The role of language proficiency in young immigrants'educational performance and post-study specialisation

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Outline

Motivation

- Science, research and technology have a key role in lifting Australian productivity. It is crucial for Australia to develop an innovative workforce with "STEM[1] skills and knowledge" (ACOLA, 2014).
- A third of children in Australia have an immigrant background, and their choice of career specialisation may happen well before entering the labour market.
- Understanding factors influencing on this choice is important to long-term changes of educational focuses and development of future workforce

[1] Science, Technology, Engineering and Mathematics

Question

- How does language skill affect young immigrants' educational performance and post secondary study specialisation?

Key findings

- Language skills do not affect migrant children's probability of further study.
- Migrant children with lower language skills choose to do more STEM subjects at high school and are more likely to complete a post-secondary degree in STEM major.
- What determines their choice is the perception of their comparative performance but not the actual test score.

Outline

Literature review

- Human capital investment occurs in ways that reinforce individuals' early endowment or investment at the earlier stage (Cunha et. al., 2006)
  - Young immigrants with better language skills will generate higher returns to investment in English/language intensive subjects compared to other peers
- Language is central to the process of immigrant assimilation. Immigrants with better language skills have higher earnings (Bleakley and Chin, 2004) and better health (Clarke and Isphording, 2017).
- Evidence in the US that childhood migrants with lower endowments of English skills are more likely to major in STEM fields (Rangel and Shi, 2019)

Contributions

- Contribute to understandings of factors influencing the choice to specialise in STEM of immigrant children in Australia.
- Provide an evidence of possible violation of the exclusion restrictions in previous studies using instrument variables for language skills.
- Provide an evidence that the STEM specialisation choice may depend on migrant children's perception of their language skills instead of their actual performance

Outline

Data

- **Longitudinal Survey of Australian Youths (LSAY)**: longitudinal data following Australian youth for over 10 years since 15 years old
- **English skill self-assessment:** self-assessment of their performance in English subject compared to other peers in the same cohort. Scale 1 (very poorly) - 5 (very well)
- **PISA scores**: OECD's Programme for International Student Assessment, measuring 15-year-old students' ability to use their reading, mathematics and science knowledge and skills to meet real life challenges
- **Sample**: Cohort 2003, cohort 2006, and cohort 2009

Outline

Identification problem

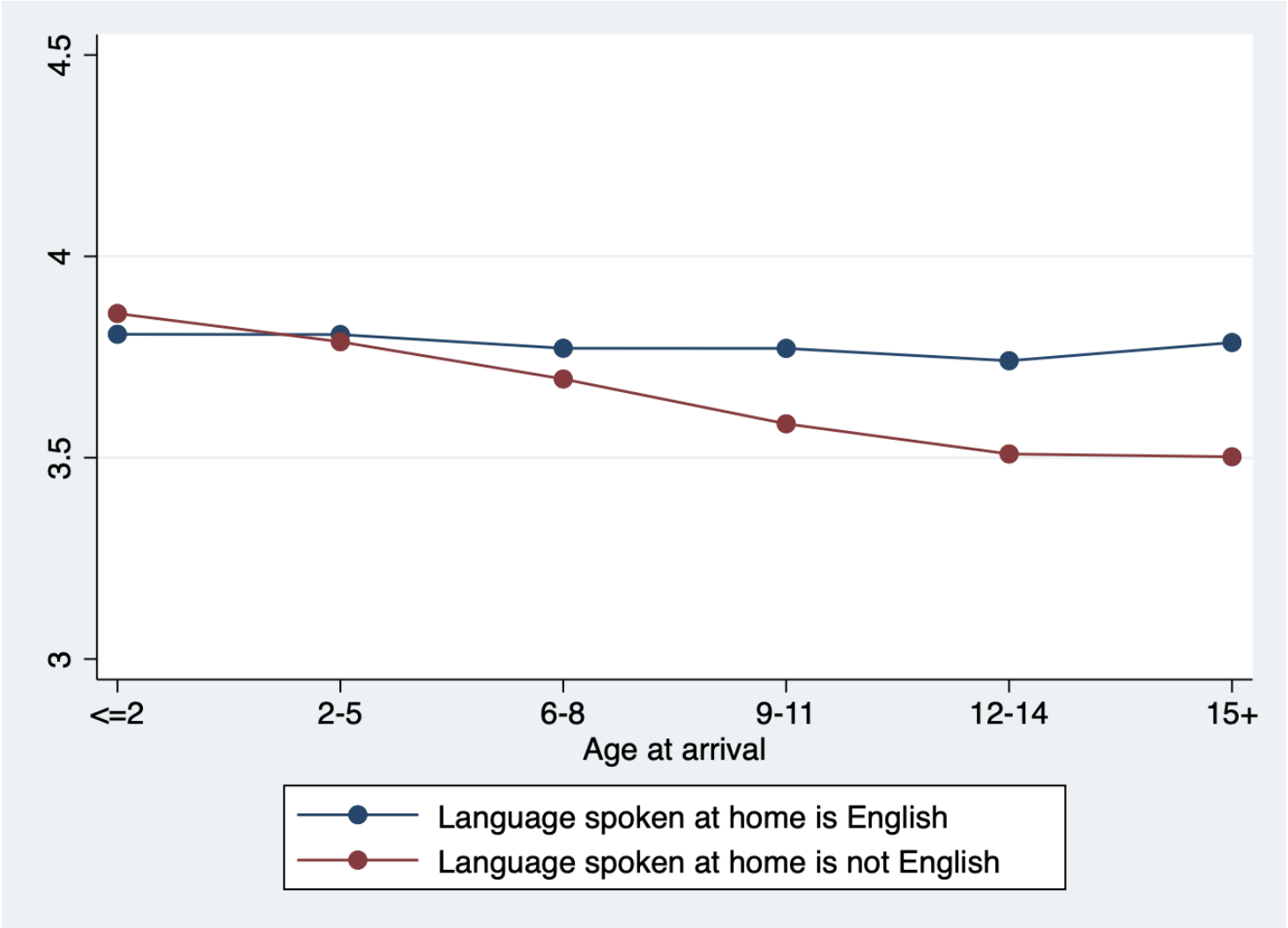
- **Question: How does language skill affect young immigrants' educational performance and post secondary study specialisation?**
- Issues:
  - Language skill is endogenous. Language skill might be positively correlated with students' cognitive skills or study ability, which influence their choice of STEM major. The effect of language skill on STEM subject or major choice may be overestimated.
- Identification:
  - Younger children acquire a new language more easily than adults or adolescents.
  - Immigrants not speaking English at home are more likely to be from a non-English speaking country and may have higher cost of acquiring the same level of English proficiency than migrant children speaking English at home
  - Use the interaction between age at arrival and not speaking English at home as instrument for language skill (Bleakley and Chin, 2004)

Identification strategy

- Assumptions
  - Children learn language more easily than adults, and there is a critical age range after which language acquisition is much more difficult (Newport, 2002; Hartshorne et al., 2018).
  - The interaction between age at arrival and not speaking English at home partials out the non-language effects of age at arrival when controling for country of birth fixed effects.
- Potential identification challenges
  - Instrument variable may influence STEM specialisation choice through other channels which are not language such as cognitive skills due to exposure to other education system –> Control for country of birth fixed effects, control for other skills using maths and science scores.

The role of age at arrival

Graph 1: English skill self-assessment by age at arrival



Notes: This figure shows means of English skill self-assessment (scale 1-5), conditioning on gender, SES, parental education and employment status, birth country fixed effects and cohort fixed effects.

Model

$$Y_i = \beta_0 + \beta_1 English_i + \beta_2 old_i + \beta_3 NHES_i + \beta_4 Math_i + \beta_5 Sci_i + \delta X_i' + \lambda COB_i + \gamma cohort_i + \epsilon_i$$

Y_i: Outcomes (STEM subjects, Post secondary qualification and STEM major) of person i from country c

$English_i$: English skill self-assessment (1: very poorly - 5: very well)

$Math_i$: Pisa maths score
Sci_i: Pisa science score
old_i: First arrived after 10 years old
$NHES_i$: Not speaking English at home

X_i: control variables (gender, SES, parental education and employment status)

$COB_i, cohort_i$: birth country fixed effects, cohort fixed effect
First stage: Instrument variable is $old_i \times NHES_i$

$$Reading_i = \alpha_0 + \alpha_1 old_i + \alpha_2 NHES_i + \alpha_3 old_i \times NHES_i + \delta X_i' + \lambda COB_i + \gamma cohort_i + \epsilon_i$$

Outline

Language skill vs. STEM subjects at high school

Table 1. The impact of language skills on the choice of STEM subjects at high school

	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) 2SLS	(6) 2SLS
English skill self-assessment	0.089	0.073	-0.013	-1.128	-1.501*	-1.744*
	(0.066)	(0.067)	(0.067)	(0.710)	(0.881)	(0.958)
Arrive after 10 years old	-0.001	0.032	0.095	-0.172	-0.181	-0.083
	(0.130)	(0.133)	(0.132)	(0.173)	(0.191)	(0.182)
Not speaking English at home	0.695***	0.287*	0.341**	0.562***	0.200	0.302
	(0.122)	(0.162)	(0.161)	(0.155)	(0.189)	(0.187)
Log Pisa maths score			1.435			2.168**
			(0.880)			(0.987)
Log Pisa science score			0.996			2.184**
			(0.779)			(1.023)
Birth country fixed effects	No	Yes	Yes	No	Yes	Yes
Characteristic controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,682	1,680	1,680	1,682	1,680	1,680
F-test first stage				17.311***	11.722***	10.721***
P-value				0.000	0.001	0.001

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The 2SLS estimations use the interaction between "arrived after 10 years old" and "not speaking English at home" as the instrument variable for English skill self-assessment. F-test first stage is the weak instrument F test.

Language skill vs. post-secondary qualification

Table 2. The impact of language skills on the probability of further study completion

	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) 2SLS	(6) 2SLS
English skill self-assessment	0.035**	0.034**	0.017	0.135	0.206	0.198
	(0.015)	(0.015)	(0.015)	(0.147)	(0.179)	(0.189)
Arrive after 10 years old	-0.037	-0.067**	-0.050	-0.024	-0.044	-0.033
	(0.033)	(0.033)	(0.033)	(0.038)	(0.041)	(0.038)
Not speaking English at home	0.058**	0.068*	0.078**	0.071**	0.080**	0.083**
	(0.027)	(0.035)	(0.035)	(0.034)	(0.038)	(0.036)
Log Pisa maths score			0.351*			0.303
			(0.193)			(0.192)
Log Pisa science score			0.148			-0.008
			(0.181)			(0.240)
Birth country fixed effects	No	Yes	Yes	No	Yes	Yes
Parental characteristic controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,496	1,496	1,496	1,496	1,496	1,496
F-test first stage				15.214***	9.831***	8.980***
P-value				0.000	0.002	0.003

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The 2SLS estimations use the interaction between "arrived after 10 years old" and "not speaking English at home" as the instrument variable for English skill self-assessment. F-test first stage is the weak instrument F test.

Language skill vs. STEM major choice

Table 3. The impact of language skills on STEM major choice

	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) 2SLS	(6) 2SLS
English skill self-assessment	-0.019	-0.019	-0.031	-0.304*	-0.379*	-0.445*
	(0.019)	(0.020)	(0.020)	(0.160)	(0.204)	(0.237)
Arrive after 10 years old (old)	0.132***	0.152***	0.163***	0.079	0.104*	0.120**
	(0.041)	(0.045)	(0.045)	(0.055)	(0.059)	(0.060)
First arrived between 4-10 years old	0.091**	0.101**	0.111***	0.065	0.067	0.083
	(0.037)	(0.039)	(0.039)	(0.045)	(0.050)	(0.051)
Not speaking English at home (NHES)	-0.004	-0.052	-0.045	-0.048	-0.097	-0.080
	(0.034)	(0.046)	(0.047)	(0.046)	(0.060)	(0.061)
Log Pisa maths score			0.430*			0.509*
			(0.233)			(0.283)
Log Pisa science score			0.013			0.398
			(0.202)			(0.326)
Birth country fixed effects	No	Yes	Yes	No	Yes	Yes
Parental characteristic controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	758	758	758	758	758	758
F-test of excluded instruments				13.199 ***	9.074 ***	7.469***
P-value				0.000	0.003	0.006

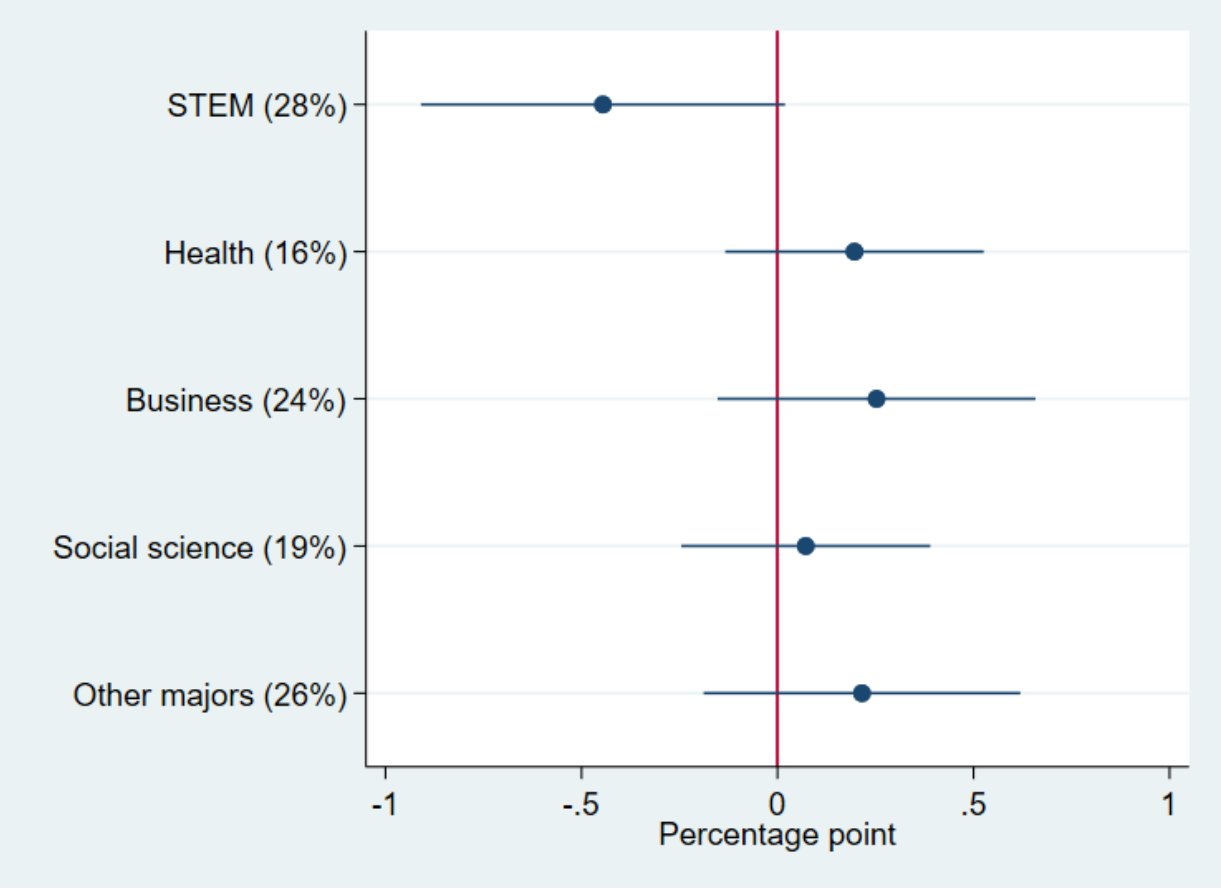
Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The 2SLS estimations use the interaction between "arrived after 10 years old" and "not speaking English at home" as the instrument variable for English skill self-assessment. F-test first stage is the weak instrument F test.

Language skill vs. other major choice

Graph 2. The impact of language skills on childhood migrants' choice of major



Notes: The effects of one unit increase in English skill self assessment on the probability of specialising in selected fields (measured in percentage point) and their 95% confidence intervals are reported. All estimations are 2SLS estimations using the interaction between "arrived after 10 years old" and "not speaking English at home" as the instrument variable for English skill self-assessment. Other control covariates include gender, SES, parental characteristics and birth country fixed effects.

Perception vs. objective test score

Table 4. The impact of objective reading test score and English skill self-assessment on STEM specialisation choice.

	(1) STEM subjects	(2) Post-study completion	(3) STEM majors
Panel A: English skill self-assessment	-1.690*	0.199	-0.429*
	(0.921)	(0.183)	(0.222)
Panel B: English proficiency based on Pisa reading score (scale 1-5)	-4.210	0.430	-1.020
	(3.000)	(0.438)	(0.703)
Panel C: Standard deviation from mean Pisa reading score	-3.134*	0.344	-0.785*
	(1.880)	(0.328)	(0.441)
Birth country fixed effects	Yes	Yes	Yes
Parental characteristic controls	Yes	Yes	Yes
Observations	1,680	1,496	758

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Outline

Conclusions

- There is no evidence that immigrants with better English skill are more likely to complete further study or choose a more language intensive major, but they tend to choose more STEM subjects at high school and more likely to choose a STEM major in their post-secondary study
    - One unit decrease in the English skill self-assessment increases the number of STEM subjects taken at high school levels by 1.7 subjects and increases the probability to complete a degree in STEM major by 43 percentage points.
- There is an evidence that without controlling for performance in maths, the IV estimations can be biased.
- While English skill self-assessment impacts on migrant children's STEM specialisation choice, the effect of their objective performance in reading is not significant.