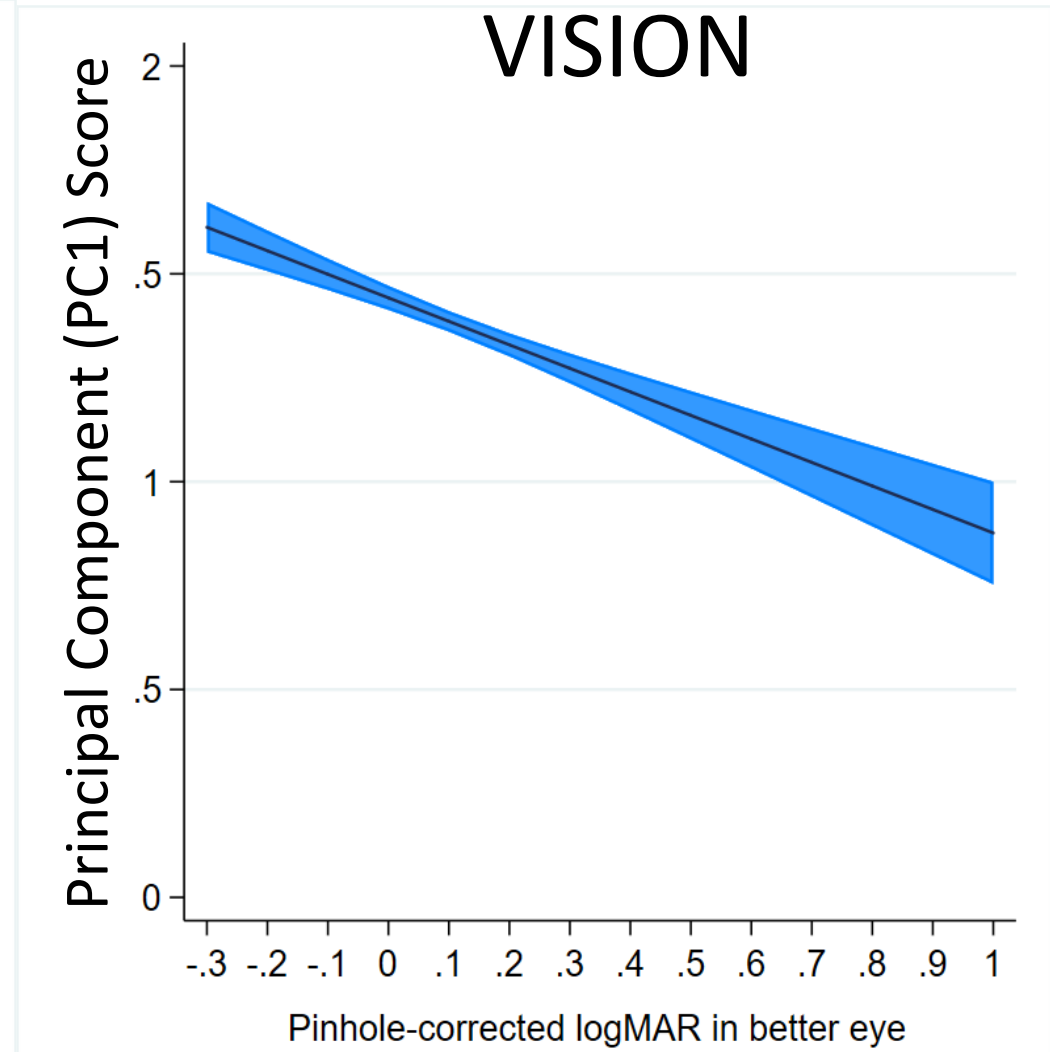
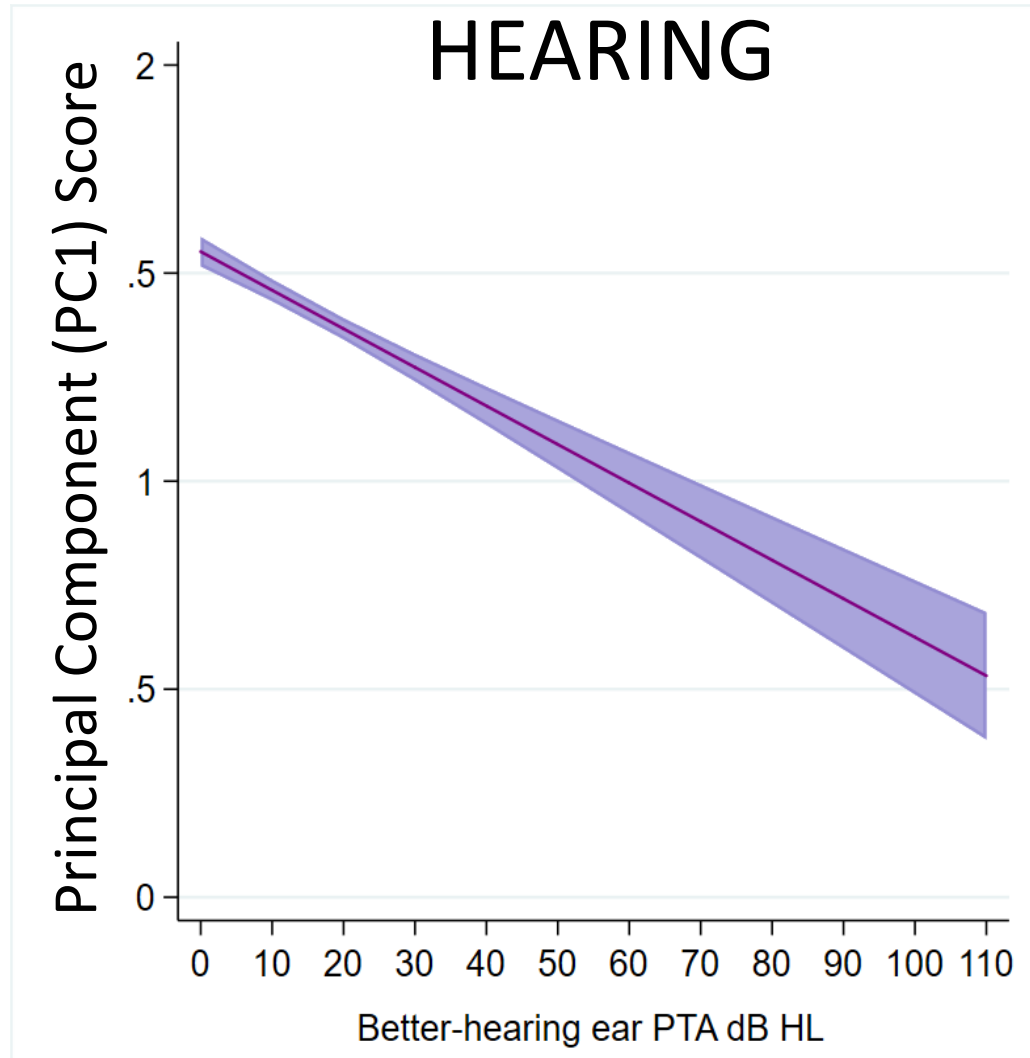


- Behavioural DSI (acuity & PTA) increases exponentially with age
- Self-reported DSI slightly increases with age
- Under age 60, behavioural measures “under”-estimate the perceived impairment
- Over age 60, behavioural measures “over”-estimate the perceived impairment

# Linking Sensory& Cognitive Measures

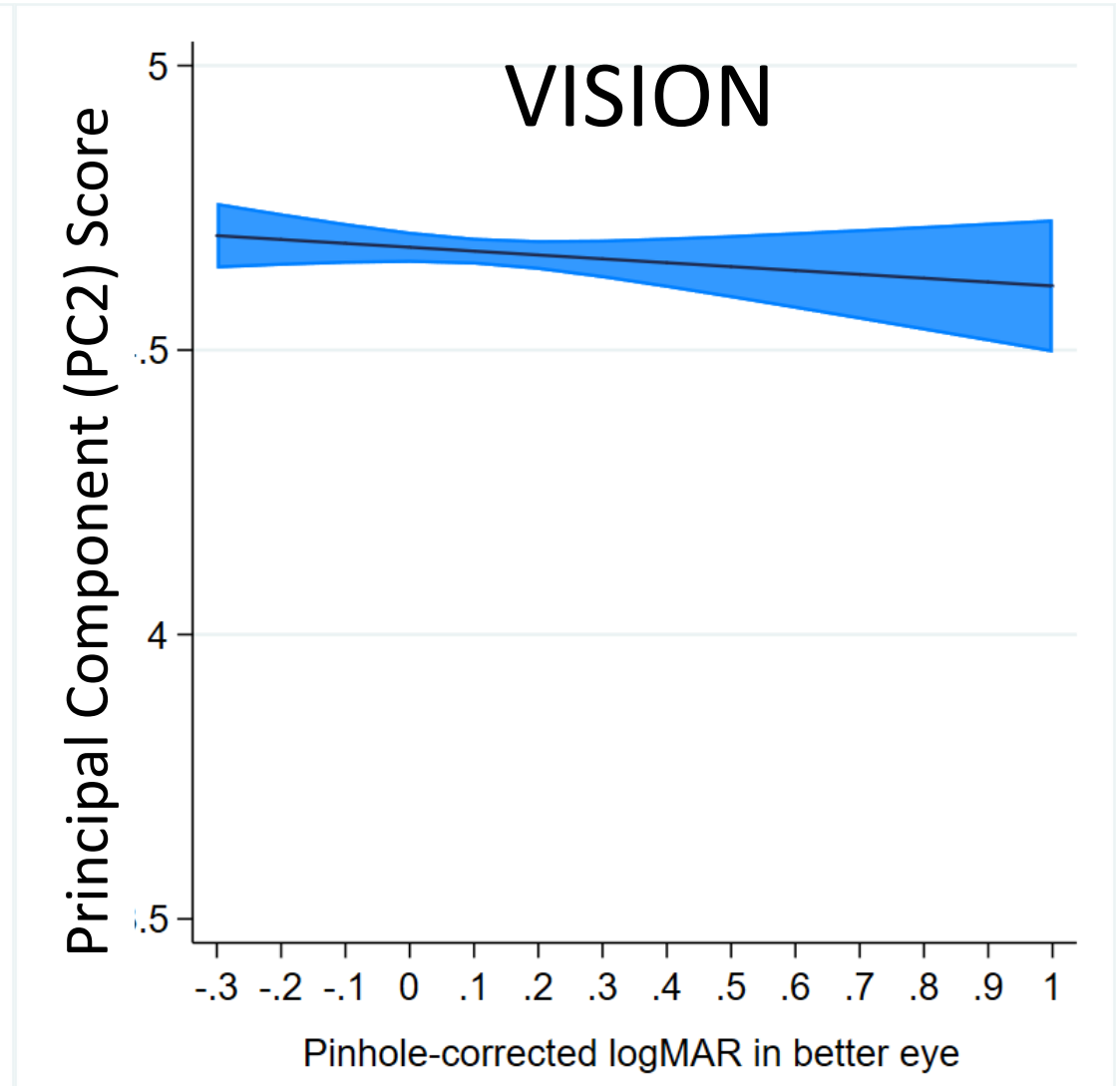
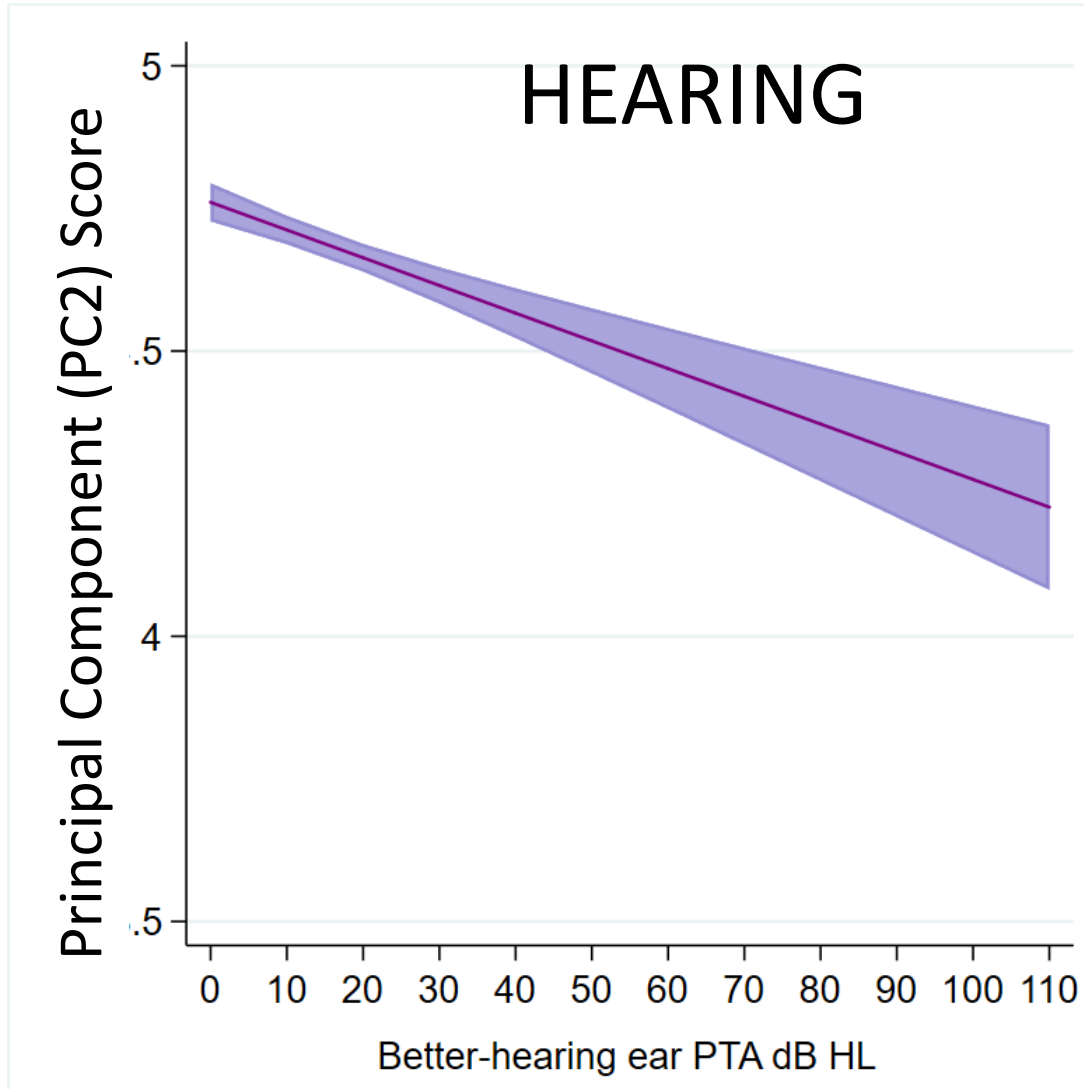
- Principal Component Analysis of Cognition Measures
- Executive function (PC1)
  - **Animal fluency test:** # of different animals named in 60 s
  - **Controlled Oral Word Association Test:** # of words in 60 s
  - **Mental alternation test:** 1-A-2-B...
  - **Stroop test:** 
- Memory (PC2)
  - **Rey Auditory Verbal Learning Test** – delayed recall of 15 words (5 min)
  - Ratio of **delayed** to **immediate** recall; REY2/REY1

# Executive Function





# Memory



# Extrapolation, using census data (2011 & 2016) and CLSA recruitment weights (sex, age, province)

- In 2016, among Canadian **males** aged 45-85 years, approximately
  - 1.5 million had hearing loss  $> 25$  dB HL ,
  - 1.8 million had vision loss  $\geq 0.2$  logMAR, and
  - **570,000 males had both impairments.**
- In 2016, among Canadian **females** aged 45-85 years, approximately
  - 1.2 million had hearing loss  $> 25$  dB HL,
  - 2.2 million had vision loss  $\geq 0.2$  logMAR, and
  - **450,000 females had both impairments.**
- Prevalence increased 8.7-16.9% between 2011 and 2016.
- Hearing loss and **dual sensory loss prevalence proportion** **increased exponentially with age** whereas the increase was more linear for vision.
- **Males were more likely to have hearing loss and dual sensory loss**, whereas females were more likely to have vision loss only.

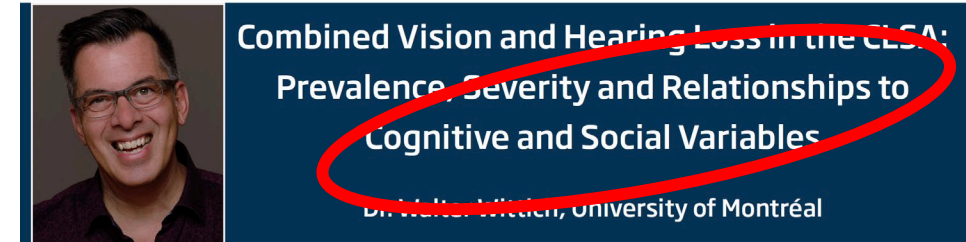
# Strengths & Weaknesses

- CLSA strengths in terms of examining DSI at population level:
  - Large sample size and age range
  - Access to lots of people with MILD sensory loss
  - Most of whom don't recognize/report/experience they have it:
  - Only 8% of those with behavioural DSI self-report this impairment
- Weaknesses:
  - “Simple” assessment of hearing and vision: nothing on speech in noise, contrast sensitivity, visual field, ...
  - Sample/recruitment is biased towards healthy people (no ASL, LSQ in CLSA)
  - Very mild impairments at baseline
  - Not fully representative of general population

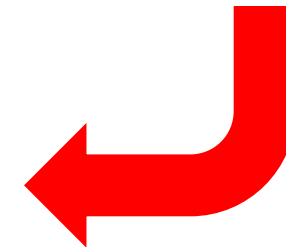
# The CCNA-CLSA-interRAI studies

- **Prevalence** is vision/hearing/dual impairment in CLSA  
(Mick et al, under revision, Can J Aging)
- Relationship of **self-reported and behavioural** sensory measures  
(Hämäläinen et al., under revision, Ear & Hearing)
- **Age-effects** among behavioural and self-reported sensory measures  
(Pichora-Fuller, et al., in prep, Ear & Hearing)
- Associations between **cognitive and sensory** function in older adults  
(Phillips et al., in prep, Gerontologist)
- Association between **social factors and sensory/cognitive** function  
(Hämäläinen et al., submitted, Scientific Reports)
- **Optimizing** evaluation of older adults with vision and/or hearing loss  
(Urqueta Alfareo, et al., under review, BMC Geriatrics)
- **Sensitivity & Specificity** of the interRAI for identifying sensory loss  
(Urqueta Alfareo, et al., in prep, PLoS ONE)
- **Portrait** of older adults with DSI  
(Urqueta Alfareo, et al., in prep, TBA)

## CLSA Webinar Series

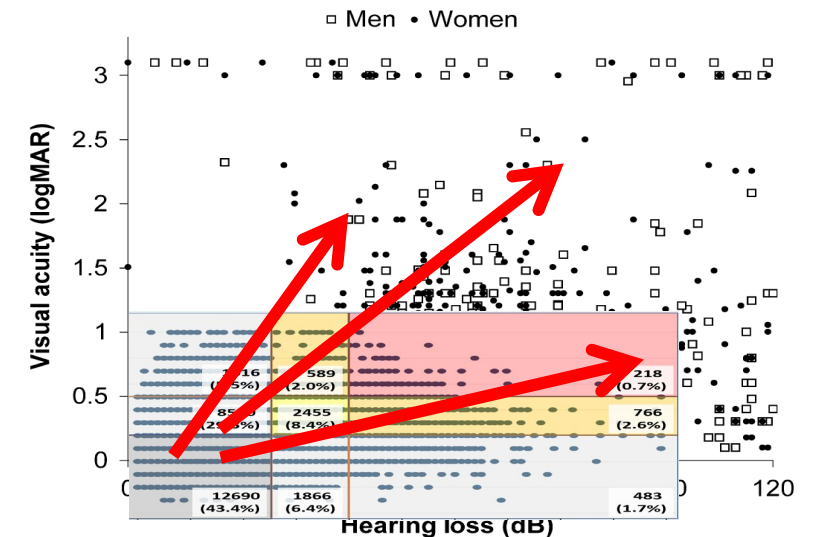
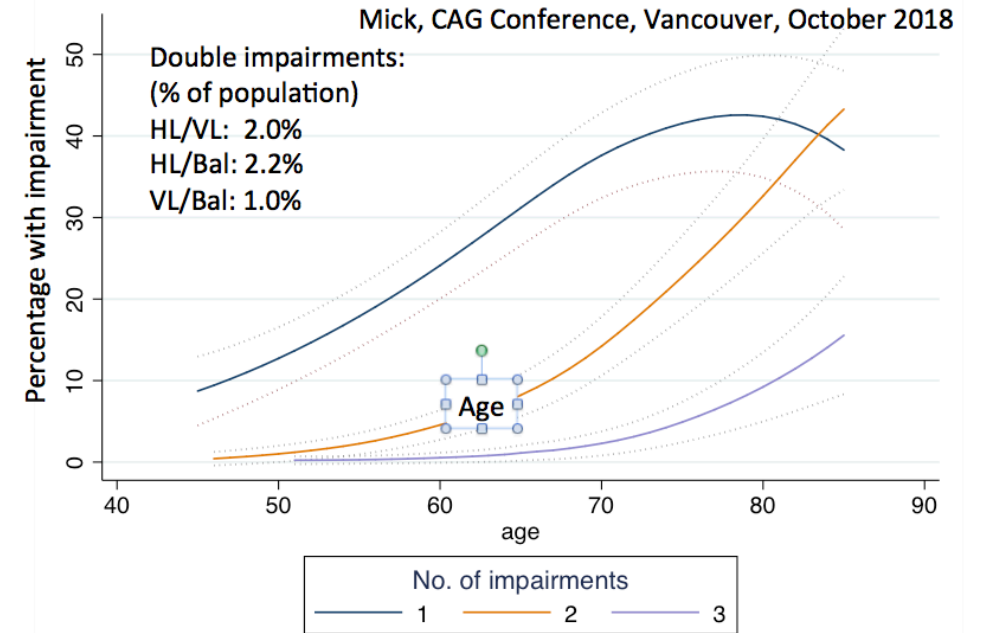


12 pm to 1 pm ET | May 21, 2019



# Next Directions

- Sensory Impairments as Multimorbidity
- Wave 2 of CLSA data:
  - Predictors of sensory decline
  - Predictors of cognitive decline
  - Predictors of social participation/loneliness
  - ...



# Interested in vision/hearing/DSI for YOUR CLSA study?

- Talk to us!



Kathy Pichora-Fuller

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Walter Wittich

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# Thank you - Merci

- Collaborators

- Paul Mick (USask)
- Natalie Phillips (Concordia U)
- Kathy Pichora-Fuller (UofT)
- Dawn Guthrie (Wilfrid Laurier U)
- Kathy McGilton (UofT)
- Jean-Pierre Gagné (U Montréal)

- Post-doc

- Sarah Fraser (McGill)
- Andrea Urqueta Alfaro (UdeM)
- Anni Hämäläinen (UdeM)

- Trainees

- Marie-Celine Lorenzini (UdeM)
- Natalie Martiniello (UdeM)
- Christine Lehane (UCopenhagen)
- Vanessa Bachir (UdeM)
- Elliott Morrice (Concordia U)
- Lorie St.Amour (UdeM)

- Research Assistants

- Karine Elalouf (UdeM)
- Don Watanabe (MMRC)
- Geneviève Groulx (MMRC)
- Alexandre Beaulieu (MMRC)
- Eve-Julie Rioux (IRD)
- Johanne St.-Gelais (IRD)
- Martine Gendron (IRD)
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