

Speech Sound Development in Typically Developing 3-year-old Bilingual Spanish–English Children

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May, 2011

INTRODUCTION

According to the United States Census Bureau (2010) for the years 2006-2008, just over 34 million people—over 12% of the United States population—spoke Spanish in the home. With the prediction that the Hispanic population (of any race) will grow just under 80 million by 2025 (United States Census Bureau, 2009), the number of Spanish–English bilingual children is also forecast to increase.

Information about typical speech sound development in bilingual children is under-represented in the field of speech-language pathology. This gap in research, coupled with a lack of normative data, and the common clinical practice of comparing bilingual speakers with monolingual speakers has led to frequent misidentification of speech sound disorders in bilingual children (Gutierrez-Clellan & Peña, 2001).

Research has demonstrated that bilingual children show differentiation between their two phonological systems from a young age (Genesee, Nicoladis, & Paradis, 1995; Pearson, Navarro, & Gathercole, 1995); however, it has been widely established that these systems interact, and thereby produce a different path of language acquisition compared to the monolingual child. Paradis and Genesee (1996) proposed several characteristics of interaction: “transfer” (the use of language-specific components in the language where these components are not used), “delay” (slower rate of acquisition) and “acceleration” (faster rate of acquisition).

While the concept of transfer in bilingual children’s phoneme production has been widely substantiated in recent research, there remains debate over the concepts of slower acquisition and acceleration. Little research in this area has concentrated on the early developmental period.

PURPOSE

To determine whether acceleration and/or slower acquisition are present in typically developing three-year-old bilingual Spanish–English children’s phoneme productions through examination of:

1. Whether phoneme productions differ in accuracy when compared to typically developing monolingual peers.
2. Whether typically the same phonological error patterns are produced with the same rate of occurrence as typically developing monolingual peers.

METHOD

- Phoneme productions of 65 pre-school children were assessed in Spanish and English using the single word Spanish and English assessments from the Phonology and Articulation Bilingual Assessment (PABA, Gildersleeve-Neumann, 2011)
- Target words were elicited using picture stimulus and prompts such as “What is this?”, giving two choices, or using delayed or direct imitation
- Single word responses were transcribed by trained graduate and post-baccalaureate students from assessment recordings
- Transcriptions were analyzed by Logical International Phonetics Program software (LIPP, Oller & Delgado, 2000)

PARTICIPANTS

	Monolingual Spanish (MS)	Bilingual Spanish-English (BSE)	Monolingual English (ME)
Total	23	19	23
Males	10	8	9
Females	13	11	14
Age range	3;3 – 3;11	3;3 – 3;11	3;3 – 3;10

INDEPENDENT ANALYSIS

Phonetic inventory (including composite consonant inventory for bilingual children) analyzed for:

- consonant place and manner
- vowels

Calculation of percentage of children producing:

- full phonetic inventory in each language
- full vowel inventory in each language
- consonants in each place class in each language
- consonants in each manner class in each language

BILINGUAL GROUP COMPOSITE CONSONANT INVENTORY

	Bilabial		Labio-dental		Inter-dental		Alveolar		Post-alveolar	Palatal		Velar		Glottal	
Plosive	p	b					t	d				k	g	ʔ	
Nasal		m						n		ɲ		ŋ			
Tap/flap								ɾ							
Trill								r							
Fricative		β	f	v	θ	ð	s	z	ʃ			x	y	h	
Approximant		w								j		ɹ			
Lateral Approximant								l							

	Voiceless Affricate	Voiced Affricate
Additional Sounds	tʃ	dʒ

Percent Not Produced	Percent Produced

- 100% produced all stops
- Full velar, affricate, nasal, postalveolar, and bilabial inventories produced by over 90% of the group
- 82% produced a full vowel inventory; all participants produced all Spanish vowels
- Full alveolar inventory produced by 79% of the group
- Full fricative inventory produced by 50% of the group

ENGLISH PHONETIC INVENTORY

Percentage of group producing complete inventory in each category

	BSE	ME		BSE	ME
Consonant place:			Consonant manner:		
Bilabial	95	100	Oral stop	100	100
Labiodental	37	57	Nasal stop	84	100
Interdental	26	39	Glide	89	100
Alveolar	63	65	Fricative	11	22
Palatal	89	100	Liquid	89	65
Velar	89	100	Affricate	84	91
Complete vowel:	63	61	Complete consonant:	0	17

- Results similar
- Overall **ME** group produced **greater amount of consonants** in each manner and place category
- **BSE** group produced **more liquids**:
 - Bilingual- 89%
 - Monolingual- 65%
 - Produced more /ɹ/

SPANISH PHONETIC INVENTORY

Percentage of group producing complete inventory in each category

	BSE	MS		BSE	MS
Consonant place:			Consonant manner:		
Bilabial	100	96	Oral stop	100	96
Labiodental	100	96	Nasal stop	100	91
Interdental	95	78	Glide	100	96
Alveolar	53	30	Fricative	89	74
Palatal	100	96	Affricate	100	100
Velar	89	78	Liquid	100	100
			Trill	53	30
			Tap	100	91
Complete vowel:	100	100	Complete consonant:	53	30

- Results similar
- Overall **BSE** group produced **slightly greater amount of consonants** in each manner and place category
- Most markedly **BSE** group produced **more trills**:
 - Bilingual- 53%
 - Monolingual- 30%

RELATIONAL ANALYSIS

Accuracy: Mean and standard deviation (SD) calculated in each language group for:

- Percentage of Vowels Correct (PVC; Schriberg, 1993).
- Percentage of Consonants Correct (PCC; Schriberg, Austin, Lewis, McSweeney, & Wilson, 1997)

Between-subject effects of accuracy (delay or acceleration) between bilingual and monolingual children’s productions assessed with two separate t-tests with a Bonferroni correction (p<0.025):

- Main independent variable: Language
- Dependent variable: PVC, PCC

RESULTS

Accuracy: Spanish context

Analysis	Group: (mean/SD)	T-test result	Significance	Effect size
PCC	BSE: 78% / 10	t(40)=0.86, p=0.397	Not significant	Small
	MS: 75% / 12			
PVC	BSE: 90% / 7	t(39)=2.02, p=0.050	Not significant	Medium
	MS: 85% / 10			

Accuracy: English context

Analysis	Group: (mean/SD)	T-test result	Significance	Effect size
PCC	BSE: 74% / 10	t(40)=-2.25, p=0.03	Not significant	Medium
	ME: 81% / 11			
PVC	BSE: 73% / 11	t(38)=-4.0, p=0.0003	Significant	Large
	ME: 86% / 10			

Phonological Error Patterns:

28 commonly occurring consonant and vowel phonological error patterns were examined following the Gildersleeve-Neumann et al. (2008) model.

Between-subject effects of phonological patterns—occurring with greater than 5% frequency and 5% difference between occurrence in the bilingual and monolingual group—were examined with separate t-tests with a Bonferroni correction (Spanish context: $p < 0.017$, English context: $p < 0.0083$):

- Main independent variable: Language
- Dependent variable: Spanish Context: Cluster reduction, tap error, trill error
English Context: Cluster reduction, final consonant deletion, gliding, vocalization, tense/lax vowel error

RESULTS**Phonological Error Patterns: Spanish context**

Analysis	Group: (mean/SD)	T-test result	Significance	Effect size
Cluster Reduction	BSE: 24% / 14	t(40)=-1.23, p=0.225	Not significant	Small
	MS: 31% / 18			
Tap Error	BSE: 47% / 30	t(36)=-1.45, p=0.155	Not significant	Small
	MS: 60% / 26			
Trill Error	BSE: 68% / 35	t(30)=-1.99, p=0.056	Not significant	Medium
	MS: 86% / 23			

Phonological Error Patterns: English context

Analysis	Group: (mean/SD)	T-test result	Significance	Effect size
Cluster Reduction	BSE: 30% / 14	t(38)=3.09, p=0.0037	Significant	Medium
	ME: 18% / 13			
Final Consonant Deletion	BSE: 17% / 9	t(27)=4.34, p=0.0002	Significant	Large
	ME: 7% / 5			
Gliding	BSE: 13% / 17	t(39)=-1.92, p=0.062	Not significant	Small
	ME: 25% / 24			
Vocalization	BSE: 42% / 10	t(40)=-1.59, p=0.119	Not significant	Small
	ME: 48% / 14			
Vowel Error Tense/Lax	BSE: 10% / 6	t(25)=4.12, p=0.0004	Significant	Large
	ME: 3% / 3			

CONCLUSIONS

- **Little evidence** to conclude that **acceleration** is present in the Bilingual children’s speech-sound productions.
- **Some evidence** to suggest that **slower acquisition** is present in terms of **vowel accuracy** and complex **word shape** production in an **English context**.

CLINICAL SIGNIFICANCE

- **Composite accuracy scores** (PCC and PVC) were **slightly higher** than the **English context** accuracy scores and **slightly lower** than the **Spanish context** accuracy scores
- **SD** scores showed **large variability** in all groups
- Overall bilingual children demonstrated **similar accuracy in speech sound production**, and **similar phonological processes** compared to monolingual children
- In English context when compared to monolingual English children, typically developing 3 year-old bilingual Spanish-English children may produce:
 - **Consonants with slightly lower accuracy**
 - **Vowels with significantly lower accuracy** (possibly due to the less complex Spanish vowel system which has only 5 tense vowels)
 - **More tense/lax vowel errors** (possibly due to the less complex Spanish vowel system which contains only tense vowels)
 - **Greater frequency** of word shape error patterns, such as **cluster reduction** and **final consonant deletion** (possibly due to interference of Spanish phonotactic rules where consonant clusters occur less frequently than in English and where only 5 consonants /s l d n r/ are permitted in word final contexts)

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