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EXPLORING THE RELATIONSHIP BETWEEN AGE OF ONSET OF LEARNING ENGLISH AND STUDENT ACADEMIC PERFORMANCE: EVIDENCE FROM PAPA NEW GUINEA

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ABSTRACT:
This paper is a follow-up on our 2017 study of the effect of Age of Onset of learning English (AO) on the academic performance of University of Papua New Guinea (UPNG) students in the School of Humanities and Social Sciences (SHSS). It investigates the relationship between three factors in the students' Early Language Education {Age of Onset of learning English (AO), Age at Literacy (AGELIT), and Early Learning Language (ELL)} and the students' academic performance, measured by their current Grade Points Average (GPA). A survey of SHSS students registered in the second Semester of the 2018 academic year was conducted using purposive cross-sectional sampling method. A self-designed pretested questionnaire yielded data on the students' language education backgrounds (their AO, AGELIT and ELL). Linear regression and correlation analyses revealed a strong and statistically significant inverse correlation between students' AO/AGELIT and their GPAs. In addition, a strong positive link was observed between ELL English and the students' GPAs. Relatively lower GPAs were associated with ELL Vernacular, and a highly significant decrease in GPAs was observed in the presence of ELL Tok Pisin. These results corroborate the findings of all our earlier studies, which established a highly significant negative correlation between students' AO and their academic performance at UPNG, as well as in all six National High Schools of Papua New Guinea.

Keywords: Second Language Acquisition (SLA), brain maturation, myelination, language education policy, Early Learning Language (ELL), Age of Onset (AO), Age of Literacy (AGELIT).
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INTRODUCTION:

English is the language of education in Papua New Guinea (PNG). In this context, the controversial issue of Age of Onset (AO) of learning English goes beyond academic debates over the techniques and methods of teaching a second language; in this country, AO has acquired vital significance, because delayed AO has been associated with lower academic proficiency among High School and university students [1 - 3].

Recent advances in neuroscience have deepened our understanding of the biological foundations of language, particularly with regard to the Critical Period Hypothesis (CPH), first postulated by Penfield [4] and Lenneberg [5].

New functional Magnetic Resonance Imaging (fMRI) technologies have been used to track brain development in real time, mapping brain anatomy to brain function. Language processing and speech production require efficient connectivity between separate and distinct regions of the brain which are not connected at birth. Imaging technologies have now revealed the genesis and development of the biological "language circuit" during post-natal brain maturation in response to environmental stimuli [6 - 11]. While the existence of CPH effects in First Language Acquisition (FLA) is generally accepted, the idea of age-related constraints in Second Language Acquisition (SLA) is still vociferously disputed by some SLA/TESOL (Teaching English to Speakers of Other Languages) professionals [12 - 17], Summer Institute of Linguistics (SIL) [18 - 20], as well as by researchers in the National Research Institute (NRI), PNG [21]. Their position is understandable, in the context of the still common social attitudes rooted in the social constructionism of the 20th century. Skepticism with regard to CPH effects extending to SLA is also prevalent up until now in many influential international organizations, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), and some Non-Governmental Organizations (NGOs). UNESCO's Mother Tongue (MT) education policy, shaped at a time when our knowledge of the biology of the Mind was very limited, has been actively promoted around the world since 1953 [22; 23]. Unfortunately, the MT education policy, built on the truism that children learn literacy more effectively in the language that they already speak, has overlooked the difference between European/ North American societies with historically established national languages and the relatively young multilingual developing societies with their own specific needs, logistics and socio-economic environments.

Most current reviews of age-related SLA research are critical of the notion that CPH effects extend to SLA, shifting focus instead to a 'wide range of socio-affective and cognitive,' as well as "input, contextual and individual factors" [24; 27].

Our research into the causes of low quality of education in PNG revealed a significant inverse correlation between three factors in students' early language education backgrounds (AO, AGELIT and ELL other than English) and their academic proficiency at high school and university levels [1-3]. These findings and conclusions (that PNG children should be taught English/ literacy in English at the youngest possible age) have received a lot of pushback, both nationally and internationally.

This paper presents the findings of yet another investigation into the relationship between the age factor and students' academic proficiency, this time in the School of Humanities and Social Sciences, UPNG.

Research questions & hypotheses:

The main objective of this study was to explore the possible causes of students' low academic proficiency in SHSS UPNG and suggest ways of raising the quality of education in UPNG. As in the 2017 study [2], our research questions addressed the relationship between the 'age factors' (AO and AGELIT), as well as ELL, in students' early language education backgrounds, and their current academic performance (GPA). Our null hypotheses assumed no relationship between these factors and the students' GPAs.

METHODOLOGY:

A survey, using purposive cross-sectional sampling method, was carried out in the SHSS UPNG during the second Semester of the 2018 academic year. All 1,063 full-time registered students in the SHSS were eligible to participate in the study. A self-designed pretested questionnaire yielded data on SHSS students' language education backgrounds, with details of their Age at Onset (AO) of learning English, Age at Literacy (AGELIT) and the Early Learning Language (ELL) in which they were taught literacy.

The survey questions were:

Which language(s) did you speak at home? How old where you when you learned to read and write? Where (in which province) did you do your elementary schooling? In what language did you learn to read and write? How old were you when you first started learning English?

Students' responses were entered into Excel spreadsheets, coded, and matched with their respective GPAs, forming our final dataset. The data set was imported into two statistical software programs, STATA 15 and SPSS 20, which were both used to conduct quantitative analysis. Descriptive statistics, comparison of means, correlation, linear regression, multiple regression and nonparametric analyses were performed, as appropriate.

Ethical clearance and permission for this study was obtained from the ethics committee in the SHSS UPNG.

Province Representation:

SHSS UPNG students come from various parts of the country. In PNG, there are four Regions (Highlands, Islands, MOMASE, and Papuan) made up of 22 provinces, including the Autonomous Region of Bougainville (AROB) and the National Capital District (NCD). Students from all the provinces are represented in the UPNG student population. UPNG, the Premier University in the South Pacific region, also has some foreign students, mainly from West Papua (Indonesian: Papua Barat), Solomon Islands and Samoa. Almost all the students received their elementary education in urban centers and townships scattered around the country. The three largest groups in our sample were from the NCD - 137 (21.0%), from Morobe - 73 (11.2%) and from Western Highlands Province (WHP) - 69 (10.6%).

RESULTS:

Of the 1,063 questionnaires distributed, 651 (61.2%) were completed and returned. The 38.8% non-response rate was due to survey time constraints, as well as to some logistical and administrative issues. Of the 651 responders, 281 (43.2%) were female, and 370 (56.8%) were male. The Gender Parity Index (GPI) was 0.759 (281/370).

Home Language (L1):

The home languages were: Tok Pisin (TP), Vernacular (V) and English (ENG).

The vast majority of students spoke Tok Pisin at home, but many were multilingual, speaking two, three, or even four languages (TP-V-ENG, TP-V or TP-ENG).

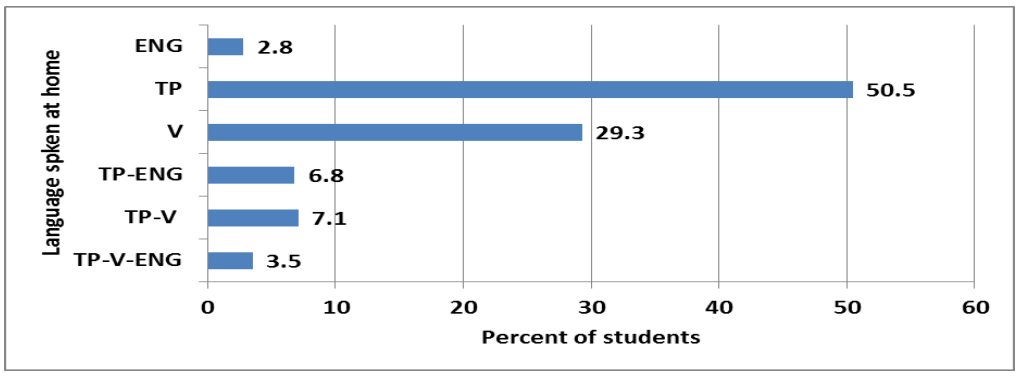

Fig. 1. Percent distribution of students according to Home Languages

The percent distribution of the students according to the language(s) spoken at home is presented in Fig. 1. Majority (329; 50.5%) of the 651 students spoke Tok Pisin at home, followed by 191 (29.3%) that spoke vernacular at home.

AO and AGELIT groups:

With regard to the Age of Onset of learning English (AO), the 651 students were separated into three age groups:

Early (AO: 1-5 years: 146 (22.4%) students who learned English before they started elementary school);

Normal (AO: 6-8 years): 370 (56.8%) students who learned English before adolescence;

Late (AO: 9-21 years): 135 (20.7%) students who were 9 or older when they first started learning English in school.

In regard to their age at literacy (AGELIT), the 651 students were also separated into three

distinct AGELIT Groups: Early (4 – 5 years): 64 (9.8%) students; Normal (6 – 8 years): 430 (66.1%) students; Late (9 – 18 years): 157 (24.1%) students.

Both AO and AGELIT variables were used as continuous in our linear and multiple regression models, as per Vanhove's recommendations [28].

Early Learning Language (ELL):

Out of 651 students, 286 (43.9%) had done their elementary schooling in English; 69 (10.6%) were taught in Tok Pisin; 57 (8.8%) were taught in Vernacular; 224 (34.4%) were taught in a mixture of English and Tok Pisin, and 15 (2.3%) had been taught in both Vernacular and English (Fig. 2).

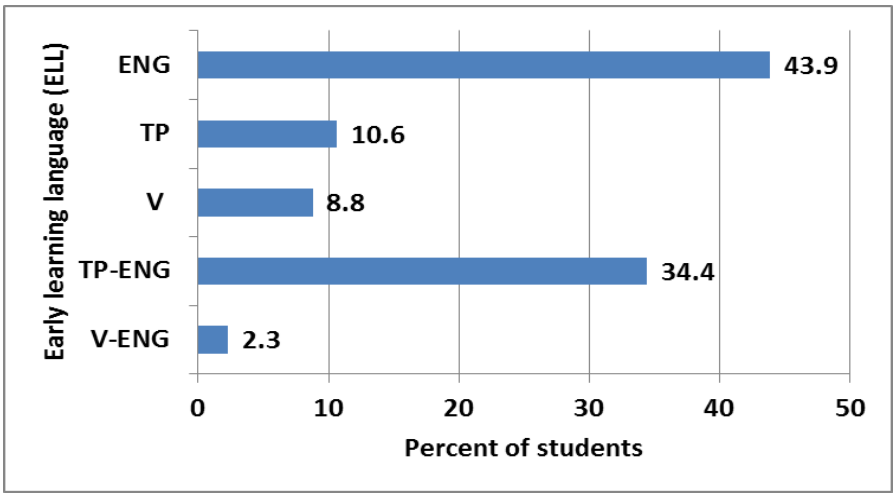

Fig. 2: Percent distribution of students according to their Early Learning Language (ELL)

Majority of the 651 students reported ELL English, followed by the second-largest group who were taught literacy in both English and Tok Pisin. The combined number of students with ELL English (ENG) and ELL English-Tok Pisin (ENG-TP) was 510 (78.3%). Surprisingly few (141, 21.7%) students named ELL TP or ELL Vernacular/ELL Vernacular-English as the languages in which they were taught to read and write.

GPA variable: The mean GPA for all the 651 students that participated in this study was 2.48, the range was 4.8 to 0.25. The GPA results obtained were separated by gender. The results for the male and female students were not normally distributed. Thus, non-parametric statistics were used for analysis of the data. The 50th percentile GPA for both male and female students was 2.50; the Interquartile range (25th and 75th percentiles) was 2.00 to 3.00 for both groups. No statistically significant difference was observed when both results were compared

using the independent samples Mann-Whitney U and Wilcoxon tests (p = 0.05, 2-tailed). This was confirmed by the Kruskal-Wallis test (p = 0.05; 2-tailed) and Chi-square test.

However, mean GPAs varied widely amongst the AO Groups (AOGs): 50th percentile GPA for the three groups were 3.16, 2.50, and 1.67 for AOG1, AOG2, and AOG3, respectively. Median GPA values were 3.00, 2.50, and 1.67 for AOG1, AOG2, and AOG3, respectively. The results for all three groups were not normally distributed.

Linear Regression analyses: Various linear regression models were used to examine the relationship between three factors (AO, AGELIT, and ELL) on the students' academic performance.

Model 1: $GPA = \beta_1(AO) + \beta_2(AGELIT) + e_i$

Model 2: $GPA = \beta_1(AO) + \beta_2(AGELIT) + \delta_1(ELL) + e_i$

Model 3: $GPA = \beta_1(AO) + \beta_2(AGELIT) + \delta_1(ELL) + \beta_3(X') + e_i$

Where $\boldsymbol{e_i}$ *is an error term in our regression models,* ***X'*** *in Model 3 includes student level control variable (i.e., gender). The results obtained are presented in Table 1.*

Table 1: Estimated coefficients from linear regression models

	Model 1	Model 2	Model 3
AO	-0.16***	-0.15***	-0.15***
AGELIT	-0.07**	-0.07***	-0.07**
ELL			
TP		-0.47***	-0.48***
V		0.07	0.05
ENG-TP		-0.26***	-0.25***
V-ENG		-0.21	-0.24
Gender			0.15***
_cons	4.07***	4.15***	4.12***
R Sq.	0.37	0.43	0.44
Adj. R Sq.	0.37	0.42	0.43
N	651	651	651
* p<0.05, **p<0.01, *** p<0.001			

The relationship between the variables was negative and statistically significant for both AO and AGELIT, even after controlling for gender (as evident in Model 3). The effect of AO on student grade point average is double that of AGELIT. For instance, in model 3, a one year increase in AO reduces the GPA by 0.15 grade points, whereas a one year increase in the AGELIT reduces the GPA by 0.07 grade points.

ELL is a categorical (dummy variable), so it has a level of each one of those variables that is taken as the reference level, and the model is adjusted taking into account these reference levels.

Therefore, to interpret the coefficients (i.e., -0.48 for ELL-TP), we can say that students with ELL Tok Pisin have a lower GPA by 0.48 grade points, compared to students with ELL English (the left-out category in the model). Similarly, students with ELL Tok Pisin-English have a lower GPA by 0.25 grade points, compared to students with ELL English.

Gender was the only statistically significant ($p<0.1$) control variable which suggested that male students have a higher GPA by 0.15 grade points, compared to their female counterparts.

The R Squared regression coefficient was 0.44 ($R2 = 0.44$); this means that AO, AGELIT and ELL explain 44% of the variation in GPA, the dependent variable in our sample. Adjusted R Squared ($R2 = 0.43$) indicates a medium effect size, according to Cohen's (1988) classification.

Correlations:

Nonparametric correlation analysis revealed a strong negative statistically significant relationship (rho = – 0.60, p = 0.000, 2-tailed) between the AO and GPA, and (rho = – 0.54, p = 0.000, 2-tailed) between the AGELIT and GPA (Table 2).

Table 2: Results of the non-parametric correlation analysis

	GPA	AO	AGELIT	ELL_ENG	ELL_TP	ELL_V	ELL_TPE	ELL_VE
GPA	1							
AO	-0.60*	1						
AGELIT	-0.54*	0.79*	1					
ELL_E	0.30*	-0.26*	-0.08*	1				
ELL_TP	-0.26*	0.19*	0.09*	-0.30*	1			
ELL_V	-0.04	0.28*	0.01	-0.28*	-0.03	1		
ELL_TPE	-0.11*	-0.03	0.01	-0.64*	-0.25*	-0.22	1	
ELL_VE	-0.04	0.04	0.01	-0.14*	-0.05*	-0.04	-0.11*	1

Table 3: Robustness check: Parametric correlation between AO & GPA, and AGELIT & GPA.

	GPA	AO	AGELIT	ELL_ENG	ELL_TP	ELL_V	ELL_TPE	ELL_VE
GPA	1							
AO	-0.64***	1						
AGELIT	-0.53***	0.71***	1					
ELL_E	0.32***	-0.31***	-0.15***	1				
ELL_TP	-0.29***	0.24***	0.14***	-0.30***	1			
ELL_V	-0.04	0.26***	0.04	-0.28***	-0.12**	1		
ELL_TPE	-0.12**	-0.00	0.04	-0.64***	-0.25***	-0.22***	1	
ELL_VE	-0.02	0.06	-0.00	-0.14***	-0.05	-0.05	-0.11**	1

* $p<0.05$, **$p<0.01$, *** $p<0.001$

As a robustness check, we conducted the Pearson correlation analysis of the data, which gave similar results as presented in Table 3.

Our regression and correlation results negate our null hypotheses, which states that AO, AGELIT, and ELL have no effect on students' GPA. Therefore, we reject our null hypotheses and accept the alternative hypotheses:

First H_1 = AO has a significant effect on students' GPAs.

Second H_1 = AGELIT has a significant effect on students' GPAs.

Third H_1 = ELL has a significant effect on students' GPAs.

DISCUSSION:

In line with our 2017 Study [3], the results obtained from the current investigation support the hypothesis that "AO has a significant negative effect on academic performance (GPA) of students in SHSS".

English proficiency is a prerequisite for comprehension of course content in all academic subjects taught at Primary, Secondary, and Tertiary levels of education. Therefore, if children have not acquired a certain level of proficiency in English before they enter Primary School, their academic performance will be compromised. According to recent studies [1-3], AO is one of the most powerful predictors of students' academic ability and overall performance at all post-elementary levels of education. The vast majority (78.3%) of the students in our present study started learning English before the age of 8 years, and the other 21.7% learned English at or after adolescence.

The mean GPA values across the three AO Groups (GPA 3.16 for Early AOG, GPA 2.51 for Normal AOG, and GPA 1.67 for Late AOG) clearly show the advantage of early AO.

Our results also strongly suggest that delayed exposure to English, mandated by the Vernacular Education policy which was implemented in PNG from the mid-1990s to 2013, may have negatively impacted PNG students' general academic potential, thus reducing the quality of education in the country. As was noted in an earlier study [2], the PNG Universal Basic Education (UBE) Syllabus implemented in 2015 offers only one hour of English learning per day (five hours per week) in the four years of Elementary school [29]. This, in our view, is 'too little, too late' for effective acquisition of English skills by students. Compounded by lack of qualified teachers, students' late AO results in a situation where most children in PNG start their Primary schooling at the pre-pubertal age of ten years or older, sorely lacking in English and literacy skills. Our results suggest that students will perform better, if they start learning English in pre-school, before the age of six years. There is a strong negative link between students' AO and their GPAs; therefore, the earlier students are taught English, the better they do at later stages of their education.

Our findings support the hypothesis that "an increase in AGELIT has a significant negative effect on students' academic performance (GPA)

in SHSS UPNG". There is a strong negative correlation between students' Age at Literacy (AGELIT) and their GPAs. English Literacy is the tool that students in PNG must use at all post-elementary levels of education. The Age factor impacts all aspects of language education; if children are not taught to read and write in early childhood, their learning potential is likely to decrease. Therefore, students will benefit most, if they acquire English literacy skills in Elementary Prep or earlier, before they start Primary school.

The earlier finding that "GPA distribution is not the same across categories of ELL" has also been corroborated by our results. Of the 651 students that participated in the present study, 78.3% had ELL English or ELL TP-English backgrounds, compared to 10.6% who received literacy education in Tok Pisin, and 11.1% who were taught in Vernacular and/or Vernacular-English. These figures indicate the relative ability of students with different ELL backgrounds to fulfil the selection criteria for tertiary education. The under-representation of ELL Vernacular students in the wake of the 'era' of Vernacular Education is indeed surprising - only 8.8% (57/651) of our sample had ELL Vernacular backgrounds. This could be explained by the lack of qualified teachers and teaching resources in Vernacular languages, as well as by the fact that many of the indigenous vernacular languages of PNG are still exclusively oral. ELL Tok Pisin background students (10.6%) had the lowest GPAs; the reasons for this should be further investigated. It is clear, however, that students with English ELL performed significantly better than those with Tok Pisin ELL. Therefore, it is reasonable to conclude that children in Papua New Guinea should be taught to read and write in English, to enable them to cope with Primary school curriculum.

Despite the indisputable complexity and interrelatedness of the various socio-economic, historical and cultural factors affecting the quality of education in PNG, the negative effect of delayed AO of learning the national language of education – English – on students' academic proficiency and, ultimately, on the quality of education in PNG, cannot be overemphasized.

Currently, the PNG National Research Institute (NRI), as well as the Development Policy Centre, Australian National University (ANU) researchers blame the Tuition Fee-Free (TFF) policy for the fall in the quality of education in PNG [25; 26]. Undoubtedly, TFF policy opened the floodgates into the nation's classrooms, causing overcrowding and putting a tremendous stress on the already inadequate teaching resources and infrastructure. However, the solution to these problems is not in limiting access to education for those who cannot pay for it. Only increased investment in teacher training and school infrastructure development will improve the quality of education and produce the human resources the country needs. Without qualified personnel to run a modern economy, there can be no progress. Poor academic performance of students in the nation's schools and universities

translates, down the line, into shortage of quality human resources. This, in turn, impedes sustainable national development, for natural resources do not develop nations; quality *human* resources do.

The way to achieving national development goals is through optimizing the nation's language and education policy, in order to ensure that every child has the English skills required to cope with school curriculum before they commence formal schooling. Above all, an effective language education policy must be based on solid scientific knowledge of human brain development. In order to ensure optimal cognitive development of the growing minds, measures must also be taken to provide families with proper nutrition (and health care generally).

The emotional appeal of calls for MT education and linguistic /cultural preservation [30] must be balanced with a pragmatic assessment of Papua New Guinea's socio-economic needs in the 21st century.

CONCLUSIONS:

An increase in the age of onset of learning both English and literacy has been found to have a significant negative effect on SHSS UPNG students' academic performance. Students with ELL English backgrounds have significantly higher GPAs than those with ELL Tok Pisin. Students with ELL Vernacular backgrounds were under-represented in our sample.

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