

Effect of Early Language Education on Students' Academic Performance: POMNATHS case study

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Introduction

Status quo:

- Dropping standards of students' academic performance in schools & universities worry teachers, parents, government
- Threat to national socio-economic development

Research Questions:

- **What are the causes of this decline?** Could VE have contributed to the problem **by delaying the Age of Onset (AO) of English learning (SLA)?**
- **Does the delayed AO affect children's ability to learn English** and, therefore, their general academic performance?
- **Does the Critical Period Hypothesis (CPH) extend to SLA?**

Theoretical Background

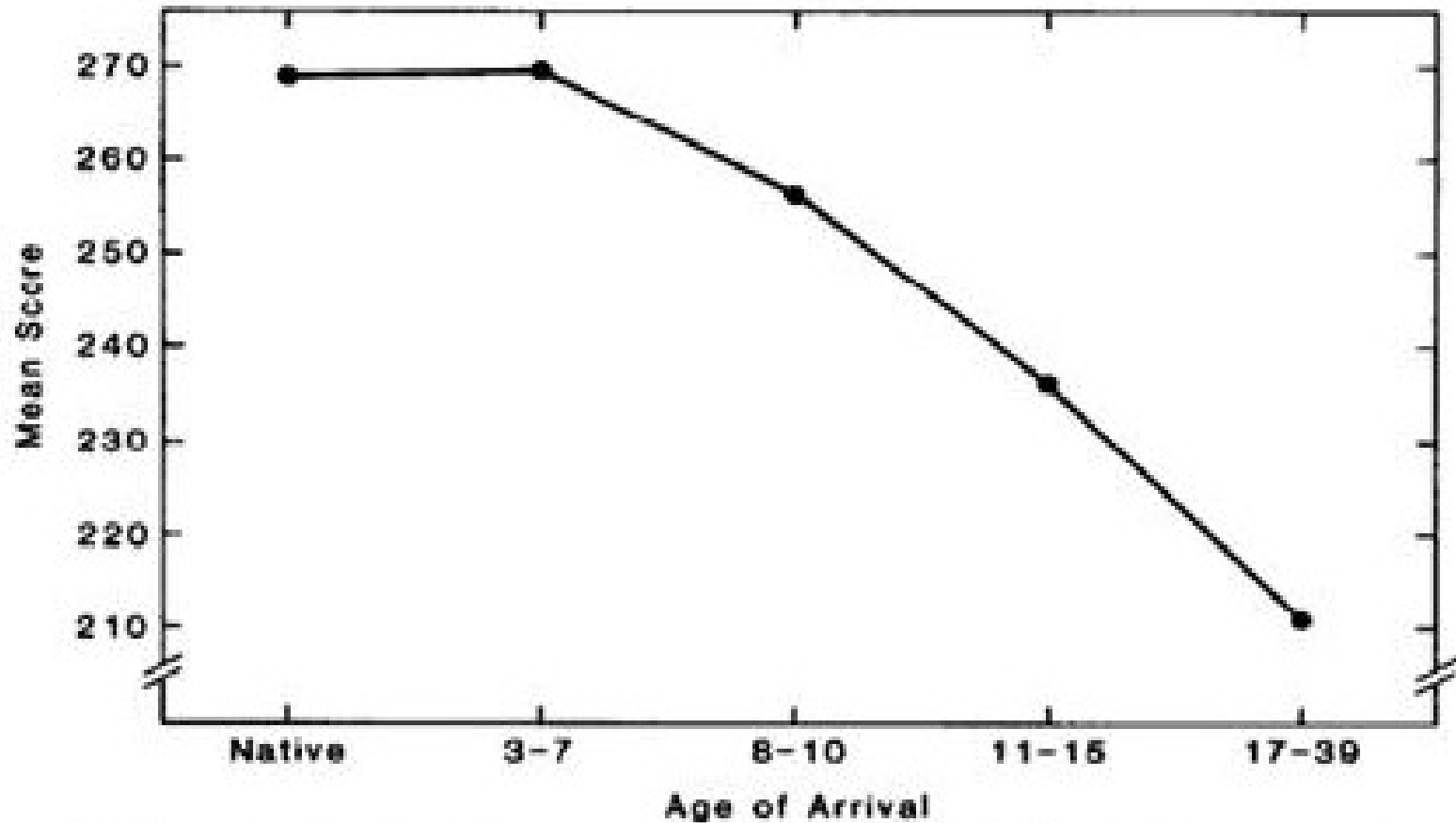
No consensus on whether CPH extends to SLA

- **Most neuroscientists**, starting with **Penfield & Roberts (1959)**, **argue FOR**:
 - **Pulvermüller, F. and Schumann, J. H. 1994**. Neurobiological Mechanisms of Language Acquisition.
 - **Johnson & Newport .1989**. Critical Period Effects in Second Language Learning: The Influence of Maturational State on the Acquisition of English as a Second Language.
 - **Hyltenstam, K. & Abrahamsson, N. 2003**. Maturational Constraints in SLA
- **Most TESOL professionals & SIL linguists argue AGAINST**:
 - **Makoto Tokudome**. Unlikely Bedfellows: The Critical Period Hypothesis and its Effects on Second Language Acquisition (2010).
 - **Marinova-Todd, S. H., Marshall, D. B., & Snow, C. E.** Three misconceptions about age and L2 learning (2000).
 - **Singleton, D. 1995**. Introduction: A critical look at the critical hypothesis in second language acquisition research.

New tool: statistics

Evidence for CPH in SLA by Johnson & Newport (1989)

CRITICAL PERIOD



The relationship between age of arrival in the United States and total score correct on the test of English grammar.

TESOL educators: **CPH in SLA is a “persistent myth”**

(Marinova-Todd et al. 2000)

Why? Because the CPH debate has huge implications for language policy and L2 teaching practice:

“... if a critical period for L2 learning does exist, then schools should obviously introduce foreign languages earlier, and all states should introduce policies to accelerate the exposure to English of immigrant children, as California has done. Clearly, knowing the facts about the critical period for SLA is relevant to policy and to practice in education” (Ibid.).

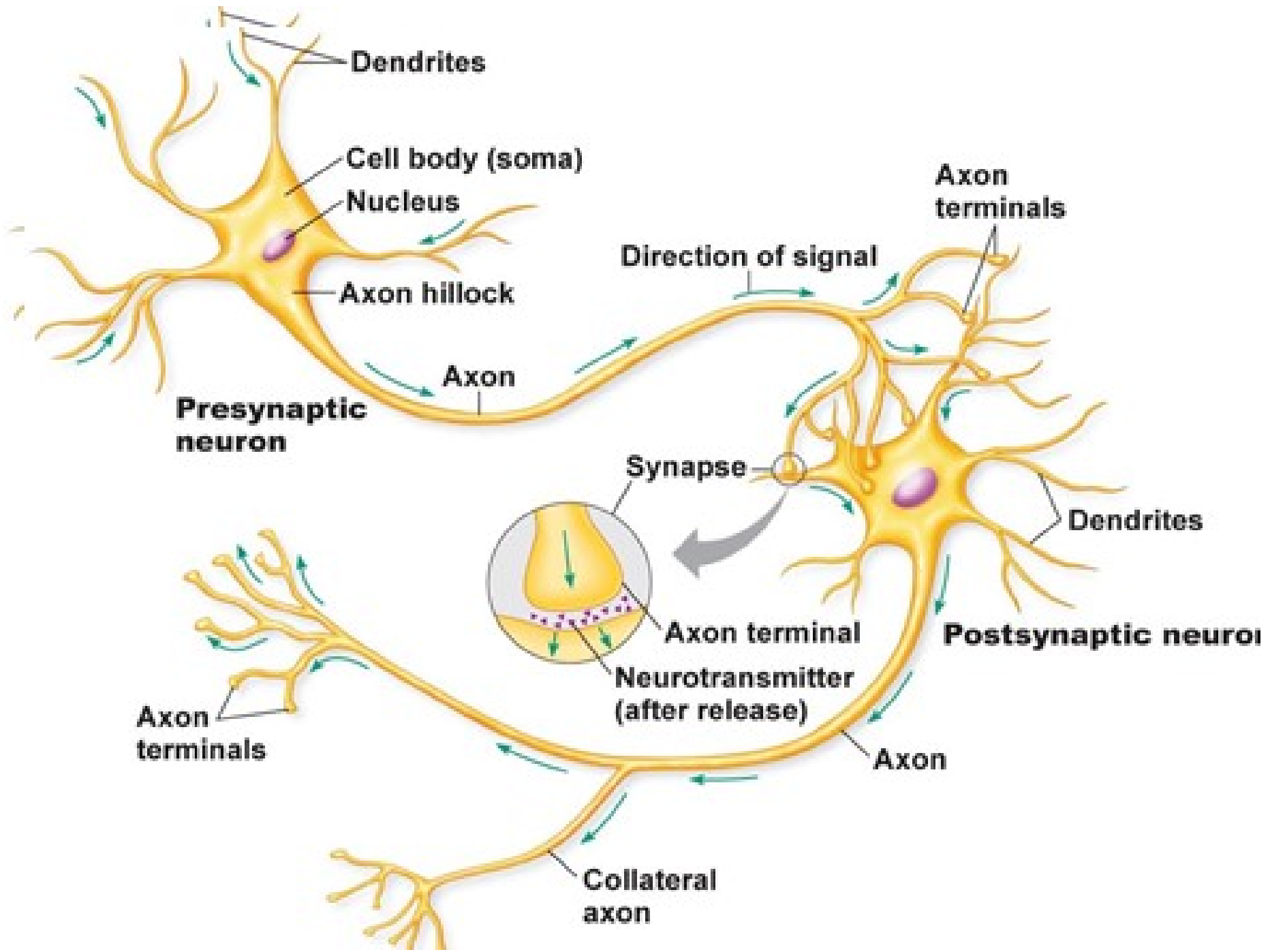
In the multilingual setting of
Papua New Guinea, where
English is the **language of education**
at secondary and tertiary levels,
resolving this issue is imperative
for national development.

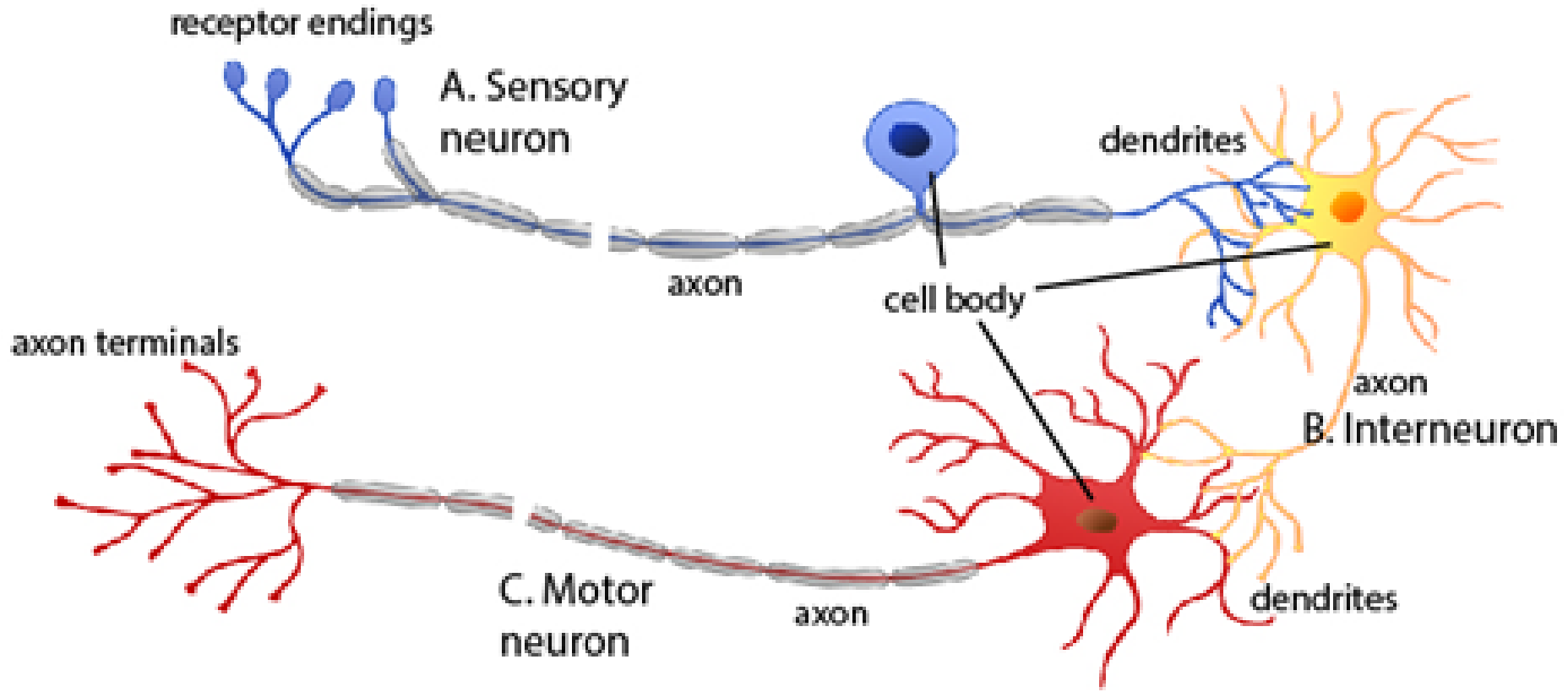
To understand how/why SLA outcomes are affected, we must look at the

MECHANISM OF LEARNING

Neurobiological Mechanisms of Language Acquisition

- Significant changes in the brain occur around the time when language acquisition outcomes begin to differ *systematically*; → a certain ‘**correlation between the two**’ (Hyltenstam & Abrahamsson, 2003).
- **Neurobiological basis for all learning** (including language acquisition) - *connections* between neurons (networking)



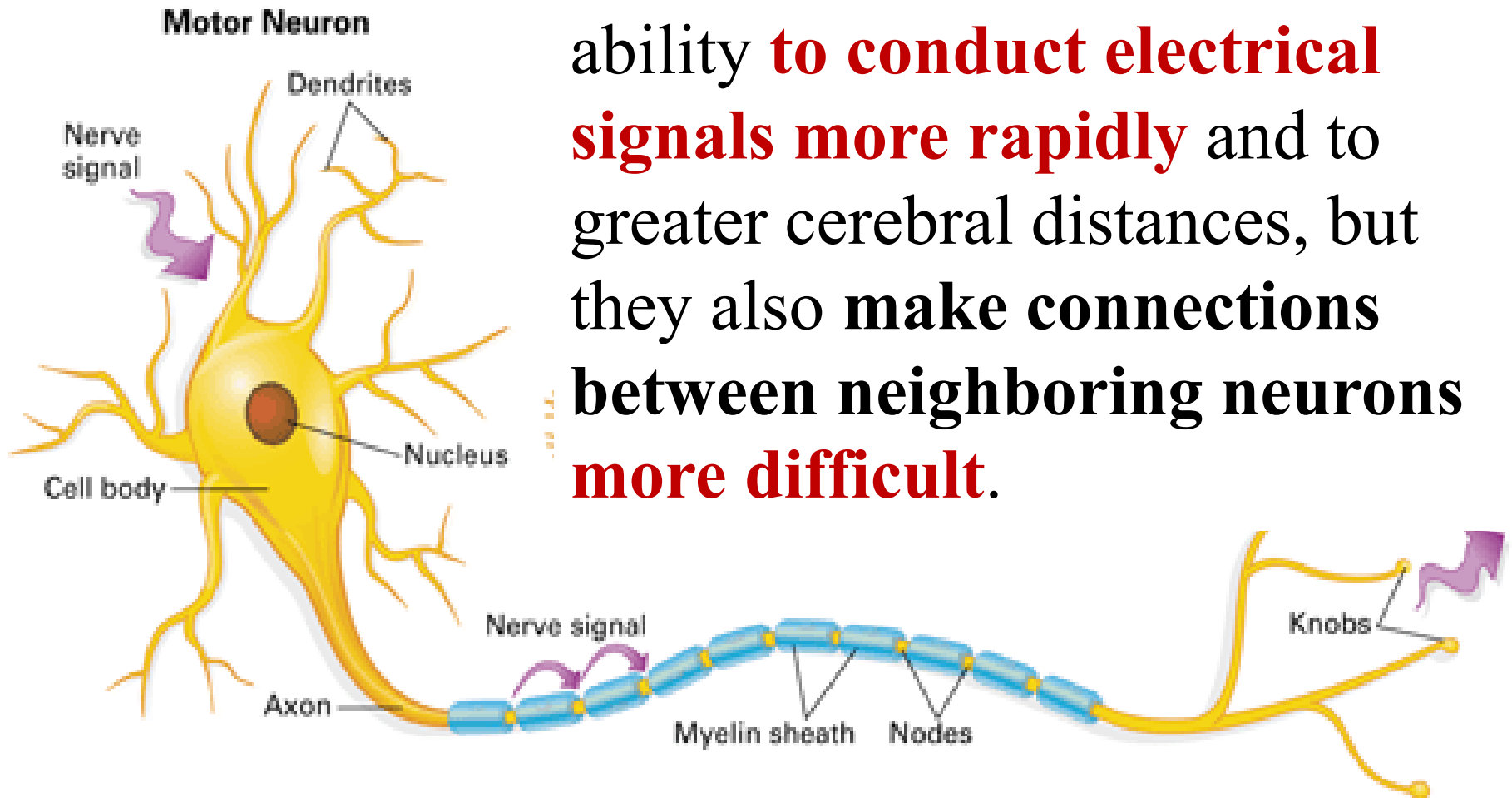


Axons can be over 1 m long – 10 000 times as long as the cell body is wide →

Need for faster connections

Myelin coating – **faster connections**

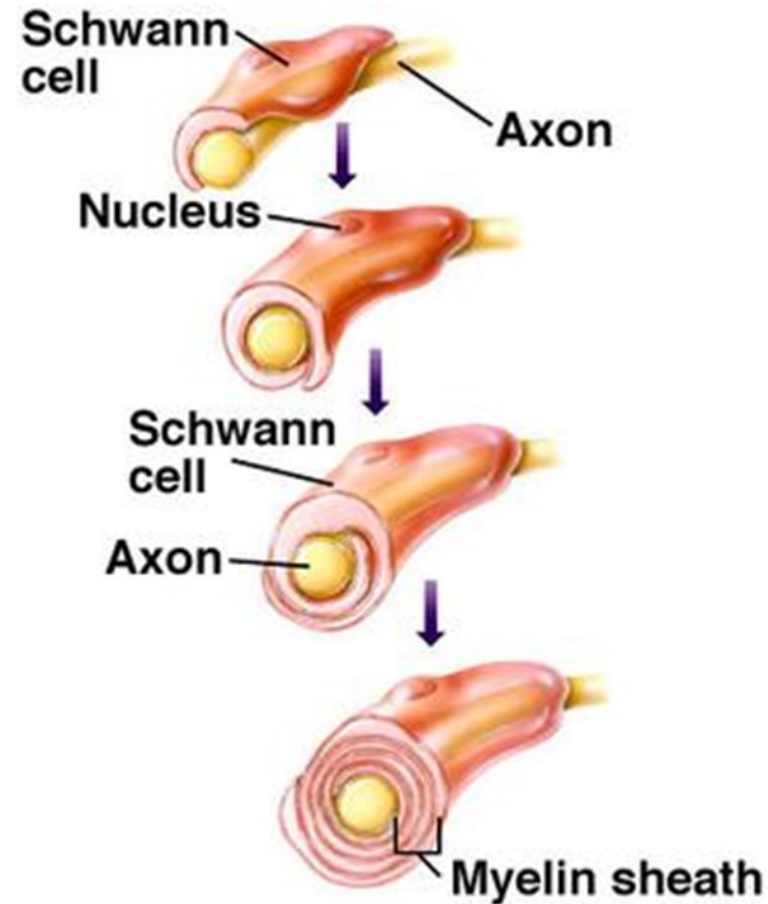
Myelin sheaths provide neurons with nutrition and increase their ability **to conduct electrical signals more rapidly** and to greater cerebral distances, but they also **make connections between neighboring neurons more difficult.**



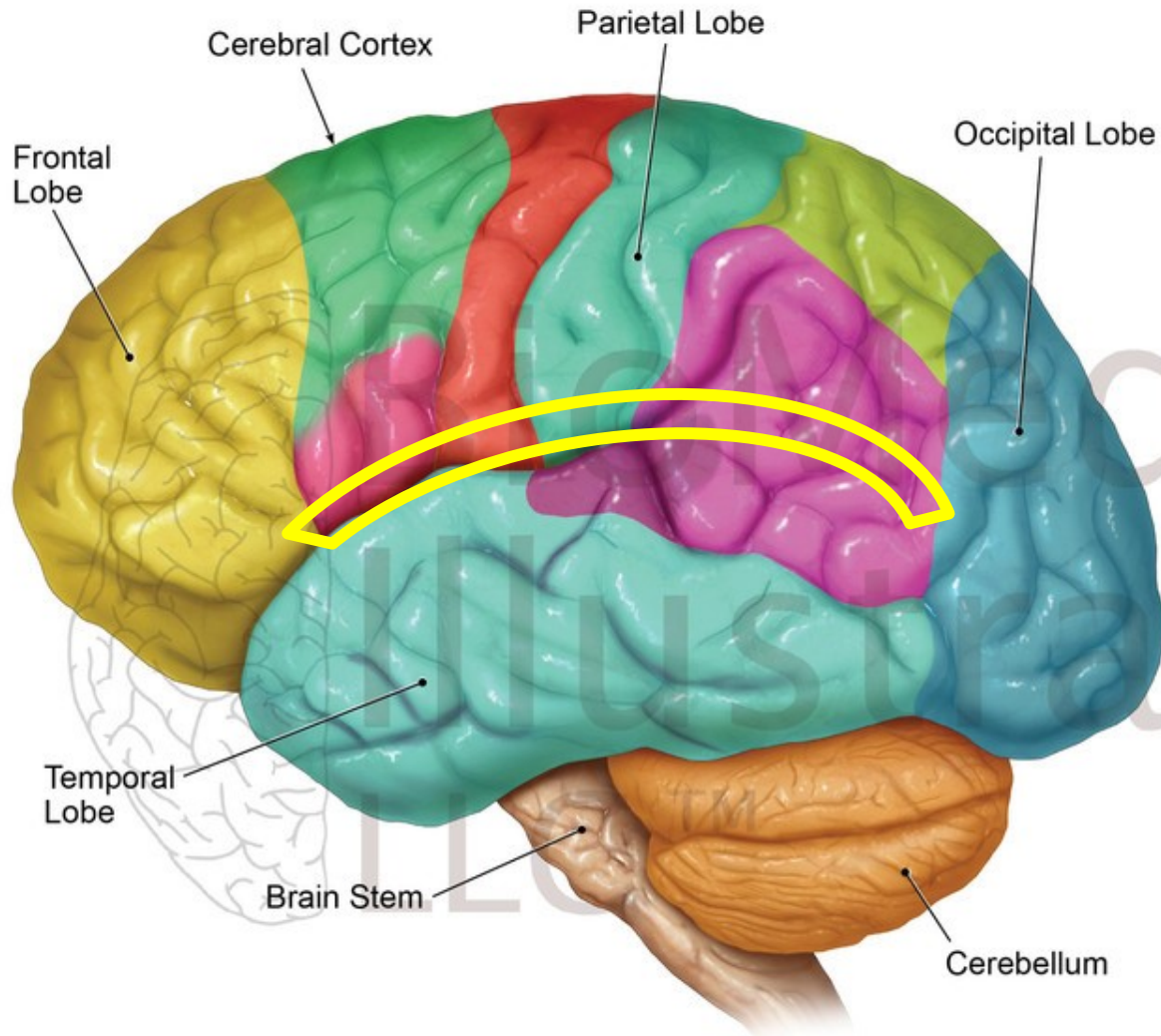
- Starts at the fetus stage; by the age of **12** months, the **primary sensory and motor areas** are myelinated.
- **Higher-order association areas** of the cortex are myelinated much later, and it is in these regions that some neurons remain unmyelinated in adults.
- **The language areas** myelinate after the primary sensory and motor areas, but before the higher-order association areas:

"Around puberty, all cortical areas, except perhaps the higher-order association cortices, have reached their full level of myelination." (Hyltenstam & Abrahamsson 2003).

Process of myelination



Brain Surface Anatomy & Functions



Cerebral Functions

- Higher Mental Function:**
Problem Solving, Thinking, Planning, Judgement, Emotional Expression, Creativity, Behavioral Control
- Motor Functions:**
Orientation, Head and Eye Movements, Posture
- Broca's Area:**
Control of Muscles for Speech Production & Ability to Comprehend Grammatical Structure
- Motor Functions:**
Initiation of Voluntary Muscles, Movement
- Sensory Functions:**
Sensation from Skin and Muscles
- Wernicke's Area:**
Comprehension of Speech Sounds & Language
- Auditory Functions:**
Perception of Sounds
- Tactile Perceptions:**
Processing of Multi-Sensory Information
- Visual Functions:**
Coordination of Eye Movements, Perception, Image Recognition, Association, Visual Memory
- Association Area:**
Short Term Memory, Equilibrium, Emotion

Cerebellar Functions

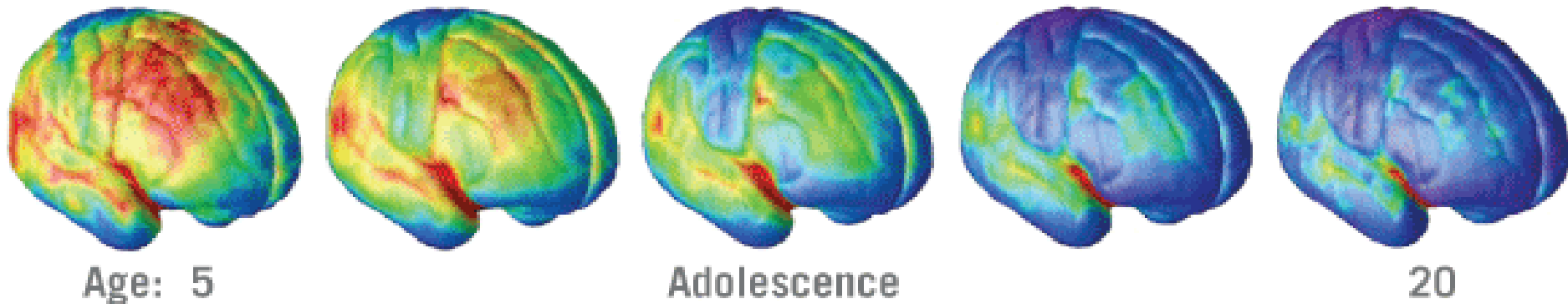
- Motor Functions:**
Coordinates Voluntary Movements:
Posture, Balance, Coordination, & Speech

Growing a Grown-up Brain

Radical changes occur in the brain at adolescence: Excess grey matter (nerve cell bodies and fibers, the bulk of brain's computing power) is pruned out, making brain connections more specialized and efficient.

Gray matter density

Gray matter becomes less dense as the brain matures.



Source: "Dynamic mapping of human cortical development during childhood through early adulthood," Nitin Gogtay et al., *Proceedings of the National Academy of Sciences*, May 25, 2004; California Institute of Technology

Language acquisition potential depends on the **type & speed** of connections in the cortical network

Two types of cortical connections between neurons:

- **long-distance** type uses apical dendrites and axons to reach far from the cell body and connect different cortical areas,
- **short-distance** type uses basal dendrites to make ‘local’ connections.

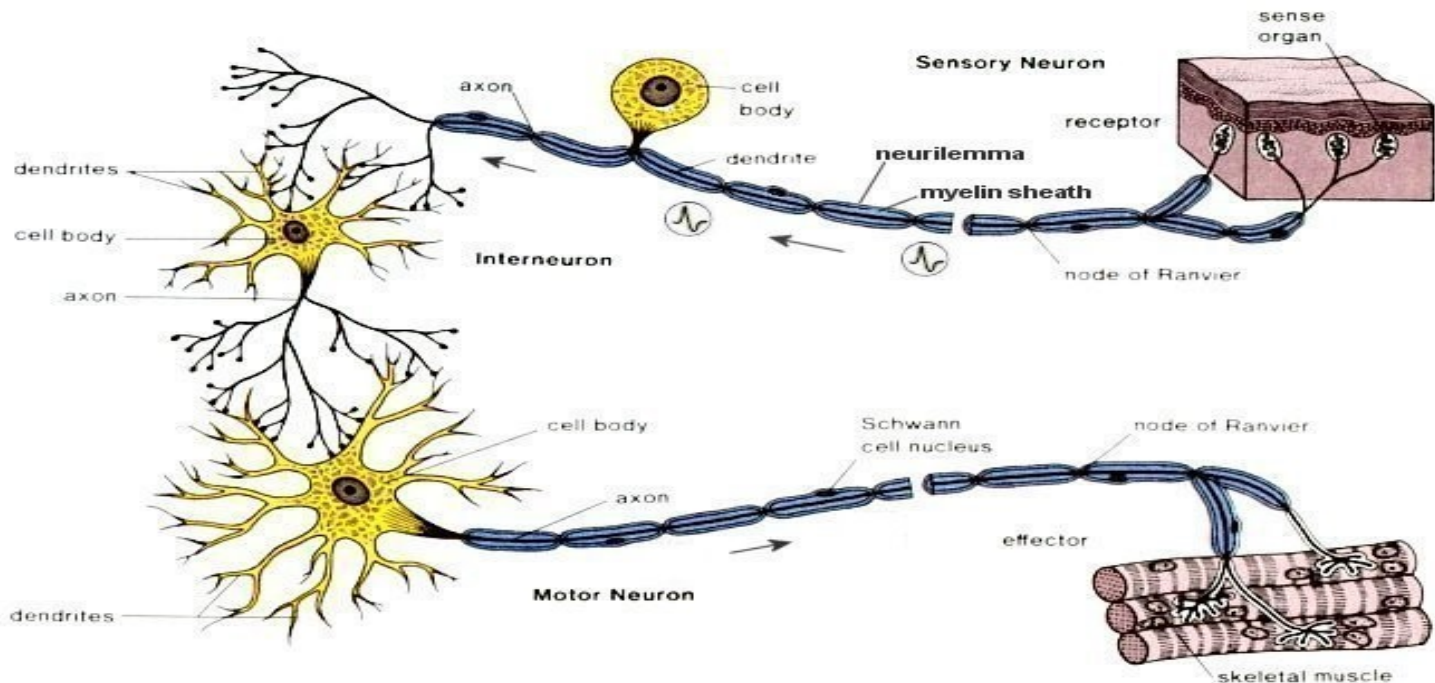
Myelination speeds up long-distance signal transmission through the axons, **but inhibits axon’s ability to connect with**

- **basal dendrites, which are close to the cell body, and**
- **local branches of the axons** (axon ‘collaterals’).

Language acquisition relies on 'local' connections within the 'language areas'

This is why

- L1 acquisition becomes impossible after puberty
- L2 acquisition becomes more effortful with the process of myelination in the 'language areas' (Hyltenstam & Abrahamsson 2003).



CPH: The ‘age advantage’ disappears after puberty, when language learning becomes a conscious effort

Higher-order association areas of the cortex are involved in SLA after puberty, as by then most of the ‘local’ connections in the ‘language’ areas have become unavailable through myelination and reduction in the ‘grey matter’ density :

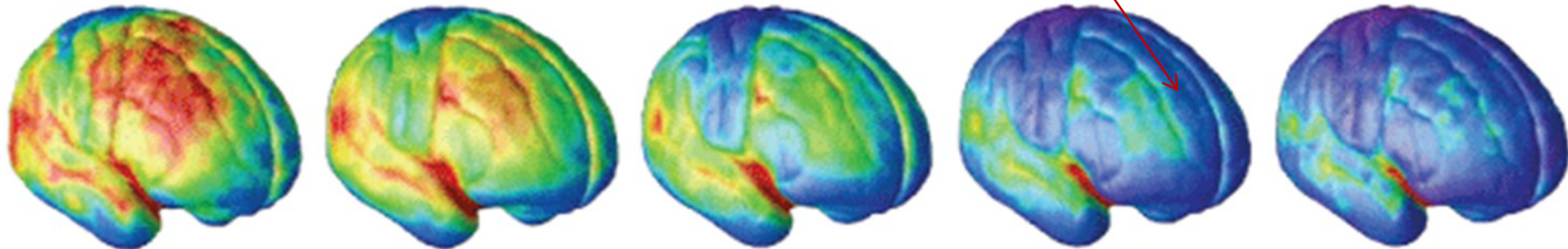
Gray
matter
density

Gray matter becomes less
dense as the brain matures.



More
dense

Less
dense



Age: 5

Adolescence

This was the theoretical basis of our research:

Aims

To establish whether there is any possible correlation between AO/Age at Literacy/ELL on POMNATHS students' academic performance

Objective

To contribute to the ongoing debate on whether CPH extends to SLA

Research Questions

1. Is there any measurable correlation between the AO and the students' overall academic performance and average English scores?
2. Is there any significant correlation between the age at literacy and the students' overall academic performance and average English scores?
3. Is there any significant correlation between the Early Learning Language (ELL) and the students' overall academic performance and average English scores?

Materials & Methods

Data collection tool:

A short pre-tested questionnaire, designed to elicit information on

- When, where, and in which language POMNATHS students first learned to read & write
- At what age they were exposed to/learned English

Methods:

- Purposive sampling
- SPSS 20 was used to analyze the data

The effect of early language education on POMNATHS students' performance

Sample Questionnaire:

You are invited to participate in a research project conducted by the School of Humanities & Social Sciences, UPNG. This study aims to help develop effective education strategies for sustainable national development.

The success of this study depends on the accuracy of your responses. **We guarantee total confidentiality** – none of your personal information shared with us will be disclosed in this study.

Your participation, however, is entirely voluntary.

PLEASE ANSWER THE EIGHT (8) QUESTIONS BELOW:

1. Please state your name, surname and academic ID

Name and Surname _____

Student ID# _____

2. Gender Male Female

3. Grade details:

- Grade 11 (Arts) Grade 11 (Science)
 Grade 12 (Arts) Grade 12 (Science)

4. What is the 1st language you spoke at home as a child?

- Vernacular (give the language name): _____
 Tok Pisin
 English

5. At what age were you taught to read and write?

- 5 years old 8 years old
 6 years old 9 years old
 7 years old Other (please specify): _____

6. Where did you do your elementary schooling?

- Port Moresby Milne Bay Jiwaka Enga
 Central Province EHP Hela ENB
 Gulf SHP WNB Bougainville
 Oro Manus New Ireland East Sepik
 Simbu Madang Morobe West Sepik
 Other

7. How old were you when you first started learning English?

- 5 years old 8 years old
 6 years old 9 years old
 7 years old 10 years old
 Other (specify) _____

8. In what language did you first learn to read and write?

- Vernacular
 Tok Pisin
 English

The effect of early language education on POMNATHS students' performance

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Your participation, however, is entirely voluntary.

PLEASE ANSWER THE EIGHT (8) QUESTIONS BELOW:

The 8 questions we asked were:

1. Your name & surname

2. Gender

3. Grade details:

- Grade 11 (Arts)
- Grade 11 (Science)
- Grade 12 (Arts)
- Grade 12 (Science)

4. What is the 1st language you spoke at home as a child?

5. At what age were you taught to read and write?

6. Where did you do your elementary schooling?

7. How old were you when you first started learning English?

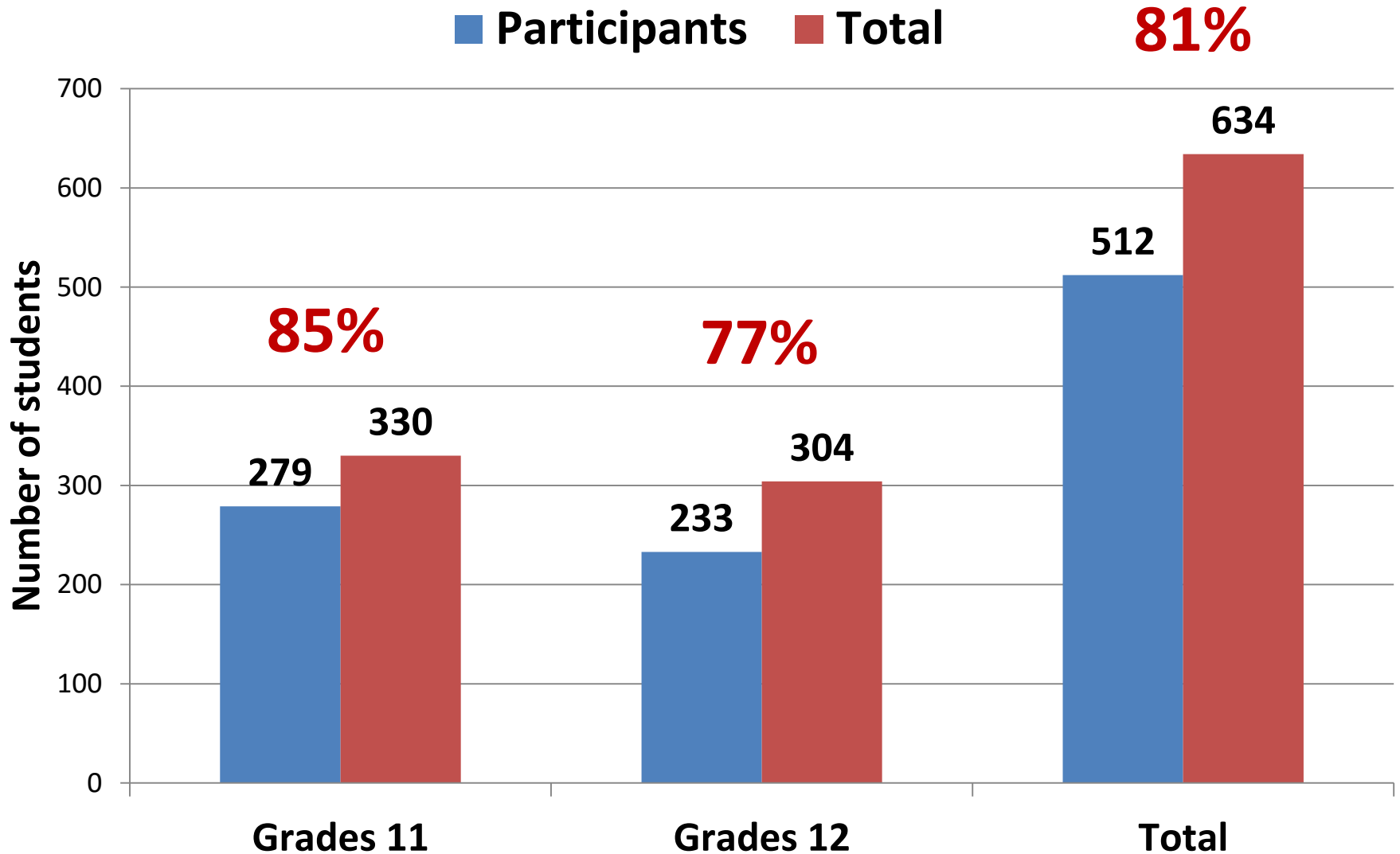
8. In what language did you first learn to read and write?

We

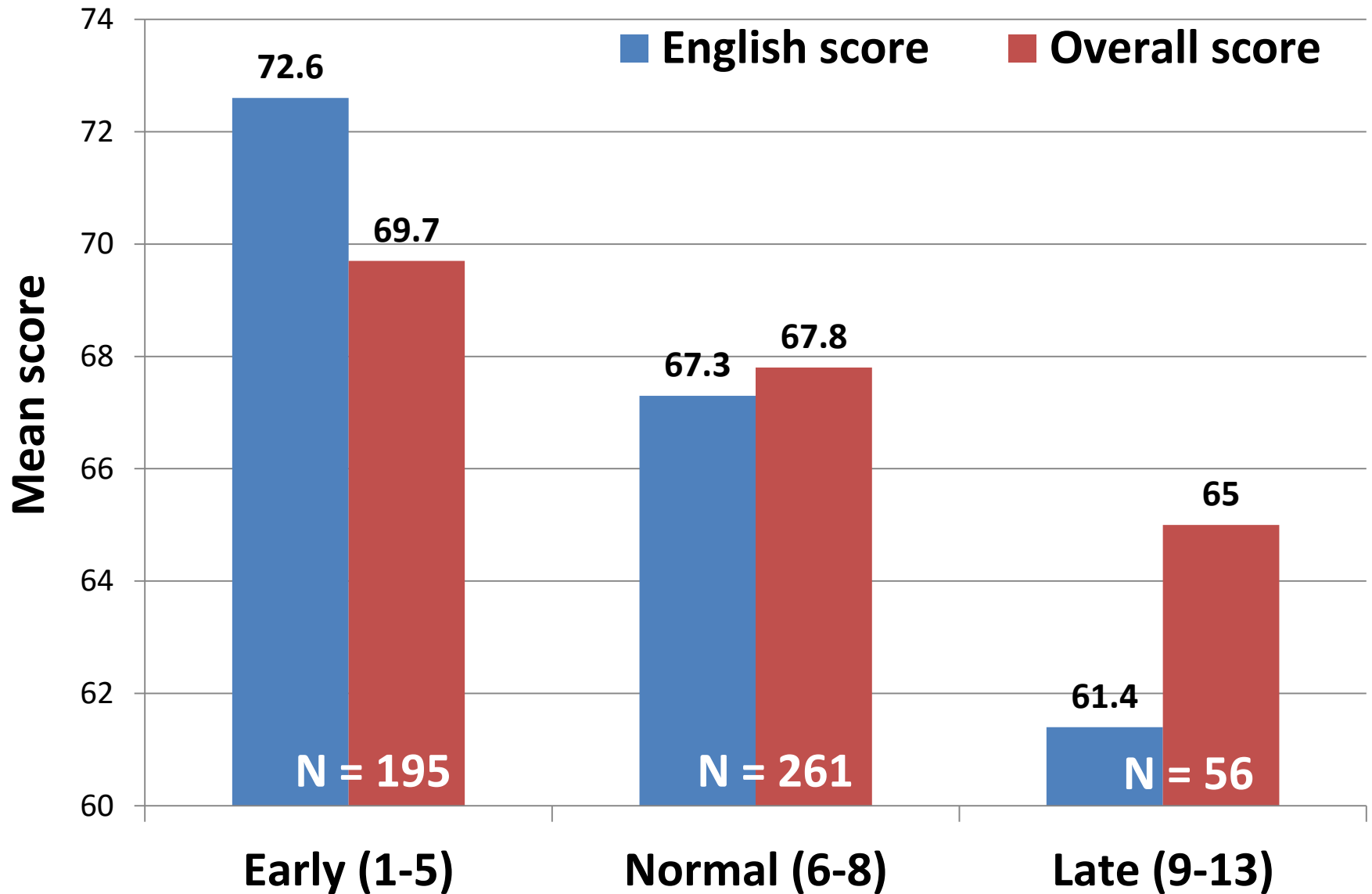
- Obtained permission from POMNATHS Administration, secured their collaboration
- Collected
 - Survey data (from students)
 - Academic scores (from school records)
- Data entry & coding
 - Information contained in 512 questionnaires was matched with the respective academic scores, forming the final dataset.
- Conducted data analysis using SPSS20
 - Descriptive statistics, comparison of means
 - A series of ANOVAs, correlation and regression analyses

FINDINGS & DISCUSSION OF RESULTS

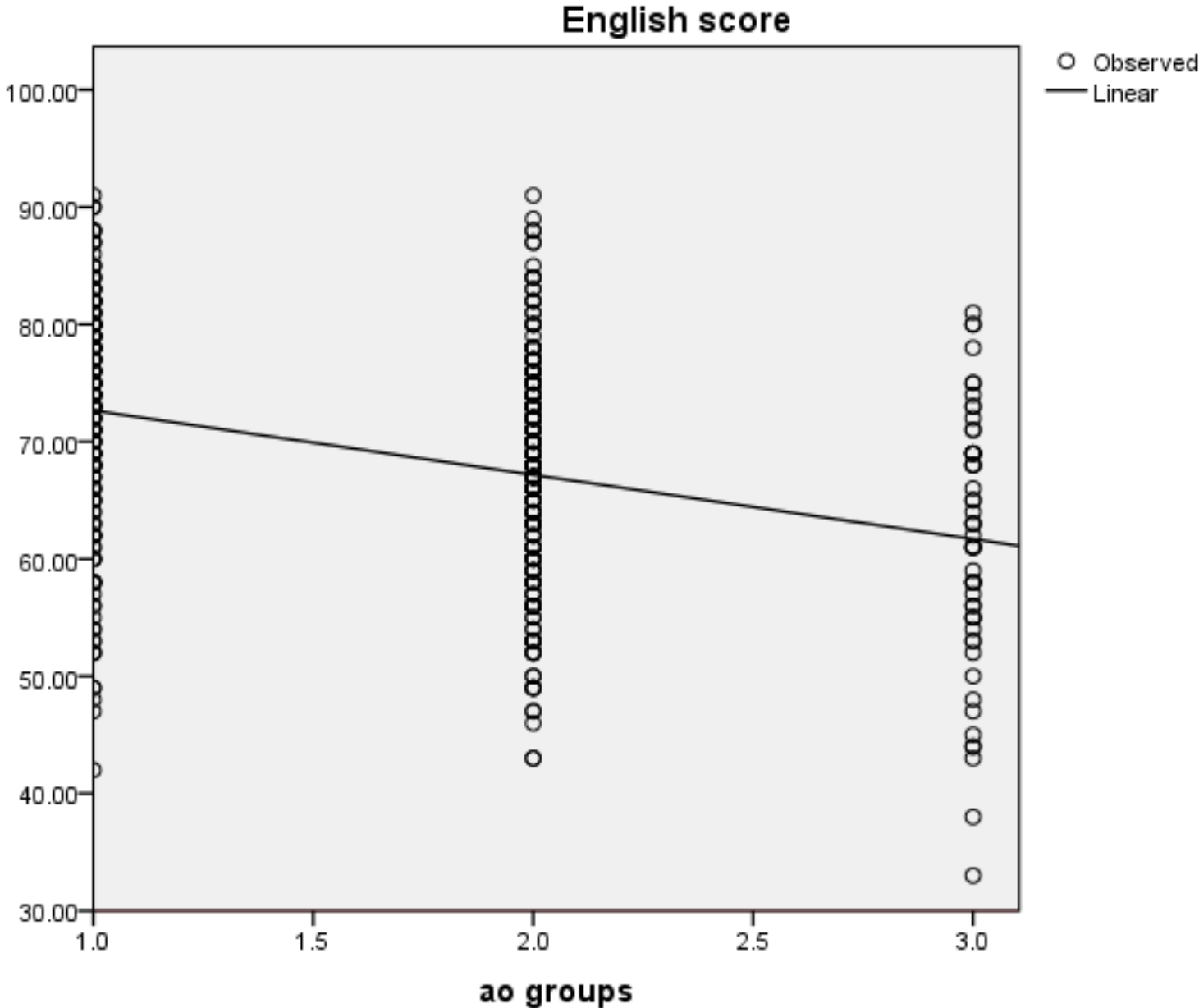
Response rates by grade level & overall



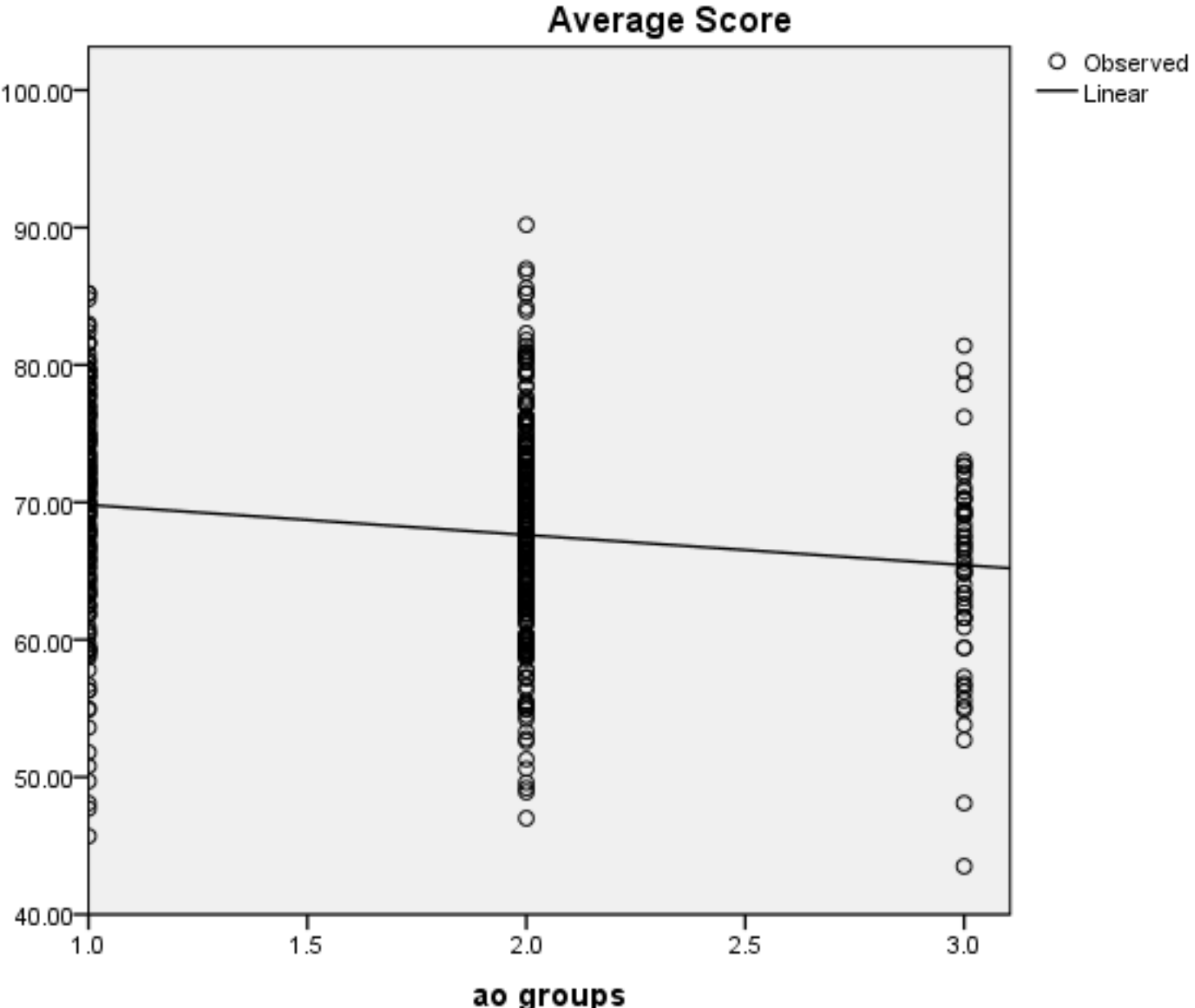
English & Overall Achievement by Age of Onset



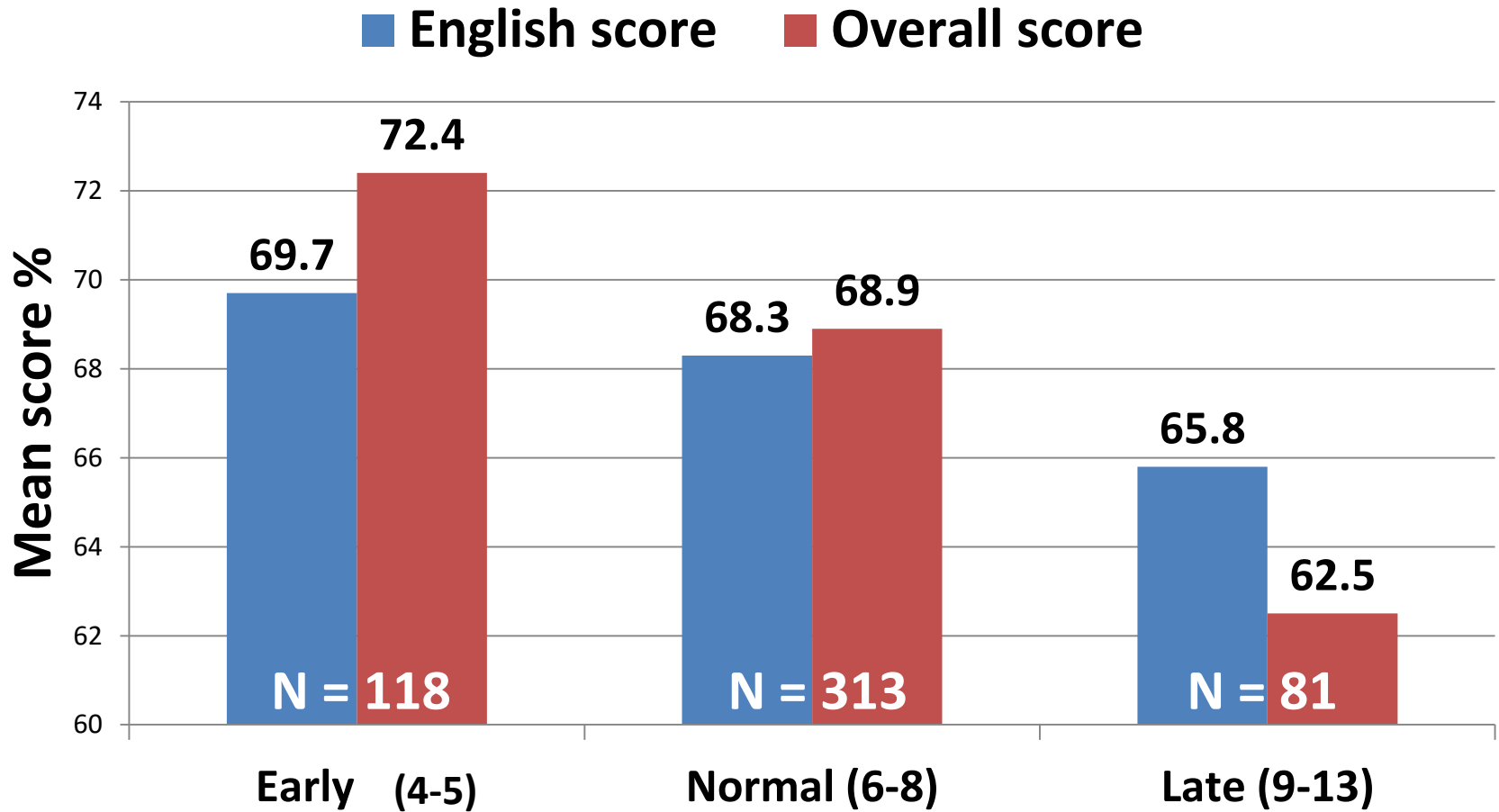
English Proficiency by Age of Onset Groups



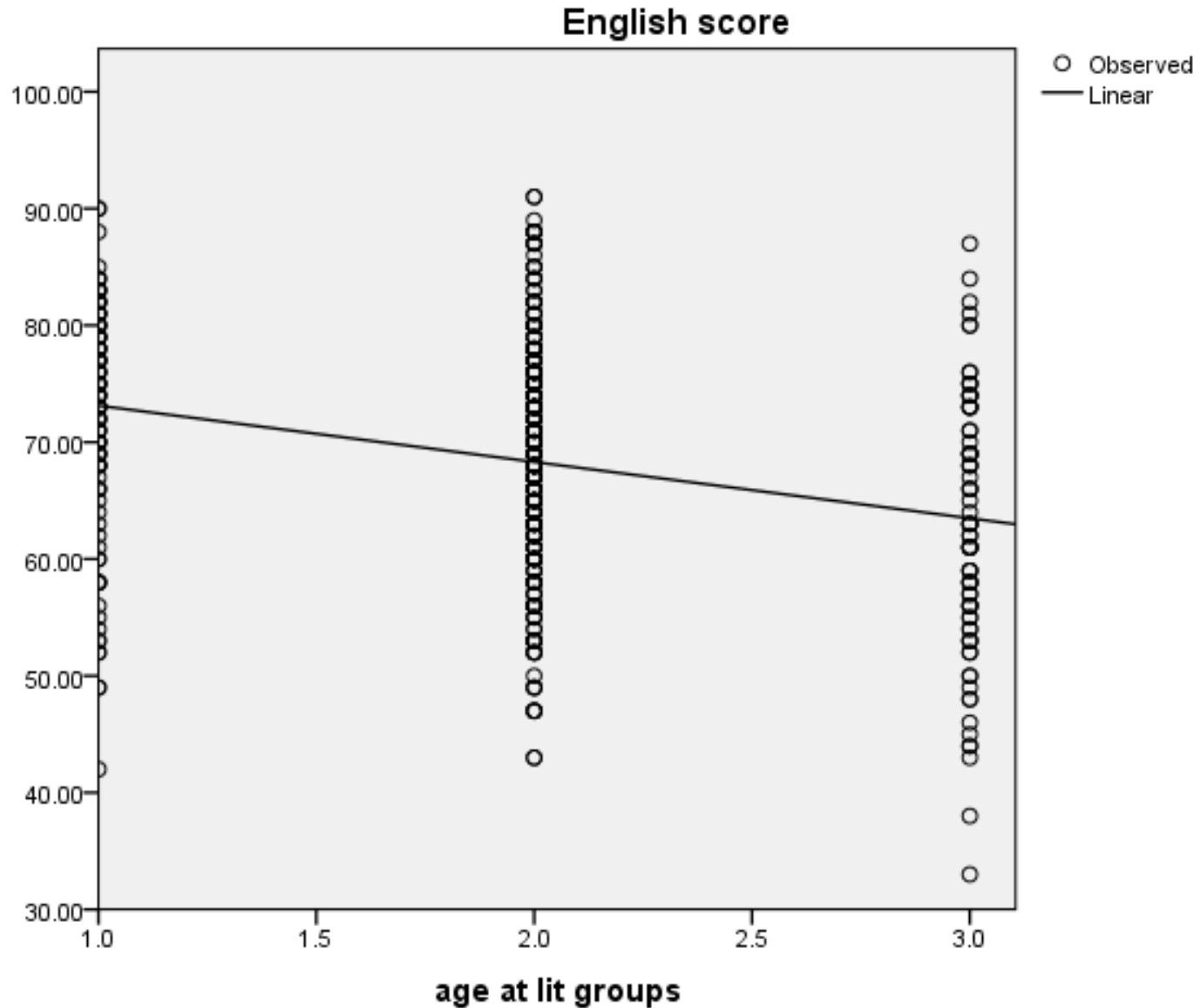
Overall mean scores by Age of Onset groups (slope less steep)



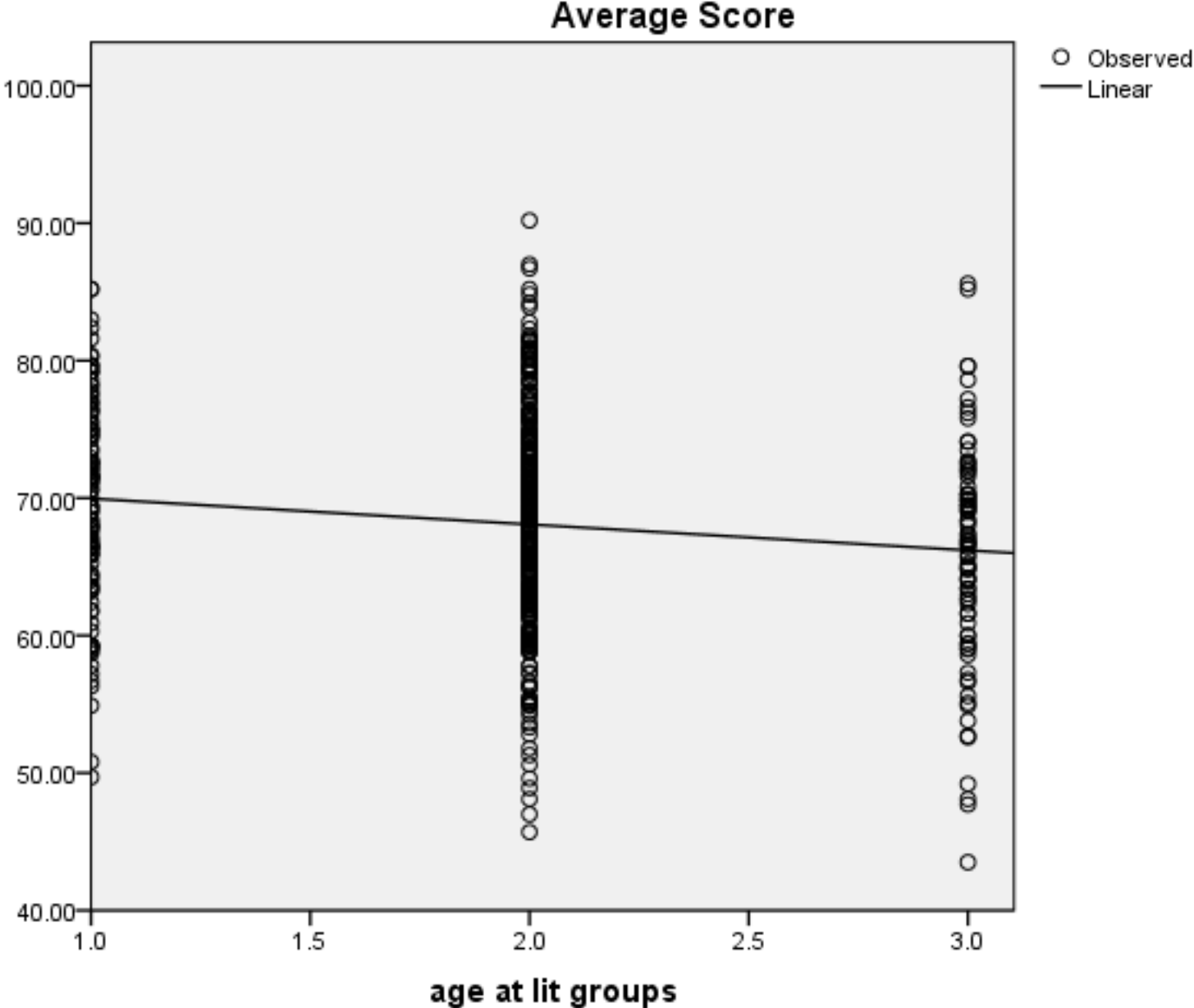
English & Overall Scores by Age at Literacy groups



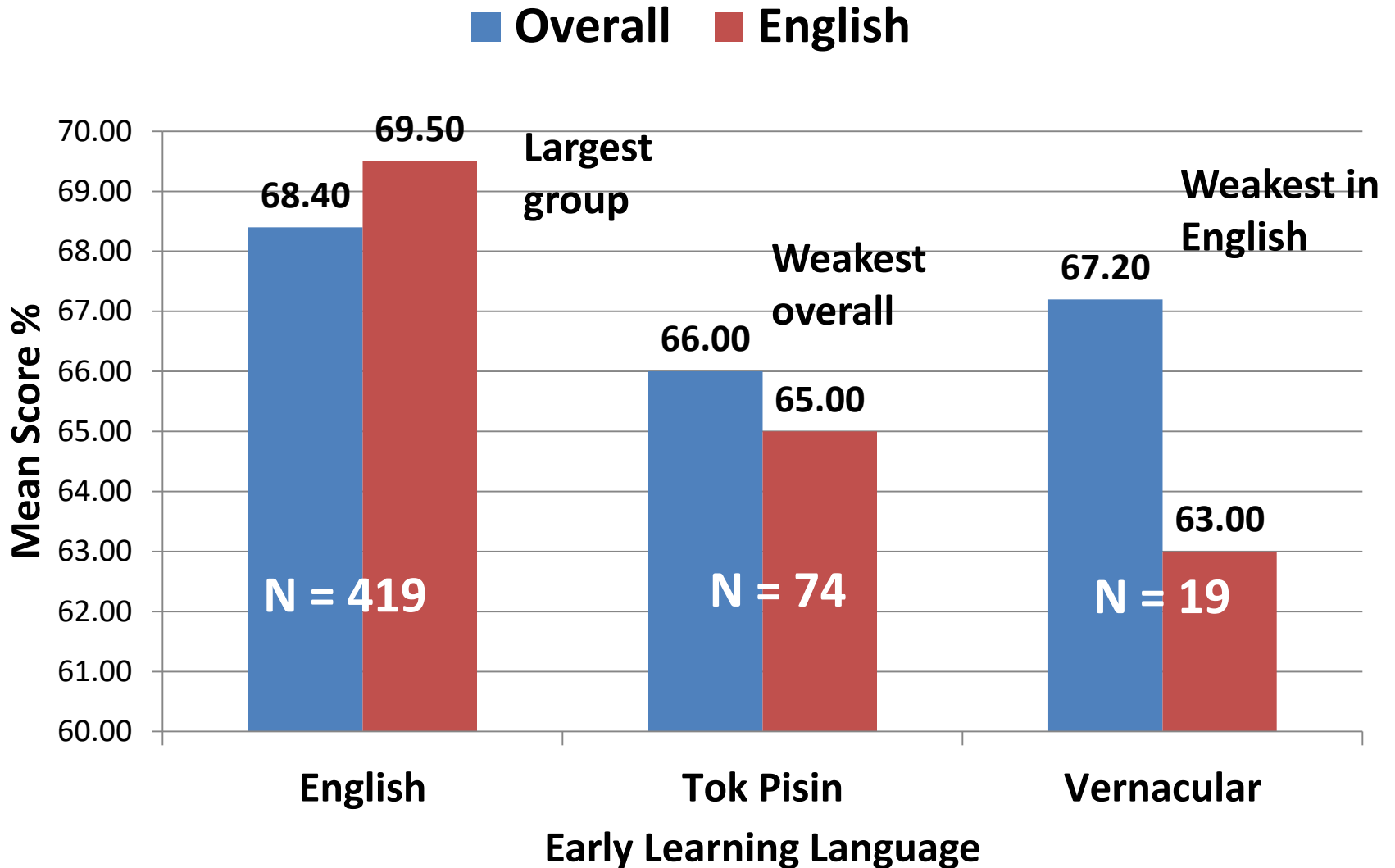
English scores by Age at Literacy groups



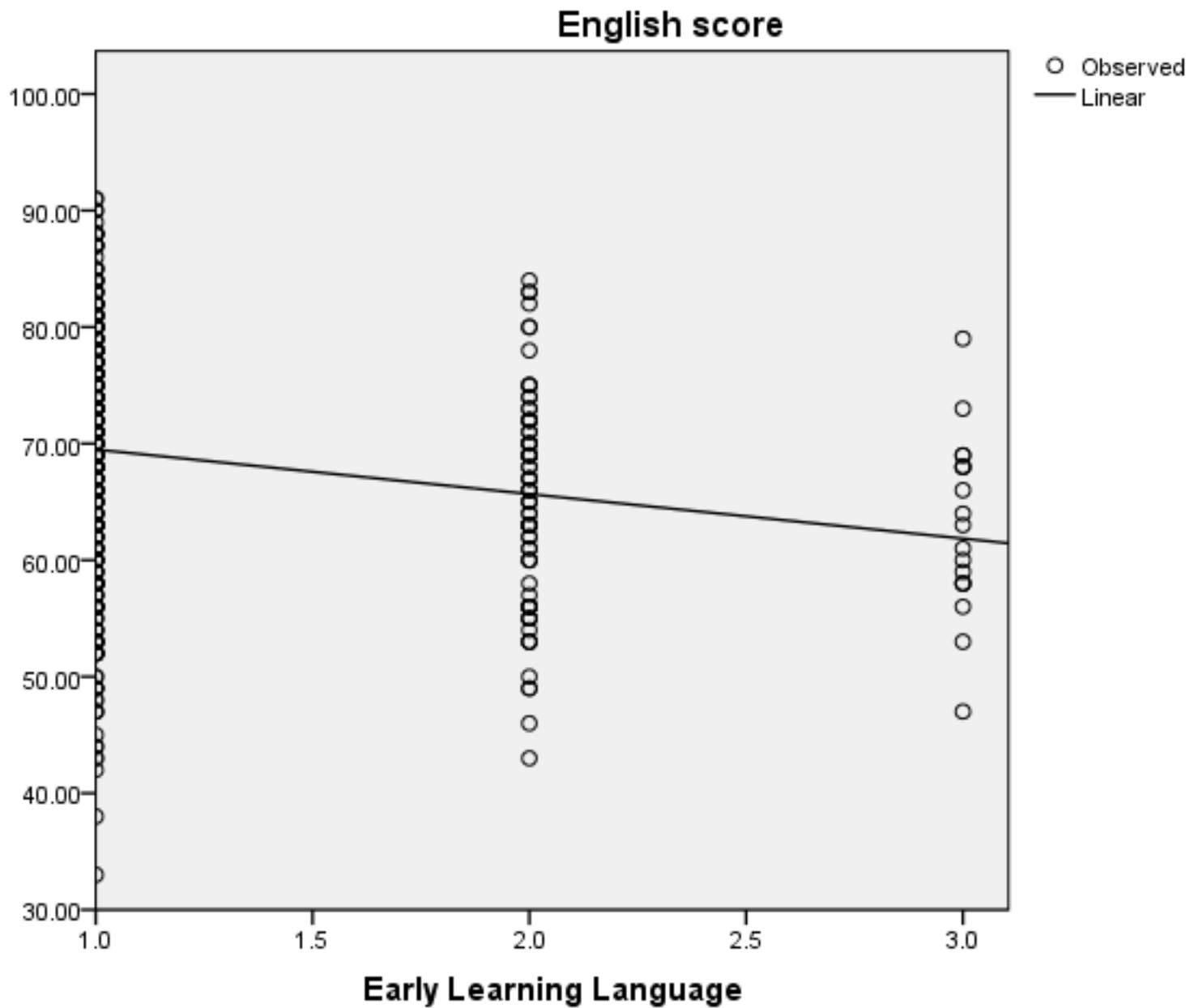
Overall performance score by Age at Literacy groups



Overall & English mean scores by Early Learning Language (ELL)

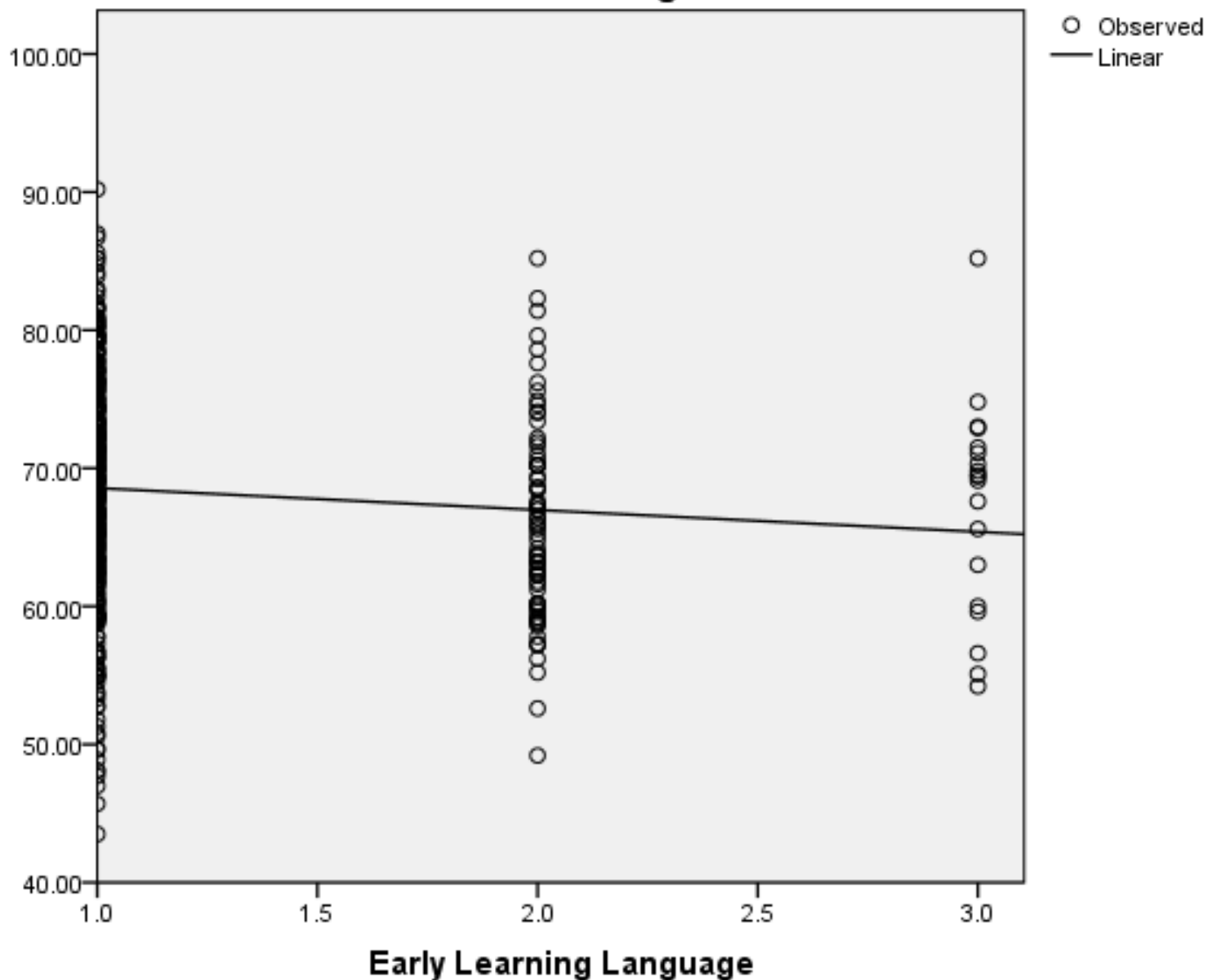


English mean scores by Early Learning Language (ELL) groups



Overall mean scores by Early Learning Language (ELL) groups

Average Score



Conclusions

1. All the ANOVAs and regression tests run show a significant correlation ($p < 0.05$) between
 - **AO** and students' mean overall/ mean English scores
 - **Age at Literacy** and mean overall/ mean English scores
 - **ELL** (English, Tok Pisin & Vernacular) and the students' mean overall/ mean English scores.
2. These results follow the trend observed in our 2015 UPNG study (LSPNG Proceedings 2015)

More research must be done

Indisputably, correlation does not imply causation – complex socio-economic & cultural factors are all at play here.

However, we hope that yet another confirmation of an inverse relationship between AO and SLA will contribute

- to the ongoing debate regarding CPH in SLA, and
- evidence for formulating an effective national Language Education policy in PNG.

We know that correlation does not imply causation – **complex socio-economic & cultural factors are all at play here, i.e.:**

- Lack of infrastructure/ trained teachers /teaching materials
- Lack of government funding
- Low family incomes
- Cultural perceptions & attitudes, and also
- Low literacy rates, etc.

Year	Human Development Index (HDI) (out of 182 listed countries)	Life Expectancy (years)	Real per Capita GDP (Kina)	Adult Literacy Rate (percent of 15 years and older)	Basic Education Gross Enrolment (pre-Gr. 8, 6 – 14 year pop.)
2010	148	58.0	1 919.8	58	85.5
2020	123	63.0	2 744.4	70	90.0
2030	98	68.0	3 663.5	80	96.5
2040	73	72.0	6 178.6	90	98.0
2050	50	77.0	10 420.5	100	100.0

Strategic Target Goals for Vision, 2050

Kanabea: 2012 El. 3 class (>100 students)



Ages in Grade Levels for Kikori District

(R. & D. Petterson: 2016)

	EP	1	2	3	4	5	6	7	8
Median	8	10	11	13	13	14	16	18	19
Min	4	4	5	8	8	10	12	14	12
Max	14	16	17	22	18	19	22	24	23
N	326	307	301	168	86	162	114	72	47

More research must be done

To get a better picture of the situation, we must

- Expand this study to cover all National High Schools
- Continue our similar UPNG study
- Expand it to other PNG Universities
- Conduct all these studies over a number of years.

We hope these studies will help shape language education policy in PNG and deepen our understanding of the CPH in SLA.

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