National Acoustic Laboratories
A division of Australian Hearing

THE HEARING CRC

# Longitudinal Outcomes of children with hearing impairment: findings from the LOCHI study

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Annual births: 134.8 million (2001)

听力损失发病率 1.2/1000

Est PCHI: 148,300

Population: 1.4 billion

Annual births: 16.5m (2012)

Est PCHI: 19,774




Population: 22.7 million

Annual births: 297,200 (2011)

Est PCHI: 327

# Why LOCHI?

- Congenital hearing loss greatly reduces childre language, psychosocial skills, academic attainment and life chances *(Thompson et al, 2001; Moeller et al, 2007; Nelson et al, 2008).*
- UNHS aims to alleviate huge burden of disability
- 2008 US Preventive Services Task Force
  - "Moderate certainty that net benefit of screening all newborn infants for hearing loss is moderate"
  - Based on a single quasi-randomised trial
- Research on population outcomes scant

In 2005,

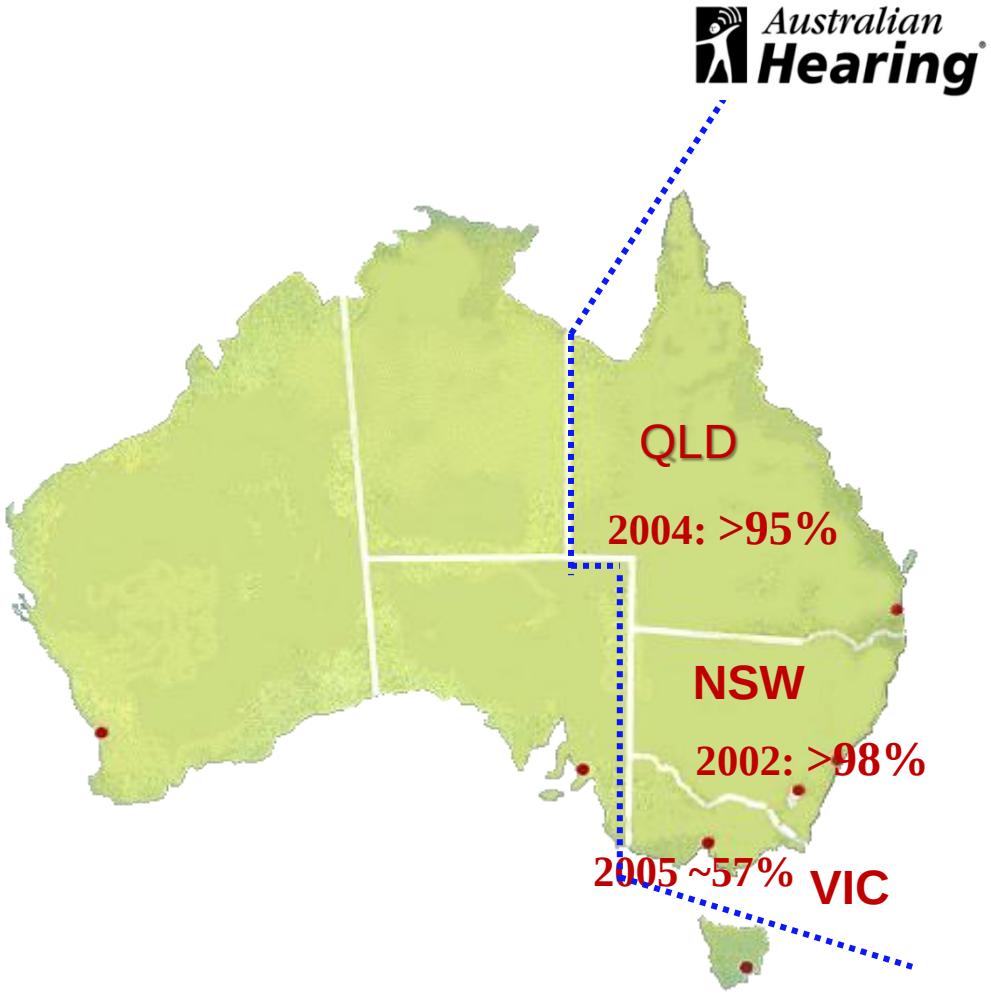
**L**ongitudinal

**O**utcomes of

**C**hildren with

**H**earing

**I**mpairment …

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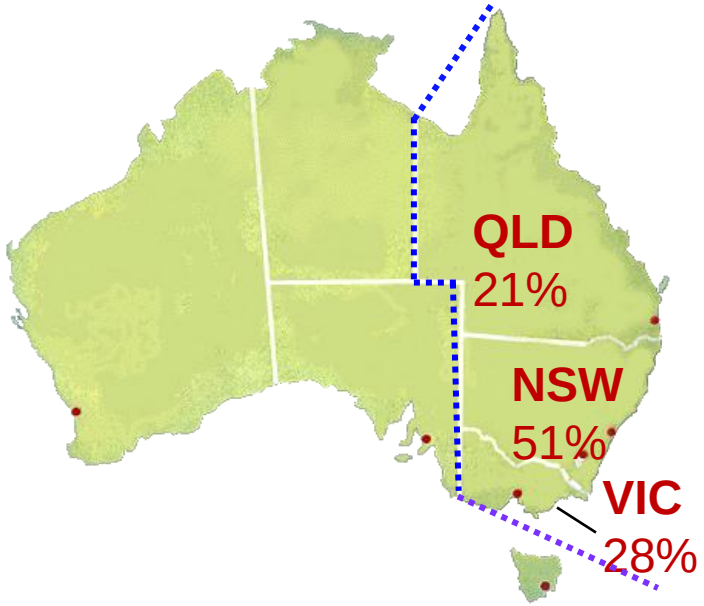
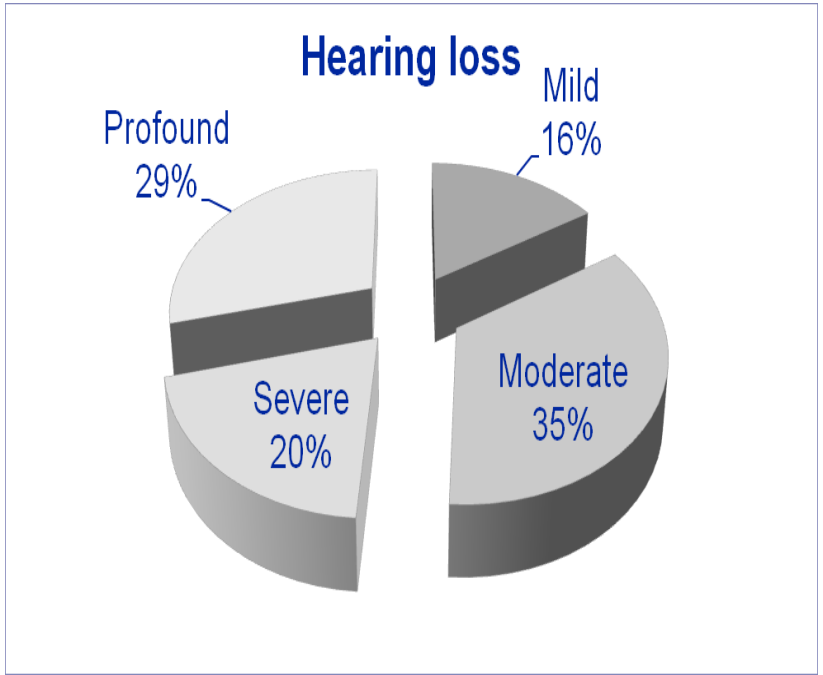
# Aims

- Does UNHS and early intervention improve child language and literacy outcomes, at *a population level*?
- What factors (modifiable or otherwise) influence outcomes?
- Does early performance predict later outcomes?

# Method




- About 460 participants from population in 3 states,
- YOB: 2002-2007
- 53% fitted with hearing aids and enrolled in early education < 6 months
- About 20% with non-English speaking background
- About 37% have additional disabilities



# We collect a range of information,

## Child

- Age at fitting
- Age at implantation
- Birthweight
- Gender
- Hearing thresholds
- HA – Prescription
- Use of device
- Additional disabilities
- Auditory neuropathy
- Aetiology
- Cognitive ability

## Family

- Communication mode
- Involvement in intervention
- Language used at home
- Maternal education
- Socio-economic status

## Intervention

- Age at enrolment
- Communication mode
- Hours of intervention
- Parental involvement

# And measure children's outcomes …

- **Expressive Communication**
- **Auditory comprehension**
- **Receptive vocab.**
- Expressive vocab.

Language

- **Articulation**
- **Phonological dev**
- Speech perception
- Spatial release from masking

Speech

- Phonological awareness
- Reading
- Spelling
- Math reasoning

Literacy & numeracy


- Aural-oral function in real life
- Pragmatics
- Mental health
- Quality of life

Psycho-social dev.

- Educational attainment
- Employment

Education & employmen

- Working memory
- Orthographic learning
- Paired associate learning
- Lexical access

Cognition

# At multiple intervals as they grow

+6 mo

+12 mo

3 yrs

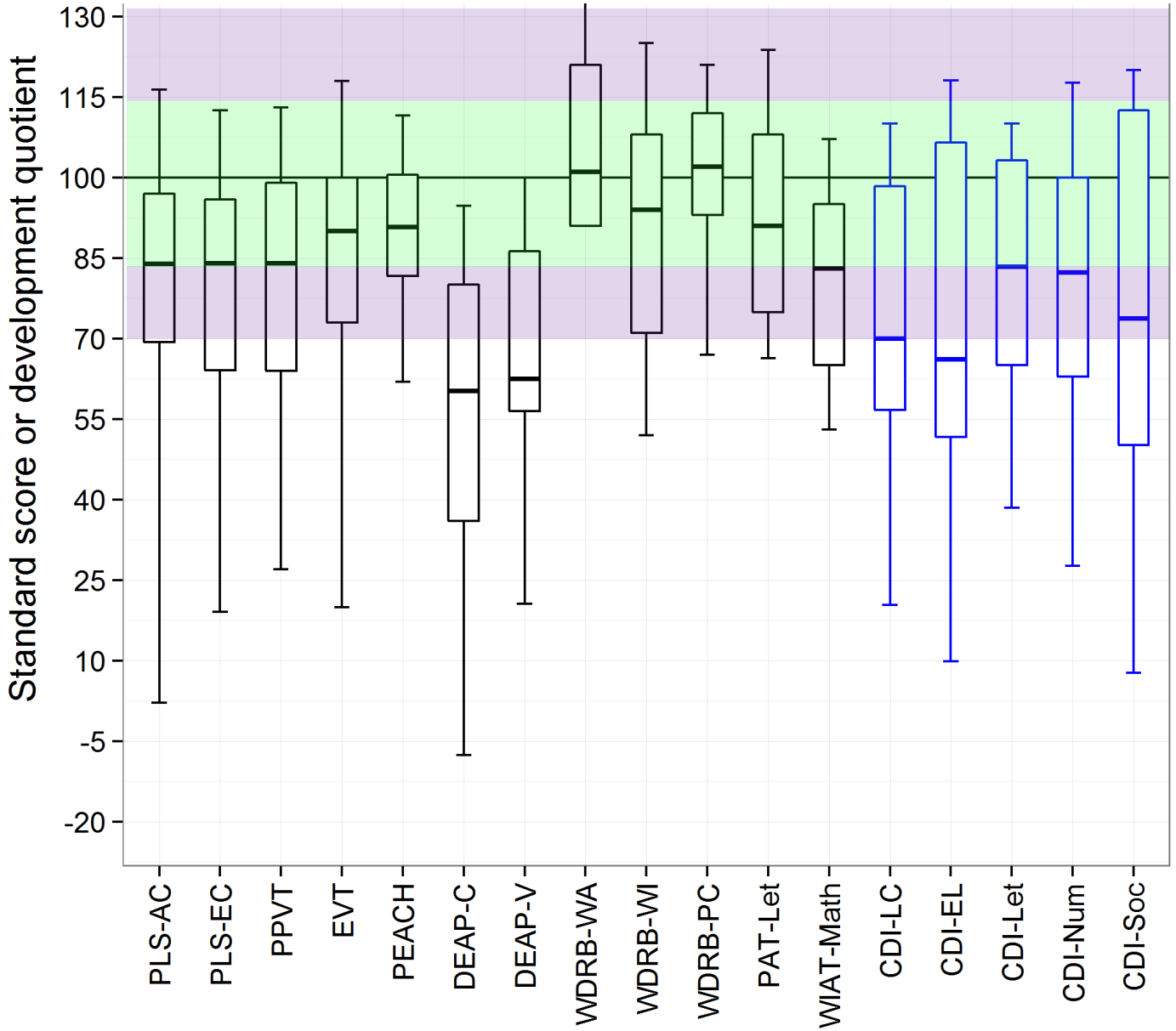
5 yrs

9 yrs

16 yrs

# AT 5 YEARS,

# Age 5 Test scores: 25th, 50th, 75th percentiles…



# To analyse findings,

- Combine multiple test scores into a global language score
- Fit regression models separately for
  - Children using hearing aids
  - Children using cochlear implants

# Children with hearing aids

# Significant Predictors for 243 children with HA

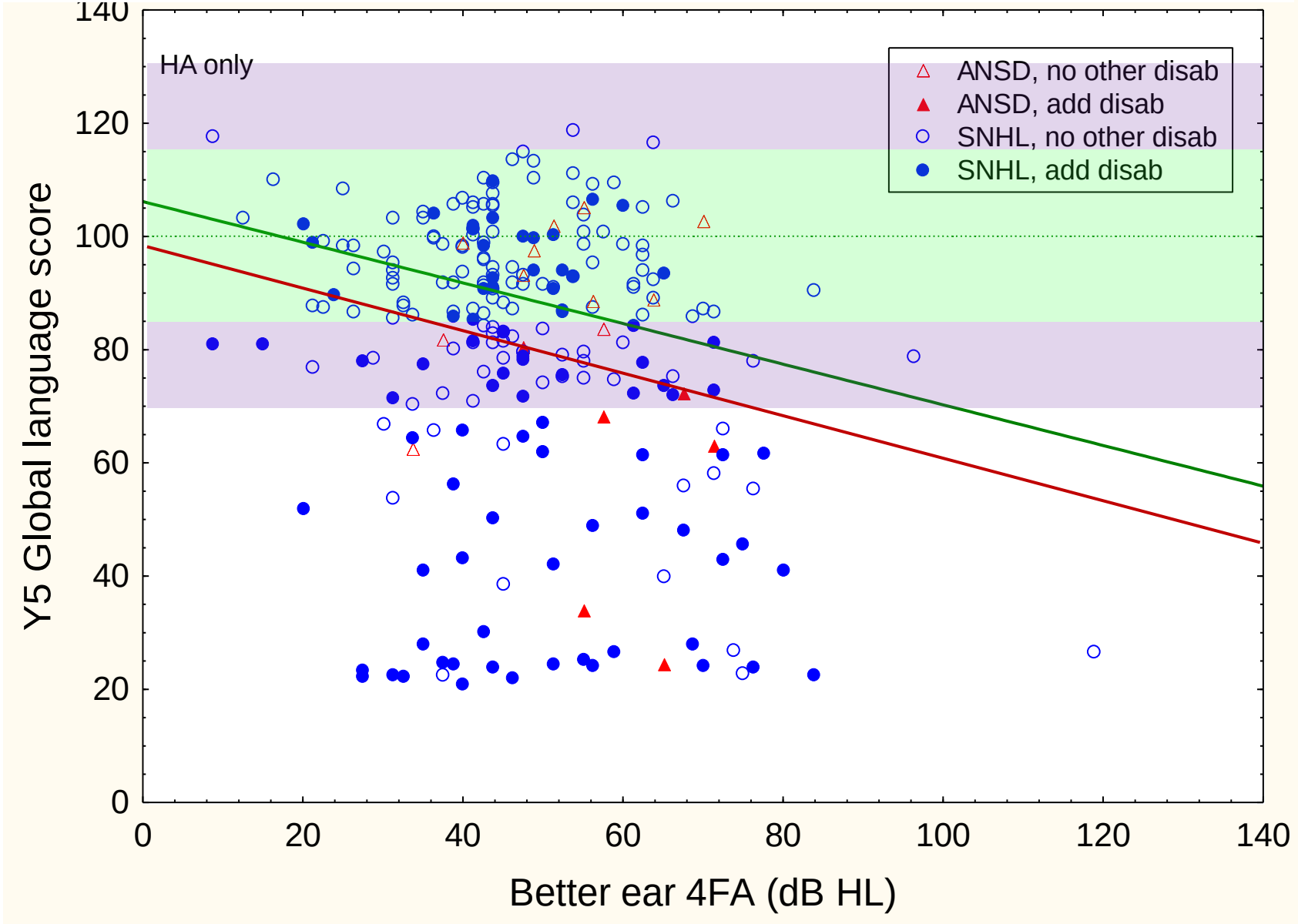
Impact of category change. For continuous variables, variation as per specification

$R^2 = 77$

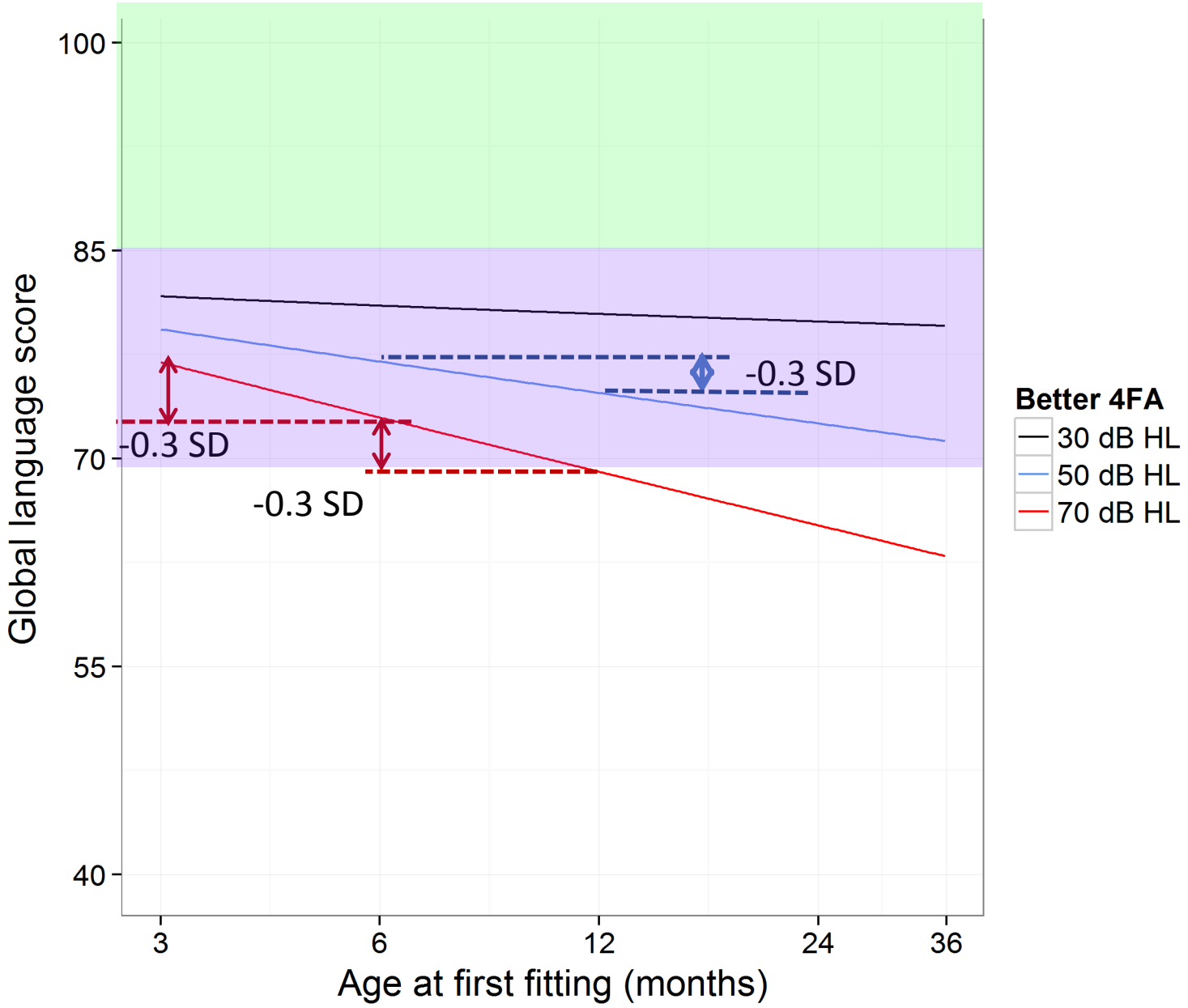
$R^2 = 69$

| Predictor | $R^2 = 74$ | Significance ($p$) | $p$ – value |
|---|---|---|---|
| Age first fit (log) | | 0.003 | 0.11 |
| 4FA hearing loss | | <0.001 | 0.002 |
| Log Age first fit x 4FA | | 0.07 | 0.06 |
| Cognitive ability/WNV | | <0.001 | <0.001 |
| Gender | | 0.16 | 0.19 |
| Birthweight | | 0.73 | 0.08 |
| Other disability | | 0.04 | 0.13 |
| Maternal education (university re school) | | <0.001 | 0.01 |
| Socio-economic status (dec) | | 0.39 | 0.44 |
| Communication mode in Edn (other re oral) | | 0.007 | 0.009 |
| | | | 0.03 |

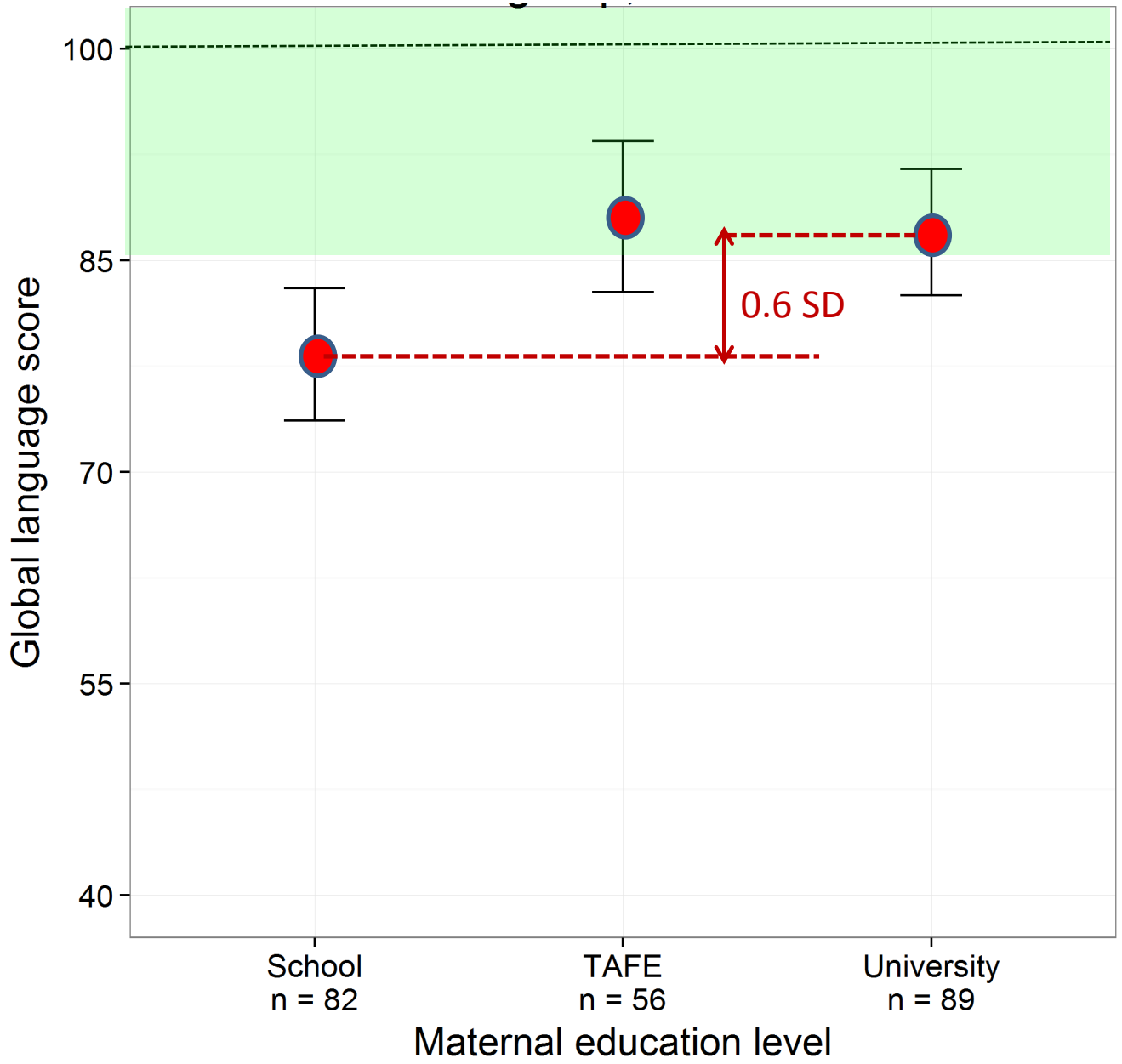
# Increase in HTL decreases language ability



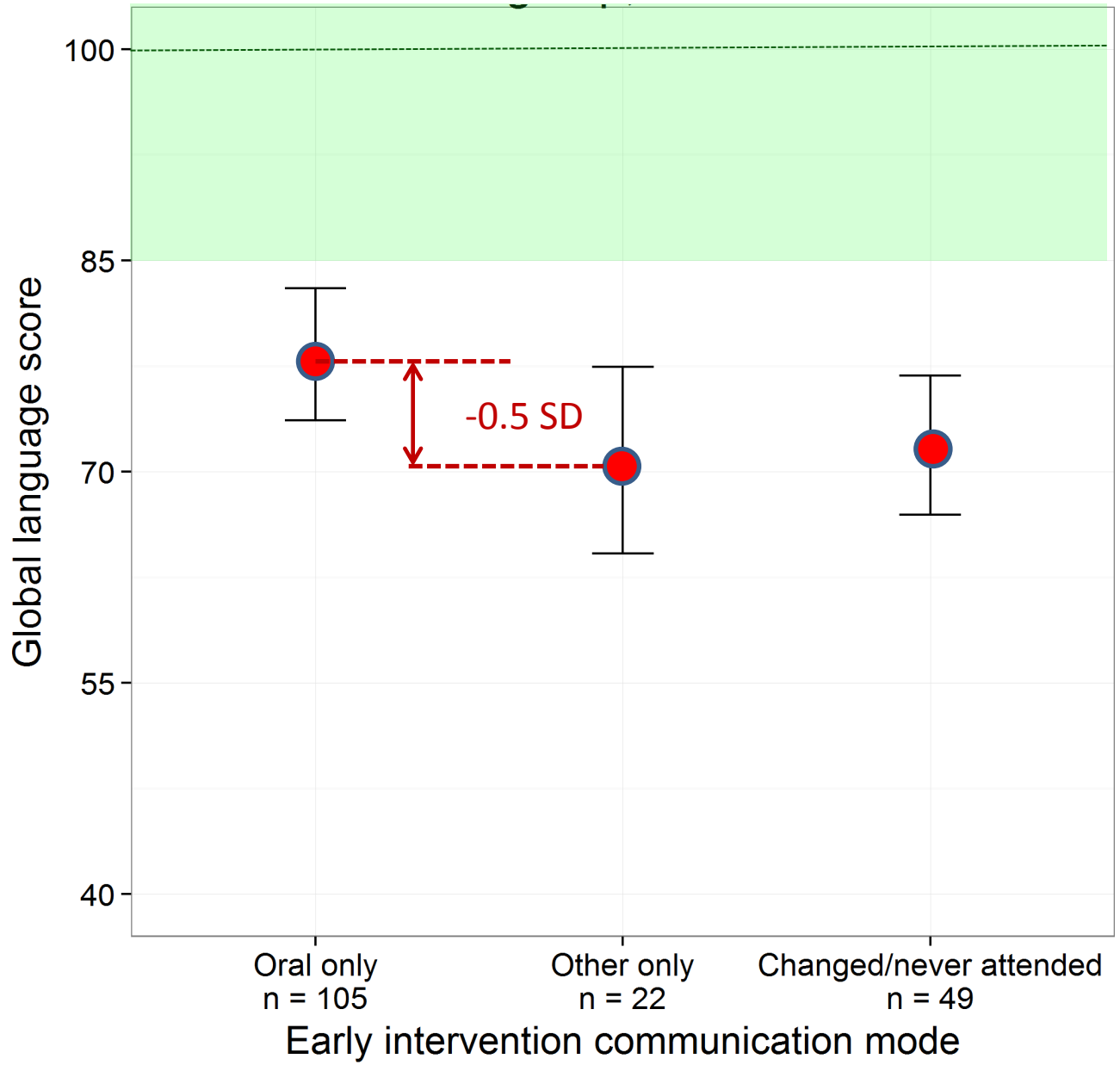
# Effect of age at fitting on language, for different HL



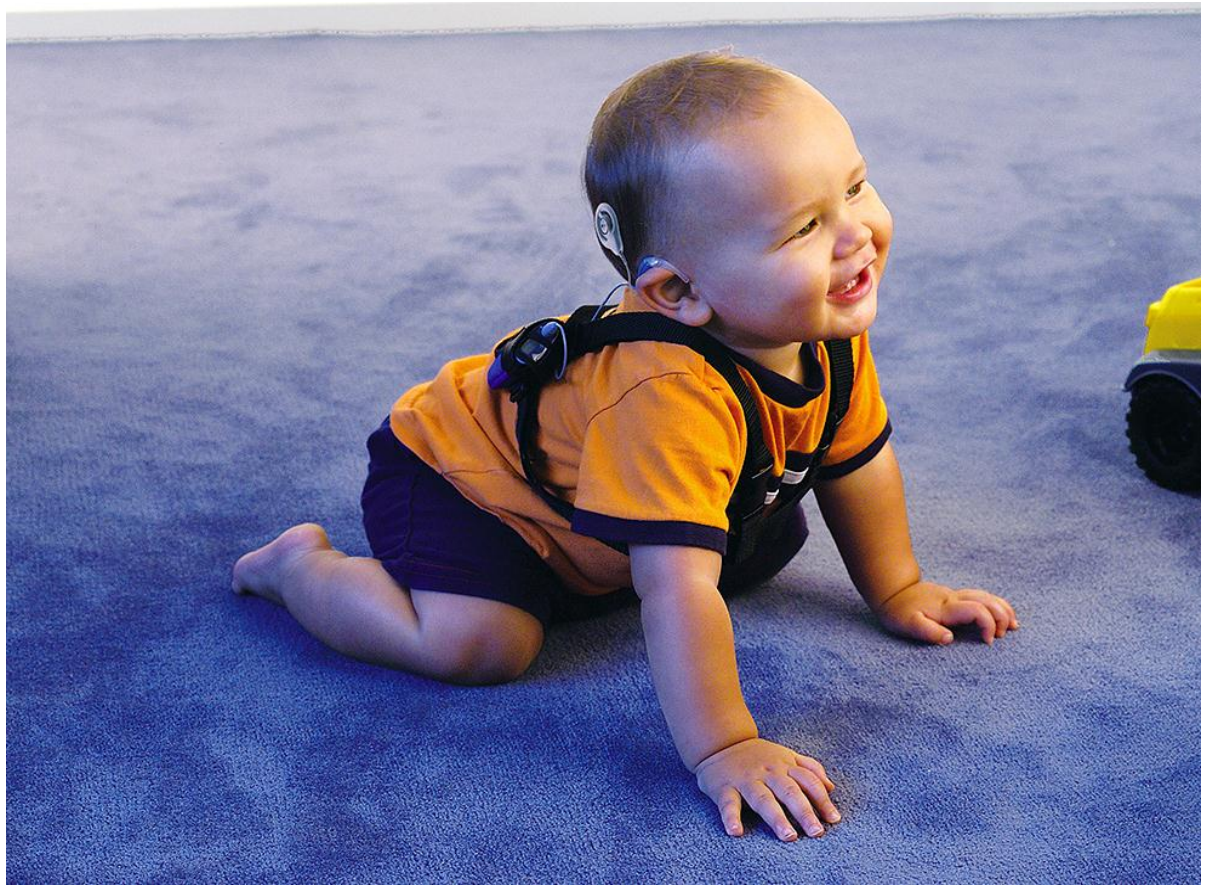
# Maternal education



# Communication mode in early education



# Children with cochlear implants

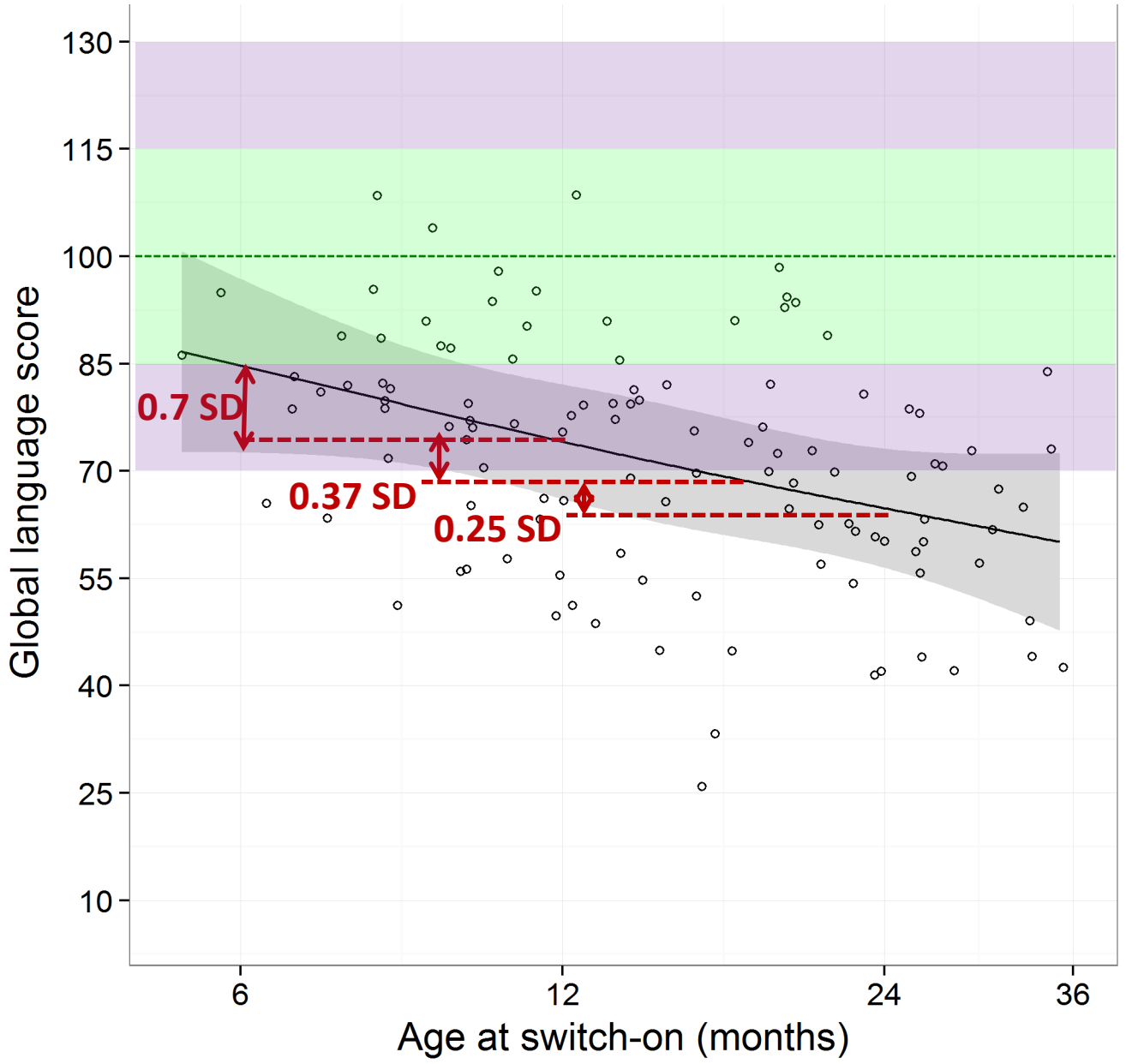


# Significant Predictors for 114 children with CI

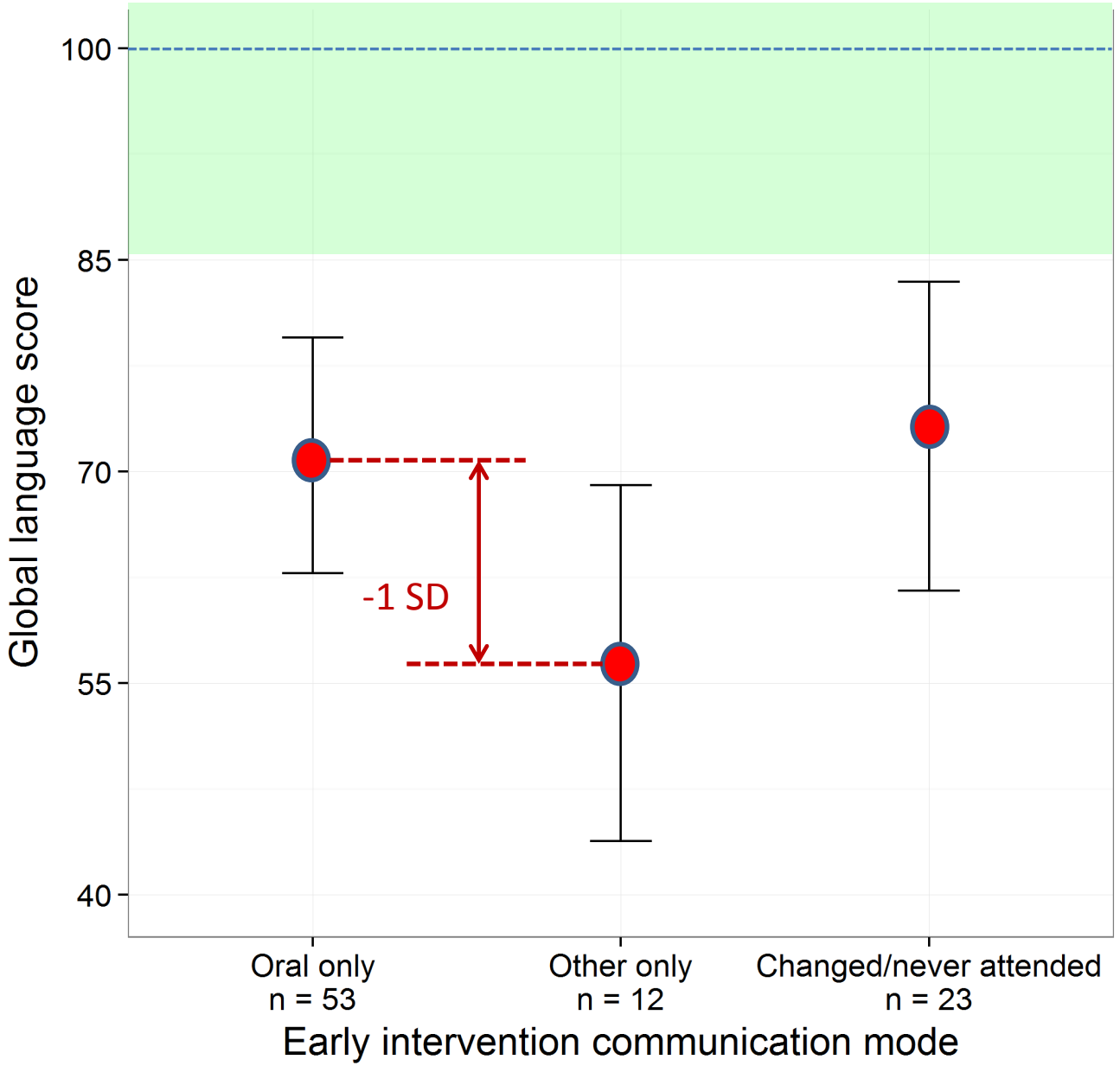
Impact of category change. For continuous variables, variation as per specification.

| Predictor | $R^2 = 70$ | Significance (p – value) | Impact |
|---|---|---|---|
| Age first switch on (log) | $R^2 = 58$ | 0.001 | |
| 4FA hearing loss | | 0.60 | -0.06 (-0.30,0.17) |
| Cognitive ability/WNV | | <0.001 | 0.53 (0.37,0.69) |
| Gender<br>(Female re male) | | 0.15 | <br>4.84 (-1.73, 11.42) |
| Birthweight | | 0.79 | 0.51 (-3.27,4.3) |
| Other disability | | <0.001 | -19.1 (-28.39,-9.83) |
| Maternal education<br>(Dip re school)<br>(university re school) | | 0.20 | <br>4.64 (-4.33,13.61)<br>8.28 (0.76,17.32) |
| Socio-economic status (dec) | | 0.40 | 2.3 (-3.05, 7.65) |
| Communication mode in Edn.<br>(other re oral)<br>(changed or nil re oral) | | 0.04 | <br>-12.38 (-24.5,-0.31)<br>2.56 (-7.42,12.55) |

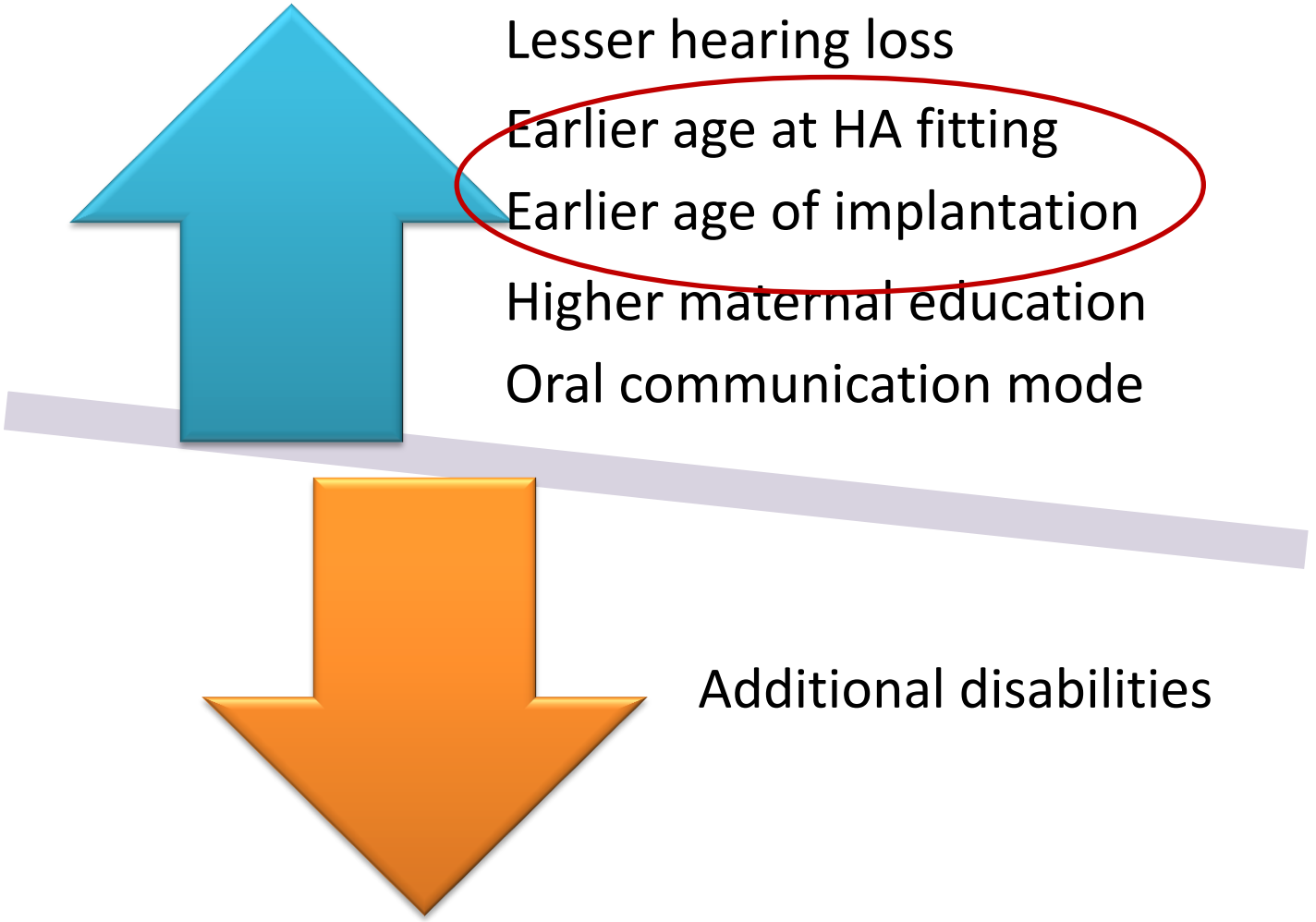
# Delaying CI switch-on decreases language ability



# Communication mode in education



# Yr 5 data suggest …



If we add 3-yr scores as a predictor,

the model accounted for 86% of total variance of scores

# SUMMARY

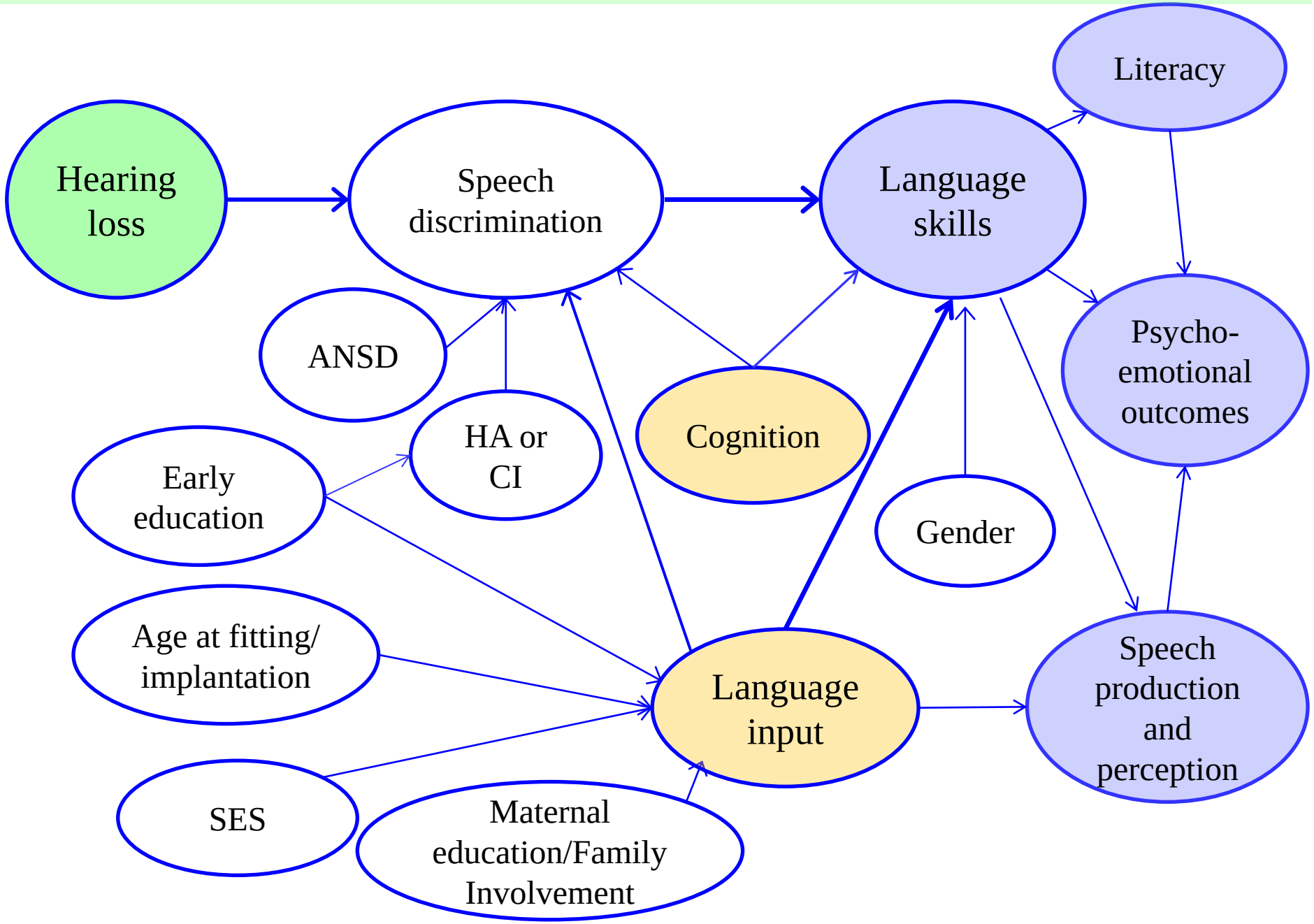
# Does UNHS improve outcomes?

Yes!

Early age at hearing-aid fitting

Early age at cochlear implantation

# Why does hearing loss affect language development?



# Does early performance predict outcomes at 5 years?

**Yes!**

- Language ability at 3 yrs accounted for 23% of variance in addition to other predictors (total: 83%)
- Language ability before 2 yrs accounted for 3% of variance at 5 yrs (total: 63%).
- Functional performance in real life (PEACH) before 2 yrs was a significant predictor of language at 3 & 5 yrs.

# To do …

- Streamline services to ensure early fitting and implantation
- Monitor early outcomes to identify children who may be “at-risk” of language impairment
  - develop effective diagnostic methods,
  - Develop evidence-based strategies for intervention

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*From left to right*: Linda Cupples, Louise Martin, Paola Incerti, Megan Gilliver, Kirst Gardner-Berry, Vicky Zhang, Sanna Hou, Vivienne Marnane, Teresa Ching, Miriam Gunnourie, Jessica Sjahalam-King, Lauren Burns, Harvey Dillon, Julia Day, Laura Street, Patricia Van Buynder, Jessica Thompson, Christopher Flynn.


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