Exploring relationships between Oral Reading Fluency & comprehension amongst ESL learners in South Africa

- Nic Spaull & Elizabeth Pretorius

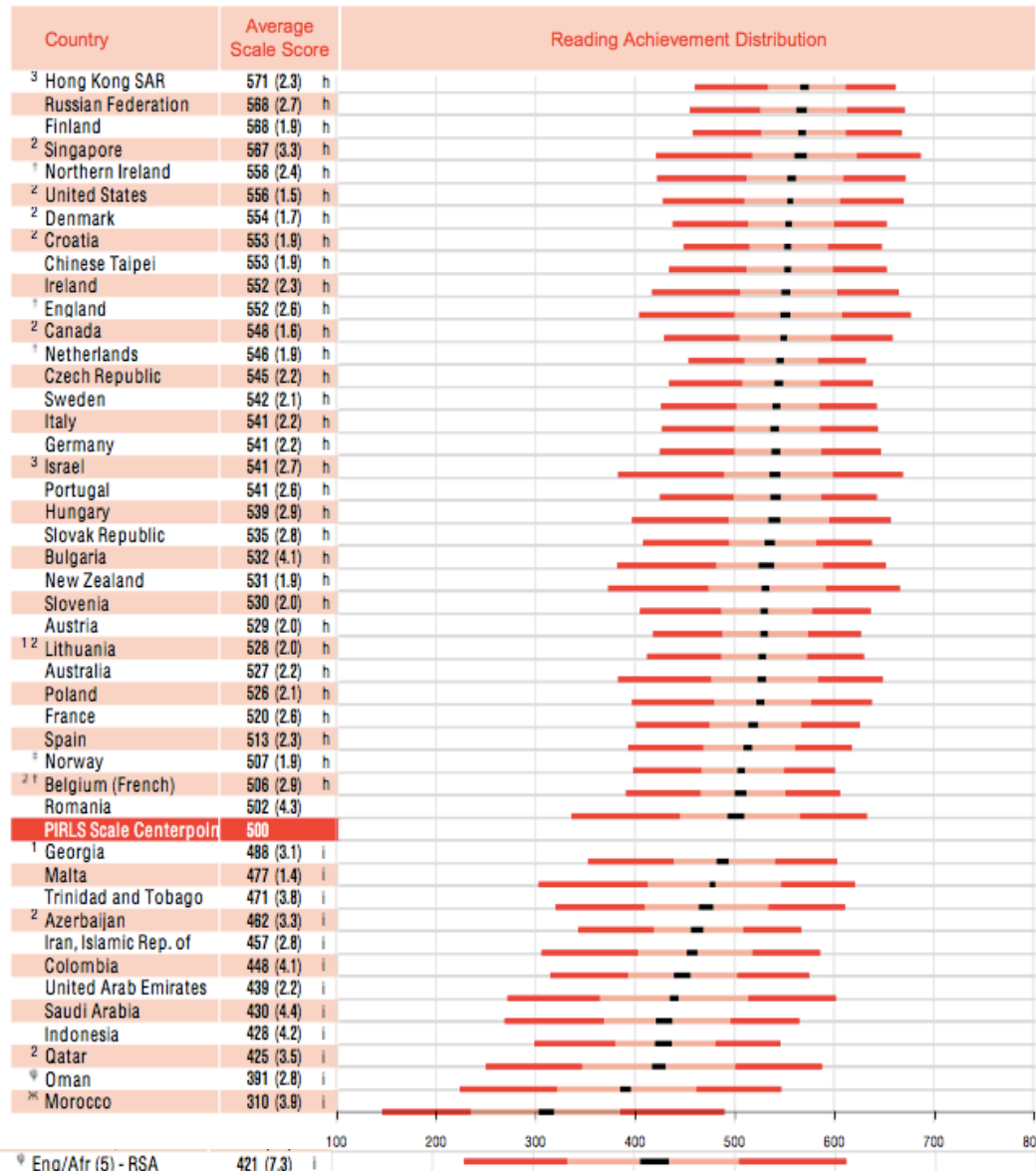*Economic Society of South Africa (ESSA)*
UCT | 4 September 2015

RESEP
Research on Socio-Economic Policy

UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

UNISA | university of south africa

South African context

(1) Low achievement
– *Pirls/prePirls 2011*

(2) Unequal achievement
– *SACMEQ 2007*

Exhibit 1.1: Distribution of Reading Achievement

PIRLS 2011 4th Grade

Country	Average Scale Score	Reading Achievement Distribution
[3] Hong Kong SAR	571 (2.3) h	
Russian Federation	568 (2.7) h	
Finland	568 (1.9) h	
[2] Singapore	567 (3.3) h	
[1] Northern Ireland	558 (2.4) h	
[2] United States	556 (1.5) h	
[2] Denmark	554 (1.7) h	
[2] Croatia	553 (1.9) h	
Chinese Taipei	553 (1.9) h	
Ireland	552 (2.3) h	
[1] England	552 (2.6) h	
[2] Canada	548 (1.6) h	
[1] Netherlands	546 (1.9) h	
Czech Republic	545 (2.2) h	
Sweden	542 (2.1) h	
Italy	541 (2.2) h	
Germany	541 (2.2) h	
[3] Israel	541 (2.7) h	
Portugal	541 (2.6) h	
Hungary	539 (2.9) h	
Slovak Republic	535 (2.8) h	
Bulgaria	532 (4.1) h	
New Zealand	531 (1.9) h	
Slovenia	530 (2.0) h	
Austria	529 (2.0) h	
[1 2] Lithuania	528 (2.0) h	
Australia	527 (2.2) h	
Poland	526 (2.1) h	
France	520 (2.6) h	
Spain	513 (2.3) h	
Norway	507 (1.9) h	
[2] Belgium (French)	506 (2.9) h	
Romania	502 (4.3)	
PIRLS Scale Centerpoint	500	
[1] Georgia	488 (3.1) i	
Malta	477 (1.4) i	
Trinidad and Tobago	471 (3.8) i	
[2] Azerbaijan	462 (3.3) i	
Iran, Islamic Rep. of	457 (2.8) i	
Colombia	448 (4.1) i	
United Arab Emirates	439 (2.2) i	
Saudi Arabia	430 (4.4) i	
Indonesia	428 (4.2) i	
[2] Qatar	425 (3.5) i	
Oman	391 (2.8) i	
Morocco	310 (3.9) i	
Eng/Afr (5) - RSA	421 (7.3) i	

100   200   300   400   500   600   700   800

prePIRLS 2011 → By Gr 4 children should be transitioning from "learning to read" to "reading to learn"

Language	Did not reach	Low International benchmark
Xitsonga	47	53
Tshivenda	53	47
siSwati	24	76
Setswana	34	66
Sesotho	36	64
Sepedi	57	43
isiZulu	29	71
isiXhosa	38	62
isiNdebele	31	69
English	10	90
Afrikaans	12	88
South Africa	29	71
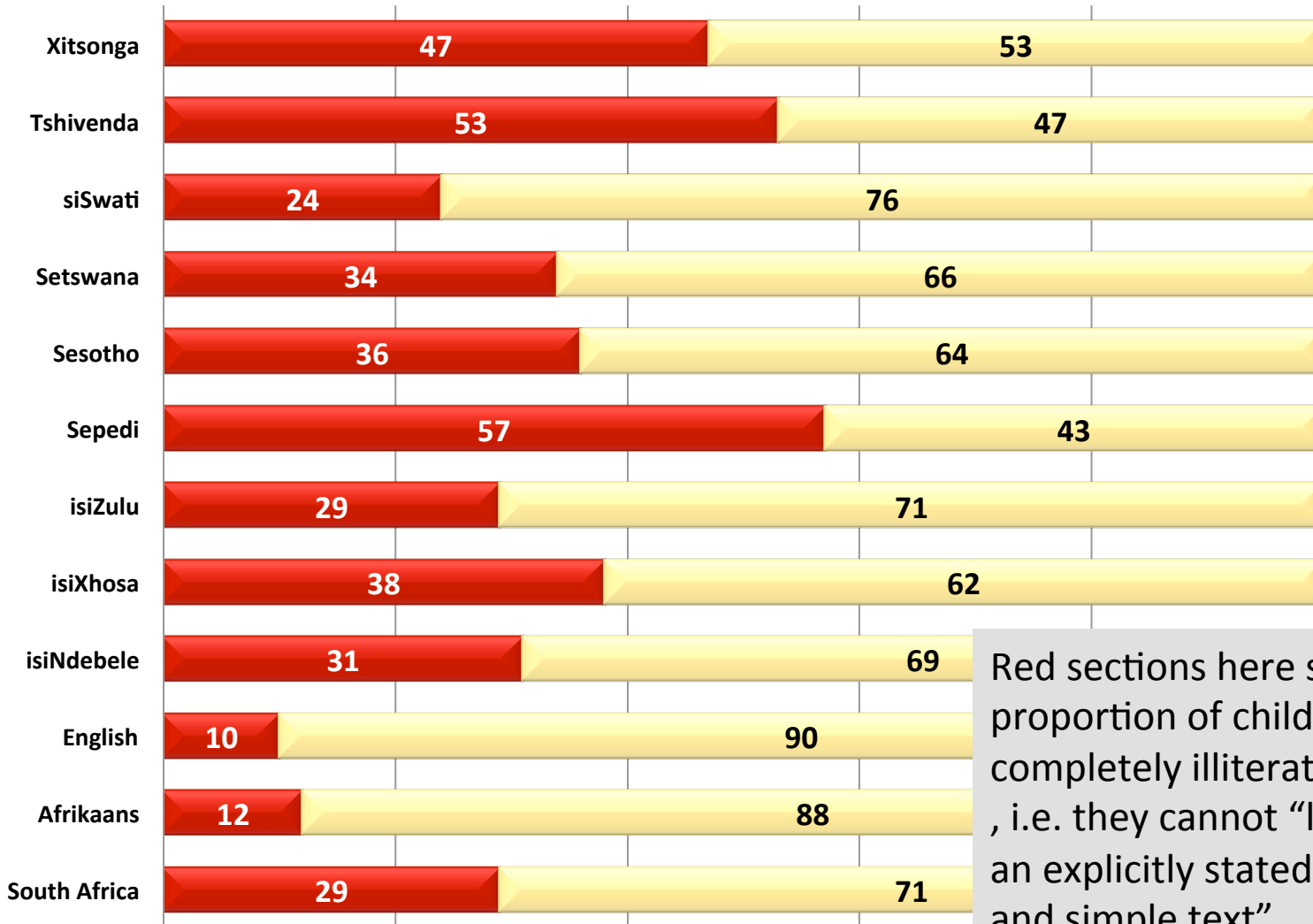
Red sections here show the proportion of children that are completely illiterate in Grade 4 , i.e. they cannot "locate and retrieve an explicitly stated detail in a short and simple text".

■ Did not reach ☐ Low International benchmark

Current study

- Large literature on OECD countries (esp. the USA, Canada and the UK) exploring:

    1. the levels of students' **oral reading fluency** (ORF) (mainly L1 learners)
    2. the relationships between **ORF and comprehension** (mainly L1 learners)

    (see Valencia et al, 2010; Fuchs et al, 2001; Rasinski & Hoffman, 2003; NICHHD, 2000 for overviews)

- Very limited literature on developing countries and ESL learners.

- We explore these two issues using ORF data from a large-scale assessment conducted by NEEDU in 2013

Fluency & reading

U.S. National Reading Panel (2000)
Identified 5 core components to reading

1. **Phonemic awareness**
   – *The ability to hear, identify & manipulate individual sounds/phonemes in spoken words and understanding that spoken words and syllables are made up of speech sounds.*

2. **Alphabetic Principle**
   – *The basic concept that words are made up of letters that represent segments of speech; the systematic relationships between letters & sounds/phonemes*

3. **Vocabulary**
   – *Involves word knowledge, word instruction and word learning strategies & usage*

4. **Comprehension**
   – *The process of constructing meaning from written text*

5. **Fluency**
   – *The ability to read connected text quickly, accurately and with meaningful expression (prosody)*

RESEP
Research on Socio-Economic Policy

ORF literature

- Oral reading fluency, defined in terms of **accuracy** and **speed** in word recognition, has been found to be a reliable indicator of reading comprehension (Fuchs et al, 2001; Spear-Swerling 2006). Although prosody is part of fluency, difficult to measure objectively.

- There is a strong empirical basis attesting to a <u>relationship</u> between fluency and reading comprehension. Fluency typically measured as **total words read correct per minute**.

- Fuchs et al. (2001) report **high correlations (0.8)** between ORF and various kinds of reading comprehension measure such as high stakes state mandated comprehension tests, as well as a variety of other comprehension tests using different formats (e.g. multiple choice or open questions, cloze procedures or story recall protocols).

- The **relationship obtains across schools serving children from different socioeconomic backgrounds** or instructional programmes, and occurs with children without reading difficulties as well as with children with learning disabilities with reading (Deno et al. 2001; Wolf & Katzir-Cohen 2001).

STORY 1

A traditional story - How Leopard got his spots
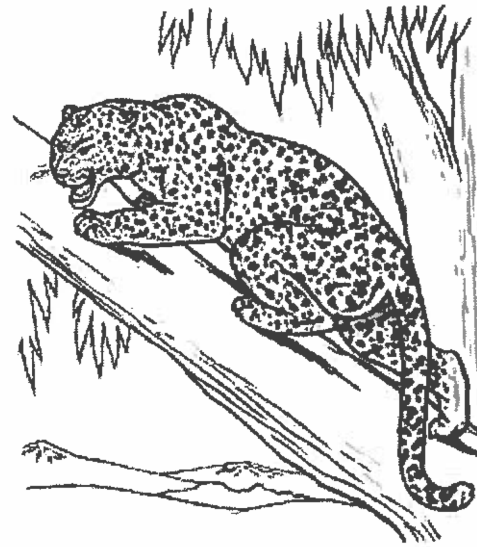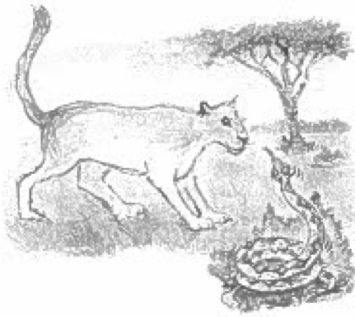
Many years ago Leopard was a creature with no spots. His fur was an ordinary brown colour. One day, he was relaxing in the shade of a thorn tree when Zebra walked past. Leopard looked longingly at Zebra's black and white stripes. "I wish I had interesting patterns in my coat," he said wishfully to Zebra.

Suddenly they heard a noise in the bushes nearby. They found Snake slithering under some dry leaves. Surprised, they asked why she was hiding away. "I am sad and lonely because I have no friends," she said.

"I'm not your friend because you have a poisonous bite," replied Zebra. "I am scared of you!"

"You have never yet hurt me," said Leopard. "I will be your friend."

Snake was pleased and wanted to make her new friend happy. "I can make your fur beautiful, but I need to bite you first," she said.

Leopard decided to trust Snake so he let her bite him. The next moment he tumbled down as if he were dead! But when he awoke, what a transformation! His fur was covered in beautiful spots! And to this day, Snake and Leopard remain the best of friends.
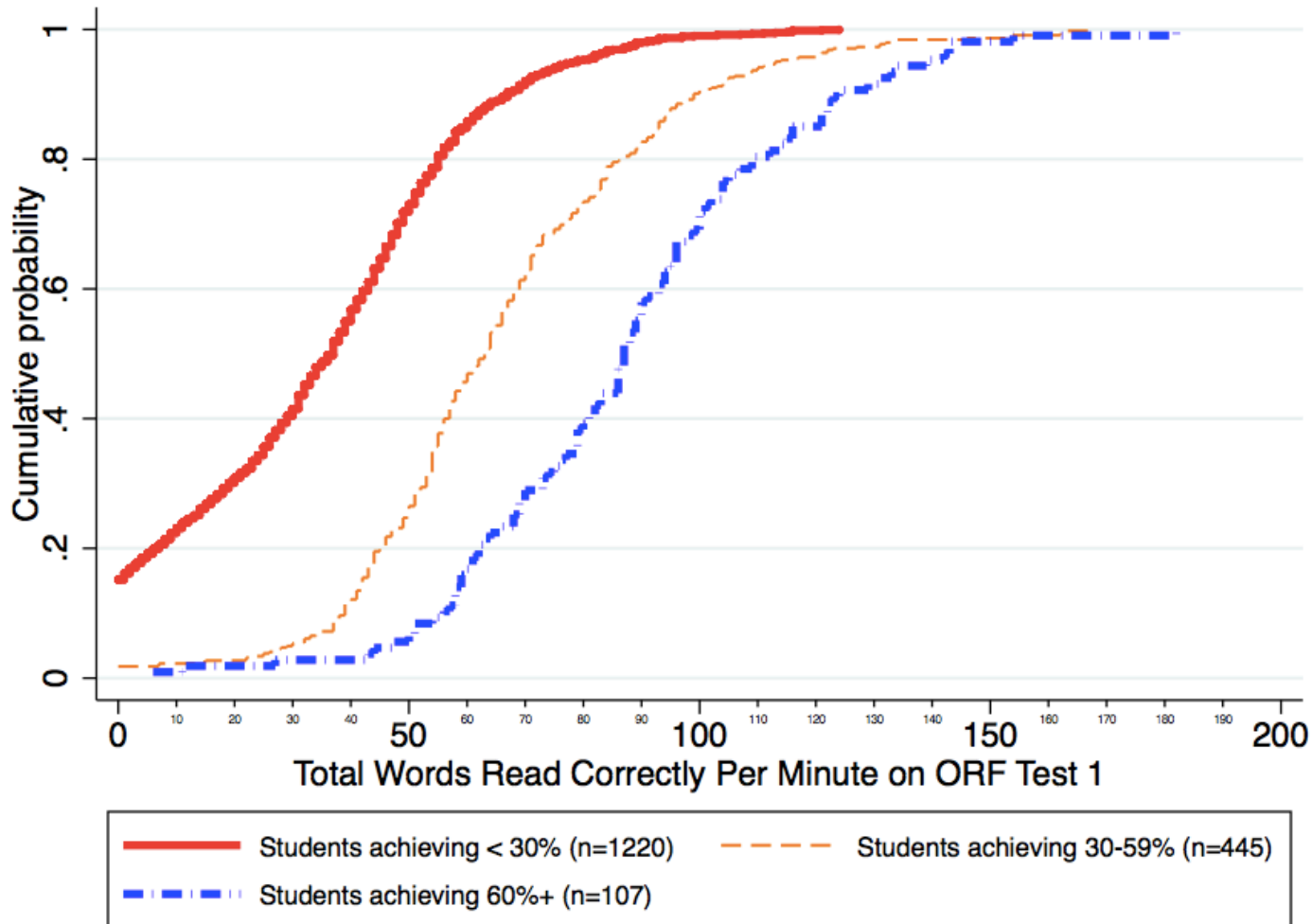
Testing procedure - 2013

All grade 5 students in one class were selected to participate

The top 3, middle 4 and bottom 3 students did the ORF 1 test

If students read past first paragraph (50 WCPM) they did the more difficult ORF test 2

214 rural primary schools

4697 grade 5 students wrote a comprehension test (San-Hunter /20)

1786 students selected to write Oral Reading Fluency Test 1 (next day)

(+ comprehension Test /5)

878 students selected to write ORF Test 2

(+ comprehension Test /5)

Tests were administered at different times in the year. Preliminary analysis shows little Relation between time of test and results.

Distributions of silent reading comprehension (in percent) and oral reading fluency (in words correct per minute) for the ORF test 1 sample (correlation: **0.49**; n=1772).
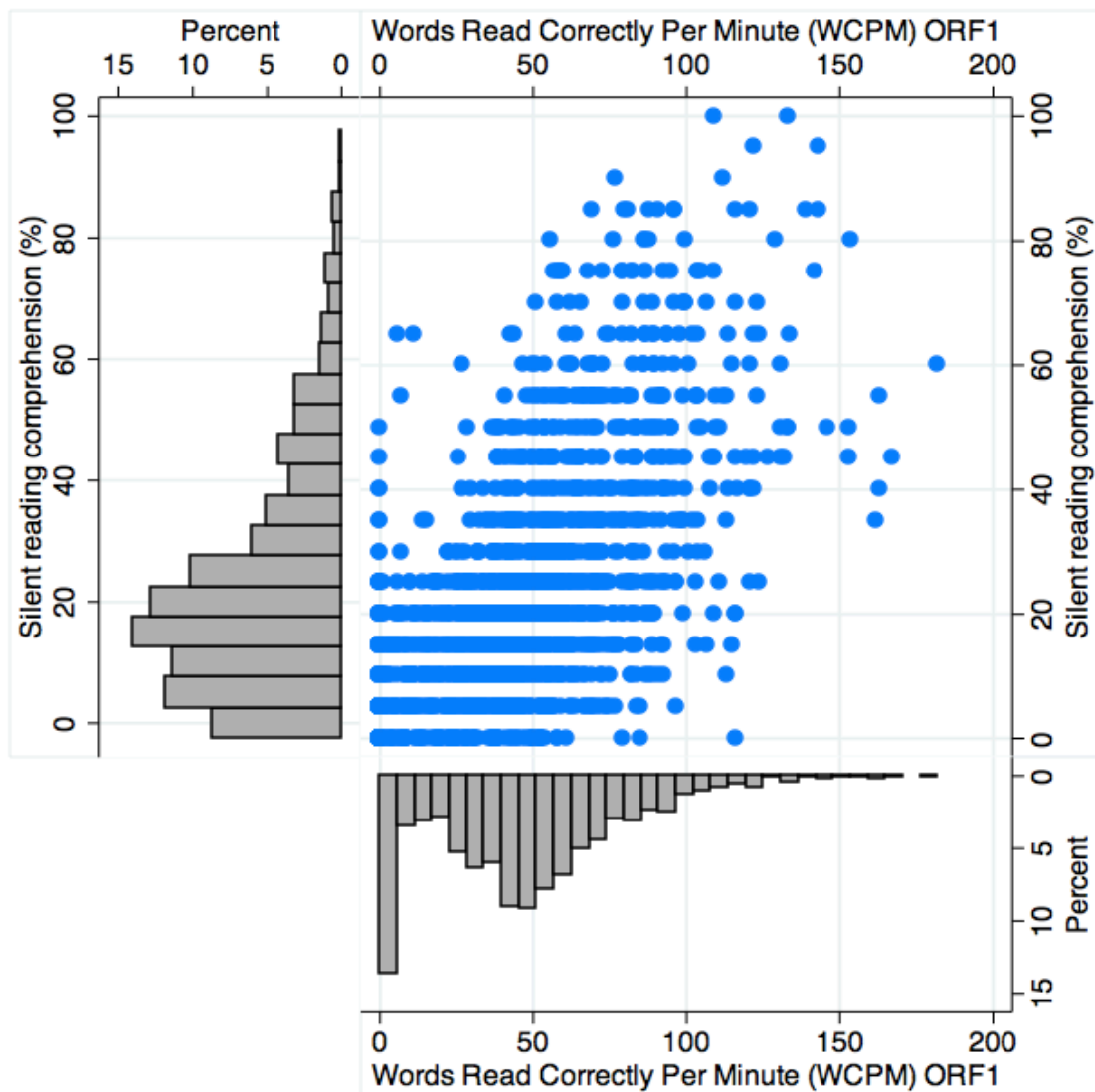
Cumulative density function (CDF) of words correct per minute on Oral reading Fluency Test 1 per category of performance on the silent reading comprehension test.
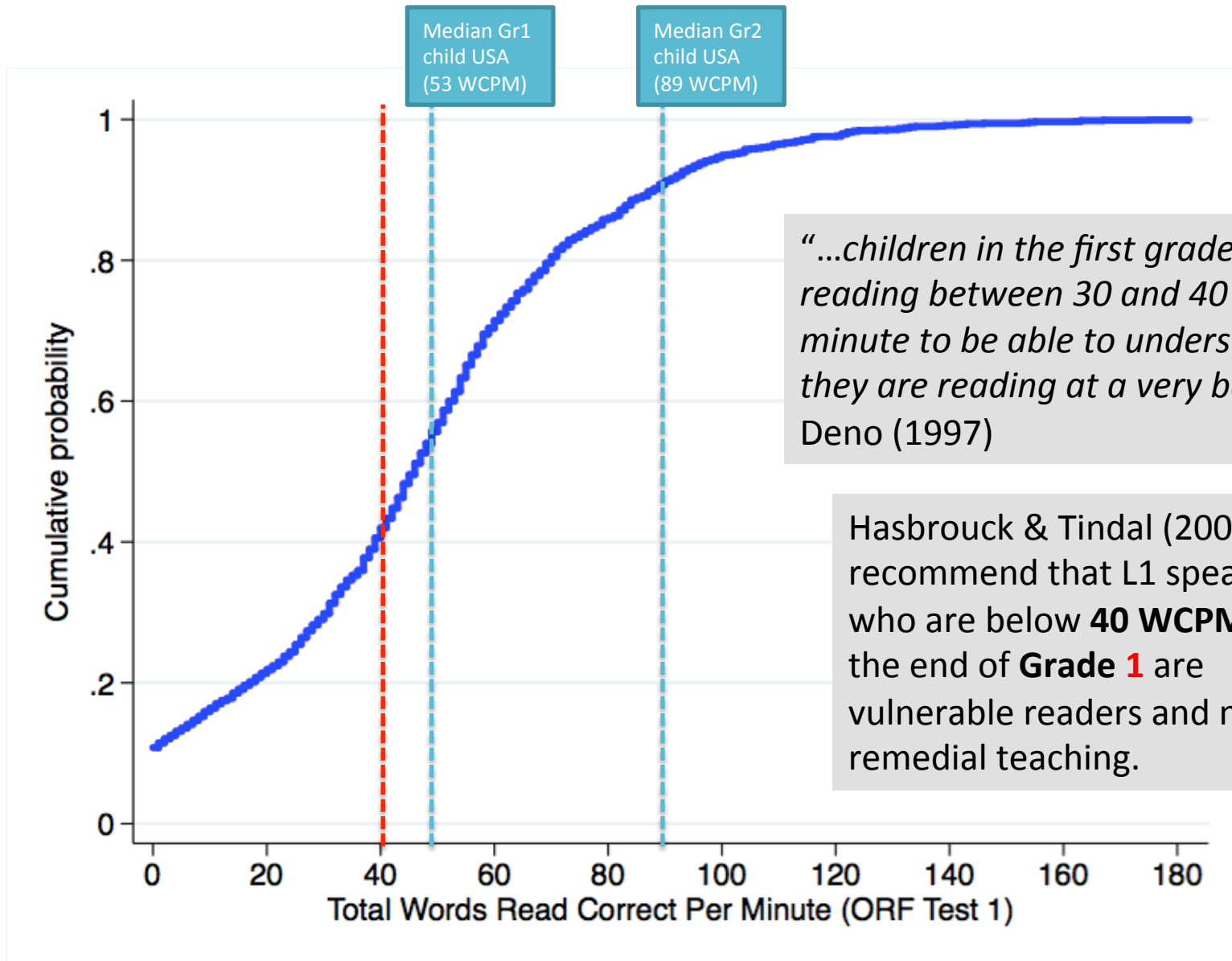

Legend:
- Students achieving < 30% (n=1220)
- Students achieving 30-59% (n=445)
- Students achieving 60%+ (n=107)

Y-axis: Cumulative probability
X-axis: Total Words Read Correctly Per Minute on ORF Test 1

ORF and comprehension

		ORF Test 1 (WCPM)			ORF Test 2 (WCPM)
		Full sample (n=1772)	<30% silent reading comprehension score	30-59% silent reading comprehension score	60%+ silent reading comprehension score	Full sample (n=855)
Percentiles	10th	0	0	39	56	51
	25th	25	13	50	68	62
	50th	46	37	63	87	74
	75th	64	52	82	104	92
	90th	87	67	99	124	109

RESEP
Research on Socio-Economic Policy

ORF 1 Cumulative Density Function
NEEDU Grade 5 (Rural)

Median Gr1 child USA (53 WCPM)

Median Gr2 child USA (89 WCPM)

"...children in the first grade must be reading between 30 and 40 words per minute to be able to understand what they are reading at a very basic level." Deno (1997)

Hasbrouck & Tindal (2006) recommend that L1 speakers who are below **40 WCPM** at the end of **Grade 1** are vulnerable readers and needs remedial teaching.

RESEP
ch on Socio-Economic Policy

CDF for those students scoring 40% + on comprehension

"*Unfortunately as poor readers rely on the conscious-attention mechanism, they expend their capacity in prediction processes to aid word recognition. Little is left over for integrative comprehension processes*" Fuchs et al (2001: p.42)
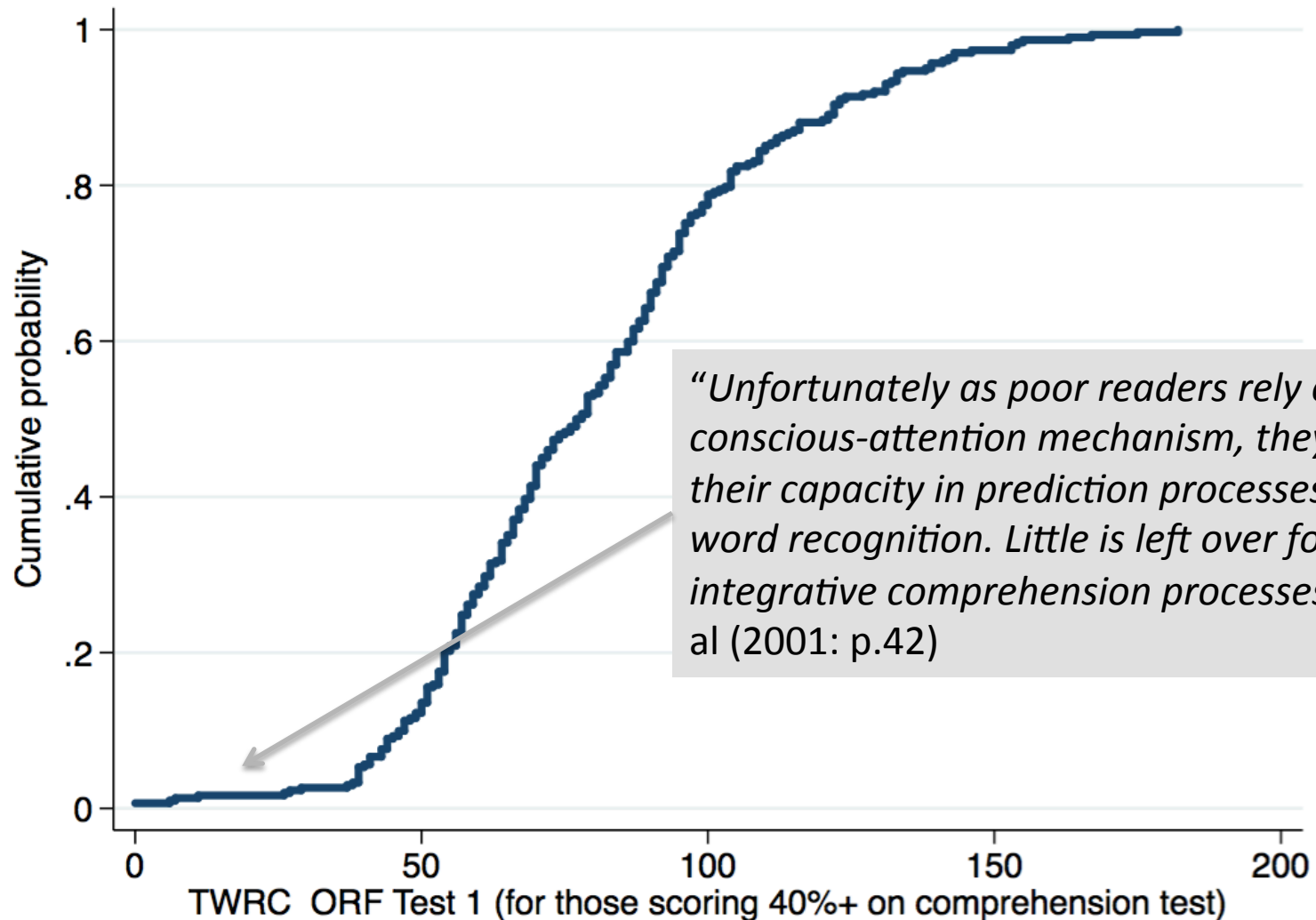
Table 13: Oral Reading Fluency scores for English Second Language (ESL/ELL) in Broward County Public Schools (Florida, US) (Broward County, 2012)

Percentiles	Non-English speaker (A1)			Limited English speaker (A2)			Intermediate English speaker (B1)		
	Fall WCPM	Winter WCPM	Spring WCPM	Fall WCPM	Winter WCPM	Spring WCPM	Fall WCPM	Winter WCPM	Spring WCPM
Grade 1 90		62	78		71	80		69	75
75		48	61		55	62		55	61
50		**34**	**43**		**38**	**43**		**41**	**46**
25		20	24		20	24		27	30
10		6	7		5	6		13	17
Grade 2 90	47	79	82	70	73	92	93	95	100
75	36	61	64	53	58	73	76	80	86
50	**23**	**41**	**44**	**35**	**41**	**52**	**57**	**62**	**69**
25	11	21	24	18	24	31	39	45	53
10	0	3	7	1	9	11	22	30	38
Grade 3 90	58	73	85	90	98	114	98	106	124
75	44	58	68	72	82	95	79	94	107
50	**29**	**41**	**49**	**52**	**65**	**74**	**59**	**80**	**89**
25	13	24	30	32	47	53	39	67	70
10	1	9	13	14	31	34	21	55	54
Grade 4 90	86	93	102	97	118	124	120	126	143
75	70	75	84	79	96	103	106	109	124
50	**51**	**56**	**65**	**60**	**73**	**80**	**90**	**90**	**103**
25	33	37	45	40	49	56	74	71	82
10	16	19	27	22	28	35	59	54	64
Grade 5 90	103	93	128	119	105	128	123	122	146
75	83	78	107	98	88	110	108	107	126
50	**61**	**62**	**85**	**74**	**70**	**89**	**92**	**89**	**104**
25	40	46	62	51	52	69	76	72	83
10	20	32	42	29	35	50	61	56	63

Approximates SA Rural Grade 5 ESL (Full ORF1 sample)

Approximates SA Rural Gr5 ESL sample scoring 60%+ on comprehension

Grade 5 ORF in context
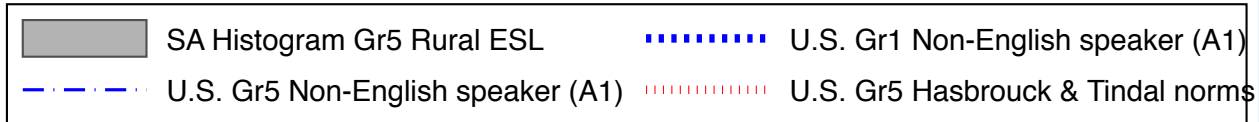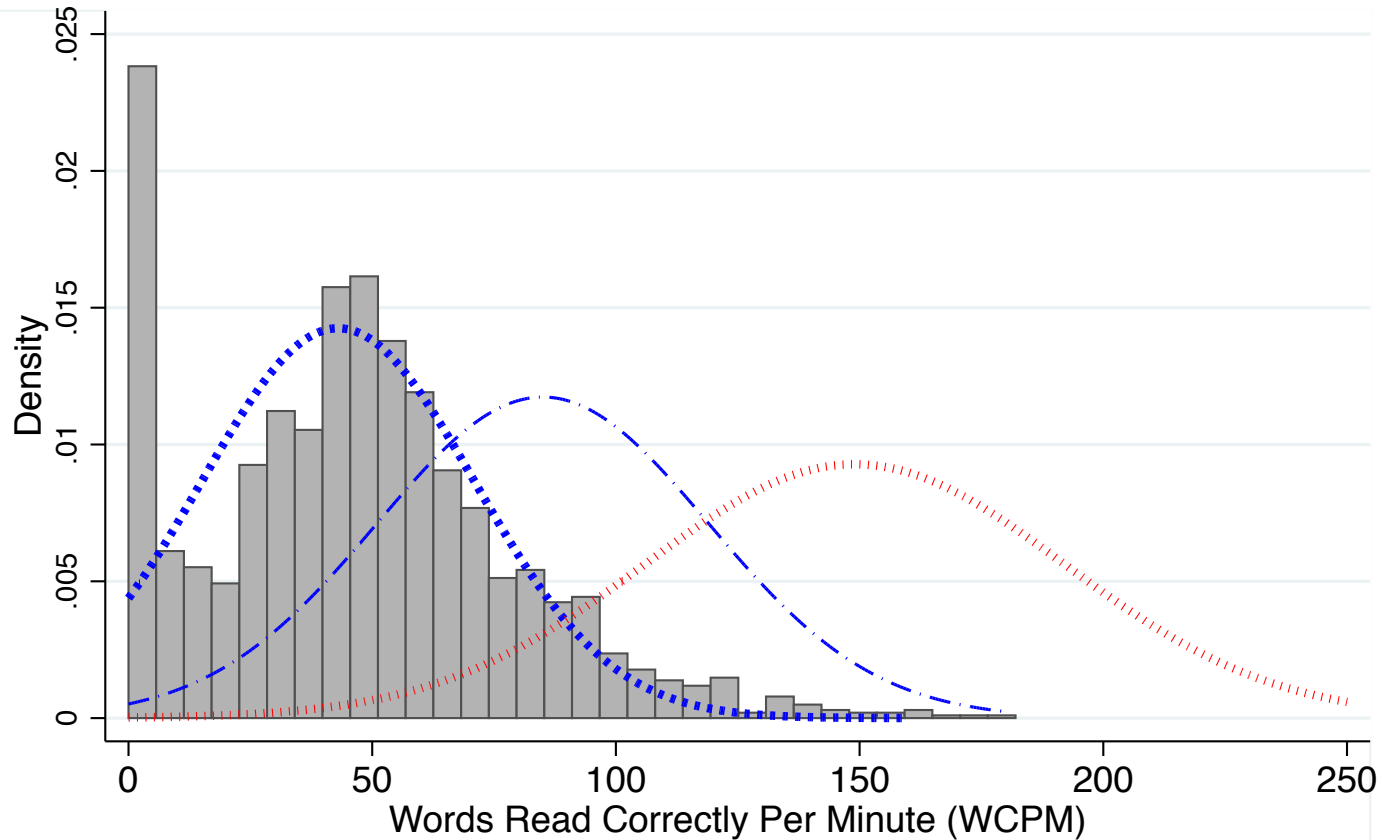
Multivariate analysis

- **Stage 1**: OLS cascade regression explaining variation in reading comprehension scores using a variety of student variables (age, gender); school variables (LOLT and multigrade) and fluency variables (WCPM, Words read incorrect per minute, words skipped

- **Stage 2:** Use school fixed-effects to account for all school-level variables

- **Stage 3:** Use school fixed-effects and create splines at progressive break-points. Use marginal effects to test for statistical significance in the difference.

REGISTRY 1 → Models predicting initial standardised comprehension score using ORF 1 (SD=1).

[Note TWRC_ORF1 original SD=32 words. Reading comprehension initial SD=19%] TWRC=Total Words Read Correctly

|	Initial comprehension score (SD=1)						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
TWRC (ORF1) standardised	0.7356***	0.7528***	0.7556***	0.7504***	0.7503***	0.7234***	0.6828***
	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Words read incorrectly (ORF1)		-0.0379***	-0.0378***	-0.0375***	-0.0377***	-0.0367***	-0.0342***
		0.00	0.00	0.00	0.00	0.00	0.00
Words skipped (ORF1)		-0.0060	-0.0060	-0.0060	-0.0059	-0.0095	-0.0086
		0.01	0.01	0.01	0.01	0.01	0.01
Female (n=852)			-0.0293	-0.0358	-0.0352	-0.0393	-0.0381
			0.05	0.05	0.05	0.05	0.05
Aged 12 or 13 (Ref <12) (n=404)				-0.0520	-0.0532	-0.0382	-0.0603
				0.05	0.05	0.06	0.06
Aged 14+ (n=109)				-0.0766	-0.0774	-0.0536	-0.0284
				0.10	0.10	0.10	0.10
Multigrade (n=810)					0.0095	-0.0286	
					0.06	0.07	
LOLT=English (n=108) (Ref=Afr)						-0.0662	
						0.17	
LOLT=Sepedi (n=276)						-0.2775**	
						0.11	
LOLT=Sesotho (n=45)						-0.1337	
						0.22	
LOLT=Setswana (n=233)						-0.2073	
						0.13	
LOLT=isiXhosa (n=341)						-0.3309***	
						0.12	
LOLT=isiZulu (n=359)						-0.2384**	
						0.11	
Includes school fixed effects	No	No	No	No	No	No	Yes
Constant	0.1794***	0.4891***	0.5019***	0.5192***	0.5158***	0.7312***	0.1418**
	0.03	0.06	0.06	0.07	0.07	0.13	0.06
N	1786.00000	1691.00000	1691.00000	1691.00000	1691.00000	1630.00000	1691.00000
F-stat	409.86070	176.80659	134.42588	90.03398	77.64281	51.47901	.

REGRESSION 2 → Models predicting standardised ORF1 comprehension score using ORF 1 (SD=1)

[Note TWRC_ORF1 original SD=32 words. ORF1 comprehension initial SD=1.4 questions or 28% (/5 question)] TWRC=Total Words Read Correctly

	ORF 1 comprehension score (SD=1)						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
TWRC (ORF1) standardised	0.6907***	0.6895***	0.6885***	0.6838***	0.6836***	0.6574***	0.6285***
	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Words read incorrectly (ORF1)		-0.0294***	-0.0295***	-0.0293***	-0.0297***	-0.0278***	-0.0205***
		0.00	0.00	0.00	0.00	0.00	0.00
Words skipped (ORF1)		-0.0055	-0.0055	-0.0048	-0.0047	-0.0089	-0.0086
		0.01	0.01	0.01	0.01	0.01	0.01
female			0.0105	0.0050	0.0072	0.0054	0.0048
			0.04	0.04	0.04	0.04	0.04
Aged 12 or 13 (Ref <12)				-0.0896*	-0.0944**	-0.0872*	-0.0784
				0.05	0.05	0.05	0.05
Aged 14+				0.0408	0.0377	0.0711	0.0891
				0.07	0.08	0.08	0.09
multigrade					0.0372	0.0085	
					0.05	0.06	
LOLT=English (n=108) (Ref=Afr)						-0.0397	
						0.14	
LOLT=Sepedi (n=276)						-0.3430***	
						0.08	
LOLT=Sesotho (n=45)						-0.2331	
						0.16	
LOLT=Setswana (n=233)						-0.2039**	
						0.09	
LOLT=isiXhosa (n=341)						-0.3501***	
						0.09	
LOLT=isiZulu (n=359)						-0.2169***	
						0.08	
Includes school fixed effects	No	No	No	No	No	No	Yes
Constant	0.0000	0.2517***	0.2471***	0.2643***	0.2510***	0.4684***	0.2411***
	0.03	0.04	0.05	0.05	0.06	0.08	0.05
N	1786.00000	1691.00000	1691.00000	1691.00000	1691.00000	1630.00000	1691.00000
F-stat	499.09937	179.01031	146.90817	103.36913	98.02533	69.75107	.

RESEP

Research on Socio-Economic Policy

ORF1 range; showing the CDF of the range (max-min ORF in each school)
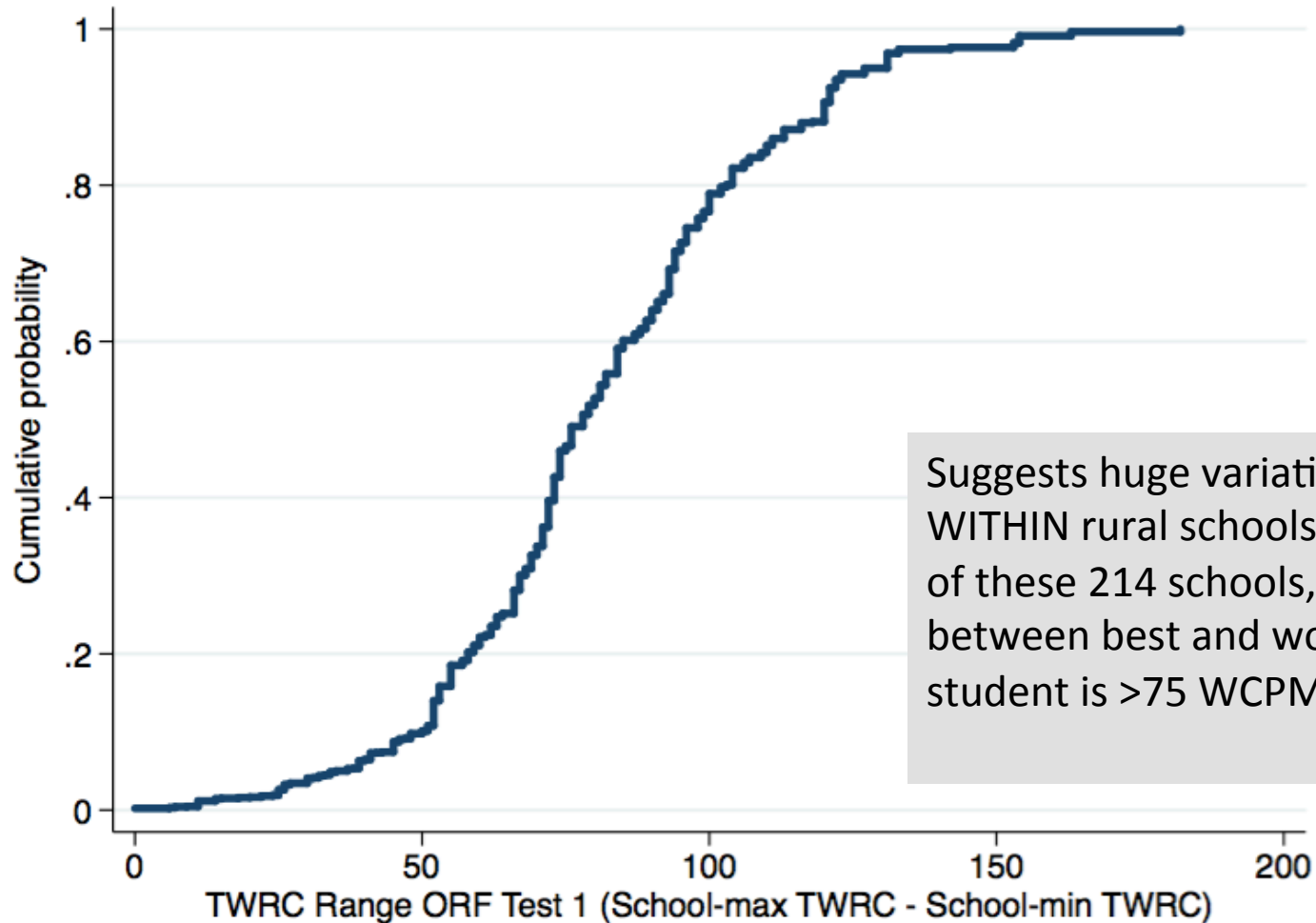
Suggests huge variation WITHIN rural schools (in 50% of these 214 schools, the gap between best and worst student is >75 WCPM)
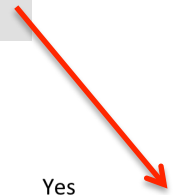
RESEP
Research on Socio-Economic Policy

2ⁿᵈ main research question

- Is there a "break" in the relationship between oral reading fluency and comprehension?

- L1 research suggests that the 'returns' to additional ORF increase faster up to 90 TWRC and declines thereafter (McGuiness, 2004. Early Reading Instruction)

- Using our sample of ESL students can we model the relationship between TWRC and comprehension such that we are able to detect a break?

- Using the fixed-effects model specification I employ splines and break the ORF variable into ten word intervals

	Non-spline	Spline regressions with splines at different cut points (using ORF1):								
		40 TWRC	50 TWRC	60 TWRC	70 TWRC	80 TWRC	90 TWRC	100 TWRC	110 TWRC	120 TWRC
Female	-0.6214	-0.6102	-0.6126	-0.6135	-0.6233	-0.6391	-0.6618	-0.6920	-0.7133	-0.7076
Age 12 or 13 (Ref <12)	-0.9852	-0.9407	-0.8886	-0.8131	-0.7828	-0.8109	-0.8605	-0.9139	-0.9431	-0.9622
Age 14+	-0.4642	-0.3659	-0.2546	-0.1203	-0.0874	-0.1346	-0.2194	-0.3164	-0.3815	-0.4032
Words read incorrectly ORF1	-0.5578***	-0.5673***	-0.5765***	-0.5905***	-0.5988***	-0.5964***	-0.5918***	-0.5863***	-0.5800***	-0.5753***
Words skipped ORF 1	-0.1408	-0.1414	-0.1398	-0.1338	-0.1318	-0.1304	-0.1295	-0.1308	-0.1336	-0.1339
TWRC ORF1	0.3528***									
Up to 40 TWRC		0.3659***								
40+ TWRC		0.3465***								
Up to 50 TWRC			0.3740***							
50+ TWRC			0.3354***							
Up to 60 TWRC				0.3841***						
60+ TWRC				0.3111***						
Up to 70 TWRC					0.3867***					
70+ TWRC					0.2801***					
Up to 80 TWRC						0.3831***				
80+ TWRC						0.2489***				
Up to 90 TWRC							0.3784***			
90+ TWRC							0.2113***			
Up to 100 TWRC								0.3736***		
100+ TWRC								0.1740***		
Up to 110 TWRC									0.3685***	
110+ TWRC									0.1440*	
Up to 120 TWRC										0.3652***
120+ TWRC										0.0914
School fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marginal Effects	NA	-0.0194	-0.0386	-0.0730	-0.1066**	-0.1342**	-0.1671***	-0.1996***	-0.2245***	-0.2738***
Constant	6.6164***	6.5587***	6.6149***	6.7754***	6.9434***	6.9767***	6.8836***	6.6019***	6.3729***	6.2091***
N	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000
R-squared	0.56875	0.56880	0.56900	0.56966	0.57048	0.57097	0.57139	0.57138	0.57092	0.57074

Total Words Read Correct ORF1

- For ESL students the 'break' seems to be at 70 TWRC not 90.

- i.e. the additional returns to ready faster than 70 TWRC are lower than those up to 70 TWRC

RESEP
Research on Socio-Economic Policy

	Non-spline	Spline regressions with splines at different cut points (using ORF1):								
		40 TWRC	50 TWRC	60 TWRC	70 TWRC	80 TWRC	90 TWRC	100 TWRC	110 TWRC	120 TWRC
Female	0.1332	0.1826	0.1475	0.1423	0.1310	0.1080	0.0695	0.0215	-0.0160	-0.0098
Age 12 or 13 (Ref <12)	-2.1917	-1.9951	-2.0339	-1.9932	-1.9602	-1.9432	-1.9952	-2.0789	-2.1233	-2.1536
Age 14+	2.4900	2.9238	2.8322	2.8865	2.9208	2.9598	2.8757	2.7236	2.6243	2.5911
Words read incorrectly ORF1	-0.5735***	-0.6153***	-0.6039***	-0.6112***	-0.6204***	-0.6285***	-0.6270***	-0.6184***	-0.6095***	-0.6024***
Words skipped ORF 1	-0.2399	-0.2425	-0.2383	-0.2319	-0.2296	-0.2251	-0.2222	-0.2242	-0.2282	-0.2284
TWRC ORF1	0.5560***									
Up to 40 TWRC		0.6136***								
40+ TWRC		0.5282***								
Up to 50 TWRC			0.5906***							
50+ TWRC			0.5276***							
Up to 60 TWRC				0.5920***						
60+ TWRC				0.5078***						
Up to 70 TWRC					0.5947***					
70+ TWRC					0.4728***					
Up to 80 TWRC						0.5992***				
80+ TWRC						0.4078***				
Up to 90 TWRC							0.5963***			
90+ TWRC							0.3330***			
Up to 100 TWRC								0.5888***		
100+ TWRC								0.2732**		
Up to 110 TWRC									0.5814***	
110+ TWRC									0.2169	
Up to 120 TWRC										0.5765***
120+ TWRC										0.1226
School fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marginal Effects	**NA**	**-0.0854**	**-0.0630**	**-0.0842**	**-0.1219**	**-0.1914***	**-0.2633****	**-0.3156****	**-0.3645****	**-0.4539****
Constant	7.5524***	7.2977***	7.5499***	7.7357***	7.9263***	8.0660***	7.9735***	7.5295***	7.1570***	6.8771***
N	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000
R-squared	0.61664	0.61709	0.61695	0.61722	0.61771	0.61878	0.61974	0.61975	0.61936	0.61923

Total Words Read Correct ORF 1

RESEP
Research on Socio-Economic Policy

Tentative conclusions

1. **New study testing oral reading fluency among L2 learners in SA.**
   - Confirms existing research; strong relationship between fluency and comprehension
   - Stresses the importance of acquiring foundational reading skills in the early years (Gr1-3) – Grade 5 is MUCH too late.
   - Extremely low levels of reading fluency. **60%** of grade 5 rural learners are reading at a grade 1 level.
   - About half of the grade 5 sample are reading so slowly that they do not understand anything that they are reading
   - High intra-class range in WCPM; in 50% of classes range (top-bot) >75 WCPM
2. **A lack of automaticity is a binding constraint to reading (and comprehension) for most of these rural learners**
   - Automaticity develops through practice
   - No reading homework
   - No reading in the classroom
   - Little access to books (60% of all SA primary schools have no library at all)
3. **If these students are still battling with the 'conscious-attention mechanism' (i.e. no automaticity and not using 'automatic activation processes') little working memory can be freed up for comprehension**.
   - Schreiner (2003) suggests that automaticity in cognitive function frees up 90% of working memory for higher-order skills.
4. **Strong relationship between fluency and comprehension**.
   - 1 standard deviation increase in WCPM is associated with a 0.7 SD increase in comprehension. (Alternatively 20 additional WCPM associated with 10 percentage point increase in comprehension)
5. **Differential return to fluency before and after about 70 TWRC**.
   - For L2 speakers returns to fluency are highest up to about 70 WCPM and decline from there. In contrast to 90 WCPM for L1 speakers (McGuiness, 2005)

- *Need to develop SA norms for African languages. English norms are not directly comparable with agglutinating languages (see Makalela & Fakude, 2014 for Sepedi)*

- *Encouraging teachers to use ORF assessments encourages individualised instruction/remediation (as opposed to choral/communal instruction)*

RESEP
Research on Socio-Economic Policy

Vast majority of kids do switch
## Language of learning and teaching (LOLT), ANA 2013
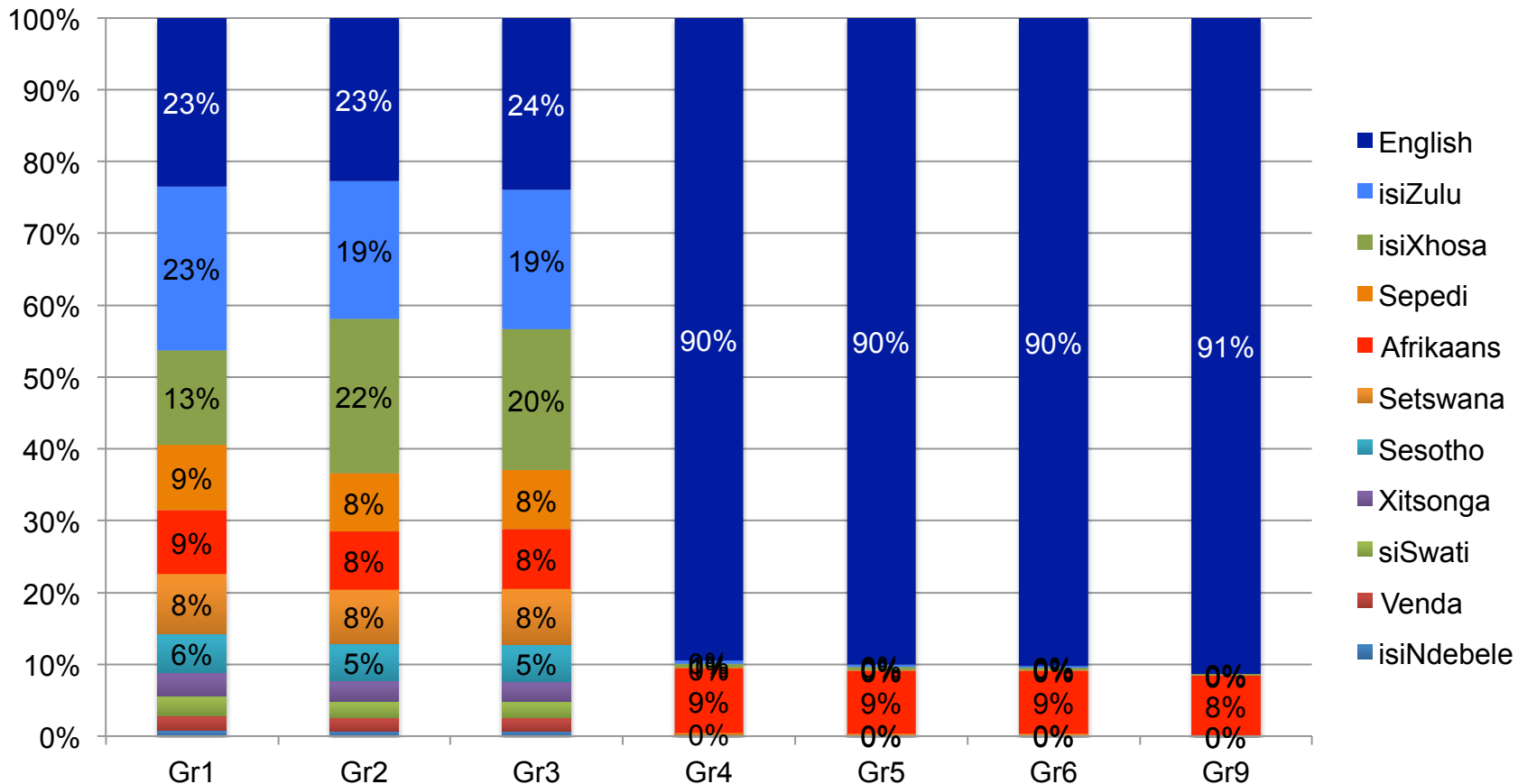
Background - SA

Hoadley (2015) summarizes the SA classroom-based research and finds the following descriptive features:

- Lack of opportunities for reading and writing (oral discourse dominates)
- Classroom interaction patterns that privilege the collective (chorusing)
- Weak forms of assessment and lack of feedback on student responses

- Similarly Pretorius & co-authors have found that a number of instructional practices (prevalent in SA) contribute to poor reading development:
  - The tendency of teachers to rely on whole class oral chorusing of reading,
  - The lack of reading homework
  - Minimal reading of extended texts in the early grades
  - (*Pretorius & Machet 2004; Pretorius & Mokhwesana 2009; Pretorius 2014*).

Current work: **semi-parametric approach** using residuals from fixed-effects

Words Read Correct Per Minute (WCPM)
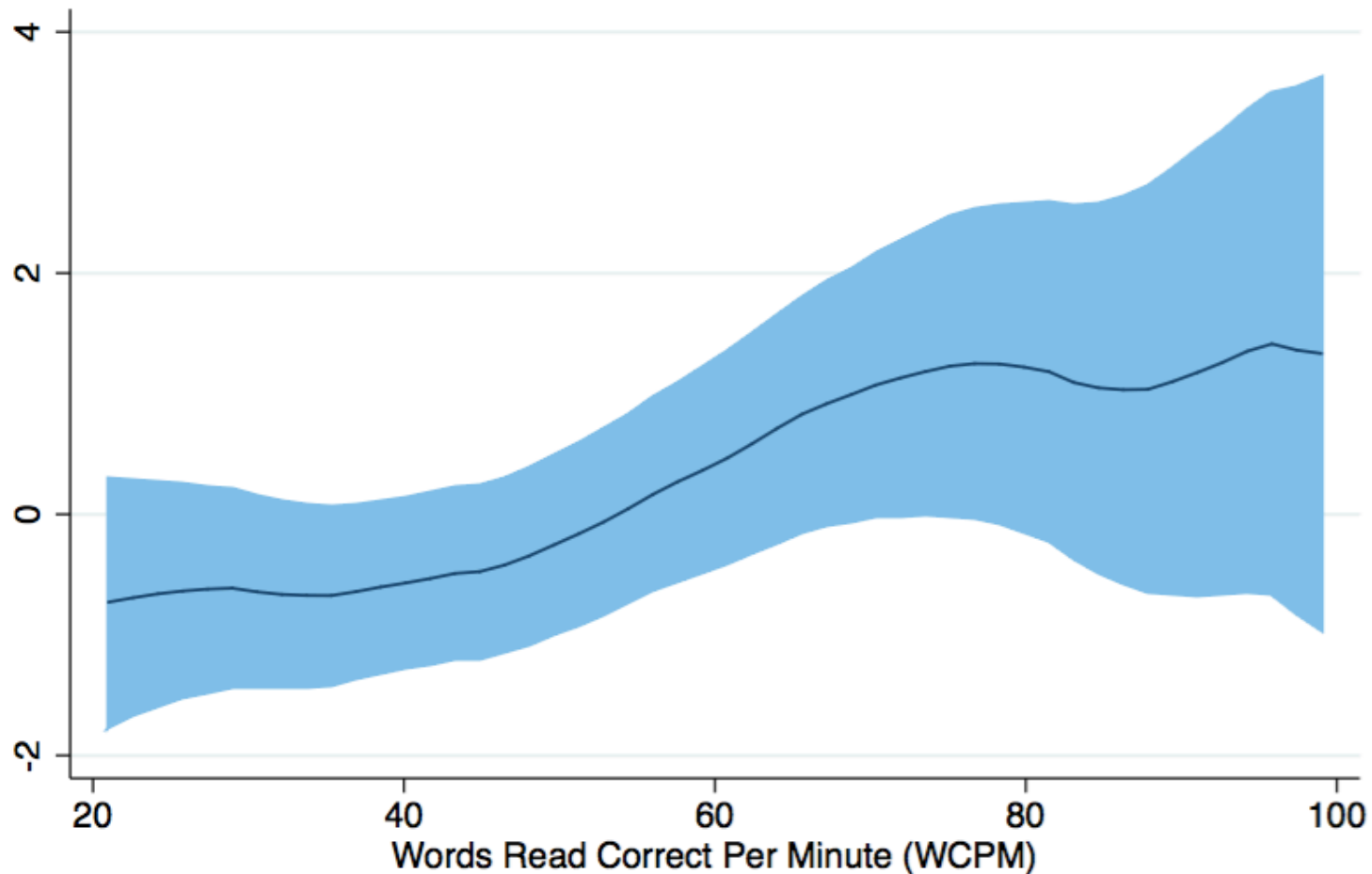
90% CI —— Local polynomial of residuals from fixed-effects regression

SPLINE 3→ Regressions predicting ORF1 comprehension score (in %) using ORF1

		Spline regressions with splines at different cut points (using ORF1):									
	Non-spline	**40 TWRC**	**50 TWRC**	**60 TWRC**	**70 TWRC**	**80 TWRC**	**90 TWRC**	**100 TWRC**	**110 TWRC**	**120 TWRC**
Female	0.1332	0.1826	0.1475	0.1423	0.1310	0.1080	0.0695	0.0215	-0.0160	-0.0098
Age 12 or 13 (Ref <12)	-2.1917	-1.9951	-2.0339	-1.9932	-1.9602	-1.9432	-1.9952	-2.0789	-2.1233	-2.1536
Age 14+	2.4900	2.9238	2.8322	2.8865	2.9208	2.9598	2.8757	2.7236	2.6243	2.5911
Words read incorrectly ORF1	-0.5735***	-0.6153***	-0.6039***	-0.6112***	-0.6204***	-0.6285***	-0.6270***	-0.6184***	-0.6095***	-0.6024***
Words skipped ORF 1	-0.2399	-0.2425	-0.2383	-0.2319	-0.2296	-0.2251	-0.2222	-0.2242	-0.2282	-0.2284
TWRC ORF1	0.5560***									
Up to 40 TWRC		0.6136***								
40+ TWRC		0.5282***								
Up to 50 TWRC			0.5906***							
50+ TWRC			0.5276***							
Up to 60 TWRC				0.5920***						
60+ TWRC				0.5078***						
Up to 70 TWRC					0.5947***					
70+ TWRC					0.4728***					
Up to 80 TWRC						0.5992***				
80+ TWRC						0.4078***				
Up to 90 TWRC							0.5963***			
90+ TWRC							0.3330***			
Up to 100 TWRC								0.5888***		
100+ TWRC								0.2732**		
Up to 110 TWRC									0.5814***	
110+ TWRC									0.2169	
Up to 120 TWRC										0.5765***
120+ TWRC										0.1226
School fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marginal Effects	**NA**	**-0.0854**	**-0.0630**	**-0.0842**	**-0.1219**	**-0.1914***	**-0.2633****	**-0.3156****	**-0.3645****	**-0.4539****
Constant	7.5524***	7.2977***	7.5499***	7.7357***	7.9263***	8.0660***	7.9735***	7.5295***	7.1570***	6.8771***
N	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000	1691.00000
R-squared	0.61664	0.61709	0.61695	0.61722	0.61771	0.61878	0.61974	0.61975	0.61936	0.61923

Total Words Read Correct ORF 1

RESEP
Research on Socio-Economic Policy

Background

- *Readability ease*
- Readability refers, broadly, to the ease or difficulty with which texts are read. Various readability formulae are employed to quantify aspects of texts that are deemed to play a role in determining the ease with which texts are read. These readability formulae typically incorporate word length and sentence length in relation to overall text length, the assumption being that short words and short sentences are easier to read than longer words and sentences. Examples of readability formulae include the Flesch Reading Ease (RE), the Dale-Chall and the Grammatik formulae that are available on software programmes such as MS Word. The assumptions underlying the readability formulae have not been without their critics, the main charge being that such formulae oversimplify the reading process, since there are also several text-based and reader-based factors that affect reading ease. Notwithstanding such criticisms, readability formulae continue to enjoy popularity as gross predictors of text difficulty.
- The Flesch Reading Ease formula, based on syllables per 100 words, words per sentence and number of passive constructions used in a text, was used for the purposes of this study, primarily because it is easily available and in the absence of standardised test instruments in the local educational context, serves as a rough guideline for establishing consistency across texts at specific grade levels.
- The higher the reading ease (RE) score, the easier the text is regarded as being; the lower the number, the more difficult the text. The scores have been measured in terms of readability categories, as shown in Table 1 below. Grade 4 and 5 textbooks fall within the 90-70 range of scores.
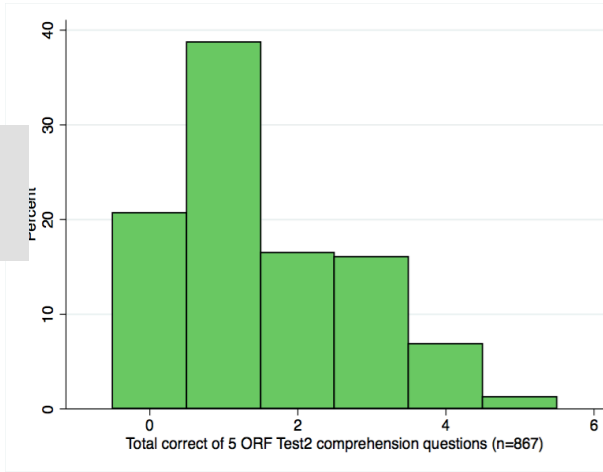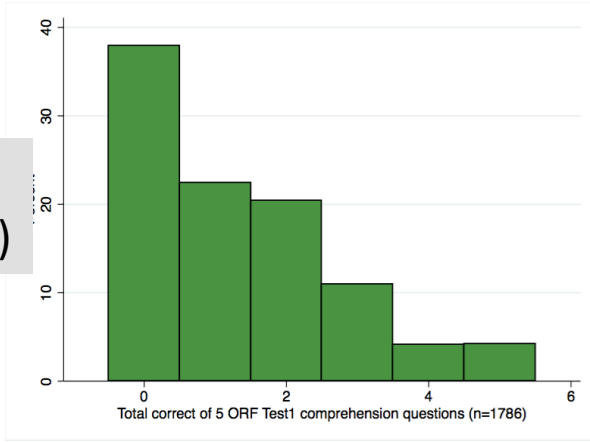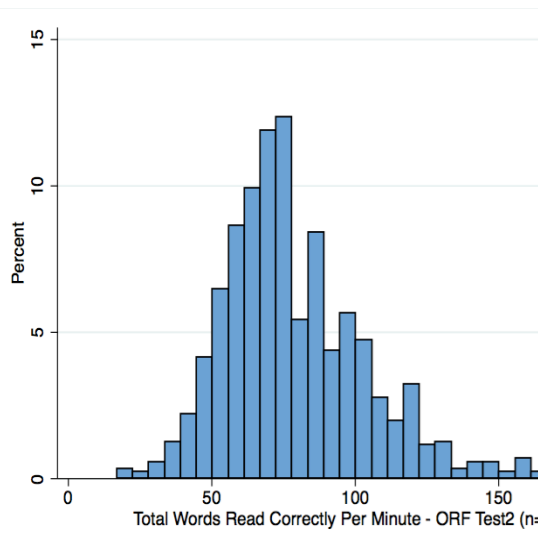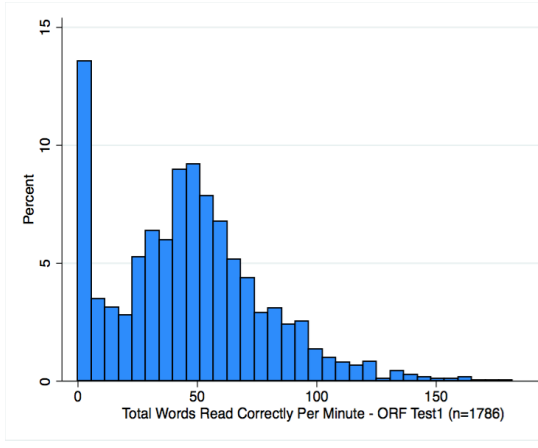
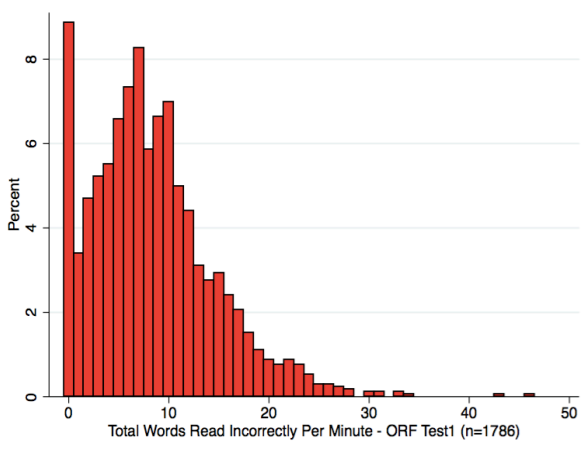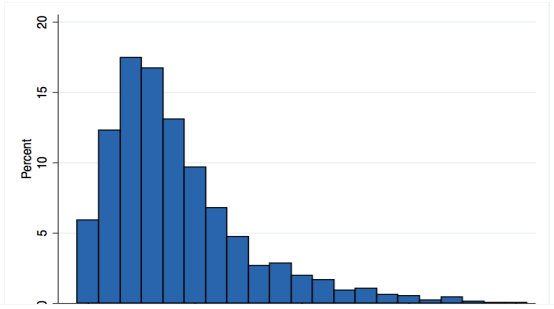RESEP
Research on Socio-Economic Policy

REGRESSION 2 → Models predicting standardised ORF1 comprehension score using ORF 1 (SD=1)

[Note TWRC_ORF1 original SD=32 words. ORF1 comprehension initial SD=1.4 questions or 28% (/5 question)] TWRC=Total Words Read Correctly

	ORF 1 comprehension score (SD=1)						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
TWRC (ORF1) standardised	0.6907***	0.6895***	0.6885***	0.6838***	0.6836***	0.6574***	0.6285***
	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Words read incorrectly (ORF1)		-0.0294***	-0.0295***	-0.0293***	-0.0297***	-0.0278***	-0.0205***
		0.00	0.00	0.00	0.00	0.00	0.00
Words skipped (ORF1)		-0.0055	-0.0055	-0.0048	-0.0047	-0.0089	-0.0086
		0.01	0.01	0.01	0.01	0.01	0.01
female			0.0105	0.0050	0.0072	0.0054	0.0048
			0.04	0.04	0.04	0.04	0.04
Aged 12 or 13 (Ref <12)				-0.0896*	-0.0944**	-0.0872*	-0.0784
				0.05	0.05	0.05	0.05
Aged 14+				0.0408	0.0377	0.0711	0.0891
				0.07	0.08	0.08	0.09
multigrade					0.0372	0.0085	
					0.05	0.06	
LOLT=English (n=108) (Ref=Afr)						-0.0397	
						0.14	
LOLT=Sepedi (n=276)						-0.3430***	
						0.08	
LOLT=Sesotho (n=45)						-0.2331	
						0.16	
LOLT=Setswana (n=233)						-0.2039**	
						0.09	
LOLT=isiXhosa (n=341)						-0.3501***	
						0.09	
LOLT=isiZulu (n=359)						-0.2169***	
						0.08	
Includes school fixed effects	No	No	No	No	No	No	Yes
Constant	0.0000	0.2517***	0.2471***	0.2643***	0.2510***	0.4684***	0.2411***
	0.03	0.04	0.05	0.05	0.06	0.08	0.05
N	1786.00000	1691.00000	1691.00000	1691.00000	1691.00000	1630.00000	1691.00000
F-stat	499.09937	179.01031	146.90817	103.36913	98.02533	69.75107	.

RESEP
Research on Socio-Economic Policy

# Distributions

ORF1
(1786)

ORF2
(867)

Test materials

- **No standardised reading tests** for Grades 4-6 in SA. Therefore a reading test was designed for this study.
- **Grade 5 level passage** was selected and modified slightly to assess reading comprehension in the written mode (literal and inferential questions in a mixed-mode format).
- **Two passages were selected from Grade 4 textbooks** to assess oral reading fluency with five accompanying oral comprehension questions. Assessed text readability…
- Comprehension and ORF tests were **piloted in early 2013 in 16 schools** (570 Grade 5 learners) across all 9 provinces. 168 did ORF 1; 115 did ORF2.

|	Total words	Words/ sentence	Characters per word	Flesch RE	Flesch-Kincaid grade-level
ORF Test 1 Leopard	205	9,8	4,1	84,7	Gr 3,8
ORF Test 2 Hare	269	10,8	4,1	83,3	Gr 4,3

Descriptive findings

- Of those scoring less than 15% on comprehension almost all (80%) have WCPM<50 and most (60%) have WCPM<30 – i.e. these are abysmally slow readers.

- Of those scoring 15-29% almost all (80%) have WCPM<60 and most (60%) have WCPM<50

- For those that score 30-60% on the comprehension test, most of the 'action' is around 50-70/80 WCPM. (look at where the lines are steepest).

- For those that scored 30-39%, only 30% of students have WCPM<50 but double that amount (60%) have WCPM<60. Or alternatively 70% have WCPM>50 but only 40% have WCPM>60. So clearly a large proportion of these students are in-between 50 and 60 WCPM.

- Students achieving 40-49% and 50-59% are very similar in WCPM

ORF 1 comprehension /5

Total correct of 5 ORF Test1 comprehension questions (n=1786)
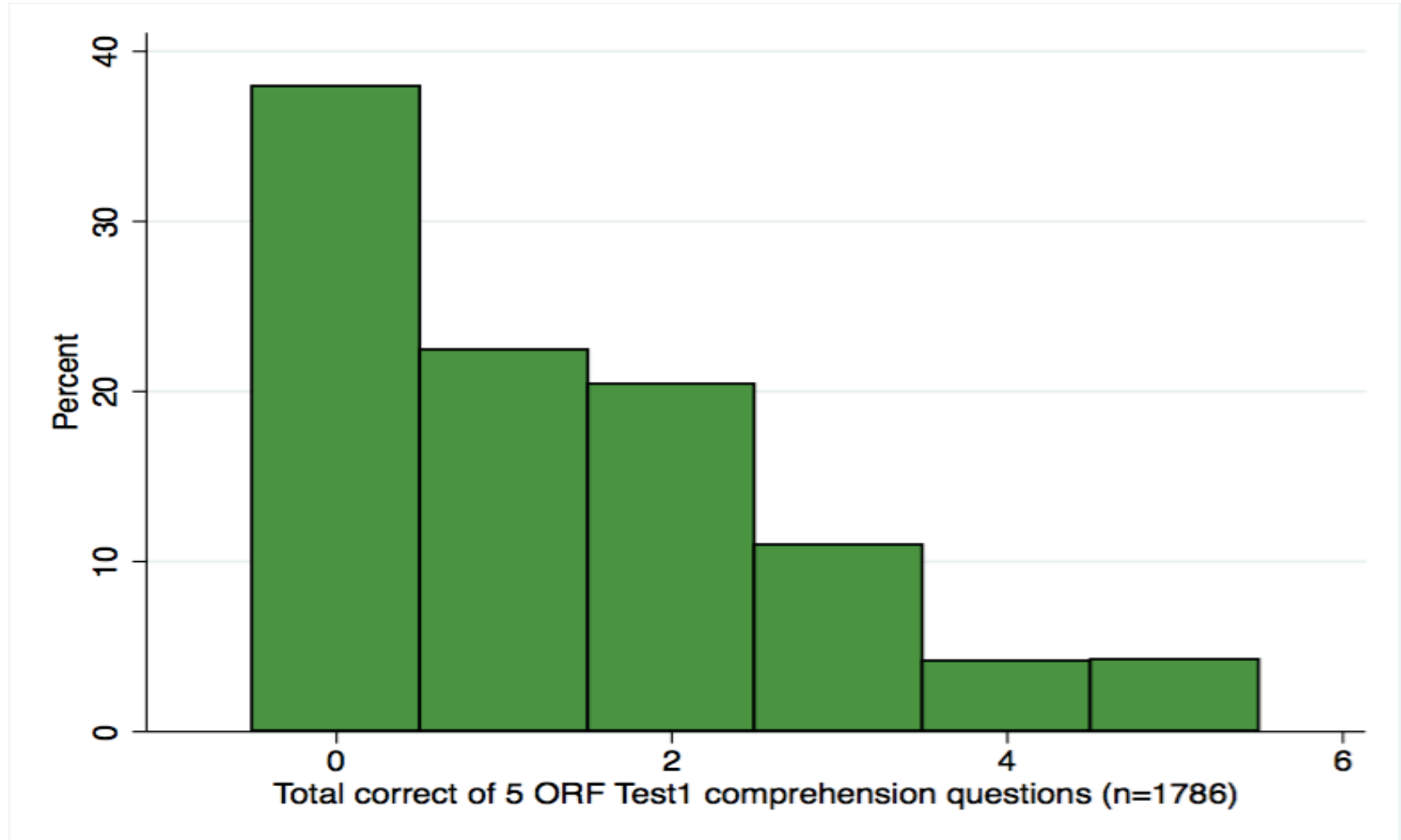
A traditional story from Africa: How Sanguru the Hare got his long ears
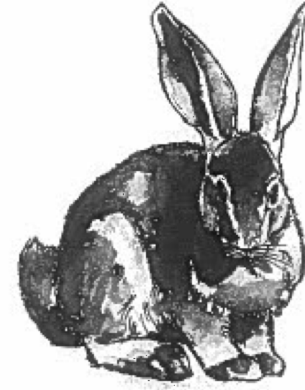
ORF Test 2

Once upon a time all the animals of Africa were very friendly with each other. They made their own laws and rules for their kingdom, and they voted for their own king. At that particular time, the Elephant was King.

One day, the Elephant called all the horned animals in his kingdom to a meeting. Sanguru the Hare did not have horns, of course. In those days he still had small, round ears. But he was an inquisitive animal, always wanting to know what was going on! He very much wanted to go to the meeting and he was annoyed that the King had not invited him. "I shall attend the meeting," the Hare grumbled, and he decided on a plan. He remembered seeing a bee's nest in the forest. He found the nest and took the beeswax from it. He shaped the wax into a pair of beautiful, long shiny horns.

The following morning the Hare fixed the horns to his little, round ears. Satisfied, he hopped off to the place where the antelopes and other horned animals were gathered for the meeting.

Then the sun became very hot. The wax horns slowly began to melt. Sanguru felt something wet trickling down his face. He wiped his cheeks and saw melted wax on his paws. He tried to hide, but the other animals noticed what was happening. The antelopes chased him and dragged him to the King, shouting 'A spy! A spy in our midst!'

SPLINE 2→ Regressions predicting initial comprehension score (in %) using ORF2

	Non-spline	Spline regressions with splines at different cut points (using ORF2):								
		40 TWRC	50 TWRC	60 TWRC	70 TWRC	80 TWRC	90 TWRC	100 TWRC	110 TWRC	120 TWRC
Female	0.1814	0.2015	0.2227	0.2137	0.1719	0.1878	0.2264	0.2052	0.1764	0.1616
Age 12 or 13 (Ref <12)	-2.1487	-2.1470	-2.1098	-2.1311	-2.1375	-2.0545	-1.9700	-1.9496	-2.0202	-2.0713
Age 14+	-1.2432	-1.2313	-1.2860	-1.2550	-1.2426	-1.2929	-1.2819	-1.2598	-1.2483	-1.2618
Words read incorrectly ORF2	-1.1128***	-1.1043***	-1.1113***	-1.1177***	-1.1097***	-1.1018***	-1.0950***	-1.0929***	-1.0956***	-1.0986***
Words skipped ORF 2	-0.1546	-0.1861	-0.1862	-0.1780	-0.1461	-0.1370	-0.1369	-0.1340	-0.1444	-0.1516
TWRC ORF2	0.2907***									
Up to 40 TWRC		0.0075								
40+ TWRC		0.2962***								
Up to 50 TWRC			0.1343							
50+ TWRC			0.2995***							
Up to 60 TWRC				0.2155*						
60+ TWRC				0.3015***						
Up to 70 TWRC					0.3127***					
70+ TWRC					0.2837***					
Up to 80 TWRC						0.3467***				
80+ TWRC						0.2542***				
Up to 90 TWRC							0.3505***			
90+ TWRC							0.2187***			
Up to 100 TWRC								0.3464***		
100+ TWRC								0.1741**		
Up to 110 TWRC									0.3304***	
110+ TWRC									0.1528	
Up to 120 TWRC										0.3165***
120+ TWRC										0.1392
School fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marginal Effects		**0.2887**	**0.1651**	**0.0860**	**-0.0290**	**-0.0925**	**-0.1318**	**-0.1722***	**-0.1776**	**-0.1774**
Constant	12.4777***	23.3713	19.7547*	16.4770**	11.2012**	9.0688*	8.7255*	8.7064**	9.4417**	10.1333**
N	866.00000	866.00000	866.00000	866.00000	866.00000	866.00000	866.00000	866.00000	866.00000	866.00000
Prob > F	.	.	.	.	.	.	.	.	.	.
R-squared	0.57297	0.57327	0.57334	0.57324	0.57303	0.57373	0.57457	0.57542	0.57499	0.57438

Total Words Read Correct ORF 2

SPLINE 4→ Regressions predicting ORF2 comprehension score (in %) using ORF2

	Non-spline	Spline regressions with splines at different cut points (using ORF2):								
		40 TWRC	50 TWRC	60 TWRC	70 TWRC	80 TWRC	90 TWRC	100 TWRC	110 TWRC	120 TWRC
Female	0.3810***									
Age 12 or 13 (Ref <12)	-1.5949	-1.5933	-1.5246	-1.5449	-1.6004	-1.5923	-1.5958	-1.6041	-1.5914	-1.5773
Age 14+	-3.2534	-3.2533	-3.1874	-3.2262	-3.2469	-3.2159	-3.2570	-3.3301	-3.3441	-3.3222
Words read incorrectly ORF2	-2.4172	-2.4163	-2.4899	-2.4355	-2.4169	-2.4370	-2.4165	-2.4108	-2.4136	-2.4006
Words skipped ORF 2	-1.0930***	-1.0924***	-1.0905***	-1.1006***	-1.0912***	-1.0887***	-1.0934***	-1.1007***	-1.1052***	-1.1057***
TWRC ORF2	-0.3346	-0.3371	-0.3882	-0.3707	-0.3297	-0.3276	-0.3350	-0.3426	-0.3419	-0.3373
Up to 40 TWRC		0.3587								
40+ TWRC		0.3814***								
Up to 50 TWRC			0.1155							
50+ TWRC			0.3959***							
Up to 60 TWRC				0.2647**						
60+ TWRC				0.3976***						
Up to 70 TWRC					0.3938***					
70+ TWRC					0.3769***					
Up to 80 TWRC						0.4033***				
80+ TWRC						0.3664***				
Up to 90 TWRC							0.3798***			
90+ TWRC							0.3824***			
Up to 100 TWRC								0.3596***		
100+ TWRC								0.4259***		
Up to 110 TWRC									0.3530***	
110+ TWRC									0.4784***	
Up to 120 TWRC										0.3581***
120+ TWRC										0.5158***
School fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marginal effects		**0.0227**	**0.2804**	**0.1329**	**-0.0169**	**-0.0369**	**0.0026**	**0.0664**	**0.1254**	**0.1577**
Constant	15.4128***	16.2693	27.7695***	21.5963***	14.6693**	14.0543**	15.4872***	16.8657***	17.5564***	17.4976***
N	865.00000	865.00000	865.00000	865.00000	865.00000	865.00000	865.00000	865.00000	865.00000	865.00000
R-squared	0.59025	0.59025	0.59098	0.59069	0.59026	0.59033	0.59025	0.59050	0.59094	0.59102

Total Words Read Correct ORF2 (row label along left margin)

RESEP
Research on Socio-Economic Policy