

Supplemental Material S1. List of target words and target consonants in the Mandarin Articulation Test (MAT).

No.	Target word	English translation	Pinyin	IPA transcription ^a	Target consonant	
					Onset	Coda
1	爸爸	father	bàba	pa 4.pa5	p	
2	妈妈	mother	māma	ma 1.ma5	m	
3	哥哥	older brother	gēge	kɤ 1.kɤ5	k	
4	弟弟	younger brother	dìdi	tɿ 4.tɿ5	t	
5	苹果	apple	píngguǒ	pʰiŋ 2.kwo3	pʰ	
6	梨子	pear	lízi	li 2.tsɿ5	l	
7	草莓	strawberry	cǎoméi	tsʰau 3.mei2	tsʰ	
8	桃子	peach	táozi	tʰau 2.tsɿ5	tʰ	
9	饼干	biscuit	bǐnggān	piŋ 3.kan1		ŋ
10	热水	hot water	rèshuǐ	ɻɤ 4.ʂwei3	ɻ	
11	桌子	desk	zhuōzi	ʈʂwo 1.tsɿ5	ʈʂ	
12	眼睛	eye	yǎnjīng	jən 3.ʈeiŋ1		n
13	嘴巴	mouth	zuǐba	tswei 3.pa1	ts	
14	牙齿	teeth	yáchǐ	ja 2.tsʰɿ5	j	
15	裙子	skirt	qúnzi	tɕʰyn 2.tsɿ5	tɕʰ	
16	裤子	trousers	kùzi	kʰu 4.tsɿ5	kʰ	
17	袜子	sock	wàzi	wa 4.tsɿ5	w	
18	鞋子	shoe	xiézi	ɕje 2.tsɿ5	ɕ	
19	虫子	worm	chóngzi	ʈʂʰuŋ 2.tsɿ5	ʈʂʰ	
20	画画	draw	huàhuà	xwa 4.xwa4	x	
21	男孩	boy	nánhái	nan 2.xai2	n	
22	睡觉	sleep	shuìjiào	ʂwei 4.ʈejau4	ʂ	
23	司机	driver	sījī	sɿ 1.ʈei1	s	
24	飞机	plane	fēijī	fei 1.ʈei1	f	
25	鸡蛋	egg	jīdàn	ʈei 1.tan4	tɕ	

^a Target syllables are highlighted in bold. The numerals within syllables indicate tones.

Supplemental Material S2. Consonant substitutions reflecting Singaporean Mandarin features (Chua, 2003; En et al., 2014) observed in Mandarin–English bilingual preschool children’s Mandarin in the current study.

	Type of substitution	Example
Syllable initial	Alveolo-palatal→ alveolar	$\widehat{t\epsilon} \rightarrow \widehat{ts}$
		$\widehat{t\epsilon^h} \rightarrow \widehat{ts^h}$
		$\epsilon \rightarrow s$
	Retroflex → alveolar	$\widehat{t\zeta} \rightarrow \widehat{ts}$
		$\widehat{t\zeta^h} \rightarrow \widehat{ts^h}$
		$\zeta \rightarrow s$
Syllable final	Velar → alveolar	$\downarrow \rightarrow l$
		$\eta \rightarrow n$

Supplemental Material S3. Phonological processes associated with Singapore English (SgE) dialect features (En et al., 2014) observed in Mandarin–English bilingual preschool children’s English in the current study.

Phonological process	SgE dialect feature	Description	Examples
Final consonant deletion	Syllable-final /l/ deletion	Dark (velarized) [ɫ] deleted after a schwa	shovel [ʃʌvəl] → [ʃʌvə]
Stopping	Dental fricatives substitution (syllable-initial)	Stopping in syllable-initial positions for /θ, ð/	thumb [θʌm] → [tʌm] that [ðæt] → [dæt]
Voicing	Syllable-final obstruent devoicing	Voiced plosives, fricatives and affricates become voiceless in the syllable-final position	web [wɛb] → [wɛp] slide [slaid] → [slait] pig [pɪg] → [pɪk] five [faɪv] → [faɪf] cheese [tʃiːz] → [tʃiːs]
/θ/ → [f]	Dental fricatives substitution (syllable-final)	[f]-substitution in syllable-final position for /θ/	teeth [tiːθ] → [tiːf]

Supplemental Material S4. Grammatical structures examined in the Mandarin Receptive Grammar Test (MRGT), with English as a comparison.

Grammatical structure examined in Mandarin		English equivalent	Form-similarity score ^a	Relevant observations
Simple transitive	Subject-Verb-Object	Subject-Verb-Object	2	Grammatical forms match.
Ditransitive	Verb-recipient-theme (e.g., <i>gei3 ta1 qian2</i> 给他钱) Verb-theme- <i>gei3</i> -recipient (e.g., <i>song4 qian2 gei3 ta1</i> 送钱给他)	Verb-recipient-theme (e.g., <i>give him money</i>) Verb-theme- <i>to</i> -recipient (e.g., <i>send money to him</i>)	2	Grammatical forms match.
Locative	Using a <u>localizer</u> after a noun to specify the location relative to the noun, often with the <u>coverb</u> <i>zai4</i> 在 (e.g., <i>zai4 zhuo1 zi shang4</i> 在桌子上)	Prepositional phrase (e.g., <i>on the desk</i>)	1	Different forms.
Classifier	Numeral/Demonstrative-Classifier-Noun (e.g., <i>yi1/zhe4-tiao2-sheng2</i> 一/这条绳 ‘a/this rope’)	N/A	0	No equivalent structure.
Pronoun	1 st , 2 nd and 3 rd person pronouns without gender and case distinctions	1 st , 2 nd and 3 rd person pronouns with gender and case distinctions	1	Different forms.
Bare reflexive	<i>Zi4ji3</i> 自己 ‘self’	N/A	0	No equivalent structure.
Negation	Negative marker (e.g., <i>mei2</i> 没, <i>bu4</i> 不) placed before the verb	Adding “not” after an auxiliary or modal verb (e.g., <i>do not</i>)	1	Different forms.
Resultative verb compound	Combining a verb with a resultative complement to indicate the result or	N/A	0	No equivalent structure.

	outcome of an action (e.g., <i>tui1dao3</i> 推倒, literally ‘push-fall’)			
Aspect marking	Optional aspect marking through adding a particle to the verb (e.g., <i>chi1 le</i> 吃了 ‘have eaten’, <i>zai4 chi1</i> 在吃 ‘is eating’)	Aspect marked through the use of auxiliary verbs and verb tense	1	Different forms.
Comparative	Subject- <i>bi3</i> 比-Compared Object-(<i>geng4</i> 更 ‘more’) Adjective; Subject-Verb- <i>de</i> 得- <i>bi3</i> 比-Compared Object-(<i>geng4</i> 更) Adverb	Subject-Copula/Verb-(more) Adjective/Adverb (-er)- <i>than</i> -Compared Object	1	Different forms.
Coordinating conjunction	Using words such as <i>he2</i> 和 ‘and’ to link elements of equal grammatical status (e.g., <i>nai3nai na2zhe tao2zi he2 ju2zi</i> 奶奶拿着桃子和桔子)	Using words such as <i>and</i> to link elements of equal grammatical status (e.g., <i>the granny is holding a peach and a tangerine</i>)	2	Grammatical forms match.
Possessive	Placing the particle <i>de</i> 的 after the processor (e.g., <i>nan2hai2 de</i> 男孩的)	Adding an apostrophe followed by the affix -s to the processor (e.g., <i>the boy’s</i>)	1	Different forms.
BA-construction	NP _{Agent} -BA-NP _{Patient} -XP	N/A	0	No equivalent structure.
BEI-passive	NP _{Patient} -BEI (-NP _{Agent})-XP	NP _{Patient} -BE-Verb (past participle) (- <i>by</i> -NP _{Agent})	1	Different forms.
Relative clause	Head-final with the particle <i>de</i> 的 linking the relative clause and the head noun (e.g., <i>xiong2mao1-bao4-zhe-de-tu4zi</i> 熊猫抱着的兔子)	Head-initial, usually introduced by a relative pronoun (e.g., <i>the rabbit that the panda is holding</i>)	1	Different forms.

^a 2: equivalent structures and similar forms and word order, 1: equivalent structures but differing forms, 0: no equivalent structure.

Supplemental Material S7. Linear regression results for English articulation scores in 63 Mandarin–English bilingual children.

Measure	Initial model				Final model				Full model			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
(Intercept)	2.85	0.16	17.34	< .001	2.85	0.14	20.63	< .001	2.85	0.14	20.30	< .001
Age (months)	-0.33	0.20	-1.63	.11	0.02	0.19	0.12	.90	0.03	0.19	0.15	.88
Nonverbal working memory	-0.25	0.19	-1.34	.19	-0.08	0.16	-0.47	.64	-0.04	0.18	-0.23	.82
Difference in number of speakers (Mandarin vs. English)	0.14	0.18	0.78	.44	0.01	0.17	0.07	.94	0.05	0.19	0.27	.79
Difference in number of native speakers (Mandarin vs. English)	-0.17	0.17	-1.01	.32	-0.06	0.15	-0.43	.67	-0.02	0.16	-0.12	.90
English receptive vocabulary	—	—	—	—	-0.46	0.16	-2.88	.01	-0.39	0.20	-1.93	.06
English receptive grammar	—	—	—	—	—	—	—	—	-0.07	0.21	-0.32	.75
Mandarin articulation	—	—	—	—	0.63	0.16	3.97	< .001	0.60	0.17	3.51	< .001
Mandarin receptive vocabulary	—	—	—	—	—	—	—	—	-0.02	0.22	-0.09	.93
Mandarin receptive grammar	—	—	—	—	—	—	—	—	-0.15	0.22	-0.68	.50
R^2	.15				.42				.43			
Adjusted R^2	.09				.36				.34			

Note. Z scores were used for measures. Dependent variable is the square root of GFTA-3 raw scores against Singapore English targets.

Supplemental Material S8. Linear regression results for Mandarin articulation in 63 Mandarin–English bilingual children.

Measure	Initial model				Final model				Full model			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
(Intercept)	1.13	0.09	12.17	< .001	1.13	0.08	13.91	< .001	1.13	0.08	14.23	< .001
Age (months)	-0.22	0.12	-1.92	.06	-0.12	0.10	-1.14	.26	-0.16	0.11	-1.47	.15
Nonverbal working memory	-0.15	0.11	-1.44	.15	-0.04	0.10	-0.37	.71	-0.06	0.10	-0.55	.59
Difference in number of speakers	-0.09	0.10	-0.86	.40	-0.04	0.10	-0.38	.71	-0.01	0.10	-0.08	.94
(Mandarin vs. English)												
Difference in number of native speakers	-0.18	0.10	-1.81	.08	-0.10	0.09	-1.11	.27	-0.07	0.09	-0.80	.43
(Mandarin vs. English)												
Mandarin receptive vocabulary	—	—	—	—	-0.22	0.11	-2.07	.04	-0.15	0.12	-1.22	.23
Mandarin receptive grammar	—	—	—	—	—	—	—	—	-0.05	0.12	-0.44	.66
English articulation	—	—	—	—	0.32	0.09	3.47	< .01	0.33	0.09	3.45	< .01
English receptive vocabulary	—	—	—	—	—	—	—	—	0.25	0.11	2.15	.04
English receptive grammar	—	—	—	—	—	—	—	—	-0.20	0.12	-1.65	.11
R^2	.27				.46				.51			
Adjusted R^2	.22				.4				.43			

Note. Z scores were used for measures. Dependent variable is the square root of MAT raw scores against Singapore Mandarin targets.

Supplemental Material S9. Linear regression results for English receptive vocabulary in 63 Mandarin–English bilingual children.

Measure	Initial model				Final model				Full model			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
(Intercept)	6.95	0.15	46.93	< .001	6.95	0.12	55.71	< .001	6.95	0.12	55.66	< .001
Age (months)	0.48	0.18	2.59	.01	0.34	0.16	2.13	.04	0.32	0.17	1.96	.05
Nonverbal working memory	0.28	0.17	1.66	.10	0.12	0.15	0.83	.41	0.17	0.16	1.10	.28
Difference in number of speakers (Mandarin vs. English)	-0.50	0.17	-3.05	< .01	-0.38	0.14	-2.69	.01	-0.29	0.16	-1.78	.08
Difference in number of native speakers (Mandarin vs. English)	-0.01	0.15	-0.05	.96	-0.04	0.13	-0.28	.78	-0.03	0.14	-0.18	.86
English articulation	—	—	—	—	—	—	—	—	-0.29	0.17	-1.73	.09
English receptive grammar	—	—	—	—	0.68	0.14	4.98	< .001	0.68	0.16	4.11	< .001
Mandarin articulation	—	—	—	—	—	—	—	—	0.23	0.18	1.33	.19
Mandarin receptive vocabulary	—	—	—	—	—	—	—	—	-0.13	0.19	-0.65	.52
Mandarin receptive grammar	—	—	—	—	—	—	—	—	-0.01	0.19	-0.03	.98
R^2	.27				.49				.52			
Adjusted R^2	.21				.44				.44			

Note. Z scores were used for measures. Dependent variable is the square root of PPVT-4 raw scores.

Supplemental Material S10. Linear regression results for Mandarin receptive vocabulary in 63 Mandarin–English bilingual children.

Measure	Initial model				Final model				Full model			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
(Intercept)	8.71	0.07	122.58	< .001	8.71	0.06	141.90	< .001	8.71	0.06	138.36	< .001
Age (months)	0.01	0.09	0.11	.91	-0.08	0.08	-1.02	.31	-0.07	0.09	-0.84	.40
Nonverbal working memory	0.27	0.08	3.26	< .01	0.19	0.07	2.54	.01	0.19	0.08	2.49	.02
Difference in number of speakers	0.27	0.08	3.44	< .01	0.23	0.07	3.34	< .01	0.22	0.08	2.91	.01
(Mandarin vs. English)												
Difference in number of native speakers (Mandarin vs. English)	0.08	0.07	1.03	.31	-0.04	0.07	-0.52	.60	-0.04	0.07	-0.51	.61
Mandarin articulation	—	—	—	—	-0.10	0.07	-1.44	.16	-0.09	0.09	-0.98	.33
Mandarin receptive grammar	—	—	—	—	0.31	0.07	4.23	< .001	0.31	0.09	3.53	< .001
English articulation	—	—	—	—	—	—	—	—	-0.02	0.09	-0.20	.85
English receptive vocabulary	—	—	—	—	—	—	—	—	-0.04	0.09	-0.47	.64
English receptive grammar	—	—	—	—	—	—	—	—	0.03	0.10	0.32	.75
R^2	.39				.56				.56			
Adjusted R^2	.34				.51				.49			

Note. Z scores were used for measures. Dependent variable is the square root of MRVT raw scores.

Supplemental Material S11. Linear regression results for English receptive grammar in 63 Mandarin–English bilingual children.

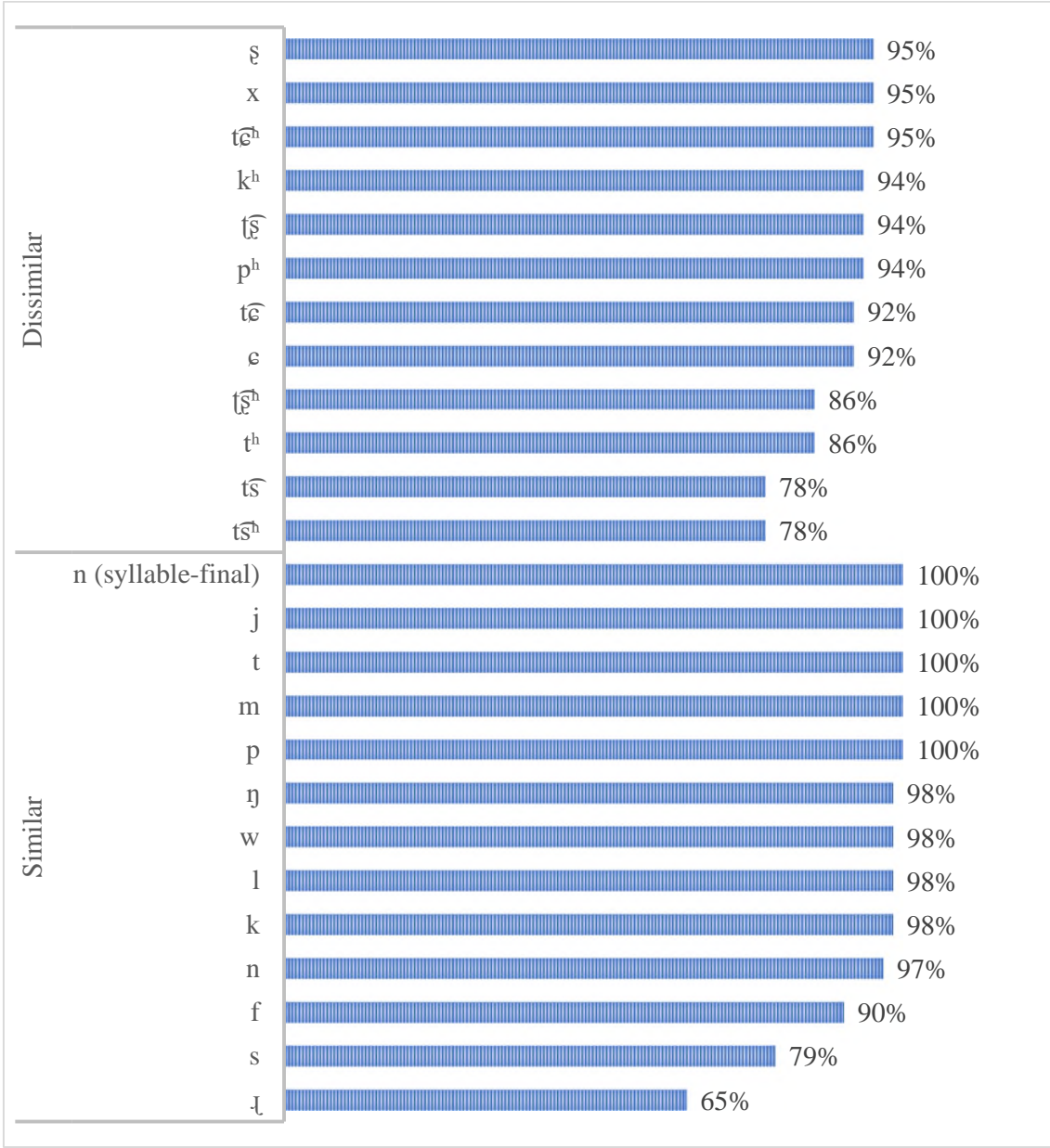
Measure	Initial model				Final model				Full model			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
(Intercept)	1.17	0.10	11.69	< .001	1.17	0.08	14.99	< .001	1.17	0.08	14.80	< .001
Age (months)	0.20	0.12	1.57	.12	-0.05	0.11	-0.50	.62	-0.05	0.11	-0.47	.64
Nonverbal working memory	0.22	0.12	1.90	.06	0.06	0.09	0.61	.54	0.05	0.10	0.47	.64
Difference in number of speakers (Mandarin vs. English)	-0.17	0.11	-1.55	.13	-0.08	0.10	-0.86	.40	-0.09	0.10	-0.89	.38
Difference in number of native speakers (Mandarin vs. English)	0.00	0.10	0.02	.99	-0.11	0.09	-1.23	.22	-0.11	0.09	-1.23	.22
English articulation	—	—	—	—	—	—	—	—	-0.07	0.11	-0.66	.51
English receptive vocabulary	—	—	—	—	0.37	0.09	3.98	< .001	0.36	0.10	3.56	< .001
Mandarin articulation	—	—	—	—	-0.19	0.09	-2.14	.04	-0.15	0.11	-1.33	.19
Mandarin receptive vocabulary	—	—	—	—	—	—	—	—	0.05	0.12	0.38	.71
Mandarin receptive grammar	—	—	—	—	0.28	0.10	2.88	.01	0.26	0.11	2.24	.03
R^2	.17				.52				.53			
Adjusted R^2	.11				.46				.45			

Note. Z scores were used for measures. Dependent variable is the square root of TROG-2 raw scores.

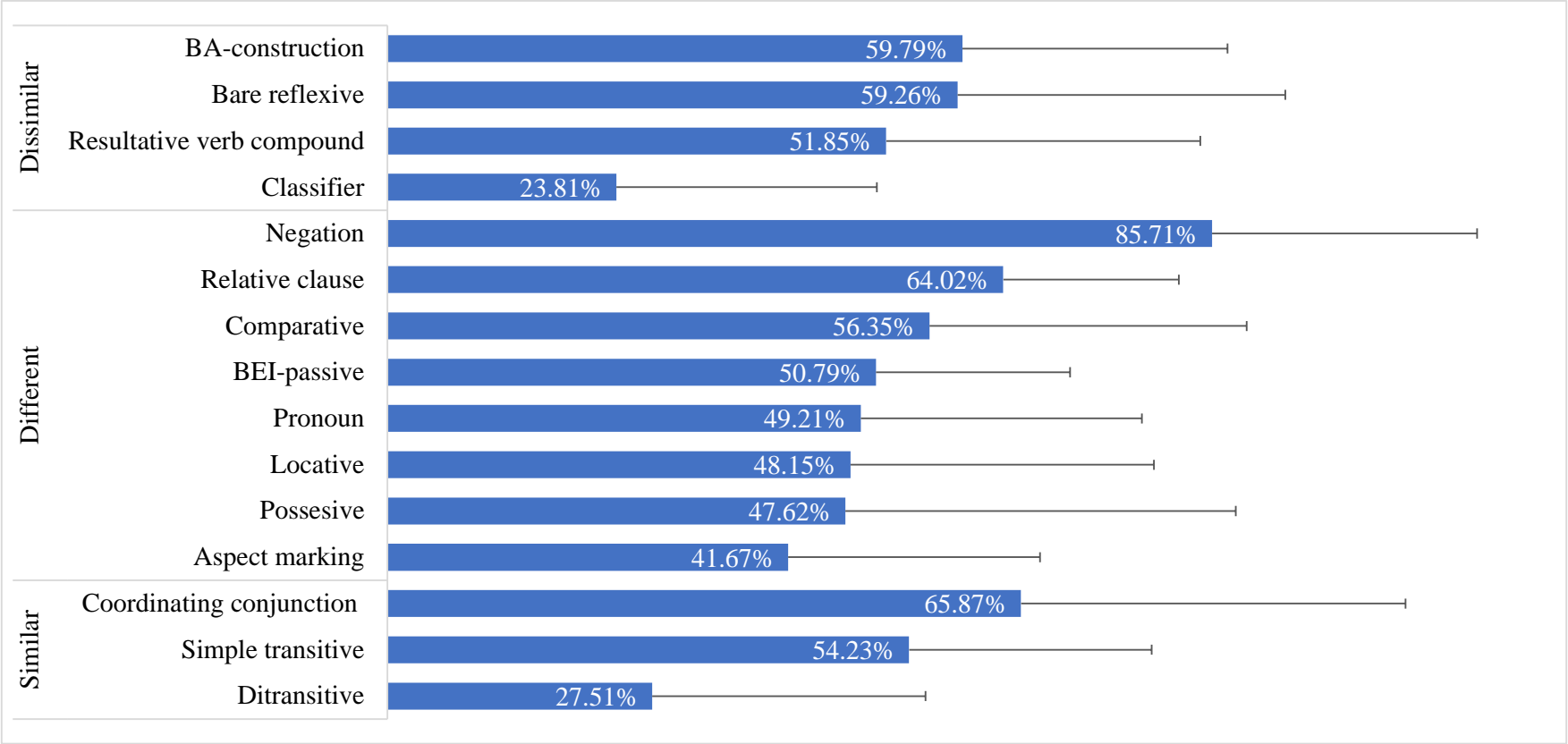
Supplemental Material S12. Linear regression results for Mandarin receptive grammar in 63 Mandarin–English bilingual children.

Measure	Initial model				Final model				Full model			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
(Intercept)	1.93	0.09	21.85	< .001	1.93	0.07	27.31	< .001	1.93	0.07	26.64	< .001
Age (months)	0.12	0.11	1.11	.27	0.07	0.09	0.73	.47	0.08	0.10	0.79	.43
Nonverbal working memory	0.22	0.10	2.16	.03	0.02	0.09	0.18	.86	0.02	0.09	0.19	.85
Difference in number of speakers (Mandarin vs. English)	0.10	0.10	1.01	.32	-0.02	0.09	-0.24	.82	-0.02	0.10	-0.22	.83
Difference in number of native speakers (Mandarin vs. English)	0.24	0.09	2.64	.01	0.19	0.07	2.54	.01	0.20	0.08	2.52	.01
Mandarin articulation	—	—	—	—	—	—	—	—	0.05	0.10	0.44	.66
Mandarin receptive vocabulary	—	—	—	—	0.41	0.10	4.26	< .001	0.42	0.10	4.18	< .001
English articulation	—	—	—	—	—	—	—	—	0.00	0.10	0.01	1.00
English receptive vocabulary	—	—	—	—	—	—	—	—	0.00	0.11	-0.04	.97
English receptive grammar	—	—	—	—	0.20	0.08	2.51	.02	0.22	0.10	2.09	.04
R^2	.31				.57				.58			
Adjusted R^2	.26				.53				.5			

Note. Z scores were used for measures. Dependent variable is the square root of MRGT raw scores.



Supplemental Material S5. Percentage of Mandarin–English bilingual children ($N = 63$) producing accurate articulation of individual consonants in the Mandarin Articulation Test (MAT). “Similar” refers to consonants that are phonetically similar between Mandarin and English; “Dissimilar” refers to consonants that are unique to Mandarin and unattested in English.



Supplemental Material S6. Accuracy rates of structures tested in the Mandarin Receptive Grammar Test (MRGT) among 63 Mandarin–English bilingual children, categorized by grammatical construction type. “Similar” refers to Mandarin constructions with closely matched structural counterparts in English, including word order and form. “Different” denotes Mandarin constructions with structural equivalents in English that exhibit variations in form. “Dissimilar” applies to unique Mandarin constructions lacking structural parallels in English.