Multitudes v3 (2024/25) Prediction Models

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> ⚠ **Cautionary Note**
>
> This document is a WORK IN PROGRESS and will be updated as new data (e.g., item recalibrations, additional demographic information) become available.

> ❗ **To Do**
>
> - ~~recompute scores for universal screening tasks with updated 2025 item parameters once available~~
> - ~~filter out implausible RAN score~~
> - ~~add 23/24 data~~
> - ~~align grades between years~~
> - ~~align tasknames between years~~
> - ~~re-run 23/24 models~~
> - ~~run 24/25 models~~
> - ~~run combined model~~
> - run two-year model
> - recompute scores for remaining tasks with updated 2025 item parameters once available
> - try out different definitions of risk (one/both lgs.)
> - try different aggregations of tasks (max, mean, etc.) for skill-specific/language-independent predictors

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1 PART I - Re-analysis of 2023/24 Data

1.1 Sample

Throughout, I only included tasks taken by at least 50 students per language per grade, so as to not distort the task selection analyses.

- $N = 2701$
- 28 schools
- 15 districts

Table 1: Demographic Characteristics of the AY 23/24 Sample (N = 2,701) by Grade and Screening Language

Characteristic	English			Spanish		
	K N = 723	**G1** N = 546	**G2** N = 704	**K** N = 354	**G1** N = 233	**G2** N = 254
Gender						
Female	373 (52%)	257 (47%)	356 (51%)	192 (54%)	120 (52%)	141 (56%)
Male	350 (48%)	289 (53%)	346 (49%)	162 (46%)	113 (48%)	113 (44%)
Unknown	0	0	2			
Race						
Asian	86 (13%)	67 (12%)	65 (9.3%)	12 (4.0%)	3 (1.3%)	5 (2.0%)
Black/African American	92 (14%)	54 (9.9%)	98 (14%)	2 (0.7%)	0 (0%)	2 (0.8%)
Not reported	157 (23%)	110 (20%)	142 (20%)	208 (69%)	154 (68%)	149 (60%)
Other	94 (14%)	74 (14%)	85 (12%)	6 (2.0%)	7 (3.1%)	6 (2.4%)
White	245 (36%)	238 (44%)	307 (44%)	75 (25%)	62 (27%)	88 (35%)
Unknown	49	3	7	51	7	4
Ethnicity						
Hispanic/Latin(o/a)	413 (58%)	281 (52%)	383 (55%)	330 (94%)	220 (94%)	237 (93%)
Not Hispanic/Latin(o/a)	299 (42%)	263 (48%)	316 (45%)	22 (6.3%)	13 (5.6%)	17 (6.7%)
Unknown	11	2	5	2	0	0
ELPD						
EL	182 (27%)	94 (17%)	122 (19%)	267 (76%)	178 (77%)	173 (69%)
EO	416 (62%)	393 (73%)	474 (72%)	24 (6.8%)	19 (8.3%)	29 (12%)
EP	51 (7.6%)	51 (9.5%)	61 (9.3%)	42 (12%)	33 (14%)	45 (18%)
TBD	20 (3.0%)	1 (0.2%)	1 (0.2%)	18 (5.1%)	0 (0%)	2 (0.8%)
Unknown	54	7	46	3	3	5
Ever IEP/504	52 (8.6%)	43 (9.0%)	57 (11%)	31 (9.5%)	21 (9.7%)	20 (10%)
Unknown	117	69	204	26	17	60
Home Language						
English	496 (69%)	411 (76%)	472 (72%)	42 (12%)	24 (10%)	34 (14%)
Other	64 (9.0%)	51 (9.4%)	63 (9.6%)	5 (1.4%)	2 (0.9%)	4 (1.6%)
Spanish	154 (22%)	81 (15%)	122 (19%)	299 (86%)	205 (89%)	209 (85%)
Unknown	9	3	47	8	2	7

1.2 Descriptives

1.2.1 Distributions of English Multitudes Tasks
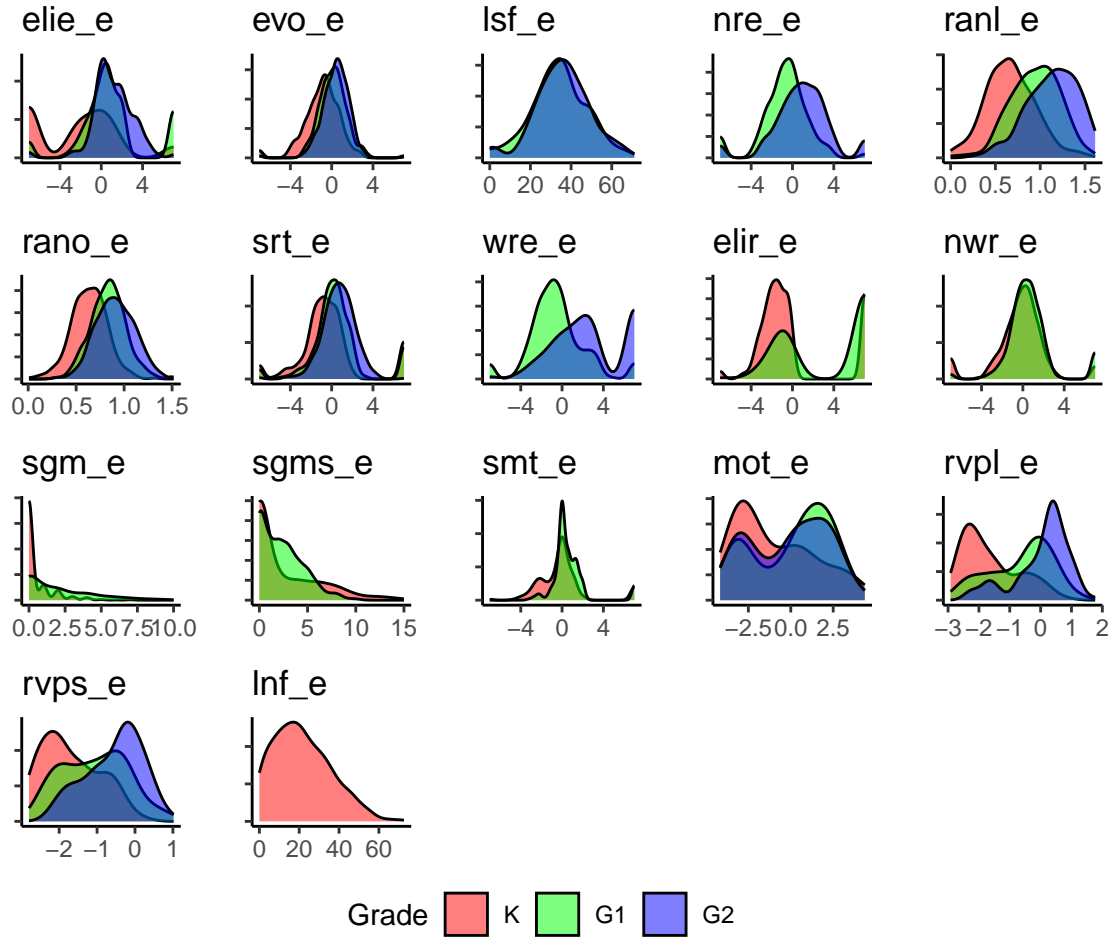
Figure 1: Distributions of English Multitudes Tasks by Grade (Fall 2023)

1.2.2 Distributions of Spanish Multitudes Tasks
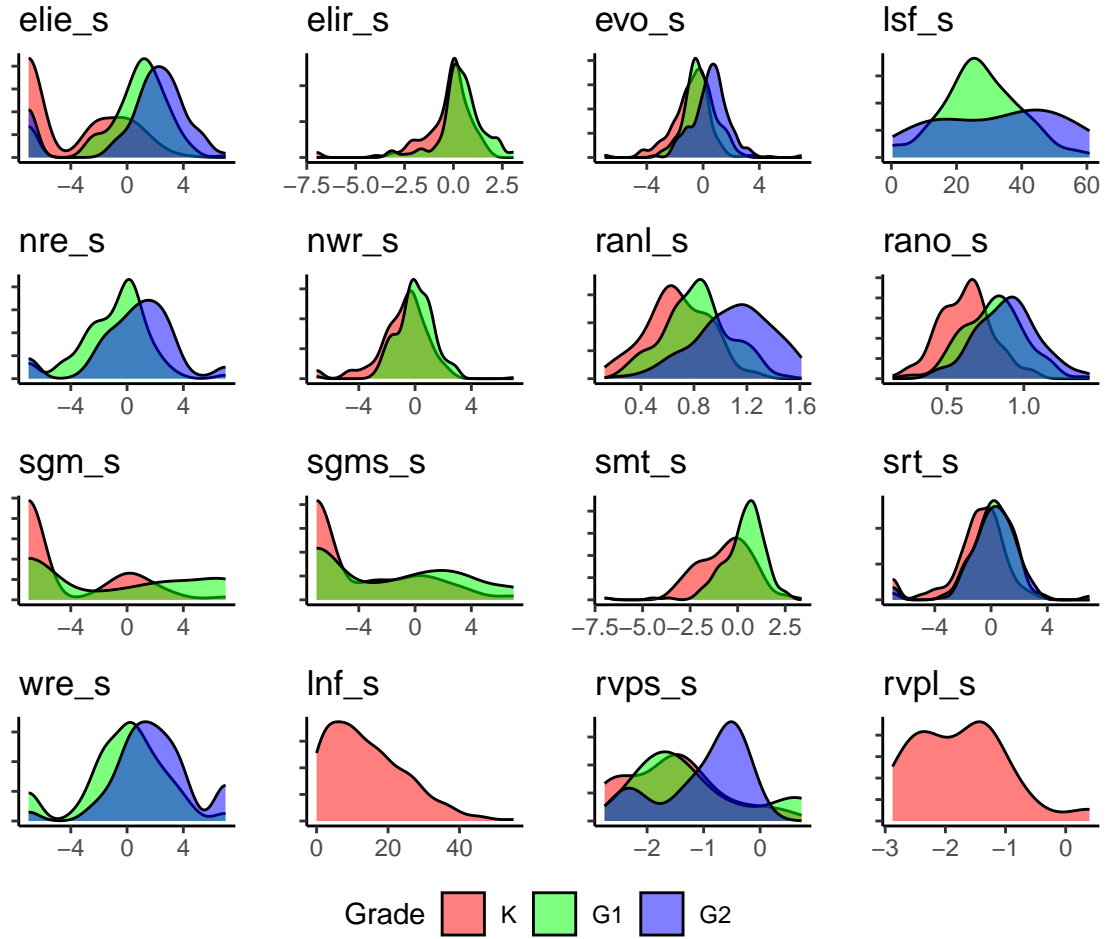
Figure 2: Distributions of Spanish Multitudes Tasks by Grade (Fall 2023)

Table 2: Comparison of Proportions of Struggling Readers ($</= $ 20th Percentile) in the Study Sample Based on Overall Multitudes Sample and on Published Woodcock-Johnson/Muñoz Norms (Spring 2024).

	English			Spanish		
Reference	**K** N = 754	**G1** N = 590	**G2** N = 780	**K** N = 375	**G1** N = 224	**G2** N = 211
Norm-based						
Not struggling	470 (62%)	415 (70%)	541 (69%)	169 (45%)	145 (65%)	106 (50%)
Struggling	284 (38%)	175 (30%)	239 (31%)	206 (55%)	79 (35%)	105 (50%)
Sample-based						
Not struggling	619 (82%)	539 (91%)	635 (81%)	300 (80%)	191 (85%)	162 (77%)
Struggling	135 (18%)	51 (8.6%)	145 (19%)	75 (20%)	33 (15%)	49 (23%)

1.2.3 Distributions of Outcome Measures
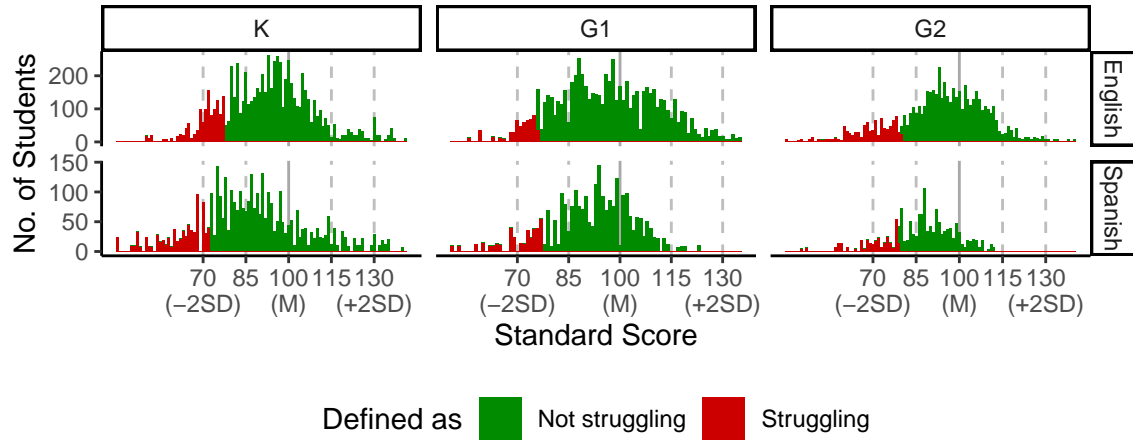
Figure 3: Distribution of Woodcock-Johnson/-Muñoz Basic Reading Skills Cluster (for Kindergarten) Broad Reading Cluster (for Grades 1 and 2) by Grade and Language with Struggling Readers ($</= $ 20th Percentile) Highlighted (Spring 2024).

1.2.4 Correlations

1.2.4.1 Kindergarten - English

Figure 4: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Kindergarten; AY 2023/24).

1.2.4.2 Kindergarten - Spanish

A

	Elision – Expressive (S)	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter Naming Fluency (S)	Nonword Repetition (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Letters (S)	Rapid Visual Processing – Symbols (S)	Segmentation – Syllables (S)	Segmentation – Words (S)	Semantic Mapping (S)	Sentence Repetition (S)
WM Basic Reading Skills	0.28	0.18	0.31	0.6	0.29	0.42	0.2	−0.07	0.39	0.17	0.26	0.23	0.21
Sentence Repetition (S)	0.26	0.11	0.38	0.24	0.45	0.11	0.3	0.28	−0.14	0.16	0.15	0.34	
Semantic Mapping (S)	0.28	0.23	0.38	0.27	0.23	0.23	0.15	0.07	0.12	0.21	0.19		
Segmentation – Words (S)	0.35	0.08	0.19	0.16	0.11	0.16	0.1	0.09	0.28	0.73			
Segmentation – Syllables (S)	0.26	0.12	0.19	0.09	0.14				0.04				
Rapid Visual Processing – Symbols (S)	0.32	0.01	−0.43	0.11	0.17	0.1	−0.06	0.36					
Rapid Visual Processing – Letters (S)	0.05		−0.34	−0.08	0.23	0.17	0.14						
Rapid Object Naming (S)	0.28	0.05	0.13	0.43	0.25	0.55							
Rapid Letter Naming (S)	0.32	0.06	0.08	0.76	0.14								
Nonword Repetition (S)	0.37	0.28	0.39	0.29									
Letter Naming Fluency (S)	0.39	0.14	0.31										
Expressive Vocabulary (S)	0.27	0.06											
Elision – Receptive (S)	0.12												

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B

	Elision – Expressive (S)	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter Naming Fluency (S)	Nonword Repetition (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Letters (S)	Rapid Visual Processing – Symbols (S)	Segmentation – Syllables (S)	Segmentation – Words (S)	Semantic Mapping (S)	Sentence Repetition (S)
WM Basic Reading Skills	269	273	281	225	271	114	211	20	16	269	266	269	249
Sentence Repetition (S)	295	306	310	240	298	110	222	24	20	297	293	296	
Semantic Mapping (S)	321	324	325	254	326	122	235	25	20	324	323		
Segmentation – Words (S)	319	321	322	251	323	120	232	25	20	321			
Segmentation – Syllables (S)	322	325	326	254	326	121	235	24	19				
Rapid Visual Processing – Symbols (S)	20	21	22	19	20	9	18	23					
Rapid Visual Processing – Letters (S)	25	26	27	24	25	11	23						
Rapid Object Naming (S)	233	240	249	238	237	121							
Rapid Letter Naming (S)	118	123	124	124	122								
Nonword Repetition (S)	324	327	328	256									
Letter Naming Fluency (S)	252	259	270										
Expressive Vocabulary (S)	325	335											
Elision – Receptive (S)	324												

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Figure 5: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Kindergarten; AY 2023/24).

1.2.4.3 Grid 1 - English

1.2.4.3 Grade 1 - English

A

	Elision – Expressive (E)	Elision – Receptive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Nonword Repetition (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Segmentation – Syllables (E)	Segmentation – Words (E)	Semantic Mapping (E)	Sentence Repetition (E)	WJ Broad Reading
Word Reading (E)	0.4	0.28	0.13	0.04	0.22	0.77	0.22	0.37	0.28	0.28		0.16	0.36	0.11	0.29	0.72
WJ Broad Reading	0.44	0.29	0.2	0.05	0.35	0.65	0.2	0.43	0.35	0.26	0.26	0.23	0.36	0.12	0.33	
Sentence Repetition (E)	0.34	0.19	0.38	0.01	0.14	0.28	0.34	0.18	0.16	0.24	0.06	0.21	0.25	0.24		
Semantic Mapping (E)	0.13	0.11	0.28	−0.09	0.09	0.12	0.06	0.08	0.04	0.21	0.09	0.13	0.2			
Segmentation – Words (E)	0.29	0.24	0.21	−0.13	0.36	0.39	0.2	0.21	0.21	0.05	−0.22	0.22				
Segmentation – Syllables (E)	0.2	0.07	0.22	−0.01	0.1	0.16	0.13	0.17	0.16		0.09					
Rapid Visual Processing – Symbols (E)	−0.01	0.02	0.02	0.05	−0.05		0.04	0.51		0.51						
Rapid Visual Processing – Letters (E)	0.24	0.03	0.18	−0.01	−0.19	0.33	0.02	0.32	0.18							
Rapid Object Naming (E)	0.27	0.13	0.1	0.08	0.54	0.38	0.1	0.57								
Rapid Letter Naming (E)	0.34	0.2	0.08	0.41	0.48	0.47	0.14									
Nonword Repetition (E)	0.21	0.14	0.2	−0.04	0.15	0.26										
Nonword Reading (E)	0.47	0.32	0.11	−0.02	0.36											
Letter–sound Fluency (E)	0.19	0.15	0.11	0.11												
Global Motion Processing (E)	−0.01	−0.03	0													
Expressive Vocabulary (E)	0.23	0.2														
Elision – Receptive (E)	0.34															

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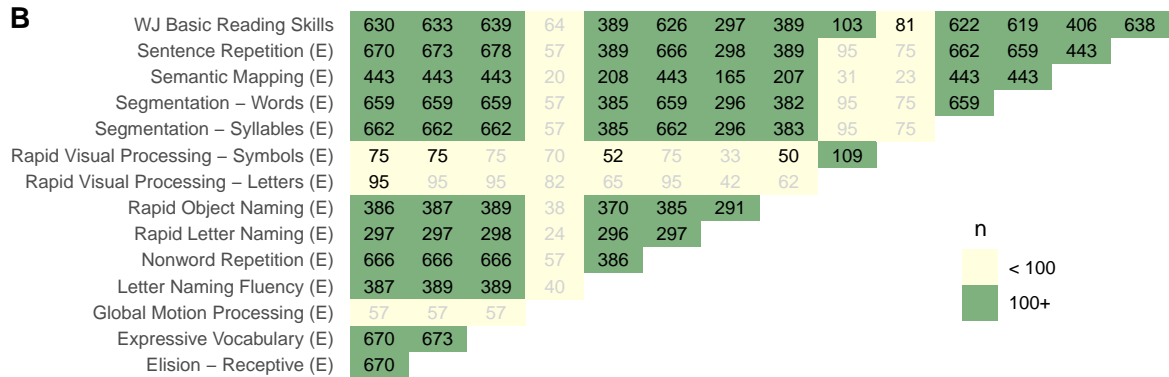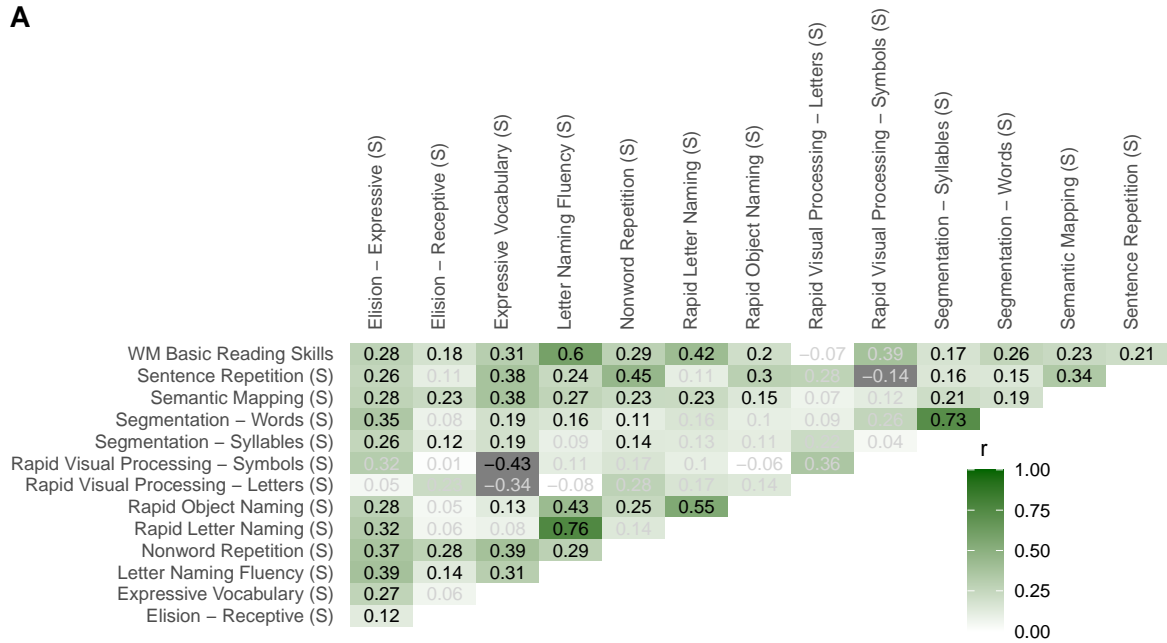|	Elision – Expressive (E)	Elision – Receptive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Nonword Repetition (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Segmentation – Syllables (E)	Segmentation – Words (E)	Semantic Mapping (E)	Sentence Repetition (E)	WJ Broad Reading
Word Reading (E)	513	513	513	72	281	513	513	265	285	101	76	513	513	355	513	494
WJ Broad Reading	504	505	507	75	286	494	504	270	290	108	79	501	497	347	506	
Sentence Repetition (E)	523	524	525	74	286	513	523	270	290	104	77	520	516	356		
Semantic Mapping (E)	356	356	356	63	236	355	356	223	238	87	65	356	356			
Segmentation – Words (E)	516	516	516	74	281	513	516	265	285	103	77	516				
Segmentation – Syllables (E)	520	520	520	74	282	513	520	266	286	104	77					
Rapid Visual Processing – Symbols (E)	77	77	77	77	39	76	77	36	39	94						
Rapid Visual Processing – Letters (E)	104	104	104	90	57	101	104	54	58							
Rapid Object Naming (E)	289	290	291	36	288	285	289	273								
Rapid Letter Naming (E)	269	270	271	33	268	265	269									
Nonword Repetition (E)	523	523	523	74	285	513										
Nonword Reading (E)	513	513	513	72	281											
Letter–sound Fluency (E)	285	286	287	35												
Global Motion Processing (E)	74	74	74													
Expressive Vocabulary (E)	523	524														
Elision – Receptive (E)	523															

n: < 100 / 100+

Figure 6: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Grade 1; AY 2023/24).

1.2.4.4 Grade 1 - Spanish

A

	Elision – Expressive (S)	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter–sound Fluency (S)	Nonword Reading (S)	Nonword Repetition (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Symbols (S)	Segmentation – Syllables (S)	Segmentation – Words (S)	Semantic Mapping (S)	Sentence Repetition (S)	WM Broad Reading
Word Reading (S)	0.3	0.11	0.13	0.42	0.77	0.17	0.38	0.24	−0.05	0.19	0.22	0.14	0.22	0.66
WM Broad Reading	0.55	0.19	0.18	0.59	0.59	0.18	0.46	0.32	0.3	0.06	0.08	0.19	0.37	
Sentence Repetition (S)	0.31	0.17	0.05	0.32	0.1	0.38	0.1	0.19	−0.08	0.11	0.09	0.09		
Semantic Mapping (S)	0.27	0.17	0.23	0.14	0.17	0.05	−0.01	0.1	0.49	0.06	0.1			
Segmentation – Words (S)	0.17	0.19	0.04	0.09	0.14	0.16	0.1	0.08		0.86				
Segmentation – Syllables (S)	0.19	0.18	0.06	0.08	0.1	0.15	0.12	0.1	0.17					
Rapid Visual Processing – Symbols (S)	0.7	0.19	−0.01	−0.24	0.04	0.14	−0.09	0.46						
Rapid Object Naming (S)	0.31	0.18	0.09	0.37	0.15	0.19	0.49							
Rapid Letter Naming (S)	0.22	0.14	0.18	0.49	0.34	0.17								
Nonword Repetition (S)	0.26	0.23	0.13	0.22	0.11									
Nonword Reading (S)	0.3	0.07	0.15	0.36										
Letter–sound Fluency (S)	0.42	0.16	0.17											
Expressive Vocabulary (S)	0.23	0.15												
Elision – Receptive (S)	0.24													

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B

	Elision – Expressive (S)	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter–sound Fluency (S)	Nonword Reading (S)	Nonword Repetition (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Symbols (S)	Segmentation – Syllables (S)	Segmentation – Words (S)	Semantic Mapping (S)	Sentence Repetition (S)	WM Broad Reading
Word Reading (S)	208	208	208	166	206	208	113	159	14	207	208	208	179	156
WM Broad Reading	169	169	173	134	158	167	105	131	11	165	164	164	147	
Sentence Repetition (S)	189	189	191	152	180	187	99	145	12	185	185	185		
Semantic Mapping (S)	216	216	216	174	210	216	118	167	14	215	216			
Segmentation – Words (S)	216	216	216	174	210	216	118	167	14	215				
Segmentation – Syllables (S)	217	217	217	175	209	217	119	168	14					
Rapid Visual Processing – Symbols (S)	14	14	14	13	14	14	9	14						
Rapid Object Naming (S)	170	170	175	172	161	169	120							
Rapid Letter Naming (S)	120	120	123	122	114	119								
Nonword Repetition (S)	220	220	220	176	210									
Nonword Reading (S)	210	210	210	168										
Letter–sound Fluency (S)	177	177	182											
Expressive Vocabulary (S)	222	222												
Elision – Receptive (S)	222													

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- < 100
- 100+

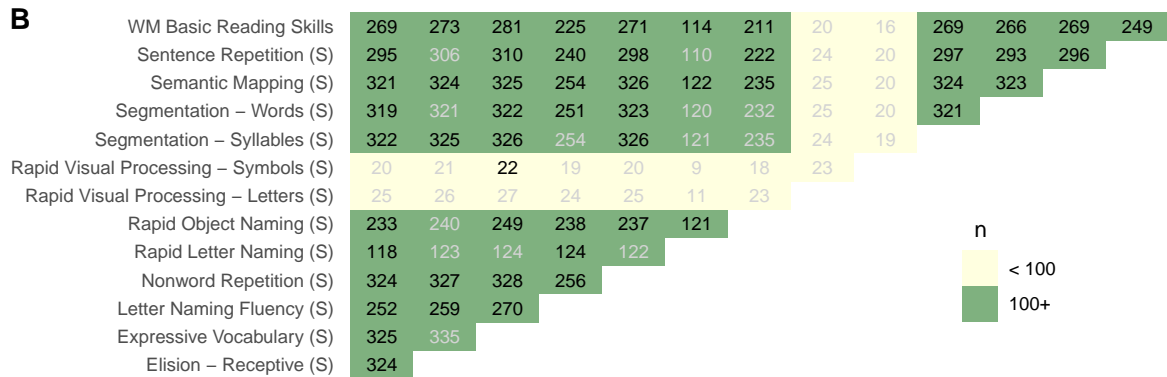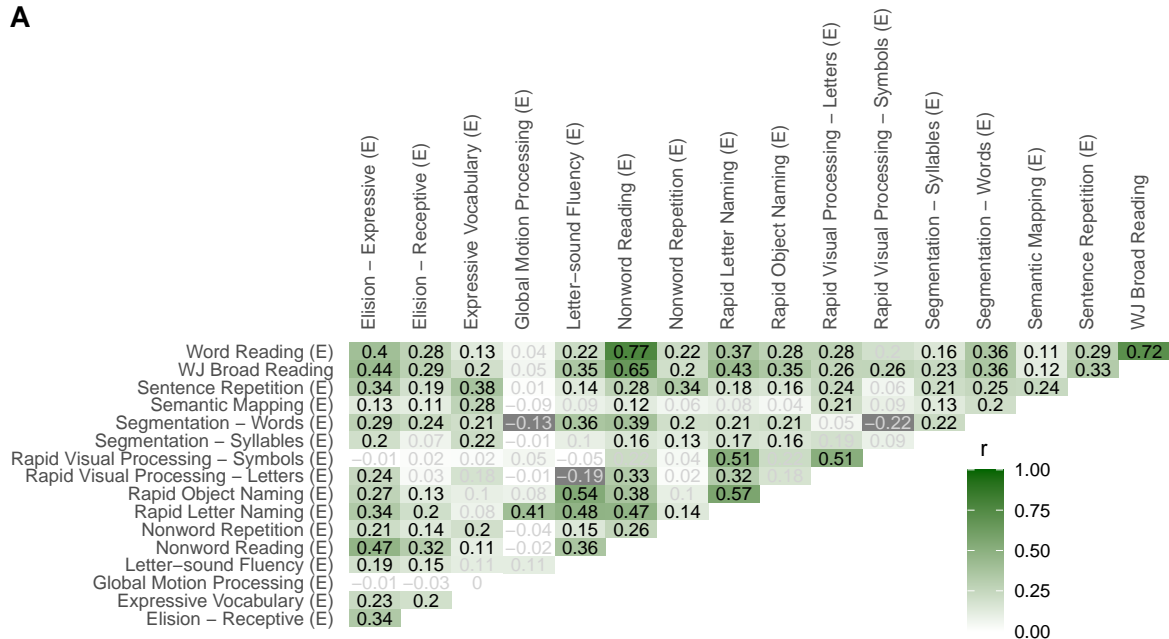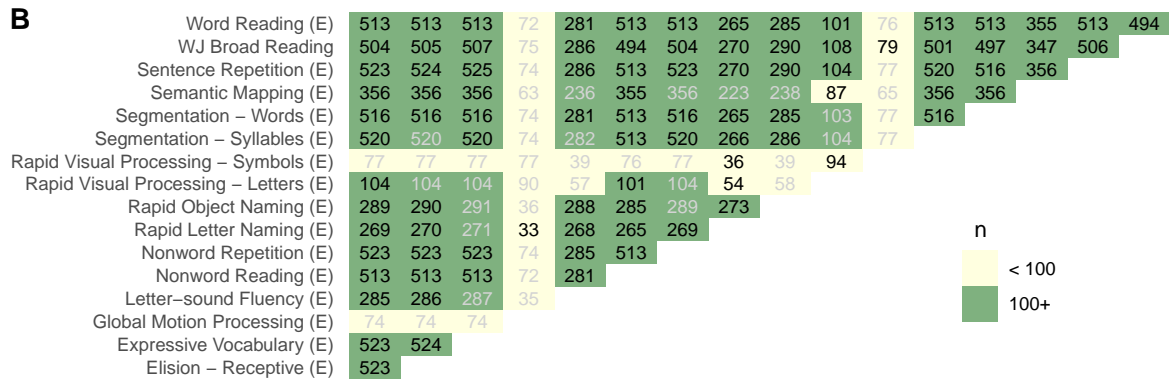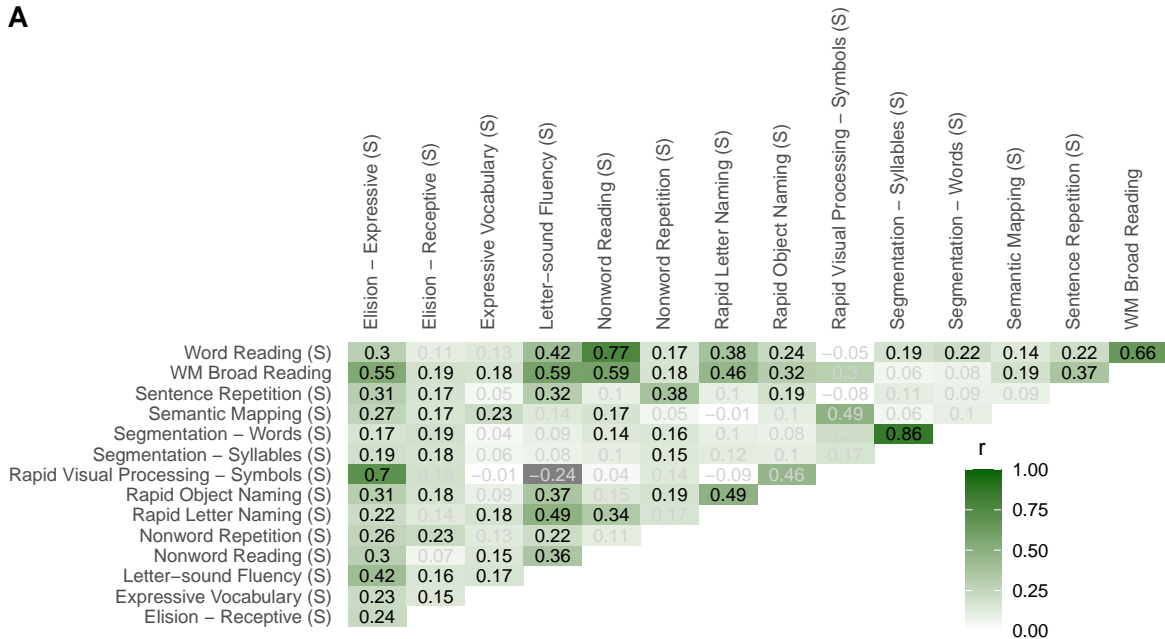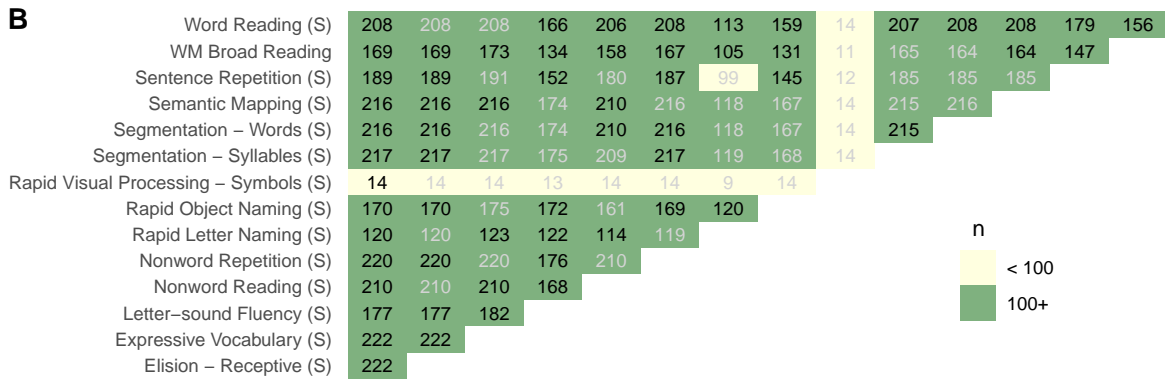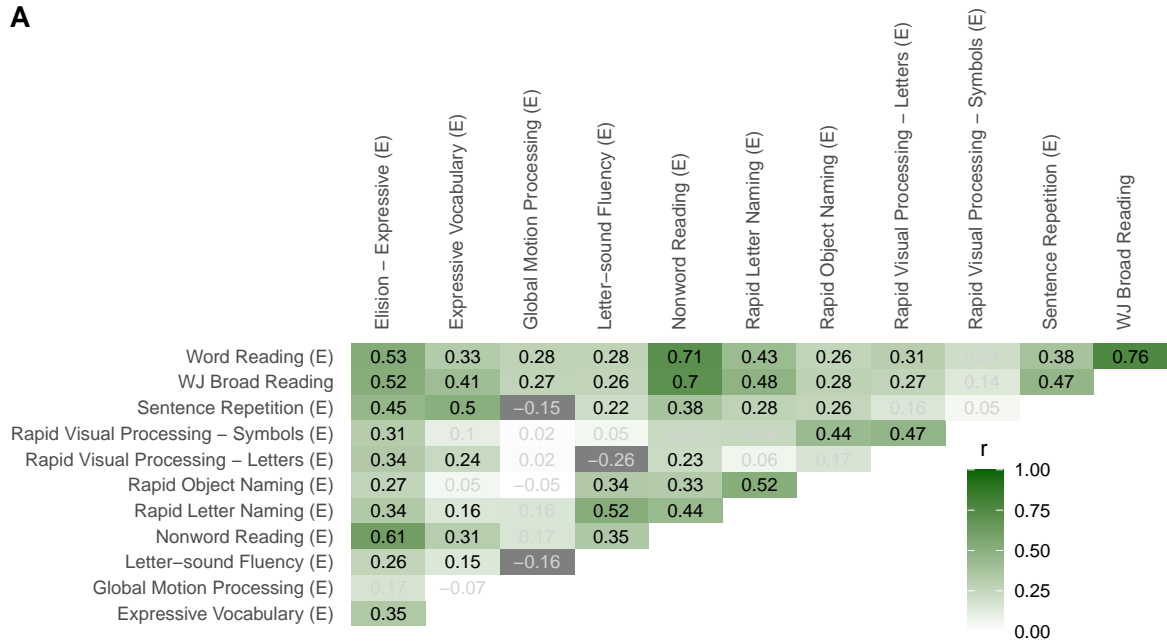Figure 7: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Grade 1; AY 2023/24).

1.2.4.5 Grade 2 - English

A
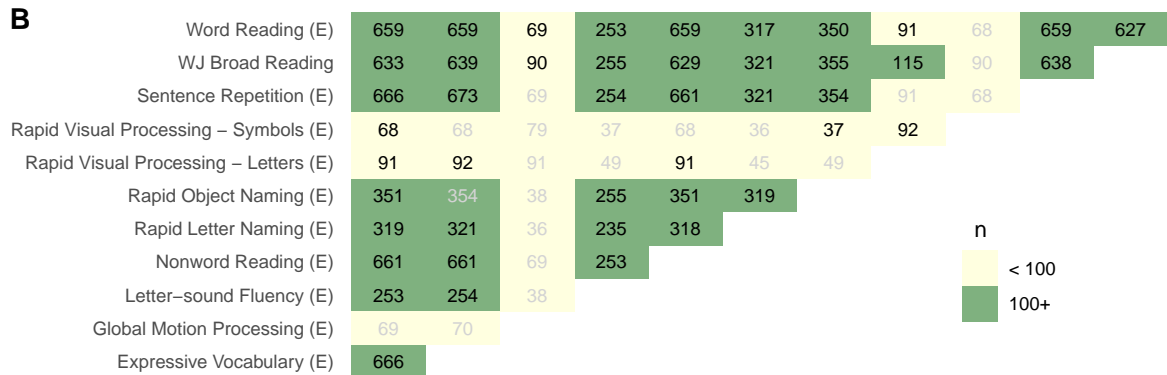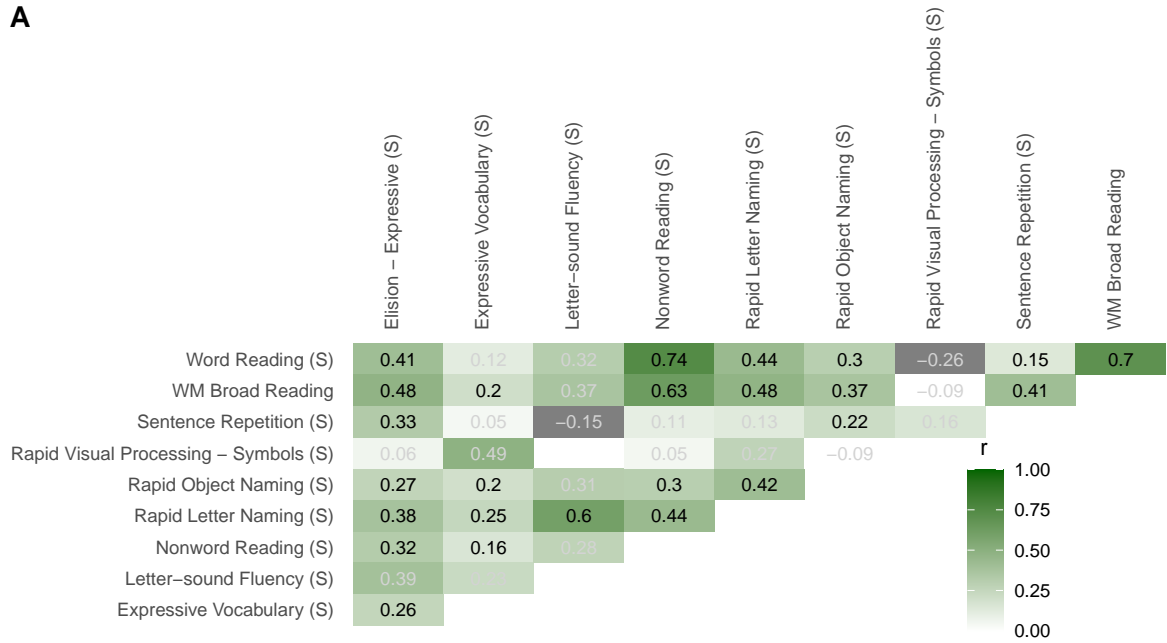

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Figure 8: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Grade 2; AY 2023/24).
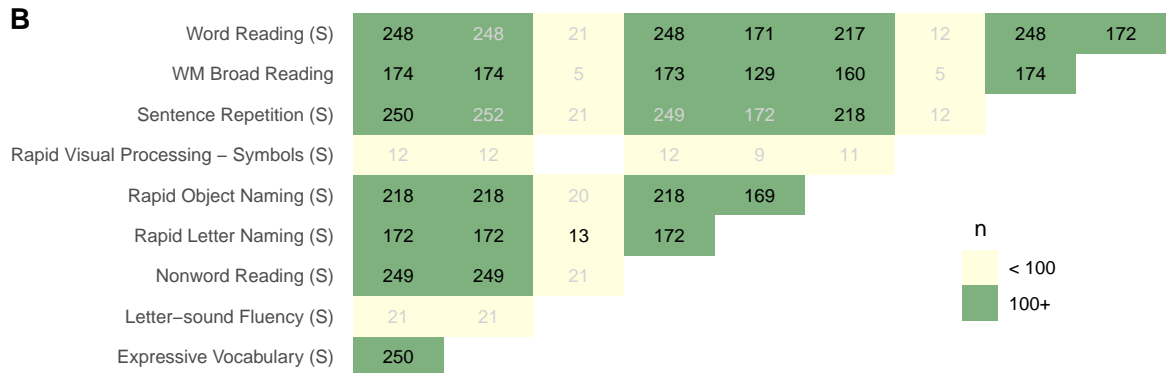
Figure 9: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Grade 2; AY 2023/24).

1.3 Task Selection

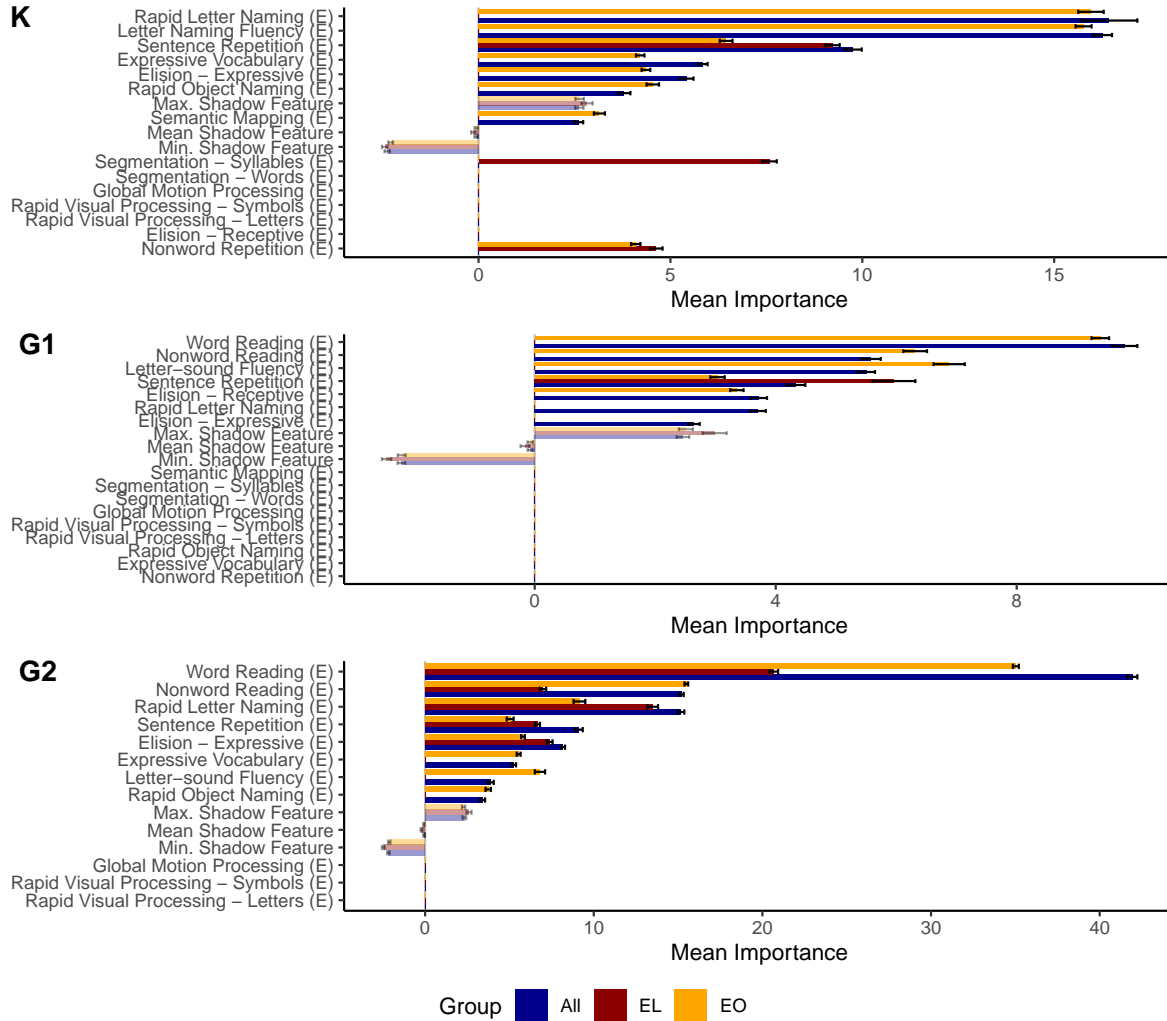### 1.3.1 English-to-English (English to English)

Figure 10: Mean Task Importance Obtained From Boruta Algorithm for English Predictions, with Results Disaggregated by English Proficiency Designation (AY 2023/24).

1.3.2 Spanish-to-Spanish (Spanish to Spanish)
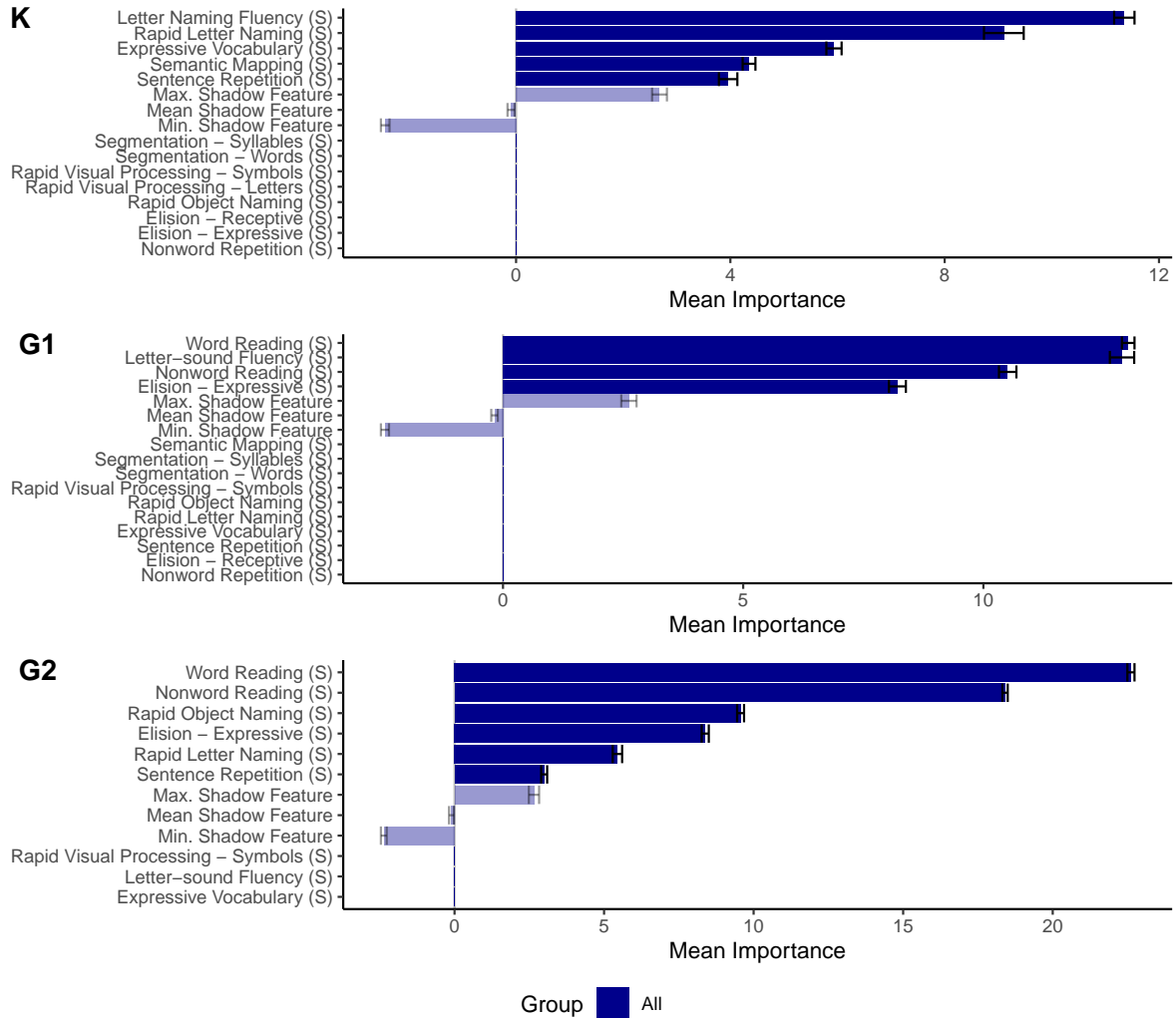
Figure 11: Mean Task Importance Obtained From Boruta Algorithm for Spanish Predictions (AY 2023/24).

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1.4 Models Evaluations - ROC Curves

1.4.1 English-to-English - Kindergarten

K – All Students

K – English Learners
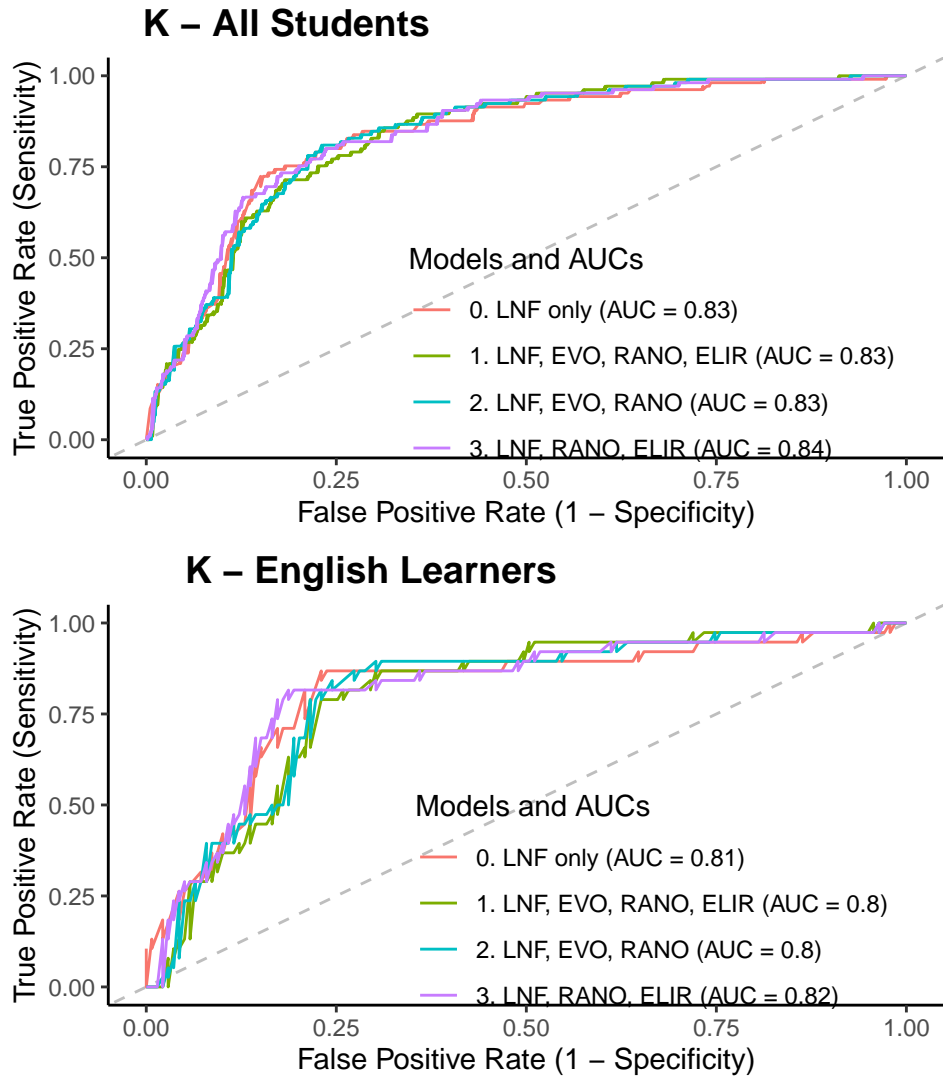
Figure 12: Receiver-operator Characteristic Curves For English-to-English Kindergarten Models (AY 2023/24).

1.4.2 English-to-English - Grade 1
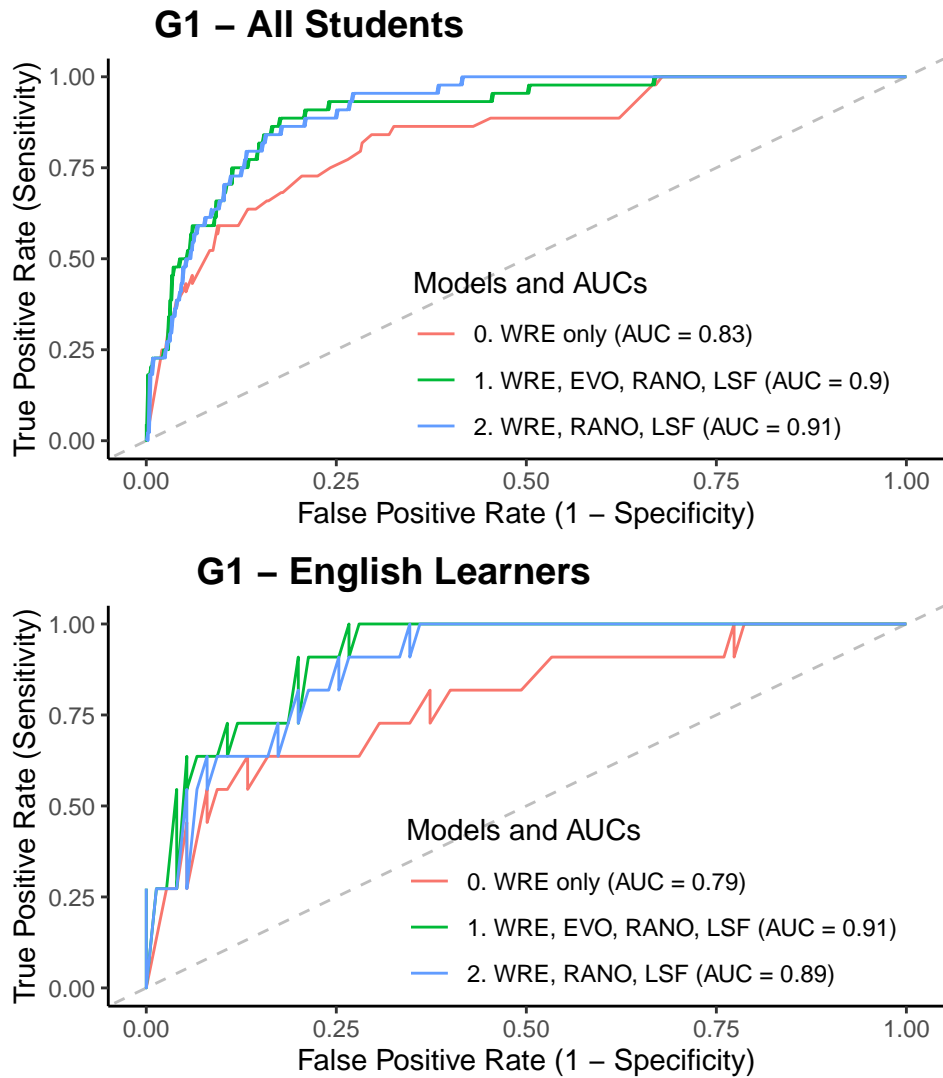
Figure 13: Receiver-operator Characteristic Curves For English-to-English Grade 1 Models (AY 2023/24).

1.4.3 English-to-English - Grade 2

Figure 14: Receiver-operator Characteristic Curves For English-to-English Grade 2 Models (AY 2023/24).

1.4.4 Spanish-to-Spanish - Kindergarten

K – All Students

K – English Learners

Figure 15: Receiver-operator Characteristic Curves For Spanish-to-Spanish Kindergarten Models (AY 2023/24).
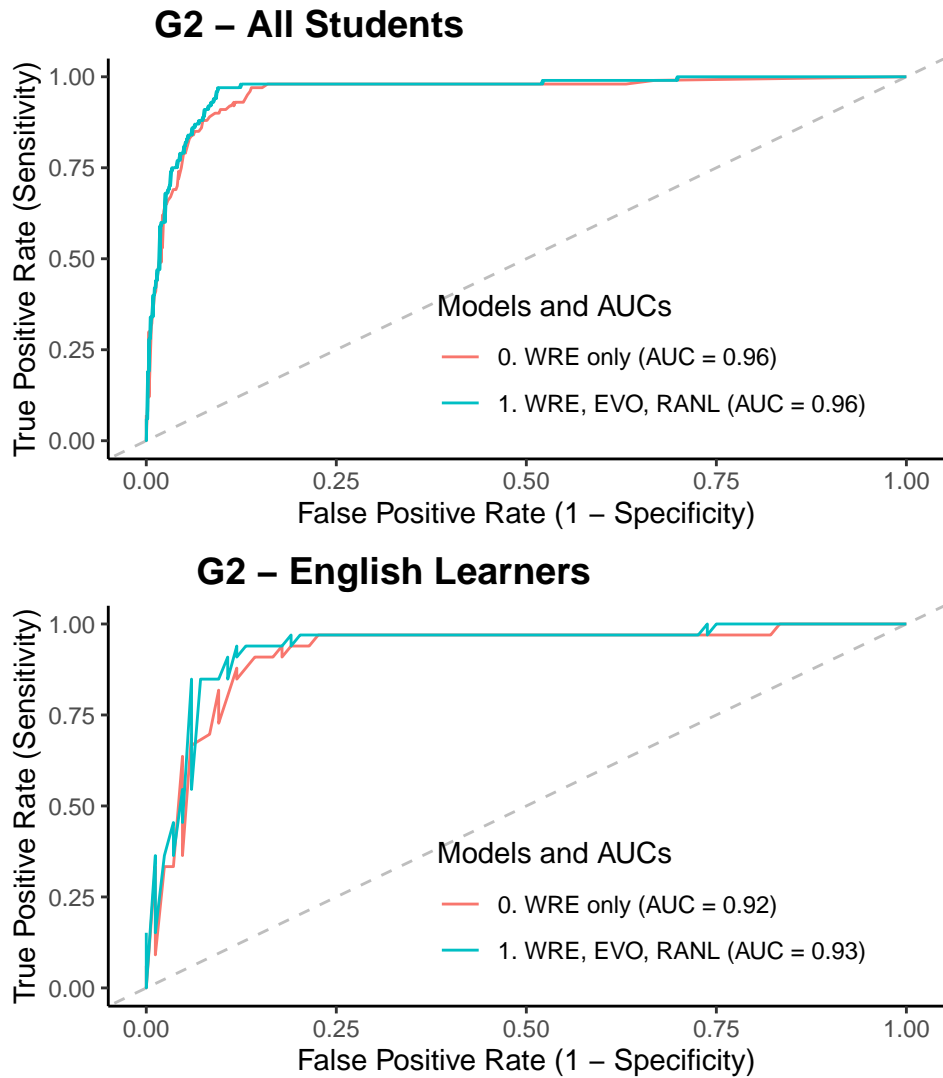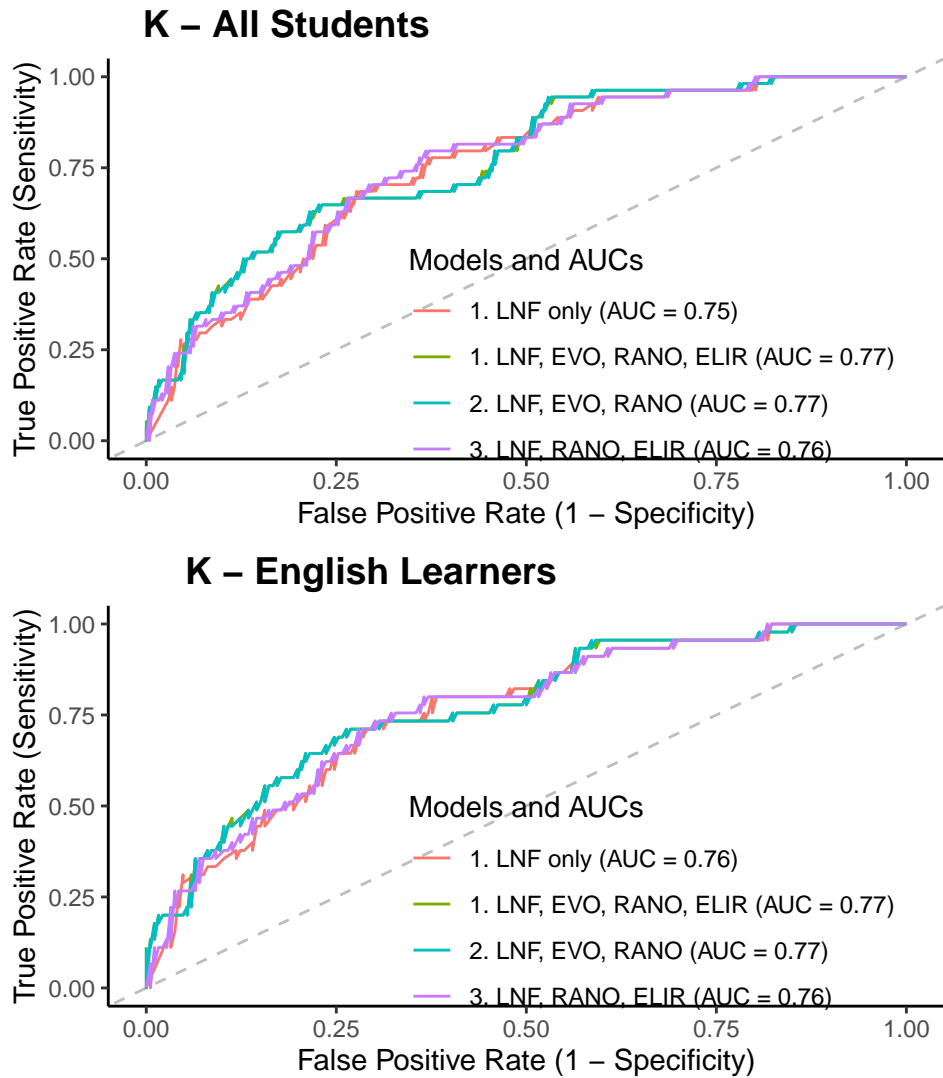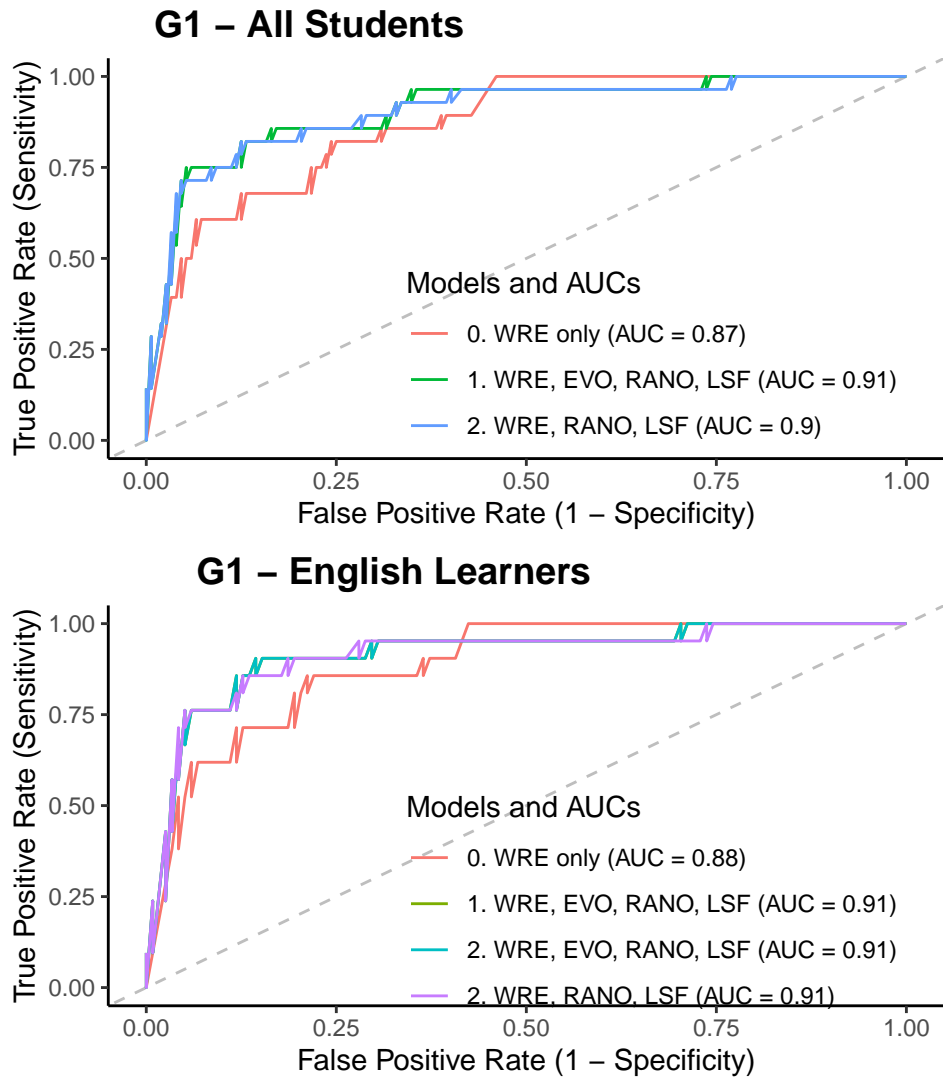
Figure 16: Receiver-operator Characteristic Curves For Spanish-to-Spanish Grade 1 Models (AY 2023/24).

1.4.6 Spanish-to-Spanish - Grade 2

G2 – All Students

G2 – English Learners
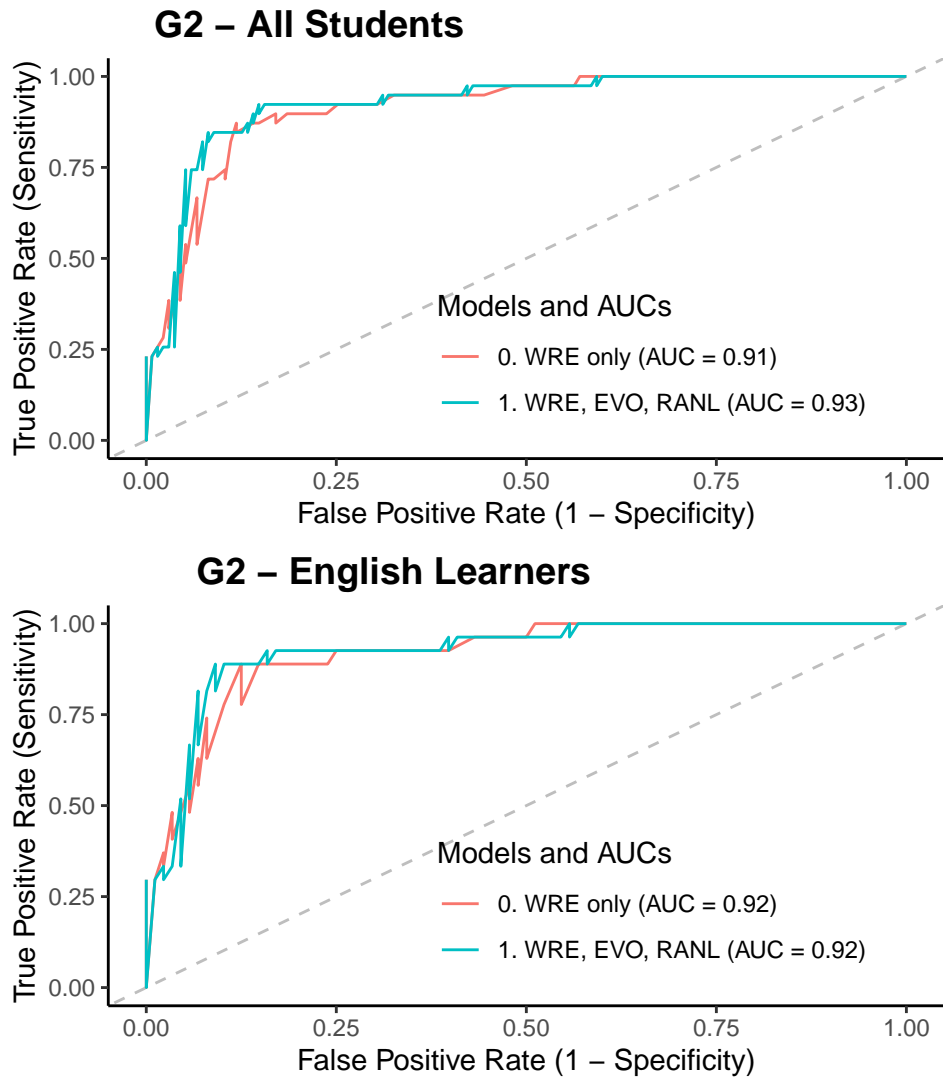
Figure 17: Receiver-operator Characteristic Curves For Spanish-to-Spanish Grade 2 Models (AY 2023/24).

Table 3: Summary of Best English and Spanish Prediction Models (AY 2023/24).

		English													Spanish			
		Sensitivity			Specificity			Accuracy			Balanced Acc.			Sens.	Spec.	Acc.	BA
Grade	Model	All	EL	EO	All	EL	EO	All	EL	EO	All	EL	EO	All	All	All	All
K	LNF only	0.7333	0.8684	0.6727	0.8311	0.7266	0.8659	0.8165	0.7822	0.7571	0.7975	0.8402	0.7693	0.6667	0.7231	0.7128	0.6949
K	LNF, RANO, ELIR	0.7905	0.8421	0.8182	0.7642	0.6475	0.7877	0.7681	0.7773	0.6893	0.7448	0.7918	0.8029	0.7778	0.6322	0.6588	0.705
K	LNF, RANO, ELIR, EVO	0.8476	0.8947	0.8727	0.6873	0.5324	0.7179	0.7112	0.7675	0.6102	0.7136	0.7385	0.7953	0.6296	0.7727	0.7466	0.7012
K	LNF, RANO, EVO	0.8	0.8947	0.7455	0.7692	0.6331	0.8101	0.7738	0.7846	0.6893	0.7639	0.8015	0.7778	0.6296	0.7727	0.7466	0.7012
G1	WRE only	0.8182	0.8182	0.8182	0.7161	0.6267	0.7254	0.7247	0.7671	0.6512	0.7224	0.7335	0.7718	0.7857	0.7566	0.7611	0.7711
G1	WRE, RANO, LSF	0.8409	0.8182	0.8485	0.8225	0.7467	0.8295	0.8241	0.8317	0.7558	0.7824	0.8311	0.839	0.7857	0.875	0.8611	0.8304
G1	WRE, RANO, LSF, EVO	0.8636	1	0.8182	0.8246	0.72	0.8382	0.8279	0.8441	0.7558	0.86	0.8364	0.8282	0.7143	0.9474	0.9111	0.8308
G2	WRE only	0.96	0.9697	0.9677	0.8635	0.7619	0.8638	0.878	0.9117	0.8205	0.8658	0.878	0.9157	0.8462	0.8815	0.8736	0.8638
G2	WRE, RANL	0.97	0.9697	0.9839	0.8812	0.7976	0.8817	0.8946	0.9256	0.8462	0.8837	0.8958	0.9328	0.8974	0.8444	0.8563	0.8709
G2	WRE, RANL, EVO	0.96	0.9697	1	0.906	0.8095	0.91	0.9142	0.933	0.8547	0.8896	0.9224	0.955	0.8974	0.8519	0.8621	0.8746

Note. green: >= .8; black: >= .7; yellow: >= .6; red otherwise

1.5 Models Evaluations - Sensitivity and Specificity

2 PART II - Analysis of 2024/25 Data

2.1 Sample

Throughout, I only included tasks taken by at least 50 students per language per grade, so as to not distort the task selection analyses.

- $N = 1390$
- 26 schools
- 12 districts

Table 4: Demographic Characteristics of the AY 24/25 Sample (N = 1,390) by Grade and Screening Language

Characteristic	English			Spanish		
	K N = 438	**G1** N = 569	**G2** N = 336	**K** N = 272	**G1** N = 305	**G2** N = 154
Gender						
Female	180 (47%)	301 (56%)	145 (45%)	98 (44%)	159 (58%)	73 (48%)
Male	202 (53%)	237 (44%)	175 (55%)	125 (56%)	115 (42%)	80 (52%)
Unknown	56	31	16	49	31	1
Race						
Asian	24 (7.7%)	47 (9.3%)	33 (10%)	8 (4.6%)	9 (3.6%)	3 (2.0%)
Black/African American	41 (13%)	65 (13%)	40 (12%)	3 (1.7%)	3 (1.2%)	1 (0.7%)
Not reported	51 (16%)	101 (20%)	41 (13%)	45 (26%)	74 (29%)	44 (30%)
Other	36 (12%)	58 (12%)	35 (11%)	22 (13%)	23 (9.1%)	8 (5.4%)
White	159 (51%)	233 (46%)	179 (55%)	95 (55%)	144 (57%)	93 (62%)
Unknown	127	65	8	99	52	5
Ethnicity						
Hispanic/Latin(o/a)	298 (81%)	433 (78%)	234 (70%)	228 (98%)	295 (98%)	147 (96%)
Not Hispanic/Latin(o/a)	71 (19%)	124 (22%)	98 (30%)	4 (1.7%)	5 (1.7%)	6 (3.9%)
Unknown	69	12	4	40	5	1
ELPD						
EL	215 (59%)	251 (49%)	124 (39%)	211 (89%)	232 (83%)	117 (77%)
EO	123 (34%)	211 (41%)	155 (49%)	0 (0%)	3 (1.1%)	6 (4.0%)
EP	19 (5.2%)	40 (7.8%)	37 (12%)	17 (7.2%)	35 (13%)	27 (18%)
TBD	8 (2.2%)	11 (2.1%)	0 (0%)	8 (3.4%)	8 (2.9%)	1 (0.7%)
Unknown	73	56	20	36	27	3
Ever IEP/504	32 (9.2%)	33 (7.1%)	30 (10.0%)	23 (10%)	12 (4.7%)	5 (3.5%)
Unknown	92	102	35	49	49	13
Home Language						
English	156 (36%)	237 (42%)	170 (51%)	0 (0%)	1 (0.3%)	2 (1.3%)
Other	11 (2.6%)	16 (2.9%)	15 (4.5%)			
Spanish	264 (61%)	306 (55%)	146 (44%)	272 (100%)	304 (100%)	152 (99%)
Unknown	7	10	5			

2.2 Descriptives

2.2.1 Distributions of English Multitudes Tasks
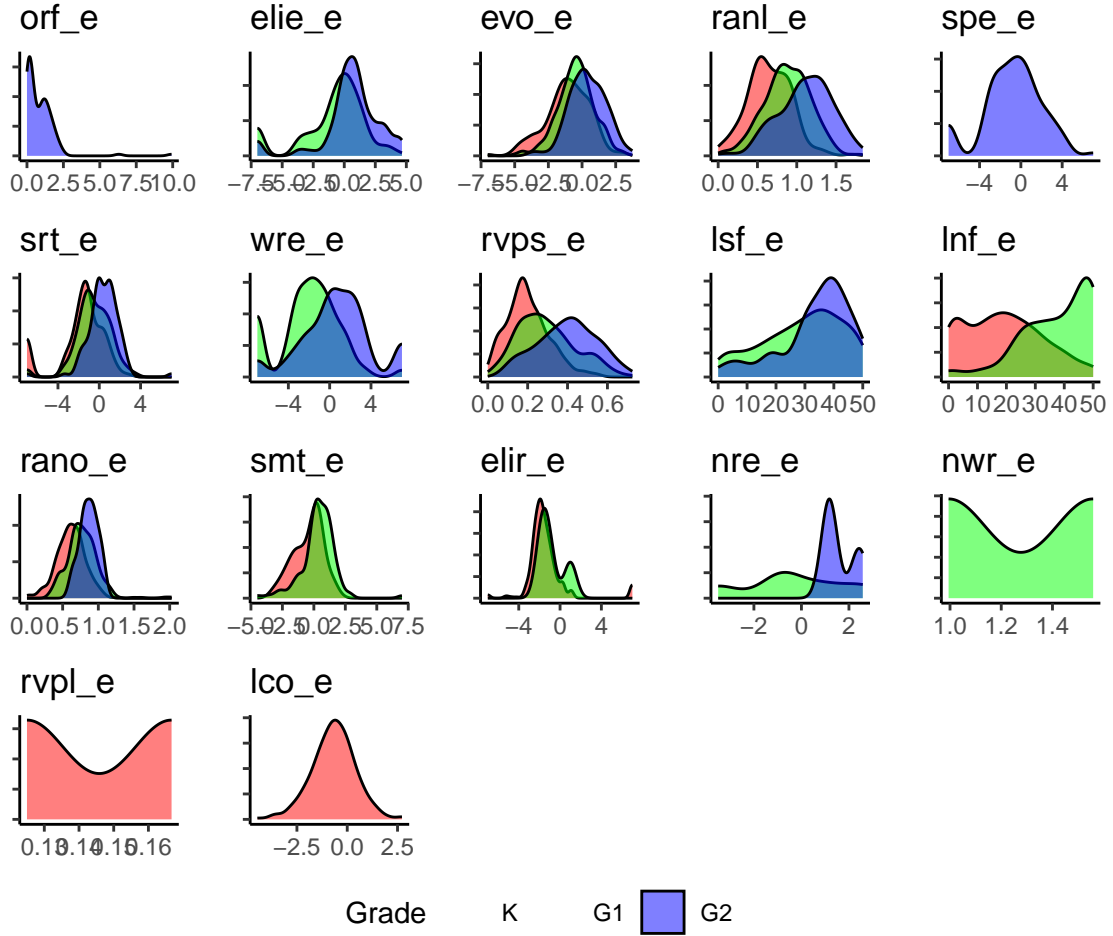
Figure 18: Distributions of English Multitudes Tasks by Grade and Language (Fall 2024).

2.2.2 Distributions of Spanish Multitudes Tasks
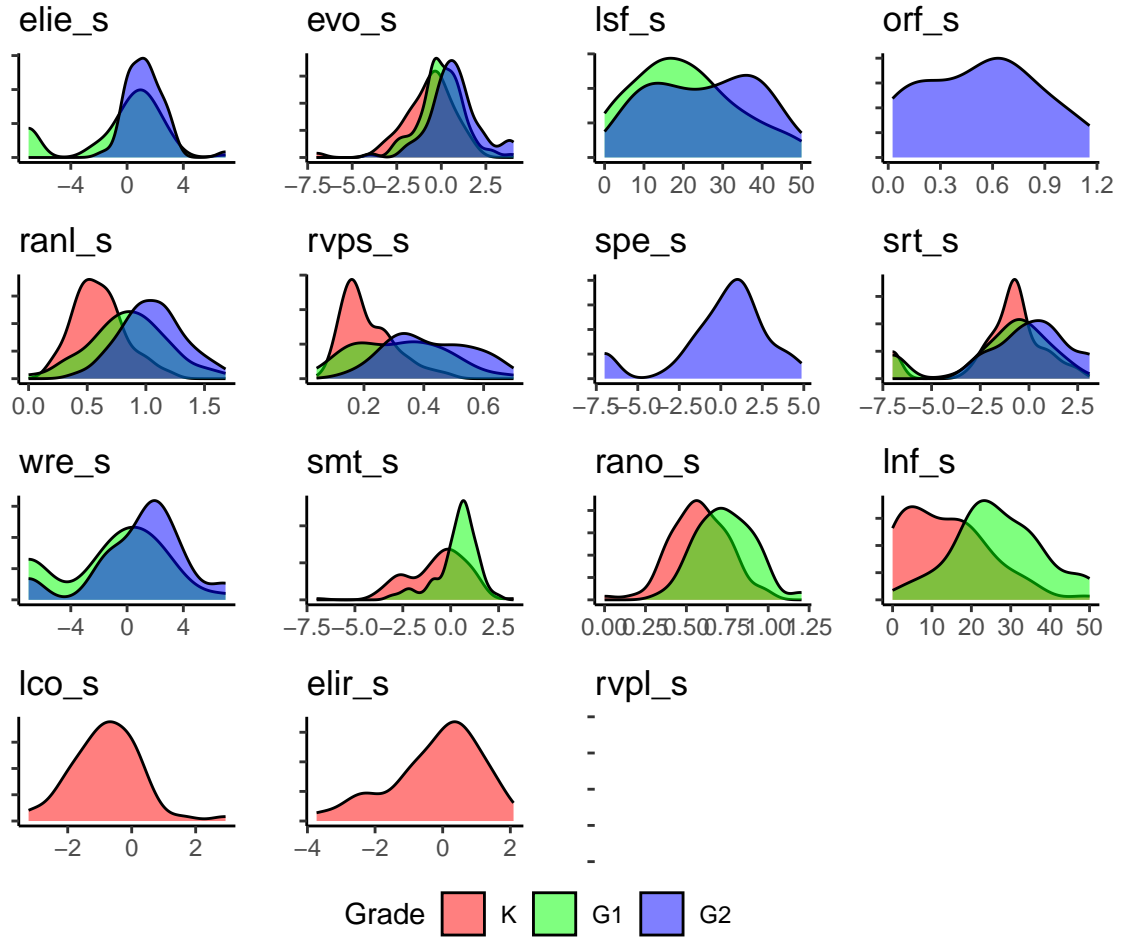
Figure 19: Distributions of Spanish Multitudes Tasks by Grade and Language (Fall 2024).

Table 5: Comparison of Proportions of Struggling Readers ($</= $ 20th Percentile) in the Study Sample Based on Overall Multitudes Sample and on Published Woodcock-Johnson/Muñoz Norms (Spring 2025).

Reference	English			Spanish		
	K N = 443	**G1** N = 561	**G2** N = 359	**K** N = 129	**G1** N = 134	**G2** N = 86
Norm-based						
Not struggling	231 (52%)	251 (45%)	211 (59%)	58 (45%)	66 (49%)	48 (56%)
Struggling	212 (48%)	310 (55%)	148 (41%)	71 (55%)	68 (51%)	38 (44%)
Sample-based						
Not struggling	336 (76%)	361 (64%)	249 (69%)	99 (77%)	88 (66%)	61 (71%)
Struggling	107 (24%)	200 (36%)	110 (31%)	30 (23%)	46 (34%)	25 (29%)

2.2.3 Distributions of Outcome Measures

Figure 20: Distribution of Woodcock-Johnson/-Muñoz Basic Reading Skills Cluster (for Kindergarten) Broad Reading Cluster (for Grades 1 and 2) by Grade and Language with Struggling Readers ($</= $ 20th Percentile) Highlighted (Spring 2025).

2.2.4 Correlations

2.2.4.1 Kindergarten - English

A

	Elision – Receptive (E)	Expressive Vocabulary (E)	Letter Naming Fluency (E)	Listening Comprehension (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Semantic Mapping (E)	Sentence Repetition (E)
WJ Basic Reading Skills	0.23	0.48	0.6	0.29	0.45	0.22	1	0.15	0.16	0.42
Sentence Repetition (E)	0.24	0.44	0.21	0.48	0.05	0.13		0.08	0.41	
Semantic Mapping (E)	0.27	0.37	0.14	0.37	0.06	0.08		0.16		
Rapid Visual Processing – Symbols (E)	0.12	0.2	0.01	0.14	0.21	0.21				
Rapid Visual Processing – Letters (E)										
Rapid Object Naming (E)	0.1	0.23	0.38	0.1	0.56					
Rapid Letter Naming (E)	0.15	0.26	0.66	0.08						
Listening Comprehension (E)	0.24	0.4	0.18							
Letter Naming Fluency (E)	0.25	0.41								
Expressive Vocabulary (E)	0.32									

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B

	Elision – Receptive (E)	Expressive Vocabulary (E)	Letter Naming Fluency (E)	Listening Comprehension (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Semantic Mapping (E)	Sentence Repetition (E)
WJ Basic Reading Skills	309	236	319	273	215	287	2	187	108	280
Sentence Repetition (E)	200	159	209	228	167	191		131	97	
Semantic Mapping (E)	106	107	107	97	78	101		76		
Rapid Visual Processing – Symbols (E)	134	103	135	128	107	136				
Rapid Visual Processing – Letters (E)				2						
Rapid Object Naming (E)	247	211	239	189	161					
Rapid Letter Naming (E)	162	135	162	173						
Listening Comprehension (E)	197	164	203							
Letter Naming Fluency (E)	259	226								
Expressive Vocabulary (E)	225									

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Figure 21: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Kindergarten; AY 2024/25).

2.2.4.2 Kindergarten - Spanish

A

	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter Naming Fluency (S)	Listening Comprehension (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Symbols (S)	Semantic Mapping (S)	Sentence Repetition (S)
WM Basic Reading Skills	0.34	0.27	0.55	0.21	0.54	0.21	0.33	0.13	0.21
Sentence Repetition (S)	0.05	0.34	0.09	0.48	0.3	0.26	0.14	0.27	
Semantic Mapping (S)	−0.09	0.24	0.01	0.3	0.03	0.12	0.18		
Rapid Visual Processing – Symbols (S)	−0.03	0.04	0.13	0.54	0.3	0.35			
Rapid Object Naming (S)	0	0.24	0.35	0.17	0.48				
Rapid Letter Naming (S)	−0.01	0.11	0.42	0.17					
Listening Comprehension (S)	0.14	0.31	0.05						
Letter Naming Fluency (S)	0.18	0.43							
Expressive Vocabulary (S)	0.13								

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B

	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter Naming Fluency (S)	Listening Comprehension (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Symbols (S)	Semantic Mapping (S)	Sentence Repetition (S)
WM Basic Reading Skills	72	111	69	59	43	79	51	119	54
Sentence Repetition (S)	53	87	54	70	26	56	39	108	
Semantic Mapping (S)	123	192	123	113	52	120	85		
Rapid Visual Processing – Symbols (S)	48	88	43	42	22	56			
Rapid Object Naming (S)	84	117	66	54	29				
Rapid Letter Naming (S)	27	47	27	29					
Listening Comprehension (S)	54	96	55						
Letter Naming Fluency (S)	76	117							
Expressive Vocabulary (S)	125								

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Figure 22: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Kindergarten; AY 2024/25).

2.2.4.3 Grade 1 - English

A

B

Figure 23: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Grade 1; AY 2024/25).

31

2.2.4.4 Grade 1 - Spanish

A

B

Figure 24: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Grade 1; AY 2024/25).

2.2.4.5 Grade 2 - English

A

	Elision – Expressive (E)	Expressive Vocabulary (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Oral Reading Fluency (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Symbols (E)	Sentence Repetition (E)	Spelling (E)	WJ Broad Reading
Word Reading (E)	0.48	0.36	0.42	0	0.44	0.52	0.06	0.33	0.39	0.78	0.81
WJ Broad Reading	0.51	0.38	0.49	0.77	0.53	0.6		0.27	0.47	0.73	
Spelling (E)	0.52	0.35	0.37	0.81	0.43	0.45	0.38	0	0.4		
Sentence Repetition (E)	0.51	0.44	0.18		0.3	0.32	0.46	0.18			
Rapid Visual Processing – Symbols (E)	0.31	–0.07	0.19		0.18	0.18	–0.29				
Rapid Object Naming (E)		0.17	0.13			0.56					
Rapid Letter Naming (E)	0.35	0.2	0.49	0.68	0.4						
Oral Reading Fluency (E)	0.35	0.07	0.39								
Nonword Reading (E)		0.95									
Letter–sound Fluency (E)	0.38	0.25									
Expressive Vocabulary (E)	0.4										

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	Elision – Expressive (E)	Expressive Vocabulary (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Oral Reading Fluency (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Symbols (E)	Sentence Repetition (E)	Spelling (E)	WJ Broad Reading
Word Reading (E)	159	221	67	3	98	234	25	69	178	225	257
WJ Broad Reading	184	220	69	3	138	241	25	90	219	236	
Spelling (E)	147	210	57	3	96	221	15	58	160		
Sentence Repetition (E)	182	144	39		114	163	24	89			
Rapid Visual Processing – Symbols (E)	70	55	25		25	65	20				
Rapid Object Naming (E)	22	23	24			21					
Rapid Letter Naming (E)	151	219	64	3	99						
Oral Reading Fluency (E)	107	93	13								
Nonword Reading (E)		3									
Letter–sound Fluency (E)	38	66									
Expressive Vocabulary (E)	142										

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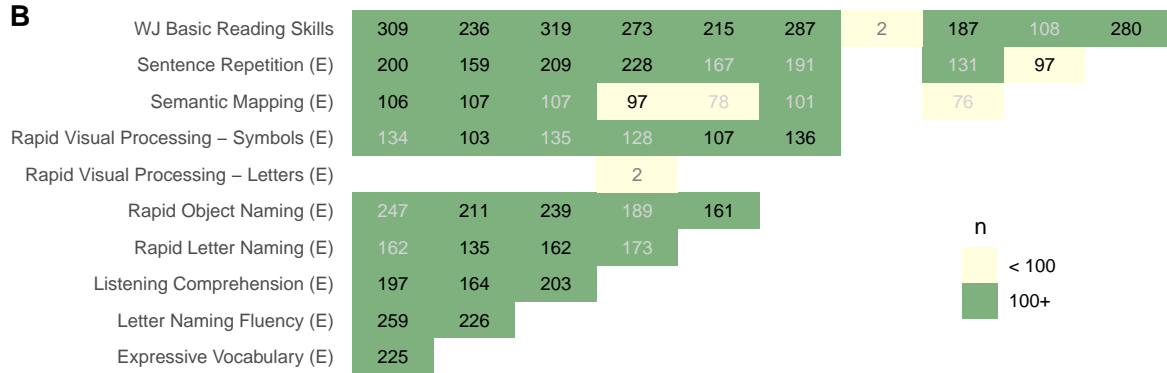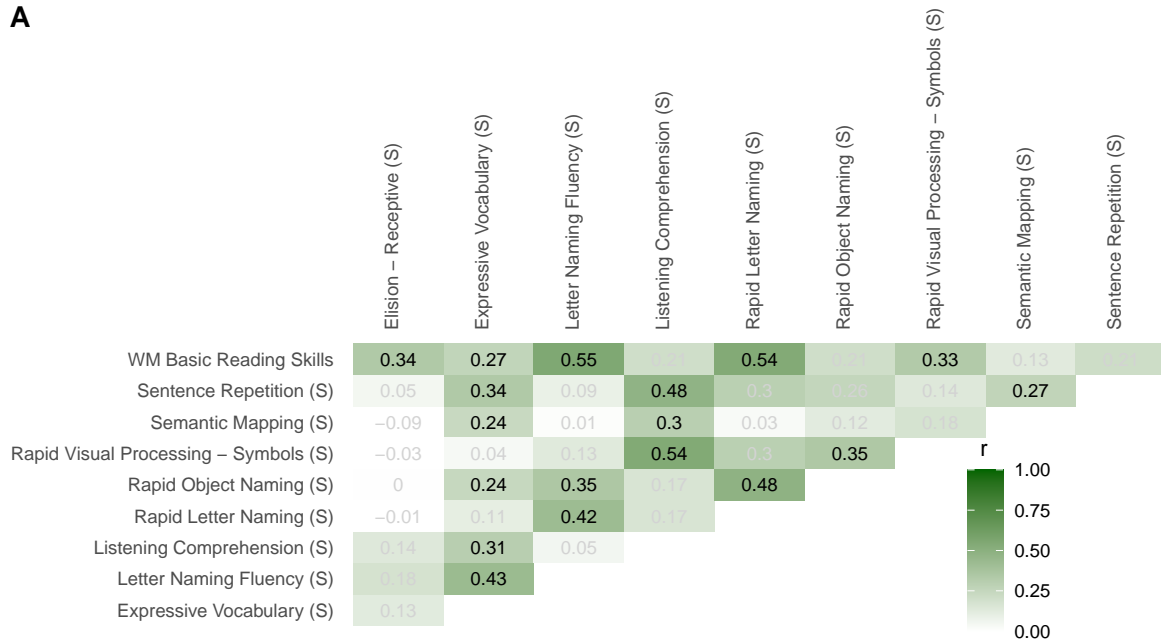
Figure 25: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Grade 2; AY 2024/25).
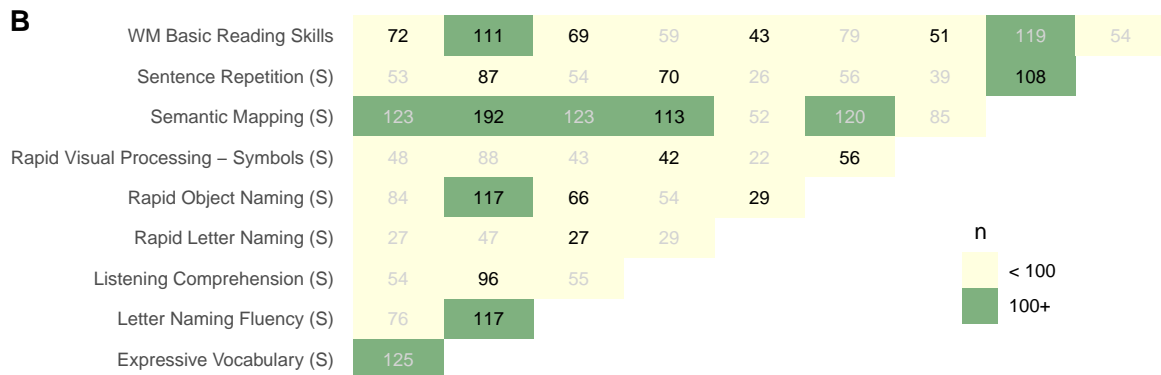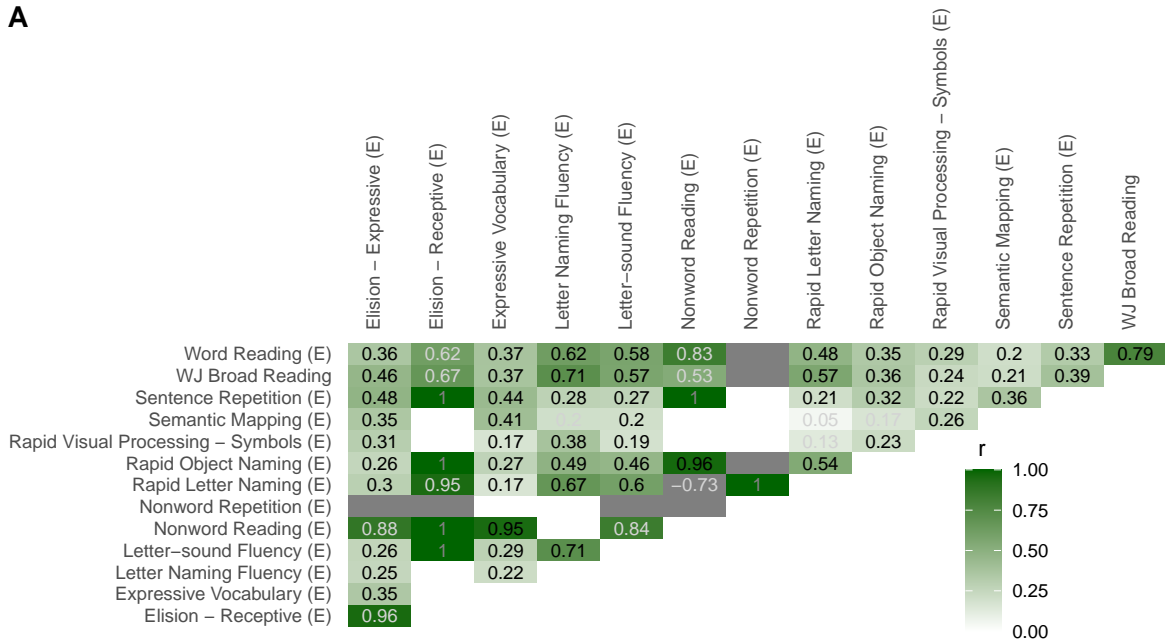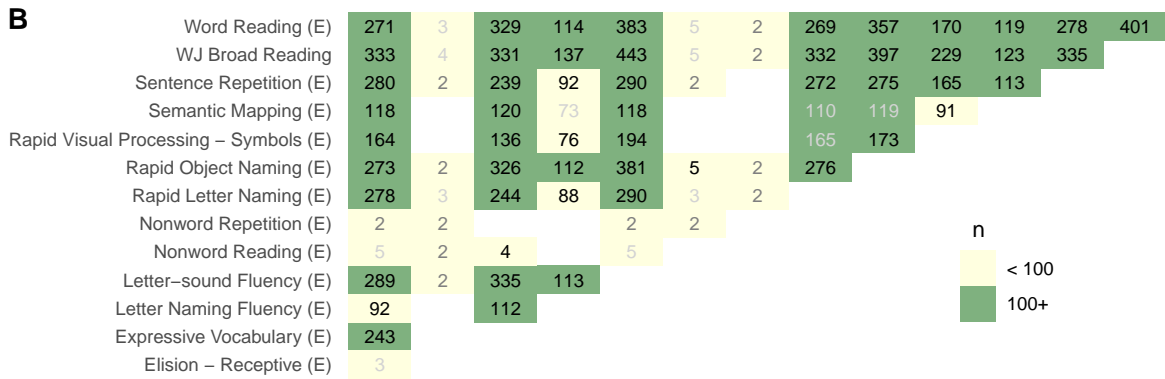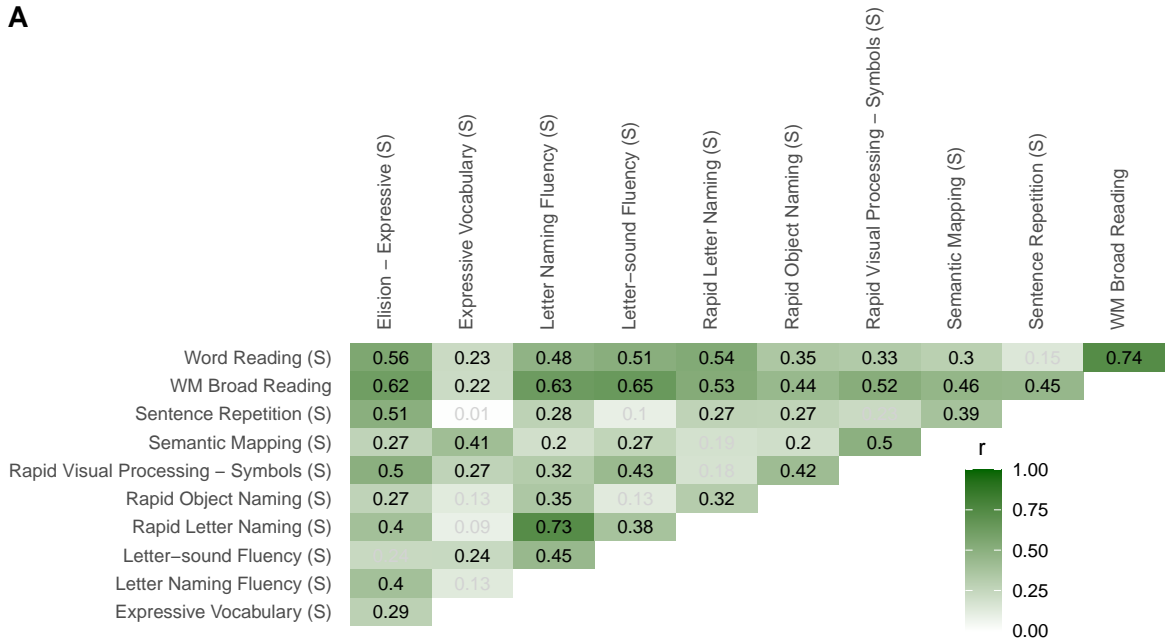
2.2.4.6 Grade 2 - Spanish

A

	Elision – Expressive (S)	Expressive Vocabulary (S)	Letter–sound Fluency (S)	Oral Reading Fluency (S)	Rapid Letter Naming (S)	Rapid Visual Processing – Symbols (S)	Sentence Repetition (S)	Spelling (S)	WM Broad Reading
Word Reading (S)	0.43	0.15	0.45	0.11	0.51	0.02	0.2	0.61	0.75
WM Broad Reading	0.08	0.12	0.46	0.82	0.67	0.17	0.37	0.71	
Spelling (S)	0.3	0.19	0.47	0.2	0.28	0.05	0.53		
Sentence Repetition (S)	0.15	0.72	0.07	−0.54	0.45	0.73			
Rapid Visual Processing – Symbols (S)	0.69	0.18	0.14	−0.38	0.68				
Rapid Letter Naming (S)	0.13	0.15	0.1	−0.29					
Oral Reading Fluency (S)	0.1	−0.71	0.81						
Letter–sound Fluency (S)	0.21	0.04							
Expressive Vocabulary (S)	0.12								

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- 0.00

B

	Elision – Expressive (S)	Expressive Vocabulary (S)	Letter–sound Fluency (S)	Oral Reading Fluency (S)	Rapid Letter Naming (S)	Rapid Visual Processing – Symbols (S)	Sentence Repetition (S)	Spelling (S)	WM Broad Reading
Word Reading (S)	28	58	22	14	47	21	8	44	42
WM Broad Reading	43	75	25	18	48	43	6	49	
Spelling (S)	36	67	26	18	53	29	8		
Sentence Repetition (S)	11	9	6	11	8	4			
Rapid Visual Processing – Symbols (S)	24	43	13	15	28				
Rapid Letter Naming (S)	33	67	26	16					
Oral Reading Fluency (S)	19	22	6						
Letter–sound Fluency (S)	21	34							
Expressive Vocabulary (S)	49								

n
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Figure 26: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Grade 2; AY 2024/25).

2.3 Task Selection

2.3.1 English-to-English (English to English)

Figure 27: Mean Task Importance Obtained From Boruta Algorithm for English-to-English Predictions, with Results Disaggregated by English Proficiency Designation (AY 2024/25).

2.3.2 Spanish-to-Spanish (Spanish to Spanish)
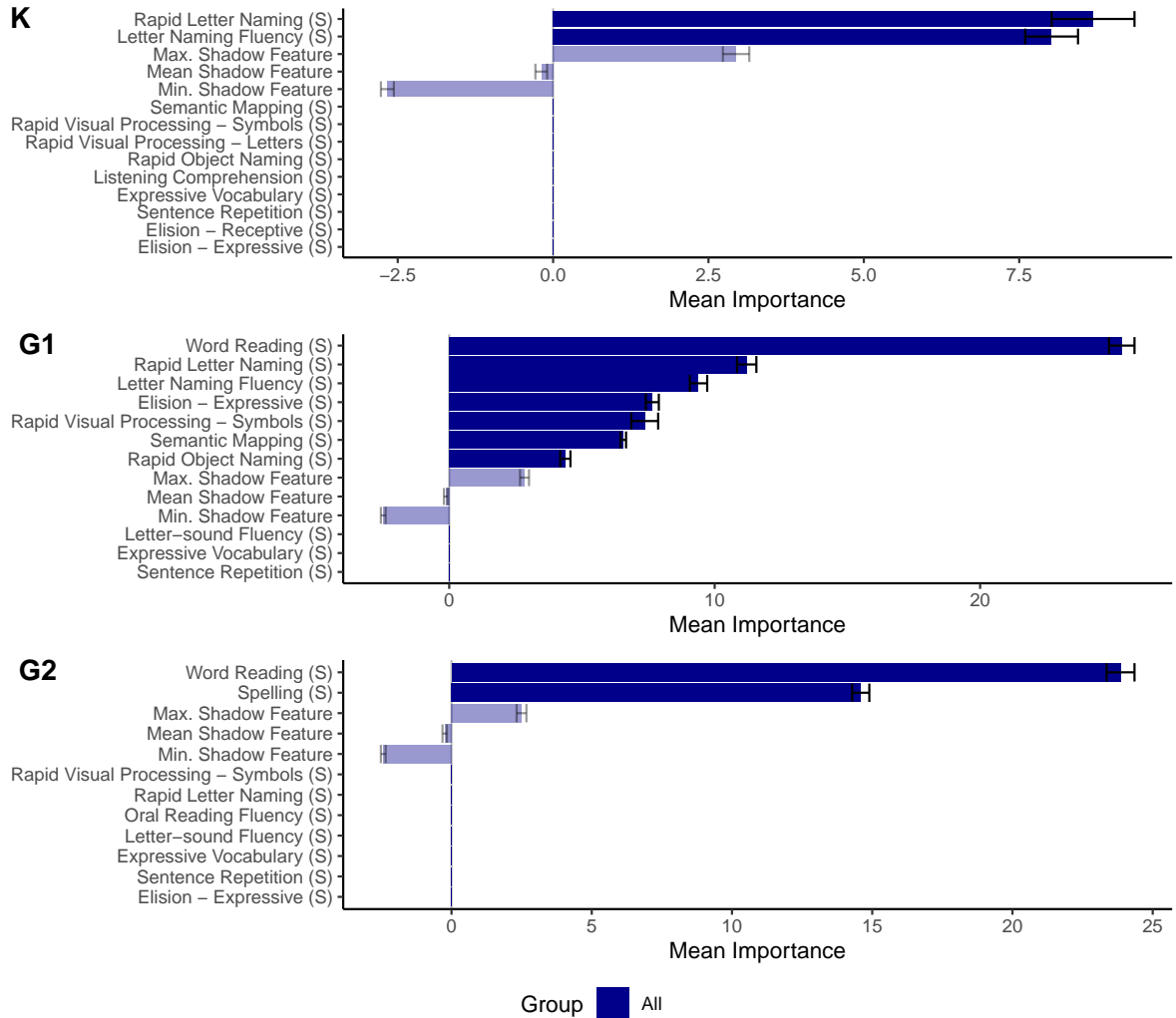
Figure 28: Mean Task Importance Obtained From Boruta Algorithm for Spanish-to-Spanish Predictions (AY 2024/25).

2.4 Models Evaluations - ROC Curves

2.4.1 English-to-English - Kindergarten

K – All Students

K – English Learners
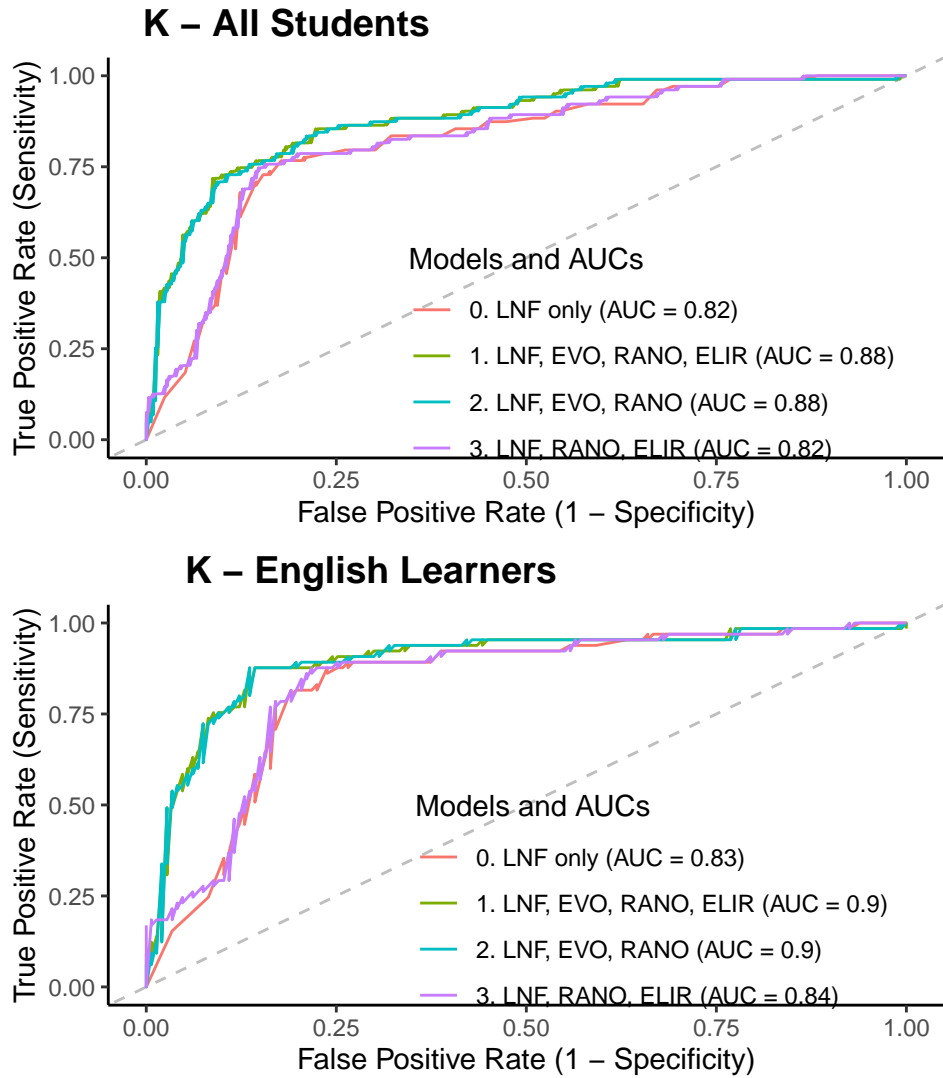
Figure 29: Receiver-operator Characteristic Curves For English-to-English Kindergarten Models (AY 2024/25).

2.4.2 English-to-English - Grade 1
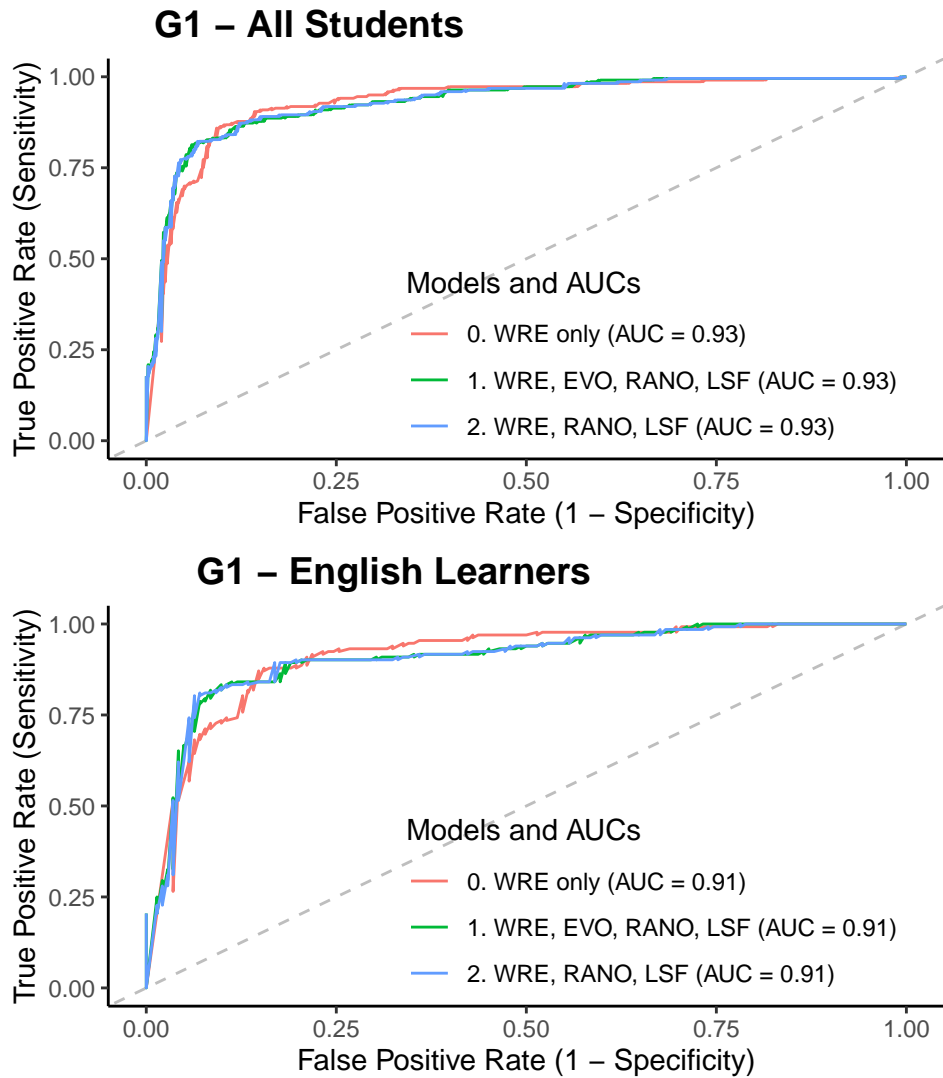
Figure 30: Receiver-operator Characteristic Curves For English-to-English Grade 1 Models (AY 2024/25).

2.4.3 English-to-English - Grade 2

G2 – All Students

G2 – English Learners
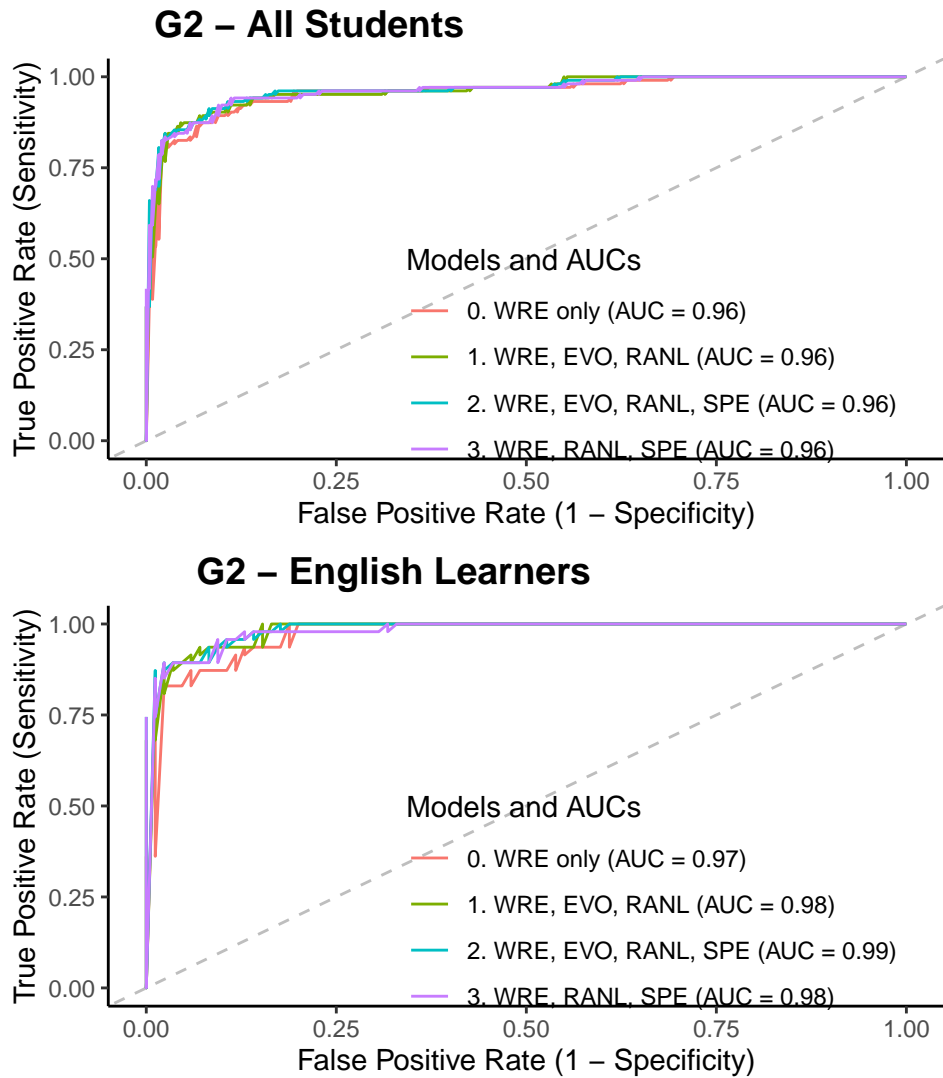
Figure 31: Receiver-operator Characteristic Curves For English-to-English Grade 2 Models (AY 2024/25).

2.4.4 Spanish-to-Spanish - Kindergarten
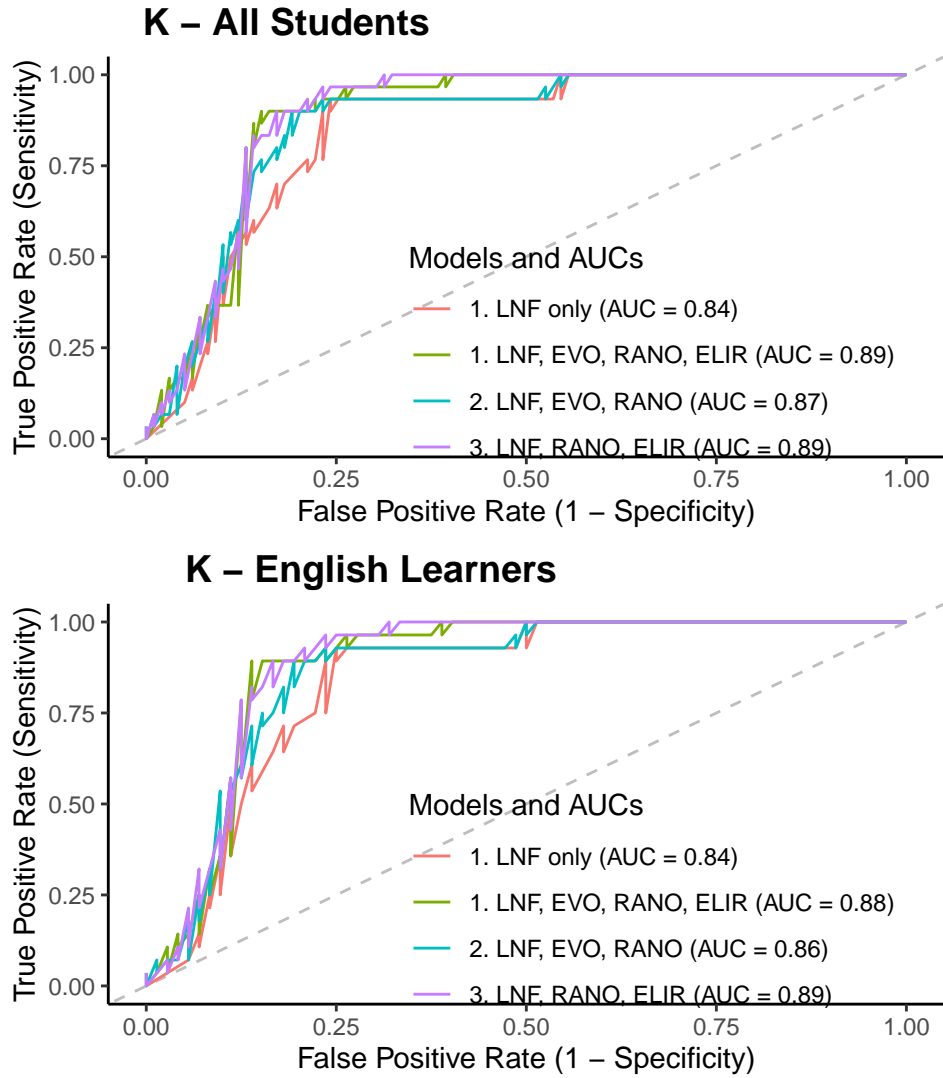
Figure 32: Receiver-operator Characteristic Curves For Spanish-to-Spanish Kindergarten Models (AY 2024/25).

2.4.5 Spanish-to-Spanish - Grade 1
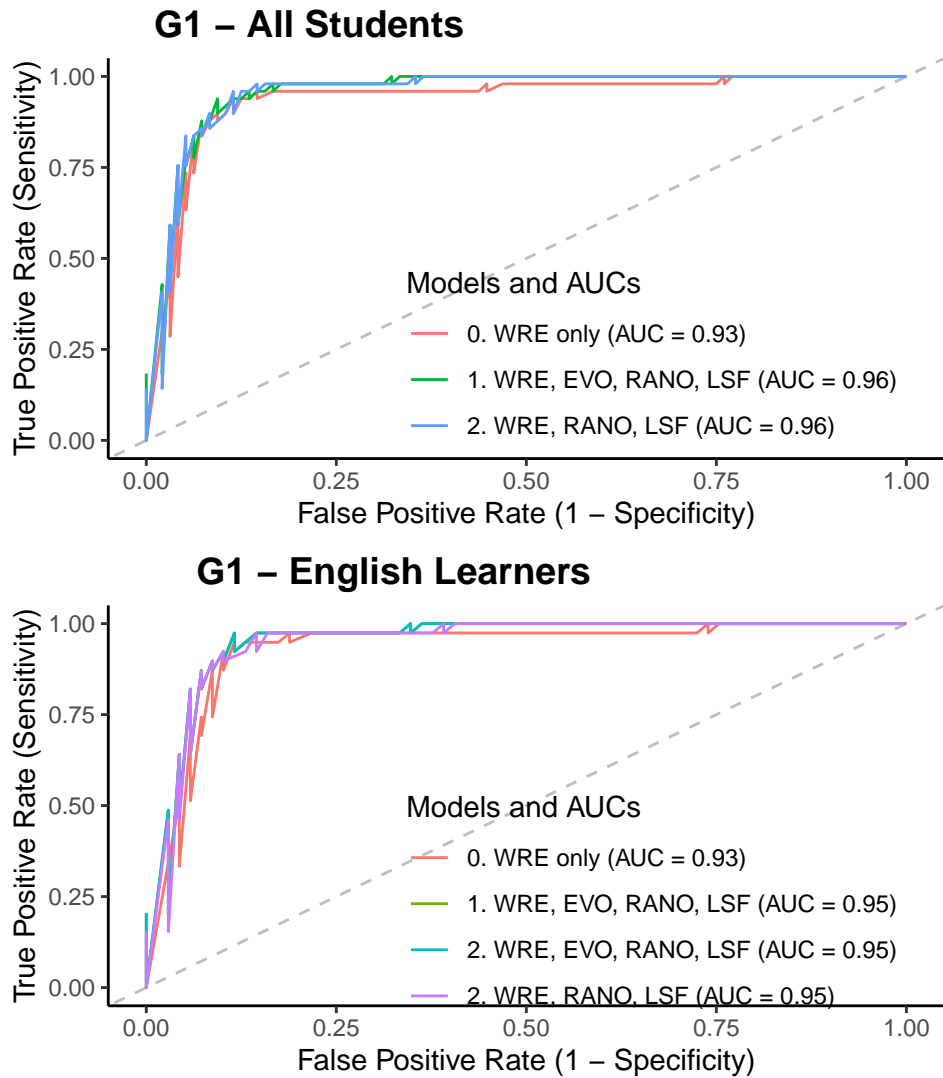
Figure 33: Receiver-operator Characteristic Curves For Spanish-to-Spanish Grade 1 Models (AY 2024/25).

2.4.6 Spanish-to-Spanish - Grade 2

No data collected.

Table 6: Summary of Best English and Spanish Prediction Models (AY 2024/25).

		English												Spanish			
		Sensitivity			Specificity			Accuracy			Balanced Acc.			Sens.	Spec.	Acc.	BA
Grade	Model	All	EL	EO	All	EL	EO	All	EL	EO	All	EL	EO	All	All	All	All
K	LNF only	0.7573	0.8615	0.48	0.8223	0.7619	0.9082	0.8069	0.7898	0.7925	0.8117	0.8211	0.6941	0.9	0.7576	0.7907	0.8288
K	LNF, RANO, ELIR	0.7476	0.8615	0.44	0.8434	0.7823	0.9286	0.8207	0.7955	0.8066	0.8219	0.8293	0.6843	0.9333	0.7677	0.8062	0.8505
K	LNF, RANO, ELIR, EVO	0.8447	0.9077	0.68	0.7771	0.7075	0.898	0.7931	0.8109	0.7689	0.8076	0.8537	0.789	0.8667	0.8485	0.8527	0.8576
K	LNF, RANO, EVO	0.8252	0.9077	0.6	0.7892	0.7143	0.9184	0.7977	0.8072	0.7736	0.811	0.8537	0.7592	0.8667	0.8081	0.8217	0.8374
G1	WRE only	0.8545	0.8712	0.807	0.9075	0.8521	0.9217	0.8887	0.881	0.8613	0.8617	0.8924	0.8644	0.9184	0.8854	0.8966	0.9019
G1	WRE, RANO, LSF	0.8182	0.8333	0.7368	0.9325	0.8873	0.9518	0.8919	0.8753	0.8613	0.8603	0.8969	0.8443	0.9388	0.8854	0.9034	0.9121
G1	WRE, RANO, LSF, EVO	0.8091	0.8333	0.7368	0.94	0.8944	0.9639	0.8935	0.8745	0.865	0.8638	0.9058	0.8503	0.898	0.9062	0.9034	0.9021
G2	WRE only	0.8641	0.8723	0.8776	0.9298	0.9412	0.9151	0.9101	0.8969	0.9167	0.9068	0.9032	0.8963	NA	NA	NA	NA
G2	WRE, RANL	0.8641	0.9149	0.8367	0.9587	0.9529	0.9434	0.9304	0.9114	0.9394	0.9339	0.9097	0.8901	NA	NA	NA	NA
G2	WRE, RANL, EVO	0.8641	0.8936	0.8367	0.9545	0.9647	0.9245	0.9275	0.9093	0.9394	0.9292	0.8968	0.8806	NA	NA	NA	NA

Note. green: >= .8; black: >= .7; yellow: >= .6; red otherwise

2.5 Models Evaluations - Sensitivity and Specificity

3 PART III - Combined Analysis of 2023/24 and 2024/25 Data

3.1 Sample

Throughout, I only included tasks taken by at least 50 students per language per grade, so as to not distort the task selection analyses.

- 4091 observations from 3533 unique students (as some took part in the study in both years)
- 42 schools
- 20 districts

Table 7: Demographic Characteristics of the Combined AY 23/24 and 24/25 Sample (N = 3,533) by Grade and Screening Language

Characteristic[1]	English			Spanish		
	K N = 1,161[1]	**G1** N = 1,114[1]	**G2** N = 1,040[1]	**K** N = 625[1]	**G1** N = 538[1]	**G2** N = 408[1]
Gender						
Female	553 (50%)	558 (52%)	501 (49%)	290 (50%)	279 (55%)	214 (53%)
Male	552 (50%)	525 (48%)	521 (51%)	286 (50%)	228 (45%)	193 (47%)
Unknown	56	31	18	49	31	1
Race						
Asian	110 (11%)	114 (11%)	98 (9.6%)	20 (4.2%)	12 (2.5%)	8 (2.0%)
Black/African American	133 (14%)	119 (11%)	138 (13%)	5 (1.1%)	3 (0.6%)	3 (0.8%)
Not reported	208 (21%)	211 (20%)	183 (18%)	252 (53%)	228 (48%)	193 (48%)
Other	130 (13%)	132 (13%)	120 (12%)	28 (5.9%)	30 (6.3%)	14 (3.5%)
White	404 (41%)	470 (45%)	486 (47%)	170 (36%)	206 (43%)	181 (45%)
Unknown	176	68	15	150	59	9
Ethnicity						
Hispanic/Latin(o/a)	711 (66%)	713 (65%)	617 (60%)	557 (96%)	515 (97%)	384 (94%)
Not Hispanic/Latin(o/a)	370 (34%)	387 (35%)	414 (40%)	26 (4.5%)	18 (3.4%)	23 (5.7%)
Unknown	80	14	9	42	5	1
ELPD						
EL	397 (38%)	345 (33%)	246 (25%)	477 (81%)	410 (81%)	290 (73%)
EO	539 (52%)	603 (57%)	629 (65%)	24 (4.1%)	22 (4.3%)	35 (8.8%)
EP	70 (6.8%)	91 (8.7%)	98 (10%)	59 (10%)	68 (13%)	72 (18%)
TBD	28 (2.7%)	12 (1.1%)	1 (0.1%)	26 (4.4%)	8 (1.6%)	3 (0.8%)
Unknown	127	63	66	39	30	8
Ever IEP/504	84 (8.8%)	76 (8.1%)	87 (11%)	53 (9.6%)	33 (7.0%)	25 (7.5%)
Unknown	209	171	239	75	66	73
Home Language						
English	652 (57%)	647 (59%)	642 (65%)	42 (6.8%)	25 (4.7%)	36 (9.0%)
Other	75 (6.6%)	67 (6.1%)	78 (7.9%)	5 (0.8%)	2 (0.4%)	4 (1.0%)
Spanish	418 (37%)	387 (35%)	268 (27%)	570 (92%)	509 (95%)	361 (90%)
Unknown	16	13	52	8	2	7

[1]Test

3.2 Descriptives

3.2.1 Distributions of English Multitudes Tasks
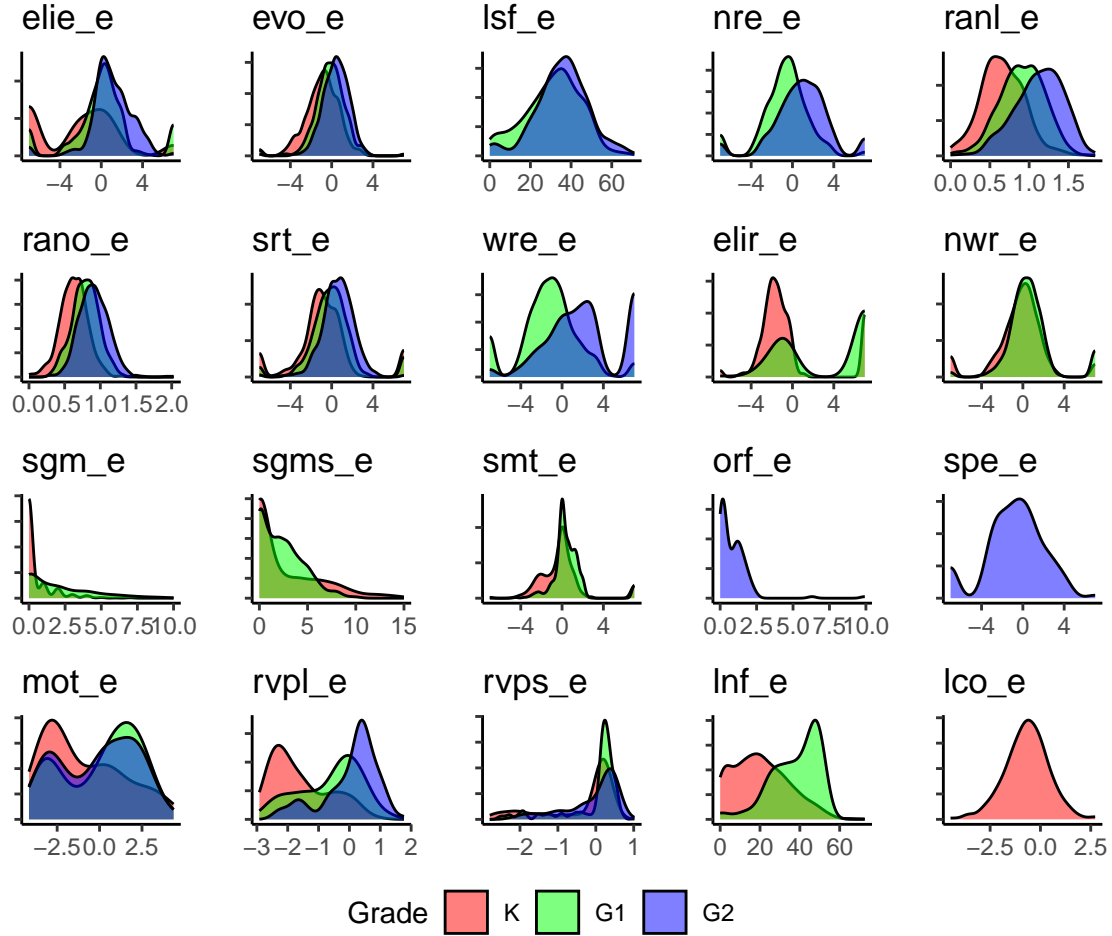
Figure 34: Distributions of English Multitudes Tasks by Grade (Fall 2023 and 2024 Combined).

3.2.2 Distributions of Spanish Multitudes Tasks
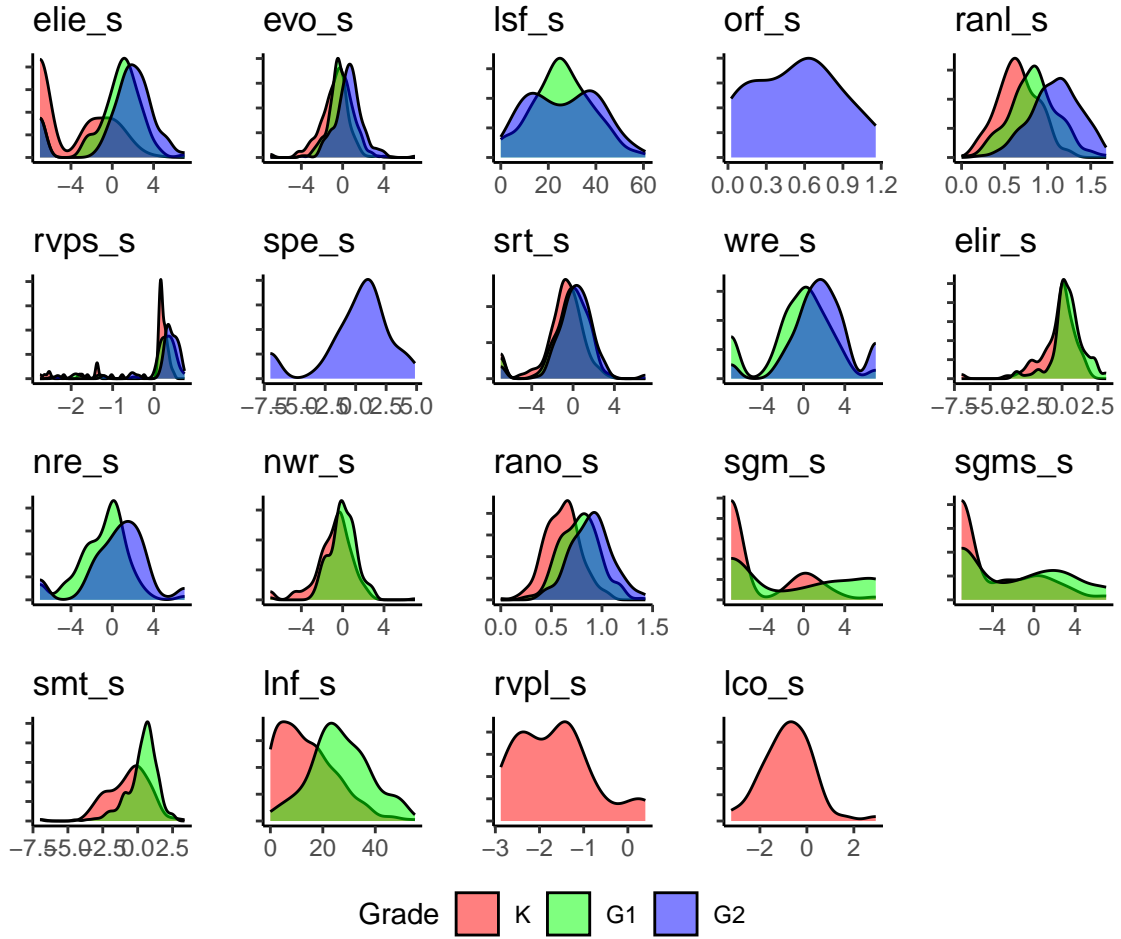
Figure 35: Distributions of Spanish Multitudes Tasks by Grade (Fall 2023 and 2025 Combined).

Table 8: Comparison of Proportions of Struggling Readers ($</=$ 20th Percentile) in the Study Sample Based on Overall Multitudes Sample and on Published Woodcock-Johnson/Muñoz Norms (Spring 2024 and 2025 Combined).

	English			Spanish		
Reference	**K** N = 1,196	**G1** N = 1,150	**G2** N = 1,139	**K** N = 504	**G1** N = 358	**G2** N = 297
Norm-based						
Not struggling	701 (59%)	666 (58%)	752 (66%)	227 (45%)	211 (59%)	154 (52%)
Struggling	495 (41%)	484 (42%)	387 (34%)	277 (55%)	147 (41%)	143 (48%)
Sample-based						
Not struggling	955 (80%)	900 (78%)	884 (78%)	399 (79%)	279 (78%)	223 (75%)
Struggling	241 (20%)	250 (22%)	255 (22%)	105 (21%)	79 (22%)	74 (25%)

3.2.3 Distributions of Outcome Measures
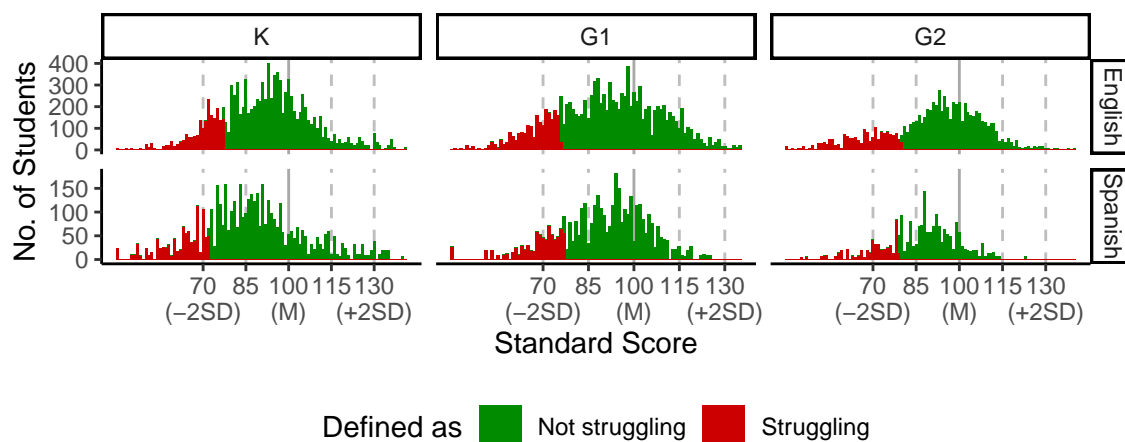
Figure 36: Distribution of Woodcock-Johnson/-Muñoz Basic Reading Skills Cluster (for Kindergarten) Broad Reading Cluster (for Grades 1 and 2) by Grade and Language with Struggling Readers ($</=$ 20th Percentile) Highlighted (Spring 2024 and 2025 Combined)

3.2.4 Correlations

3.2.4.1 Kindergarten - English

A

	Elision – Expressive (E)	Elision – Receptive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter Naming Fluency (E)	Listening Comprehension (E)	Nonword Repetition (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Segmentation – Syllables (E)	Segmentation – Words (E)	Semantic Mapping (E)	Sentence Repetition (E)
WJ Basic Reading Skills	0.45	0.29	0.38	0.11	0.59	0.29	0.26	0.47	0.29	0.11	0.03	0.24	0.37	0.24	0.34
Sentence Repetition (E)	0.39	0.27	0.47	−0.01	0.3	0.48	0.46	0.15	0.21	−0.04	−0.22	0.29	0.31	0.24	
Semantic Mapping (E)	0.35	0.24	0.28	−0.44	0.18	0.37	0.23	0.16	0.12	−0.23	−0.21	0.27	0.27		
Segmentation – Words (E)	0.42	0.26	0.29	−0.14	0.38		0.23	0.38	0.25	0.02		0.27			
Segmentation – Syllables (E)	0.39	0.26	0.3	−0.15	0.25		0.2	0.18	0.23	0.19	0.12				
Rapid Visual Processing – Symbols (E)	0.27	0.07	0.09	0.03	0.17	0.14	0	0.15	0.14	0.42					
Rapid Visual Processing – Letters (E)	0.41	0.16	0.18	−0.01	0.16		0.02	−0.16	0.04						
Rapid Object Naming (E)	0.36	0.16	0.23	−0.19	0.49	0.1	0.18	0.6							
Rapid Letter Naming (E)	0.37	0.18	0.23	−0.24	0.76	0.08	0.27								
Nonword Repetition (E)	0.33	0.16	0.31	0.05	0.35										
Listening Comprehension (E)		0.24	0.4		0.18										
Letter Naming Fluency (E)	0.48	0.25	0.38	−0.2											
Global Motion Processing (E)	0	−0.09	−0.09												
Expressive Vocabulary (E)	0.39	0.26													
Elision – Receptive (E)	0.39														

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B

	Elision – Expressive (E)	Elision – Receptive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter Naming Fluency (E)	Listening Comprehension (E)	Nonword Repetition (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Segmentation – Syllables (E)	Segmentation – Words (E)	Semantic Mapping (E)	Sentence Repetition (E)
WJ Basic Reading Skills	630	942	875	64	708	273	626	512	676	105	268	622	619	514	918
Sentence Repetition (E)	670	873	837	57	598	228	666	465	580	96	206	662	659	540	
Semantic Mapping (E)	443	549	550	20	315	97	443	243	308	31	99	443	443		
Segmentation – Words (E)	659	659	659	57	385		659	296	382	95	75	659			
Segmentation – Syllables (E)	662	662	662	57	385		662	296	383	95	75				
Rapid Visual Processing – Symbols (E)	75	209	178	70	187	128	75	140	186	109					
Rapid Visual Processing – Letters (E)	95	96	95	82	66	2	95	42	63						
Rapid Object Naming (E)	386	634	600	38	609	189	385	452							
Rapid Letter Naming (E)	297	459	433	24	458	173	297								
Nonword Repetition (E)	666	666	666	57	386										
Listening Comprehension (E)		197	164		203										
Letter Naming Fluency (E)	387	648	615	40											
Global Motion Processing (E)	57	57	57												
Expressive Vocabulary (E)	670	898													
Elision – Receptive (E)	670														

n: < 100 / 100+

Figure 37: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Kindergarten; AYs 2023/24 and 2024/25 Combined).

3.2.4.2 Kindergarten - Spanish

A

Panel A — Correlations (r):

	Elision – Expressive (S)	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter Naming Fluency (S)	Listening Comprehension (S)	Nonword Repetition (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Letters (S)	Rapid Visual Processing – Symbols (S)	Segmentation – Syllables (S)	Segmentation – Words (S)	Semantic Mapping (S)	Sentence Repetition (S)
WM Basic Reading Skills	0.28	0.21	0.29	0.59		0.29	0.46	0.21	−0.03		0.17	0.26	0.2	0.21
Sentence Repetition (S)	0.26	0.1	0.36	0.22	0.48	0.45	0.16	0.27	0.28	−0.03	0.16	0.15	0.31	
Semantic Mapping (S)	0.27	0.15	0.32	0.19	0.3	0.23	0.17	0.14	0.13	−0.04	0.21	0.19		
Segmentation – Words (S)	0.35	0.08	0.19	0.16		0.11		0.1	0.09		0.73			
Segmentation – Syllables (S)	0.26	0.12	0.19	0.09		0.14		0.13	0.11	0.04				
Rapid Visual Processing – Symbols (S)	0.3	0.2	−0.03	−0.01	0.54	0.17		0.06	−0.1	0.36				
Rapid Visual Processing – Letters (S)	0.05		−0.31	−0.08		0.28		−0.07	0.14					
Rapid Object Naming (S)	0.28	0.02	0.16	0.41	0.17		0.25	0.54						
Rapid Letter Naming (S)	0.32	0.04	0.08	0.7	0.17	0.14								
Nonword Repetition (S)	0.37	0.28	0.39	0.29										
Listening Comprehension (S)		0.14	0.31	0.05										
Letter Naming Fluency (S)	0.39	0.15	0.34											
Expressive Vocabulary (S)	0.27	0.08												
Elision – Receptive (S)	0.12													

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0.50
0.25
0.00

B

Panel B — Sample sizes (n):

	Elision – Expressive (S)	Elision – Receptive (S)	Expressive Vocabulary (S)	Letter Naming Fluency (S)	Listening Comprehension (S)	Nonword Repetition (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Letters (S)	Rapid Visual Processing – Symbols (S)	Segmentation – Syllables (S)	Segmentation – Words (S)	Semantic Mapping (S)	Sentence Repetition (S)
WM Basic Reading Skills	270	345	392	294	59	271	157	290	21	67	269	266	388	303
Sentence Repetition (S)	296	359	396	294	70	298	136	278	24	59	297	293	403	
Semantic Mapping (S)	322	447	516	377	113	326	174	355	26	105	324	323		
Segmentation – Words (S)	319	321	322	251		323	120	232	25	20	321			
Segmentation – Syllables (S)	322	325	326	254		326	121	235	24	19				
Rapid Visual Processing – Symbols (S)	21	69	110	62	42	20	31	74	23					
Rapid Visual Processing – Letters (S)	25	27	28	24		25	12	23						
Rapid Object Naming (S)	234	324	366	304	54	237	150							
Rapid Letter Naming (S)	119	150	171	151	29	122								
Nonword Repetition (S)	324	327	328	256										
Listening Comprehension (S)		54	96	55										
Letter Naming Fluency (S)	253	335	387											
Expressive Vocabulary (S)	326	460												
Elision – Receptive (S)	324													

n
< 100
100+

Figure 38: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Kindergarten; AYs 2023/24 and 2024/25 Combined).

3.2.4.3 Grade 1 - English

A

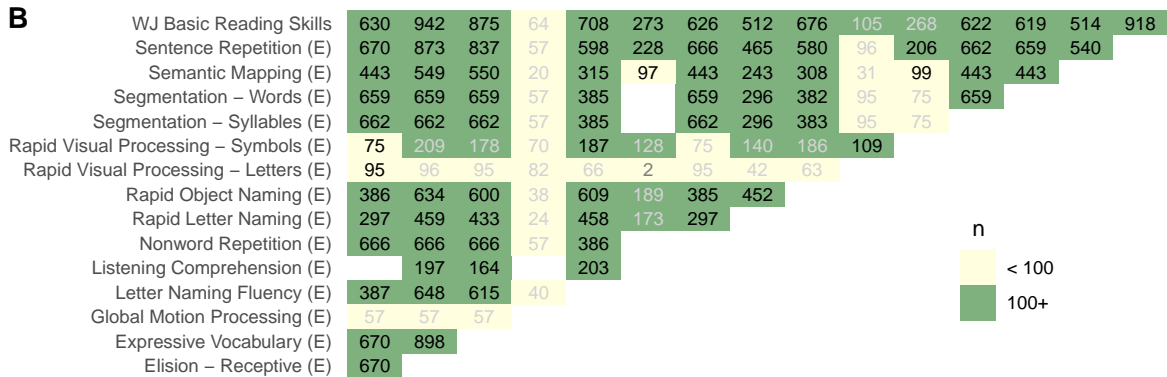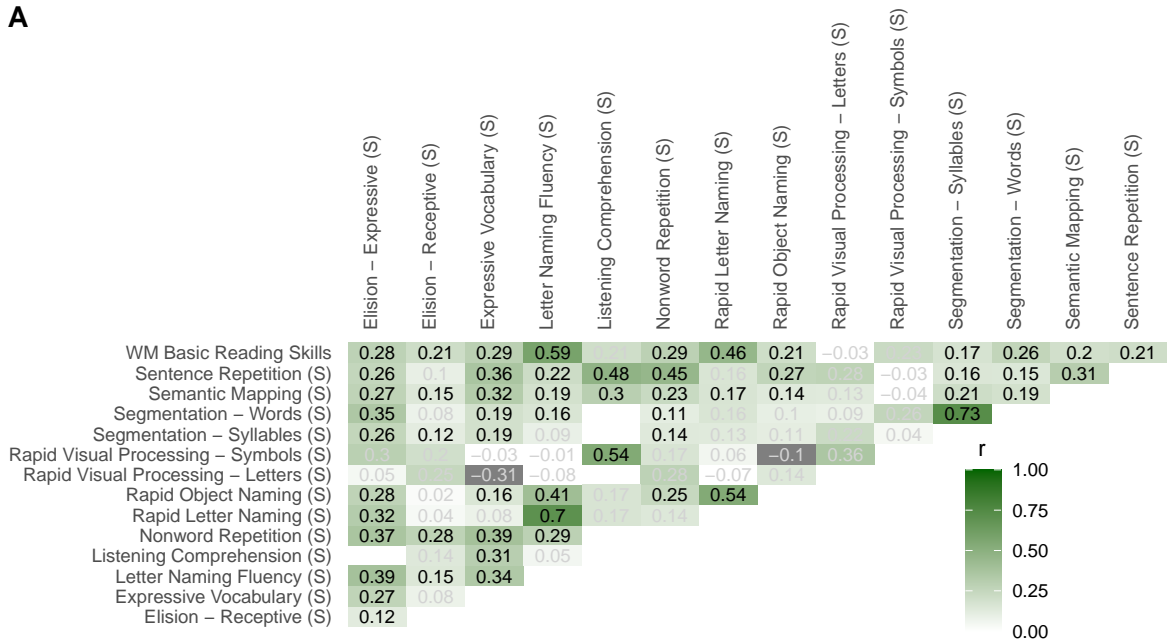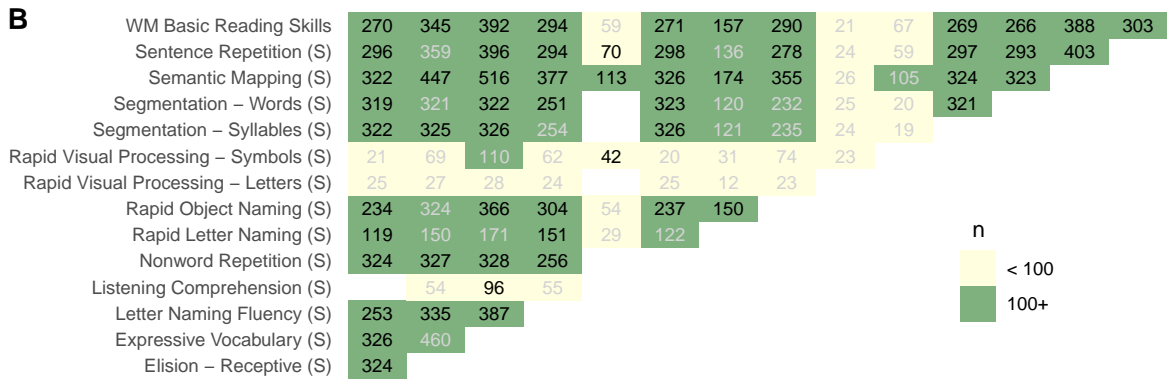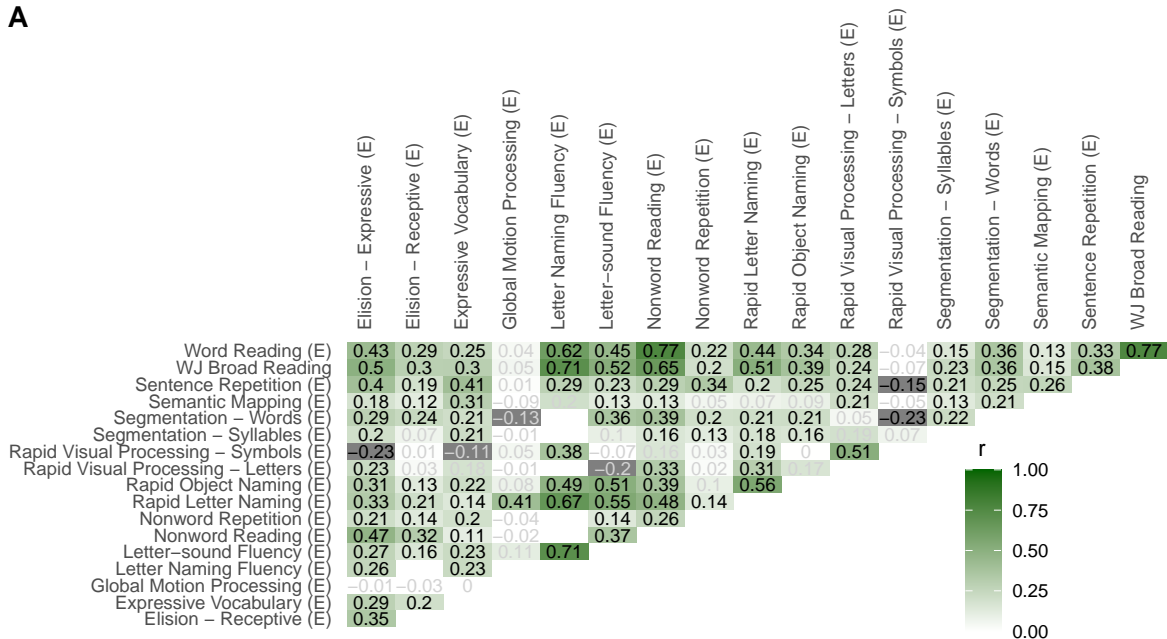|	Elision – Expressive (E)	Elision – Receptive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter Naming Fluency (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Nonword Repetition (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Segmentation – Syllables (E)	Segmentation – Words (E)	Semantic Mapping (E)	Sentence Repetition (E)	WJ Broad Reading
Word Reading (E)	0.43	0.29	0.25	0.04	0.62	0.45	0.77	0.22	0.44	0.34	0.28	−0.04	0.15	0.36	0.13	0.33	0.77
WJ Broad Reading	0.5	0.3	0.3	0.05	0.71	0.52	0.65	0.2	0.51	0.39	0.24	−0.07	0.23	0.36	0.15	0.38	
Sentence Repetition (E)	0.4	0.19	0.41	0.01	0.29	0.23	0.29	0.34	0.2	0.25	0.24	−0.15	0.21	0.25	0.26		
Semantic Mapping (E)	0.18	0.12	0.31	−0.09		0.13	0.13	0.05	0.07	0.09	0.21	−0.05	0.13	0.21			
Segmentation – Words (E)	0.29	0.24	0.21	−0.13		0.36	0.39	0.2	0.21	0.21	0.05	−0.23	0.22				
Segmentation – Syllables (E)	0.2	0.07	0.21	−0.01		0.1	0.16	0.13	0.18	0.16		0.07					
Rapid Visual Processing – Symbols (E)	−0.23	0.01	−0.11	0.05	0.38	−0.07		0.03	0.19	0	0.51						
Rapid Visual Processing – Letters (E)	0.23	0.03		−0.01	−0.2	0.33	0.02	0.31	0.17								
Rapid Object Naming (E)	0.31	0.13	0.22	0.08	0.49	0.51	0.39	0.1	0.56								
Rapid Letter Naming (E)	0.33	0.21	0.14	0.41	0.67	0.55	0.48	0.14									
Nonword Repetition (E)	0.21	0.14	0.2	−0.04	0.14	0.26											
Nonword Reading (E)	0.47	0.32	0.11	−0.02	0.37												
Letter–sound Fluency (E)	0.27	0.16	0.23	0.11	0.71												
Letter Naming Fluency (E)	0.26		0.23														
Global Motion Processing (E)	−0.01	−0.03	0														
Expressive Vocabulary (E)	0.29	0.2															
Elision – Receptive (E)	0.35																

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B

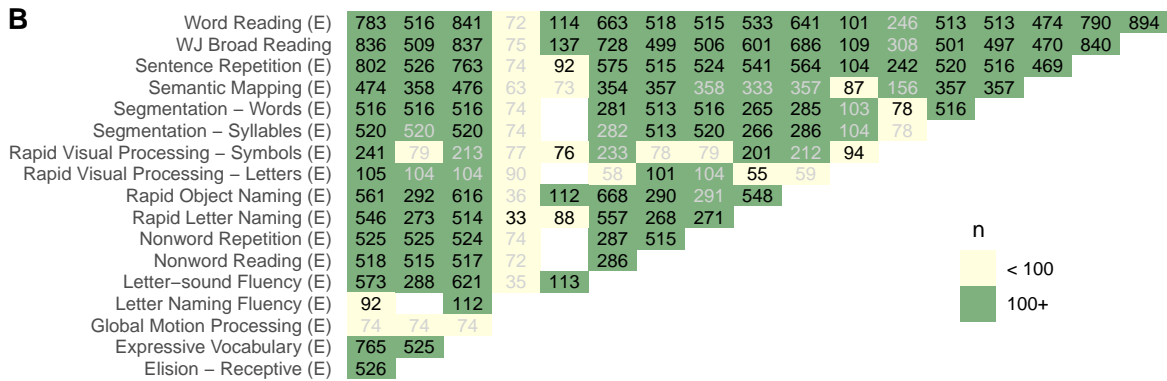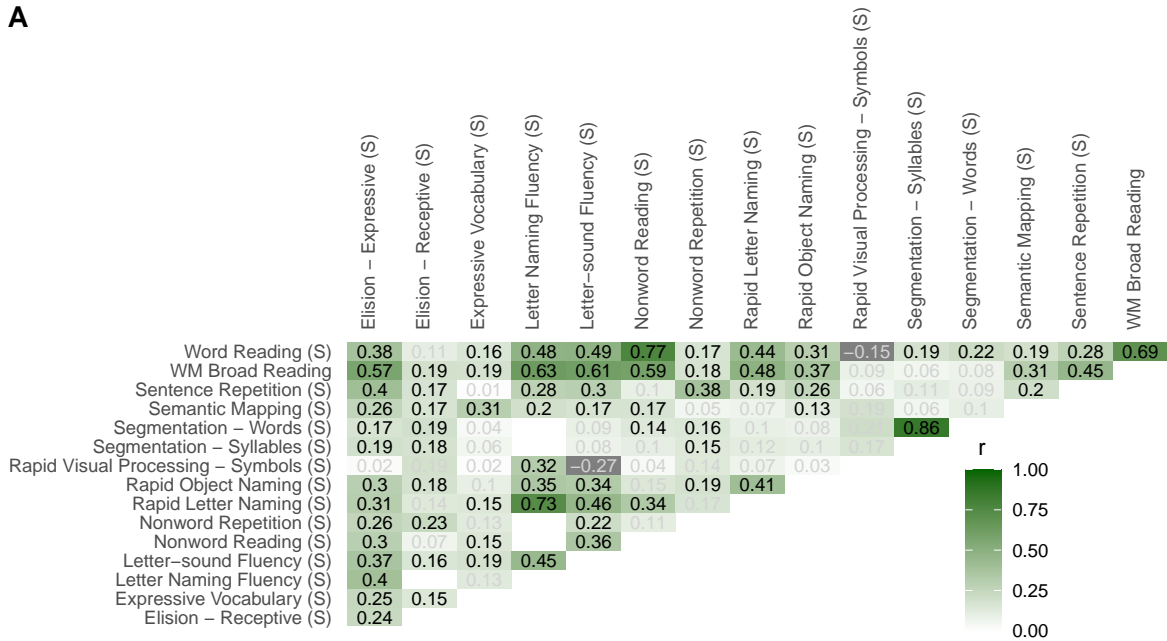|	Elision – Expressive (E)	Elision – Receptive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter Naming Fluency (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Nonword Repetition (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Segmentation – Syllables (E)	Segmentation – Words (E)	Semantic Mapping (E)	Sentence Repetition (E)	WJ Broad Reading
Word Reading (E)	783	516	841	72	114	663	518	515	533	641	101	246	513	513	474	790	894
WJ Broad Reading	836	509	837	75	137	728	499	506	601	686	109	308	501	497	470	840	
Sentence Repetition (E)	802	526	763	74	92	575	515	524	541	564	104	242	520	516	469		
Semantic Mapping (E)	474	358	476	63	73	354	357	358	333	357	87	156	357	357			
Segmentation – Words (E)	516	516	516	74		281	513	516	265	285	103	78	516				
Segmentation – Syllables (E)	520	520	520	74		282	513	520	266	286	104	78					
Rapid Visual Processing – Symbols (E)	241	79	213	77	76	233	78	79	201	212	94						
Rapid Visual Processing – Letters (E)	105	104	104	90		58	101	104	55	59							
Rapid Object Naming (E)	561	292	616	36	112	668	290	291	548								
Rapid Letter Naming (E)	546	273	514	33	88	557	268	271									
Nonword Repetition (E)	525	525	524	74		287	515										
Nonword Reading (E)	518	515	517	72		286											
Letter–sound Fluency (E)	573	288	621	35	113												
Letter Naming Fluency (E)	92		112														
Global Motion Processing (E)	74	74	74														
Expressive Vocabulary (E)	765	525															
Elision – Receptive (E)	526																

n: < 100 / 100+

Figure 39: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Grade 1; AYs 2023/24 and 2024/25 Combined).
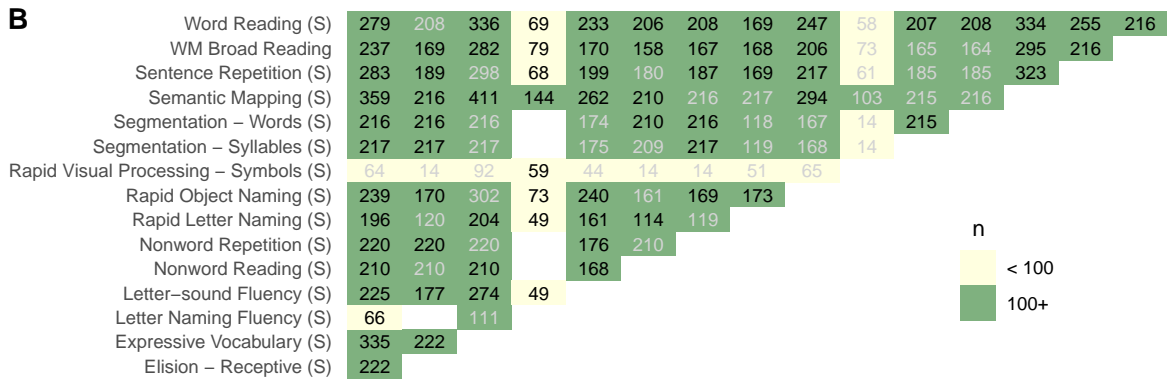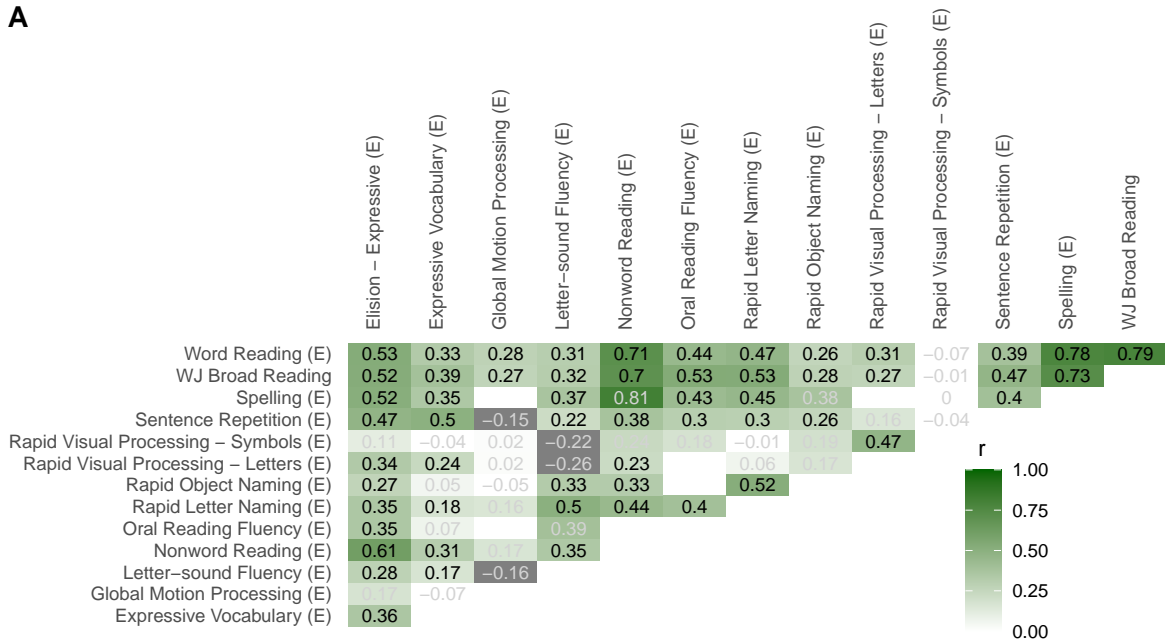
3.2.4.4 Grade 1 - Spanish

Figure 40: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Grade 1; AYs 2023/24 and 2024/25 Combined).
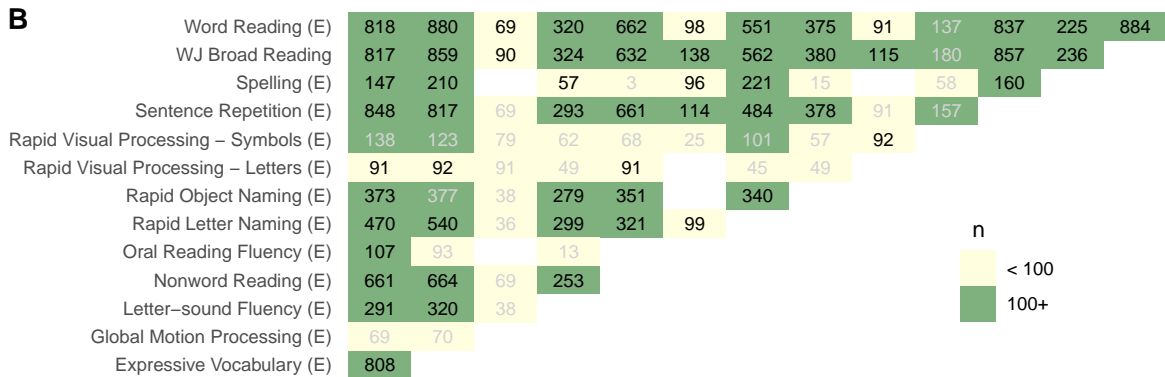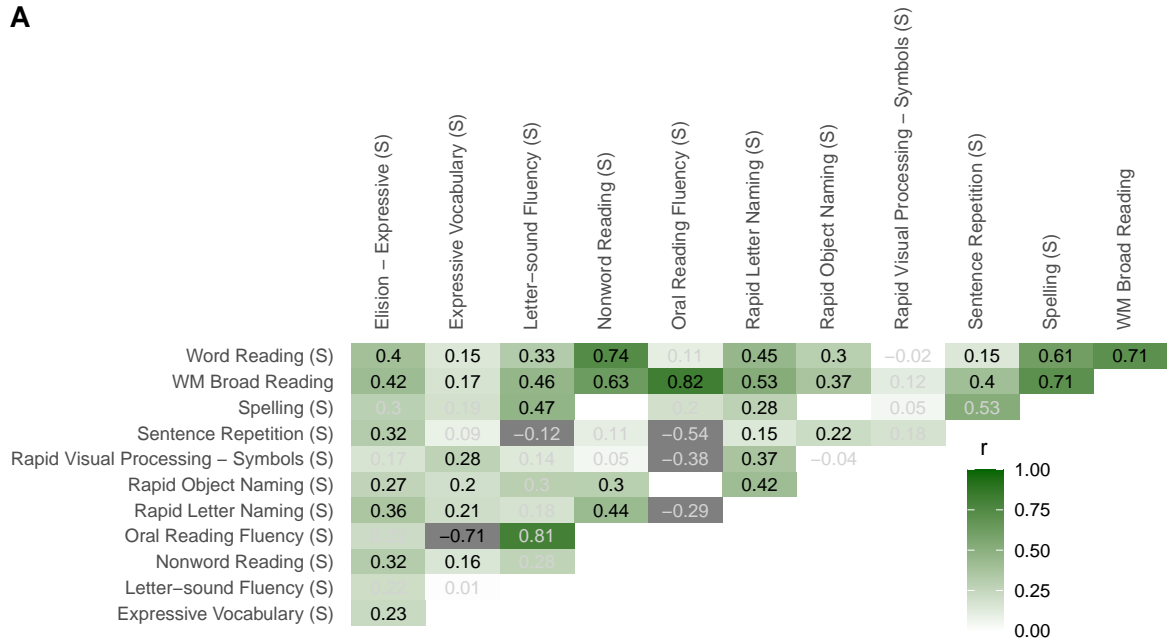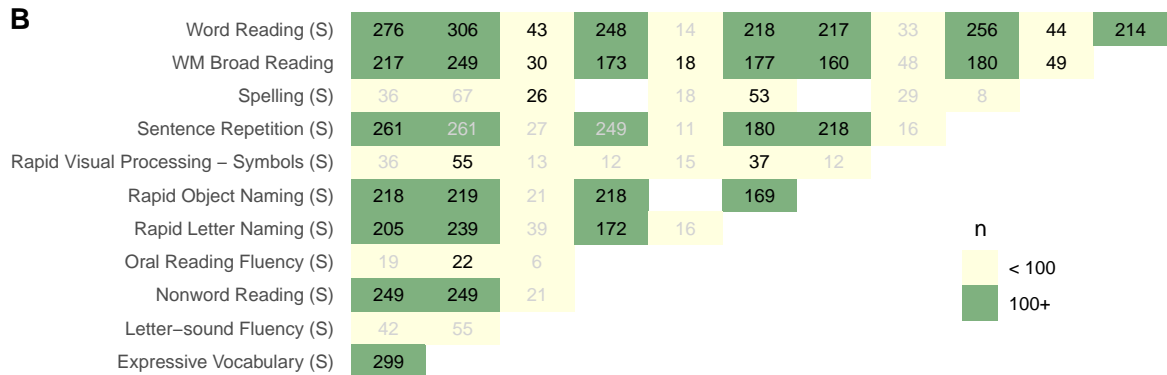
3.2.4.5 Grade 2 - English

A

	Elision – Expressive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Oral Reading Fluency (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Sentence Repetition (E)	Spelling (E)	WJ Broad Reading
Word Reading (E)	0.53	0.33	0.28	0.31	0.71	0.44	0.47	0.26	0.31	−0.07	0.39	0.78	0.79
WJ Broad Reading	0.52	0.39	0.27	0.32	0.7	0.53	0.53	0.28	0.27	−0.01	0.47	0.73	
Spelling (E)	0.52	0.35		0.37	0.81	0.43	0.45	0.38		0	0.4		
Sentence Repetition (E)	0.47	0.5	−0.15	0.22	0.38	0.3	0.3	0.26	0.16	−0.04			
Rapid Visual Processing – Symbols (E)	0.11	−0.04	0.02	−0.22		0.18	−0.01	0.19	0.16		0.47		
Rapid Visual Processing – Letters (E)	0.34	0.24	0.02	−0.26	0.23		0.06	0.17					
Rapid Object Naming (E)	0.27	0.05	−0.05	0.33	0.33		0.52						
Rapid Letter Naming (E)	0.35	0.18	0.16	0.5	0.44	0.4							
Oral Reading Fluency (E)	0.35	0.07		0.39									
Nonword Reading (E)	0.61	0.31	0.17	0.35									
Letter–sound Fluency (E)	0.28	0.17	−0.16										
Global Motion Processing (E)	0.17	−0.07											
Expressive Vocabulary (E)	0.36												

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- 0.25
- 0.00

B

	Elision – Expressive (E)	Expressive Vocabulary (E)	Global Motion Processing (E)	Letter–sound Fluency (E)	Nonword Reading (E)	Oral Reading Fluency (E)	Rapid Letter Naming (E)	Rapid Object Naming (E)	Rapid Visual Processing – Letters (E)	Rapid Visual Processing – Symbols (E)	Sentence Repetition (E)	Spelling (E)	WJ Broad Reading
Word Reading (E)	818	880	69	320	662	98	551	375	91	137	837	225	884
WJ Broad Reading	817	859	90	324	632	138	562	380	115	180	857	236	
Spelling (E)	147	210		57	3	96	221	15		58	160		
Sentence Repetition (E)	848	817	69	293	661	114	484	378	91	157			
Rapid Visual Processing – Symbols (E)	138	123	79	62	68	25	101	57			92		
Rapid Visual Processing – Letters (E)	91	92	91	49	91		45	49					
Rapid Object Naming (E)	373	377	38	279	351		340						
Rapid Letter Naming (E)	470	540	36	299	321	99							
Oral Reading Fluency (E)	107	93		13									
Nonword Reading (E)	661	664	69	253									
Letter–sound Fluency (E)	291	320	38										
Global Motion Processing (E)	69	70											
Expressive Vocabulary (E)	808												

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Figure 41: Correlations Between English Multitudes Tasks and English Reading Outcome Scores (Grade 2; AYs 2023/24 and 2024/25 Combined).

3.2.4.6 Grade 2 - Spanish

A

	Elision – Expressive (S)	Expressive Vocabulary (S)	Letter–sound Fluency (S)	Nonword Reading (S)	Oral Reading Fluency (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Symbols (S)	Sentence Repetition (S)	Spelling (S)	WM Broad Reading
Word Reading (S)	0.4	0.15	0.33	0.74	0.11	0.45	0.3	−0.02	0.15	0.61	0.71
WM Broad Reading	0.42	0.17	0.46	0.63	0.82	0.53	0.37	0.12	0.4	0.71	
Spelling (S)	0.3	0.19	0.47		0.2	0.28		0.05	0.53		
Sentence Repetition (S)	0.32	0.09	−0.12	0.11	−0.54	0.15	0.22	0.18			
Rapid Visual Processing – Symbols (S)	0.17	0.28	0.14	0.05	−0.38	0.37	−0.04				
Rapid Object Naming (S)	0.27	0.2	0.3	0.3		0.42					
Rapid Letter Naming (S)	0.36	0.21	0.18	0.44	−0.29						
Oral Reading Fluency (S)		−0.71	0.81								
Nonword Reading (S)	0.32	0.16	0.28								
Letter–sound Fluency (S)	0.22	0.01									
Expressive Vocabulary (S)	0.23										

r
- 1.00
- 0.75
- 0.50
- 0.25
- 0.00

B

	Elision – Expressive (S)	Expressive Vocabulary (S)	Letter–sound Fluency (S)	Nonword Reading (S)	Oral Reading Fluency (S)	Rapid Letter Naming (S)	Rapid Object Naming (S)	Rapid Visual Processing – Symbols (S)	Sentence Repetition (S)	Spelling (S)	WM Broad Reading
Word Reading (S)	276	306	43	248	14	218	217	33	256	44	214
WM Broad Reading	217	249	30	173	18	177	160	48	180	49	
Spelling (S)	36	67	26		18	53		29	8		
Sentence Repetition (S)	261	261	27	249	11	180	218	16			
Rapid Visual Processing – Symbols (S)	36	55	13	12	15	37	12				
Rapid Object Naming (S)	218	219	21	218		169					
Rapid Letter Naming (S)	205	239	39	172	16						
Oral Reading Fluency (S)	19	22	6								
Nonword Reading (S)	249	249	21								
Letter–sound Fluency (S)	42	55									
Expressive Vocabulary (S)	299										

n
- < 100
- 100+

Figure 42: Correlations Between Spanish Multitudes Tasks and Spanish Reading Outcome Scores (Grade 2; AYs 2023/24 and 2024/25 Combined).

3.3 Task Selection

3.3.1 English-to-English (English to English)
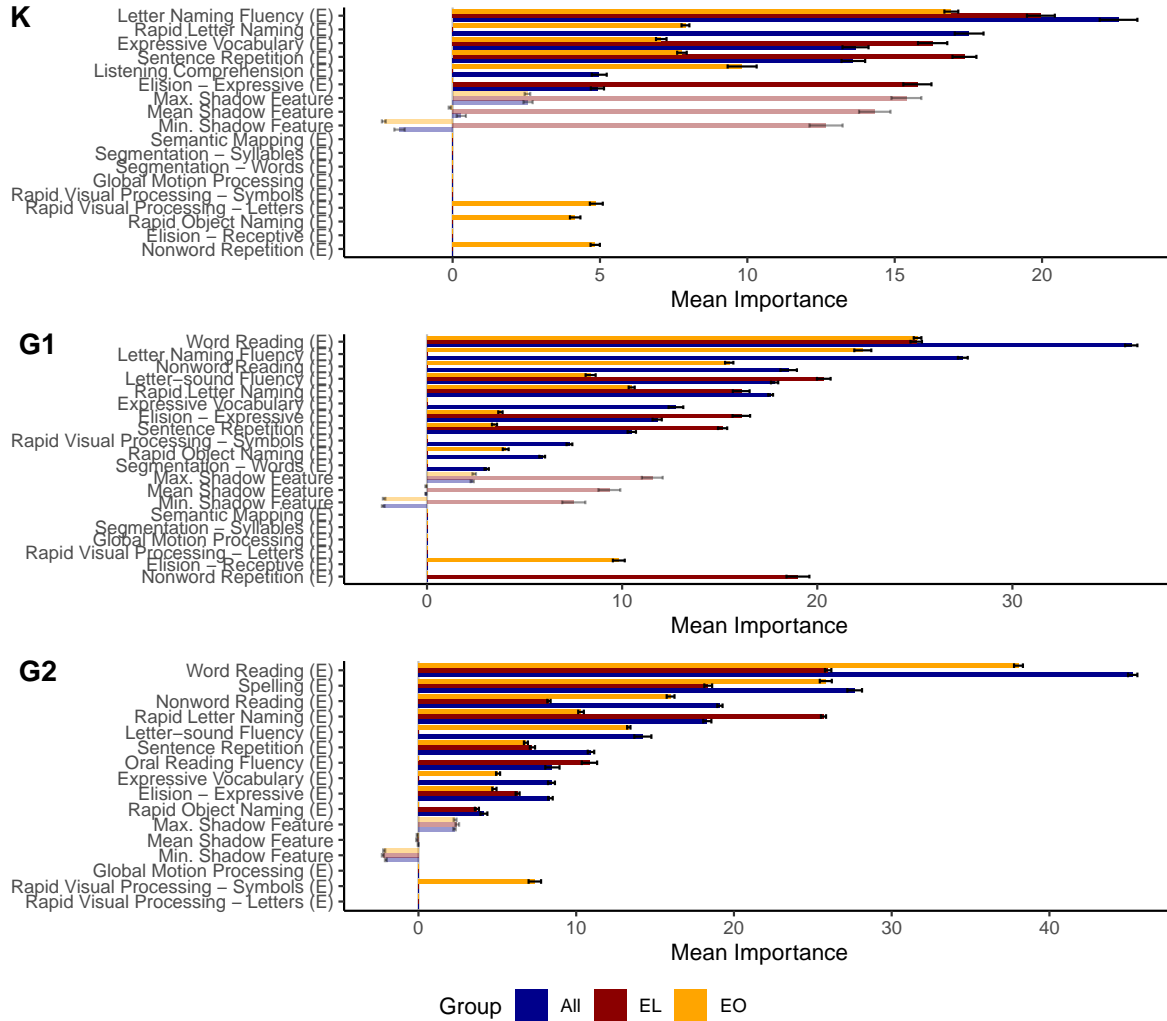
Figure 43: Mean Task Importance Obtained From Boruta Algorithm for English-to-English Predictions, with Results Disaggregated by English Proficiency Designation (AYs 2023/24 and 2024/25 Combined).

3.3.2 Spanish-to-Spanish (Spanish to Spanish)
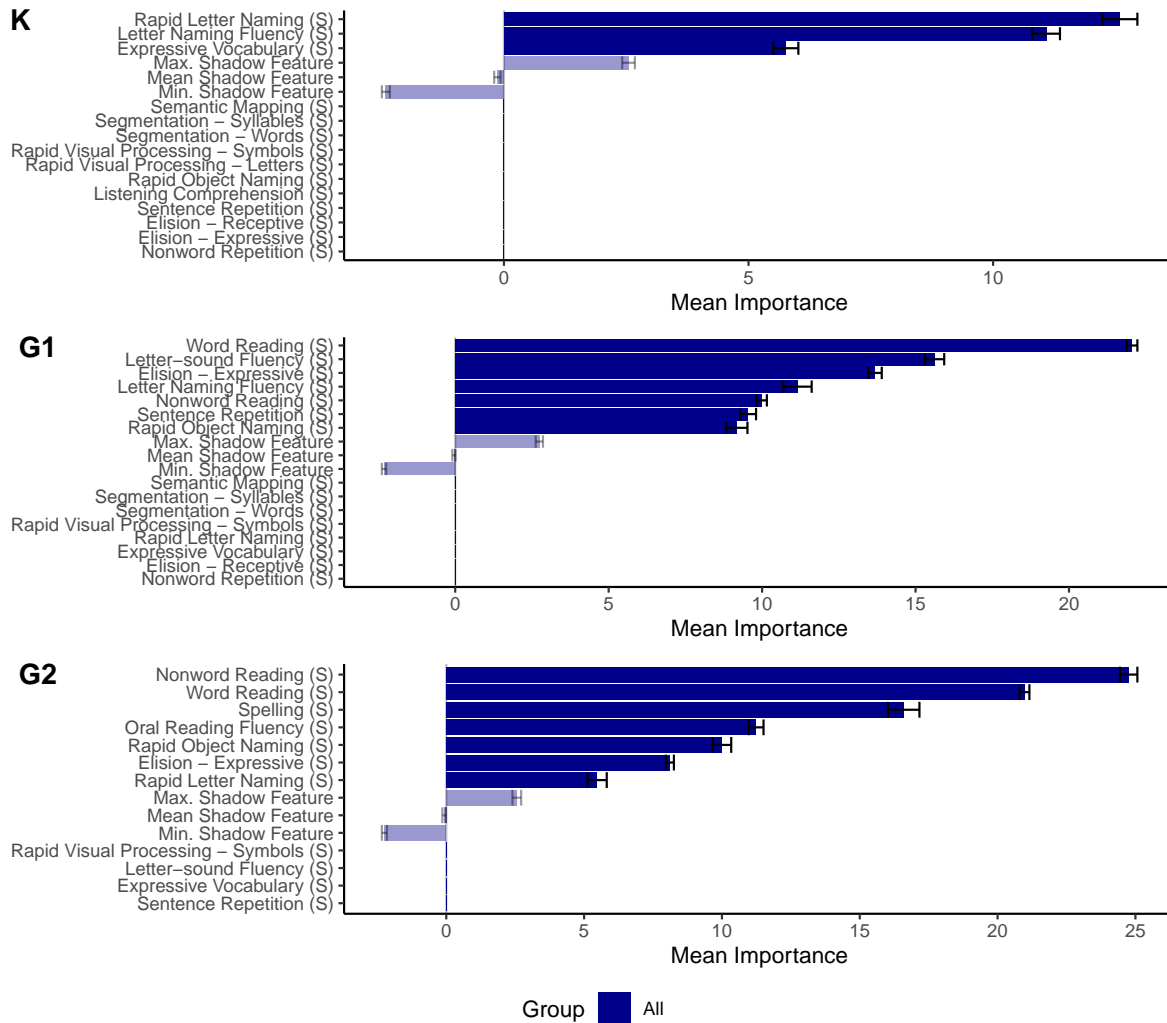
Figure 44: Mean Task Importance Obtained From Boruta Algorithm for Spanish-to-Spanish Predictions (AYs 2023/24 and 2024/25 Combined).

3.4 Models Evaluations - ROC Curves

3.4.1 English-to-English - Kindergarten
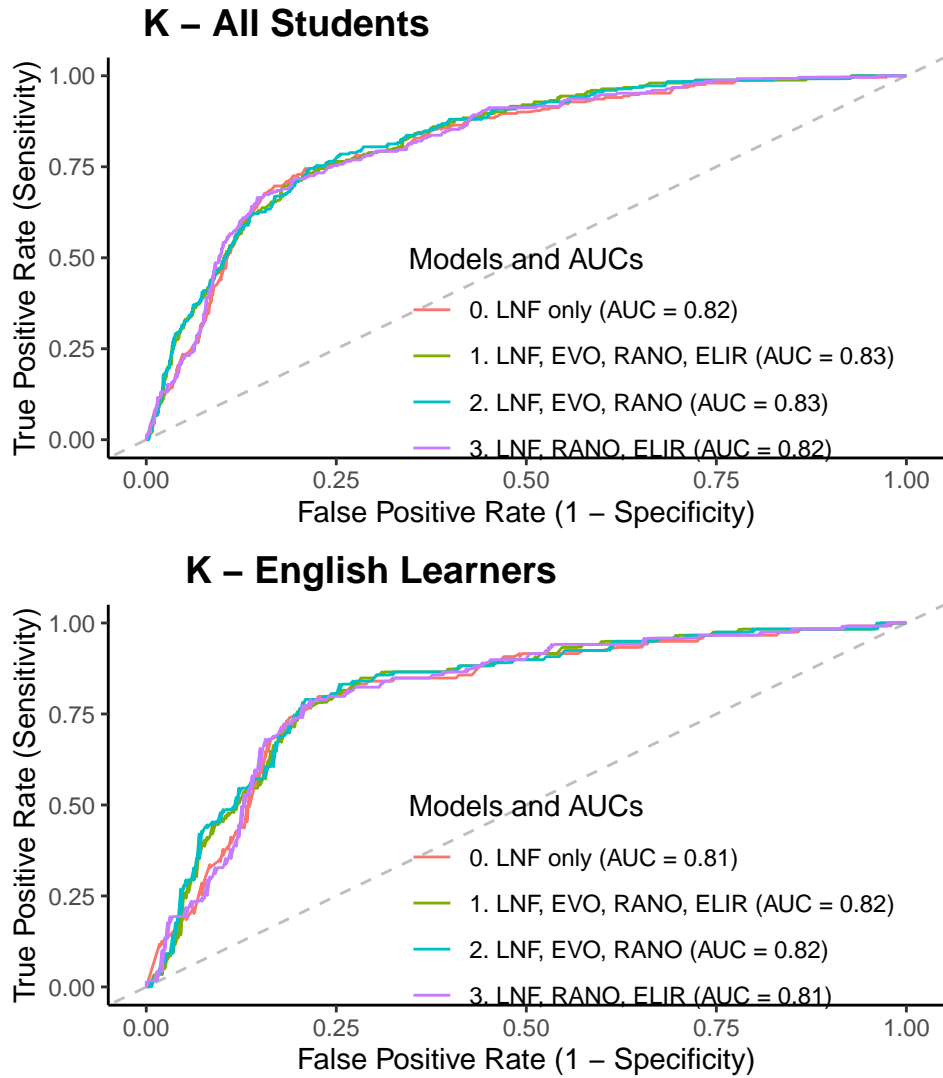
Figure 45: Receiver-operator Characteristic Curves For English-to-English Kindergarten Models (AYs 2023/24 and 2024/25 Combined).

3.4.2 English-to-English - Grade 1

G1 – All Students

G1 – English Learners
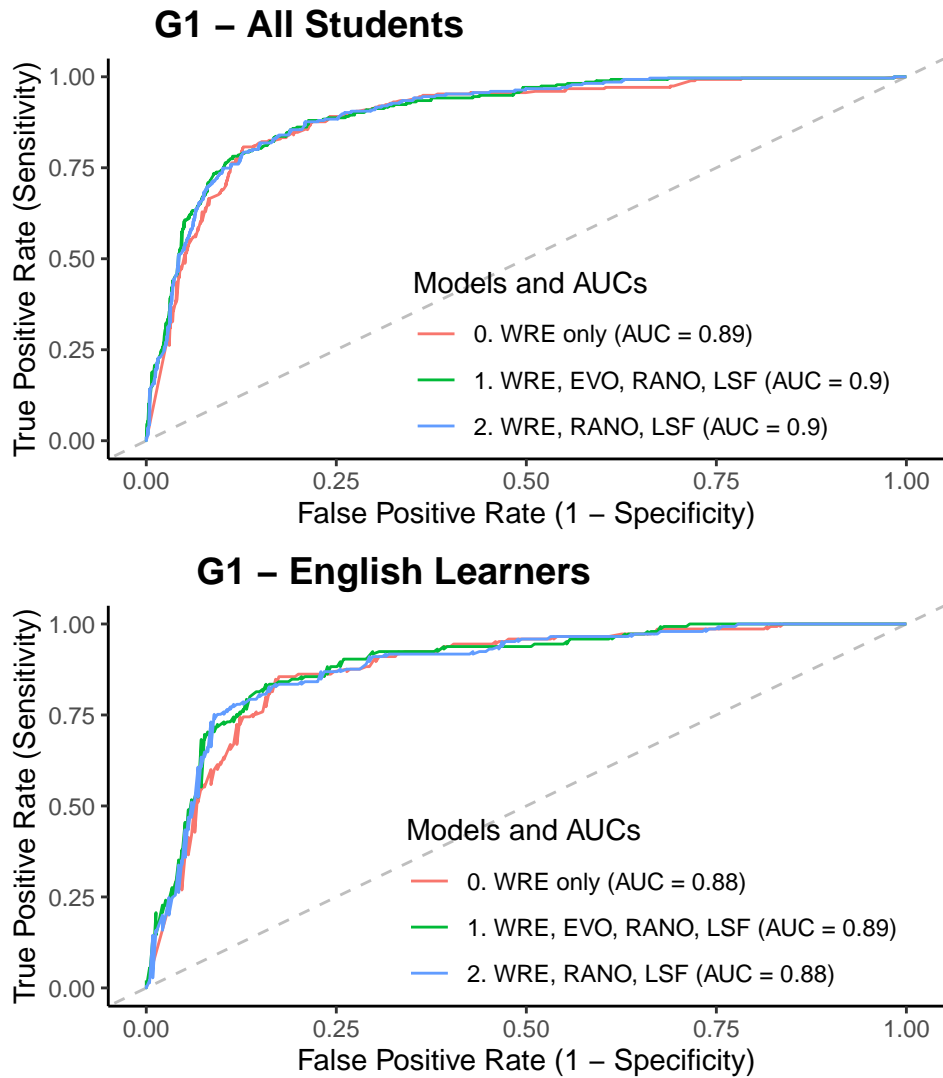
Figure 46: Receiver-operator Characteristic Curves For English-to-English Grade 1 Models (AYs 2023/24 and 2024/25 Combined).

3.4.3 English-to-English - Grade 2

G2 – All Students

G2 – English Learners
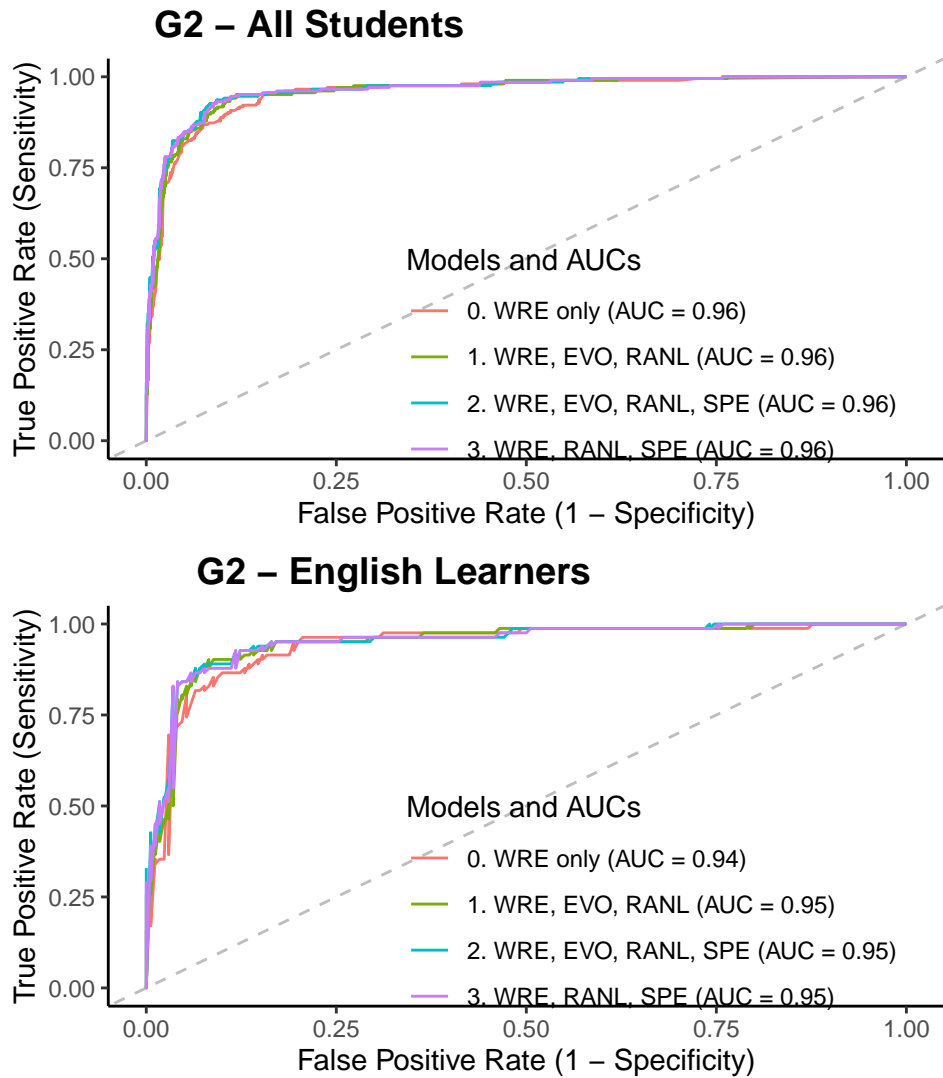
Figure 47: Receiver-operator Characteristic Curves For English-to-English Grade 2 Models (AYs 2023/24 and 2024/25 Combined).

3.4.4 Spanish-to-Spanish - Kindergarten

K – All Students

K – English Learners
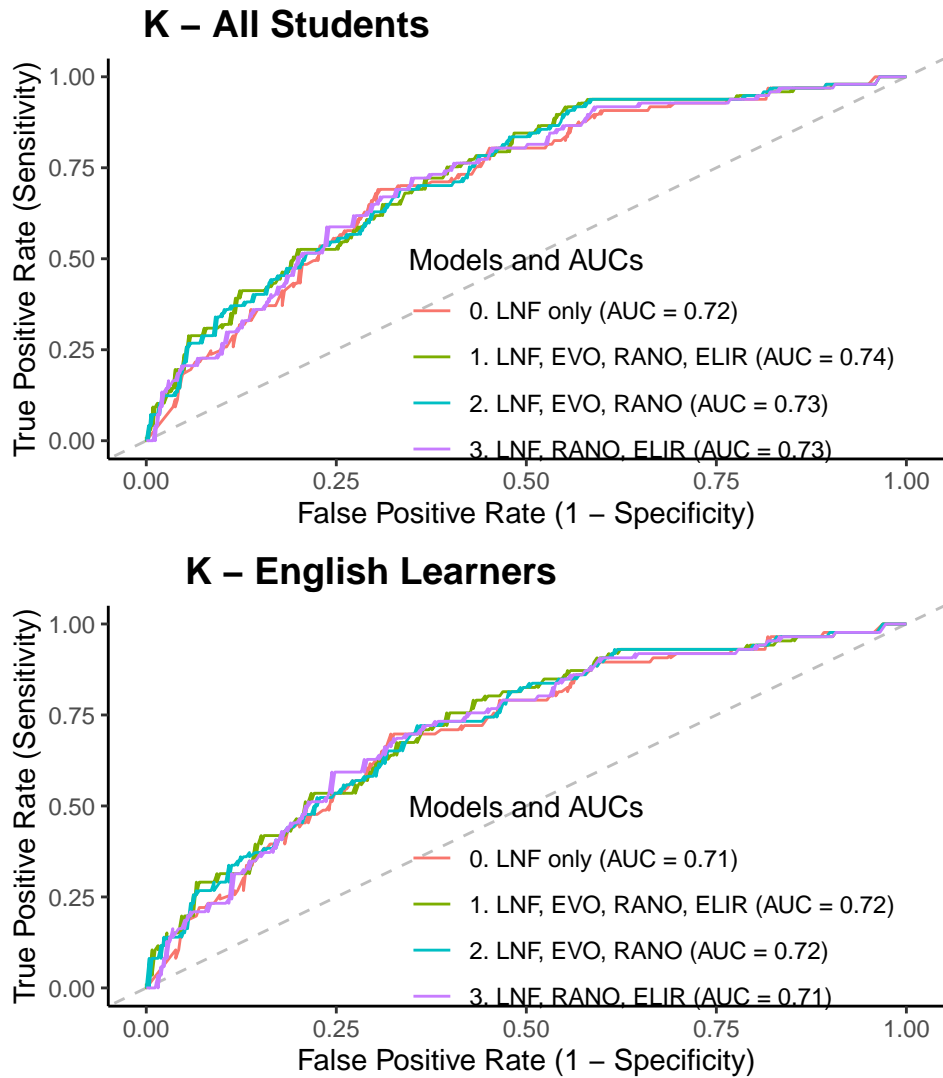
Figure 48: Receiver-operator Characteristic Curves For Spanish-to-Spanish Kindergarten Models (AYs 2023/24 and 2024/25 Combined).

3.4.5 Spanish-to-Spanish - Grade 1
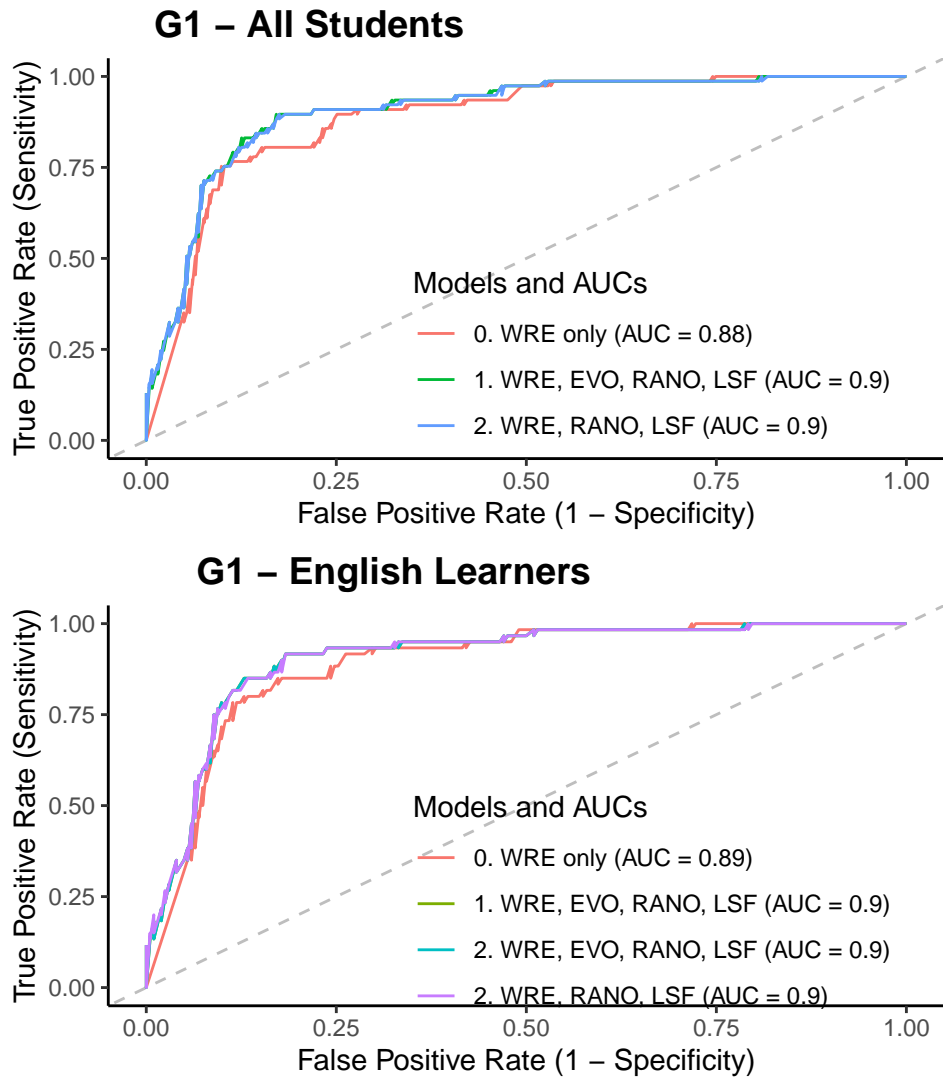
Figure 49: Receiver-operator Characteristic Curves For Spanish-to-Spanish Grade 1 Models (AYs 2023/24 and 2024/25 Combined).

3.4.6 Spanish-to-Spanish - Grade 2

G2 – All Students

G2 – English Learners
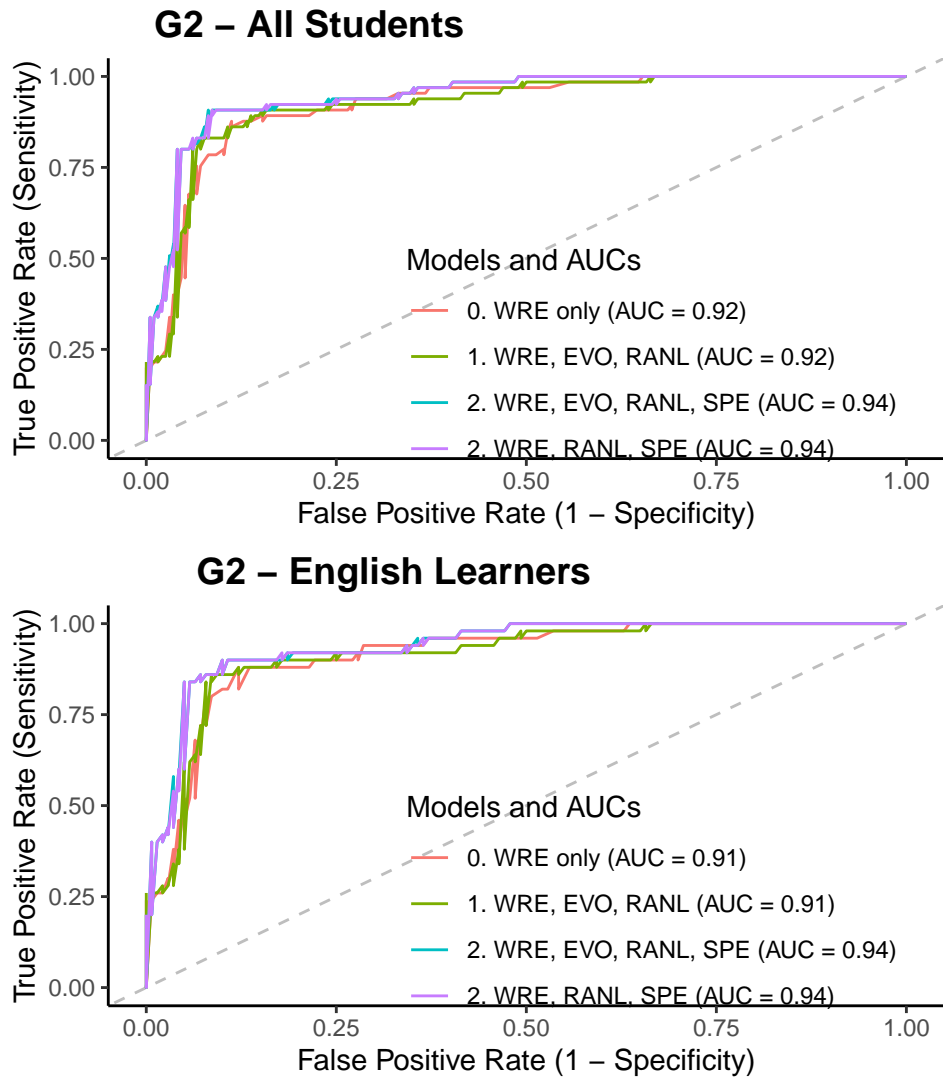
Figure 50: Receiver-operator Characteristic Curves For Spanish-to-Spanish Grade 2 Models (AYs 2023/24 and 2024/25 Combined).

Table 9: Summary of Best English and Spanish Prediction Models (AYs 2023/24 and 2024/25 Combined).

| | | English | | | | | | | | | | | | | | Spanish | | | |
| | | Sensitivity | | | Specificity | | | Accuracy | | | Balanced Acc. | | | Sens. | Spec. | Acc. | BA |
Grade	Model	All	EL	EO	All	EL	EO	All	EL	EO	All	EL	EO	All	All	All	All
K	LNF only	0.741	0.8403	0.6471	0.7921	0.7073	0.8355	0.7813	0.7666	0.7463	0.7738	0.8014	0.7413	0.6804	0.695	0.6918	0.6877
K	LNF, RANO, ELIR	0.7131	0.8151	0.6176	0.806	0.7282	0.842	0.7864	0.7596	0.7537	0.7717	0.8014	0.7298	0.7113	0.651	0.6644	0.6812
K	LNF, RANO, ELIR, EVO	0.7251	0.8655	0.598	0.7921	0.676	0.8528	0.778	0.7586	0.7315	0.7708	0.8067	0.7254	0.9072	0.4487	0.5502	0.6779
K	LNF, RANO, EVO	0.741	0.8655	0.6176	0.7857	0.676	0.8442	0.7763	0.7634	0.7315	0.7708	0.8032	0.7309	0.6804	0.6686	0.6712	0.6745
G1	WRE only	0.8036	0.8483	0.7245	0.8734	0.8298	0.8783	0.8574	0.8385	0.8368	0.839	0.8544	0.8014	0.7532	0.8897	0.8588	0.8215
G1	WRE, RANO, LSF	0.8145	0.8345	0.7653	0.8506	0.7957	0.8652	0.8424	0.8326	0.8105	0.8151	0.8497	0.8152	0.8831	0.8251	0.8382	0.8541
G1	WRE, RANO, LSF, EVO	0.7782	0.8414	0.6735	0.8864	0.8213	0.9045	0.8616	0.8323	0.8289	0.8313	0.8687	0.789	0.8831	0.8289	0.8412	0.856
G2	WRE only	0.9512	0.9634	0.955	0.8444	0.7882	0.8454	0.866	0.8978	0.8452	0.8758	0.8654	0.9002	0.8615	0.8878	0.8812	0.8746
G2	WRE, RANL	0.9317	0.9268	0.9459	0.8901	0.8529	0.8855	0.8985	0.9109	0.877	0.8899	0.8966	0.9157	0.8769	0.8673	0.8697	0.8721
G2	WRE, RANL, EVO	0.9415	0.9268	0.964	0.8815	0.8353	0.8815	0.8936	0.9115	0.8651	0.8811	0.8966	0.9227	0.8154	0.9286	0.9004	0.872

Note. green: >= .8; black: >= .7; yellow: >= .6; red otherwise

3.5 Models Evaluations - Sensitivity and Specificity

4 Part IV - Evaluating 23/24 Model With 24/25 Data

Table 10: Re-evaluation of 2023/24 Prediction Model Using 2024/25 Data.

| | | English | | | | | | | | | | | | | Spanish | | | |
| | | Sensitivity | | | Specificity | | | Accuracy | | | Balanced Acc. | | | Sens. | Spec. | Acc. | BA |
Grade	Model	All	EL	EO	All	EL	EO	All	EL	EO	All	EL	EO	All	All	All	All
K	LNF, EVO, ELIR, RANO	0.7429	0.8182	0.7222	0.8196	0.6269	0.8632	0.8122	0.7812	0.6538	0.7225	0.851	0.7927	0.6	0.7811	0.7577	0.6905
G1	WRE, EVO, LSF, RANO	0.8462	NA	0.8462	0.7689	0.6667	0.797	0.7726	0.8075	0.6667	NA	0.8	0.8216	0.7059	0.95	0.9145	0.8279
G2	WRE, EVO, RANL	0.9767	1	1	0.8718	0.75	0.8837	0.8861	0.9243	0.8043	0.875	0.8984	0.9419	0.75	0.9327	0.8984	0.8413

Note. green: >= .8; black: >= .7; yellow: >= .6; red otherwise