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ABSTRACT

This study is a detailed analysis of the phonological development of Sylvia, a bilingual child, in her acquisition of American English and Brazilian Portuguese from the age of 1 year, 7 months to 3 years, 8 months. The study is divided into four stages: ages 1.7 - 1.9; 1.9 - 2.1; 2.1 - 2.3; and 2.3 - 2.8. Up to the age of 1.9, the same phonological substitutions applied to Sylvia's production of phonetically identical segments in both English and Portuguese. After the age of 1.9, phonological differentiation developed, and with it a distinct set of substitutions became associated with each language. Although this study involves only one child, it does suggest that child phonology can reveal significant things about the adult system. It also suggests that the two languages have quite different trends for future change. Evidence for this can be found from dialect comparisons as well as from Sylvia's different treatment of the two languages. Perhaps a language's tendency toward a specific type of change is governed by a language specific speech posture and a specific set of phonological processes which is a natural consequence of such a posture. (Author/CFM)

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Phonological Differentiation of a Bilingual Child

Roy C. Major

0. Introduction

0.1. Scope and Purpose

Although previously there have been many studies of bilingual children, none deal extensively with the way surface phonetic realizations of the two phonological systems become separate or differentiated. This study will concentrate on the mechanisms by which the systems become differentiated with respect to language and will suggest some reasons why the substitutions take the form they do. The study is based on my analysis of the phonological development of my daughter Sylvia in her acquisition of American English and Brazilian Portuguese from the age one year seven months to two years eight months.

I will deal with the issue of whether a bilingual child has one or two phonological systems. Up to the age of 1;9 (referred to here as Stage I), the same phonological substitutions apply to her production of phonetically identical segments in either language. After the age of 1;9 (referred to as Stages II, III, and IV), very different substitutions affect identical segments of her English and Portuguese. This paper describes Sylvia's phonological differentiation of English and Portuguese and why it takes the form it does.

Many of her English substitutions occur in various English dialects which she has not heard, and many of her Portuguese substitutions occur in various Portuguese dialects (which likewise she had not heard). Her speech seems to reflect what Sapir has called the distinct "genius" of each language--a genius which guides the unique historical "drift" of each language.

0.2. Theoretical Framework.

The theoretical framework employed in this study is David Stampe's natural phonology theory (Stampe 1969, 1973) which postulates a system of phonological processes motivated by innate limitations of the speech capacity. According to this theory, during acquisition the child's mental representation of speech is approximately identical to the adult's. However, due to natural phonological processes reflecting limitations of phonetic capabilities, pronunciation is often very different from the adult. These processes typically fall into opposing pairs: the syntagmatic processes which make sequences of segments easier to pronounce (e.g., the voicing of obstruents in voiced environments eliminates the adjustment of the glottis from voiced to voiceless and back again), and the paradigmatic processes which make individual segments to perceive and often easier to pronounce (e.g., the devoicing of obstruents increases their

perceptual distinctness from vowels and also eases the pronunciation since their oral stricture impedes the air flow which is necessary for voicing). In order to achieve adult pronunciation the child must suppress, limit, or order those processes of the innate system which are not identical to the system of adult speakers of the language.

Some general processes affecting consonants are:

Paradigmatic

(a) Obstruents become voiceless
[+obs] → [-voi]

(b) Obstruents become stops
[+obs] → [+stop]

(c) Anterior coronal consonants become laminal

$$\begin{bmatrix} +\text{anterior} \\ +\text{coronal} \end{bmatrix}^{C} \rightarrow [+\text{laminal}]$$

Syntagmatic

(d) Obstruents become voiced in voiced environments
[+obs] → [+voi]/[+voi]

(e) Obstruents become continuants after vowels
[+obs] → [+cnt]/V____

(f) Sonorants become nasalized in nasal environments
[-obs] → [+nasal]/[+nasal]

Sylvia's speech production is often characterized by much greater effort than an adult, involving relatively greater subglottal pressure as well as greater muscular force in the oral cavity. Process (c) above, which laminalizes anterior coronal consonants, is one possible realization of the tendency to overarticulate or hyperarticulate. If the child uses great force in his articulation of an anterior coronal consonant (such as a dental or alveolar involving the apex or the front laminal region of the tongue), a large portion of the lamina will tend to be forced upward and to make contact with hard palate. This could be because of inertia or because the child is unable to concentrate the force exclusively at the front portion of the tongue. The tendency for children to palatalize dentals noted by Jakobson (1968:78) is quite likely a consequence of hyperarticulation. Sylvia's l is somewhat palatal, but this is because it is a laminally articulated lateral that is simultaneously dental, alveolar, and palatal.

Hyperarticulation is also evident in Sylvia's production of /p/ and /k/. Because of the high pressure in the oral cavity the articulators frequently slip, allowing air to leak out before the closure is willfully released. This results in a very tight bilabial trill in the case of /p/ (although it is definitely not the affricate [pΦ]), and an affricate [kx] for /k/. The non-existence of [+θ] for /t/ is probably due to the fact that the mass of the tongue involved for the production of /t/ is much less than for that of /k/.

The following processes affecting vowels are the result of the work of Patricia Donegan (Donegan, forthcoming, and Miller 1973). The following terminology is employed: color (or chromatic) = palatal and/or labial; palatal = front; labial = round; achromatic = -palatal and -labial; bleach = loss of color; tense = intense color (as in [i] vs. [ɪ]; achromatic vowels, e.g., [ɨ], are therefore always -tense); ! = especially. "!" has a specific meaning in terms of implicational hierarchy. For example, in (g) below !lower means that if the process affects high or mid vowels, it necessarily affects any low vowels, but if the process affects low vowels it does not necessarily affect mid or high vowels. That is, mid, high ⊃ low, but low ⊅ mid, high.

Paradigmatic

(g) bleaching

Syllabics which are especially low, bi-colored, short, unstressed, and lax lose their palatality and/or their labiality, especially in the environment of vowels of the same color.

$$\begin{bmatrix} +\text{syl} \\ !\text{lower} \\ !\text{bicolored} \\ !\text{short} \\ !\text{unstressed} \\ !\text{lax} \end{bmatrix} \rightarrow \begin{bmatrix} \text{-pal and/or} \\ \text{-lab} \end{bmatrix} / \begin{bmatrix} \text{same} \\ \text{color} \end{bmatrix} \quad (!\text{V})$$

(h) coloring (palatalization)

Non labial syllabics which are especially high and stressed become palatal, especially in the environment of labial vowels.

$$\begin{bmatrix} +\text{syl} \\ \text{-lab} \\ !\text{higher} \\ !\text{stressed} \end{bmatrix} \rightarrow [+\text{pal}]/[+\text{lab}] \quad (!\text{V})$$

(i) coloring (labialization)

Non palatal syllabics which are especially high and stressed become labial, especially in the environment of palatal vowels.

$$\begin{bmatrix} +\text{syl} \\ \text{-pal} \\ !\text{higher} \\ !\text{stressed} \end{bmatrix} \rightarrow [+\text{lab}]/[+\text{pal}] \quad (!\text{V})$$

(j) raising

Chromatic syllabics which are especially tense, low, and short are raised, especially in the environment of achromatic or lax vowels.

$$\begin{bmatrix} +\text{syl} \\ +\text{chrom} \\ !\text{tense} \\ !\text{lower} \\ !\text{short} \end{bmatrix} \rightarrow [\text{higher}] / \begin{bmatrix} \text{achromatic} \\ \text{or lax} \end{bmatrix}$$

(k) lowering

Syllabics which are especially chromatic, lax, bi-colored, and long are lowered especially in the environment of tense chromatic non-syllabics.

$$\begin{bmatrix} +\text{syl} \\ !\text{chromatic} \\ !\text{lax} \\ !\text{bicolored} \\ !\text{long} \end{bmatrix} \rightarrow [\text{lower}] / \begin{bmatrix} +\text{chromatic and} \\ +\text{tense} \\ -\text{syl} \end{bmatrix}$$

(l) vowel denasalization

Vowels become denasalized.

$V \rightarrow [-\text{nas}]$

As specified above, the paradigmatic processes, if they do not apply regardless of context, may apply dissimilatively. Thus, in (g) above, bleaching is especially likely in vowels adjacent to glides of the same color; e.g., [iu̯] → [i̯u̯] ⊃ [uu̯] → [i̯u̯].

Syntagmatic

(m) assimilation in terms of color

$$V \rightarrow [\alpha\text{color}] / [\alpha\text{color}]$$

examples: [eu] → [ø] (French)
[ɑu] → [ʊu] (Portuguese Paulo)

(n) assimilation in terms of height

$$V \rightarrow [\alpha\text{height}] / [\alpha\text{height}]$$

example: [ɑu/ɑo] → [o] (French au)

(o) vowel nasalization

$V \rightarrow [+\text{nas}] / [+\text{nas}]$

0.3. Brief History of Sylvia's Language Exposure.

Sylvia was born in Rio de Janeiro, GB, Brazil where she lived until the age of 1;2. During this period her Brazilian mother

and I (an American) both talked to her exclusively in Portuguese. The only exposure to English she received was through overhearing my wife and me converse in English (the language we usually use together). After we moved to the U.S. (when Sylvia was 1;2), I starting talking to her mostly in English while her mother has continued in Portuguese. Up to approximately 1;8 Sylvia was cared for at home by us. From 1;8 to 2;1 she was cared for by another Brazilian for about four hours a day. Since 2;1 Sylvia has been attending a day care center run by the Ohio State University. She has no siblings.

Even though Sylvia is exposed to Portuguese every day and understands it well, at present she has largely dimished her use of Portuguese in favor of English. Even when spoken to by monolingual Brazilian children she frequently responds in English.

0.4. Procedures and Notations.

Through my daily interactions with Sylvia which were at least two hours in length, I collected data by transcribing on the spot. Although I did not transcribe every day, since often there was no observable change from one day to the next, when a change did occur I took note of it. In addition to these transcriptions and daily observations I made tape recordings at irregular intervals at all Stages. The total tape time was approximately five hours.

The consonant symbols employed in this paper are those used by the IPA, except where stated otherwise. The vowel symbols used her and their classification is slightly different, especially in terms of height. The tense/lax distinctions apply only to mid and high front and back vowels (not central or low vowels). [C̰] indicates any laminal consonant; it is really simultaneously dental, alveolar, and palatal. (See above for discussion on overarticulation).

		Front		Central		Back	
		unr	rnd	unr	rnd	unr	rnd
High	tense	i	y	ɨ	ʉ	ɯ	u
	lax	ɪ					ʊ
Mid	tense	e	ø	ə	ɵ	ɣ	o
	lax	ɛ		ʌ			ɔ
Low		æ					
		a				ɑ	ɒ

A segment in "syllable onset" and "syllable offset" refers to the position of the segment in the syllable. Thus, the r's in spray, pray, and ray occur in the syllable onset and will be represented as /.(C)(C)____, while the r's in for, Ford, and Fords occur in the syllable offset and correspondingly will be represented as /____(C)(C).

In some cases a process occurring at one Stage carries over to the following stage. Thus, a process of an earlier stage which

is not mentioned at a later stage has remained the same.

0.5. Appendixes.

Appendix A contains a list of some irregularities, assimilation, consonant and vowel harmony, and metatheses. Appendix B contains a list of Portuguese phonemes with some very brief comments about dialect variation.

1. Stage I: Ages 1;7-1;9.

Sylvia's speech at this stage consists mostly of one and two word utterances, the two word utterances often containing one Portuguese and one English word. The processes are thus far sufficiently general that they apply to phonetically identical segments in both languages.[2] Thus, there is evidence at this stage that Sylvia does not differentiate phonologically between the two languages.

1.1. Obstruents.

(1) A neutral vowel schwa ([ə]) may be added to a vowel final voiced stop. If the schwa does not occur, the stop is devoiced by (2) below.

$$\text{OPT } \emptyset \rightarrow \begin{bmatrix} V \\ -\text{chrom} \\ -\text{low} \end{bmatrix} / \begin{bmatrix} -\text{cnt} \\ +\text{voi} \end{bmatrix} \text{\_\_\_\_} \#$$

[pɪgə] ~ [pɪk] pig

(2) Obstruents are devoiced in word final position. This process is obligatory if (1) has not applied. In initial and medial positions voiced/voiceless obstruents contrast.

[+obs] → [-voi]/____ #

	[pis]	please
	[dɔk]	dog
but	[papa]	Portuguese papa 'eat, food'
	[baba]	baba(dor) 'bib'

(1) bleeds (2) but (1) does not imply that the release of the stop triggers schwa insertion becuase stops can be devoiced regardless of whether they are released or not. It seems then that schwa insertion prevents devoicing.

(3) A voiced velar stop optionally becomes a continuant intervocalically.[3]

$$\text{OPT} \begin{bmatrix} +\text{obs} \\ +\text{velar} \\ +\text{voi} \end{bmatrix} \rightarrow [+\text{cnt}] / V\_\_\_V$$

[dɔgi] ~ [dɔɣi]	doggie
but [kuki]	cookie

Thus, the process of voicing in voiced environments, ((d) in section 0), has been completely suppressed and (e), (spirantization of obstruents after vowels), has been limited to intervocalic voiced velar stops--phonetically plausible because there is a larger mass of the tongue involved than with dental or alveolar stops. (a) (devoicing of obstruents), has been limited to word final position. Devoicing of word final obstruents may also be viewed as assimil tion, i.e., [+obs] → [-voi]/____[-voi].

(4) Affricates become stops. This is a limitation of (b) in which all obstruents become stops.

[-cnt] → [-delayed release]

[tɑu̯]	tchau [tʃɑu̯] 'tchau, bye'

(5) Anterior coronal consonants (except flaps) become laminal. (This is (c) above. Also see discussion on overarticulation).

$$\begin{bmatrix} +\text{anterior} \\ +\text{coronal} \end{bmatrix}^{C} \rightarrow [+\text{laminal}]$$

The point of articulation for these laminal consonants cover a broad region which extends from the teeth to the beginning of the hard palate. The somewhat palatal sounding character of these consonants (especially for l) reflects their laminal nature. ([C̟] indicates any laminal consonant).

[t̟ɔi̯]	toy

(6) Anterior coronal stops become affricated before high front vowels.[4]

$$\begin{bmatrix} +\text{ant} \\ +\text{cor} \\ -\text{cnt} \end{bmatrix}^{C} \rightarrow [+\text{del rel}] / \_\_\_\_ \begin{bmatrix} +\text{high} \\ +\text{front} \end{bmatrix}^{V}$$

[tʃis]	cheese, teeth
[tʃitʃiʌ]	titia [tʃitʃiʌ] 'aunty'[5]

(7) Interdental fricatives become labiodental. There are examples for initial and final positions but no words with intervocalic [θ] and [ð] occurred in Sylvia's vocabulary. I assume these would have been treated the same way.

$$\begin{bmatrix} +obs \\ +cnt \\ +dent \\ -sib \end{bmatrix} \rightarrow [+lab]$$

[baˁf]	bath
[vaˁf]	that

(8) Dental fricatives become sibilants when adjacent to high front vowels.

$$\begin{bmatrix} +obs \\ +cnt \\ +dent \end{bmatrix} \rightarrow [+sib] / \underset{\begin{bmatrix} +high \\ +front \end{bmatrix}}{V}$$

[tʃis]	teeth
[kɔsi]	coffee
contrast [gaʃu] and examples under (7)	garfu [gaχfu] 'fork'

Sylvia's pronunciation of her name is especially illustrative of (8).

[siɰvʌ] ~ [sizʌ]	Sylvia

(note *[siɰzʌ] and *[sivʌ] don't occur).[6]

1.2. Sibilants and Shibilants.

Because no conclusive minimal pairs occur, I am reluctant to say [s] and [z] contrast with [ʃ] and [ʒ] respectively. I do, however, suspect they are beginning to become separate since Sylvia's sibilants have a slight whistling sound of a much higher frequency to the ear than do her shibilants. This slight difference continues through Stage IV when even at this late stage the sibilant/shibilant difference is not nearly as great as it is in adult English and Portuguese.[7]

(9) When [s] occurs before a consonant in syllable onset it optionally syllabifies (or it deletes as in (10) below. (In Portuguese there are no tautosyllabic sequences of s plus consonant).

OPT [+sib] → [+syl]/.____C

[stʌɾ'i] ~ [tʌɾ'i]	study
[spun] ~ [pun]	spoon

(10) If s does not syllabify before a consonant in syllable onset it deletes. Thus, (9) bleeds (10). (See (9) above for examples.)

$$\begin{bmatrix} +sib \\ -syl \end{bmatrix} \rightarrow \emptyset / .\_\_\_\_C$$

(11) Voiceless stops are optionally aspirated in either language. (In adult Portuguese voiceless stops are unaspirated).

OPT $\begin{bmatrix}-\text{cnt}\\-\text{voi}\end{bmatrix} \rightarrow$ [+aspirated]

[kok] ~ [k^hok]	Coke
[papa] ~ [$p^h ap^h a$]	papa 'food, eat'
[pun] ~ [p^hun]	spoon
[taụ] ~ [t^haụ]	tchau

(12) Glottal and uvular fricatives are deleted everywhere.[8]

$$\begin{bmatrix}\text{C}\\-\text{ant}\\-\text{cor}\\+\text{cnt}\end{bmatrix} \rightarrow \emptyset$$[9]

[aị]	hi
[pɔtʌ]	porta [pɔxtʌ] 'door'

1.3. Liquids[10]

(13) Liquids (except flaps) in syllable offset are optionally deleted.

$$\text{OPT} \begin{bmatrix}\text{C}\\+\text{liq}\\-\text{flap}\end{bmatrix} \rightarrow \emptyset / \_\_\_\_ (\text{C})(\text{C}).$$

[bɛ]	bear
[mɔ]	more
[bɔ]	ball

(14) Syllable offset laterals (except flaps) are obligatorily delateralized, leaving behind a non-syllabic back rounded vowel.

$$\begin{bmatrix}+\text{lat}\\-\text{flap}\end{bmatrix} \rightarrow [-\text{lat}] / \_\_\_\_ (\text{C})(\text{C}).$$

[mɪụk][11]	milk

(15) American English r in syllable offset is optionally deretroflexed, leaving its labiality.

OPT [+retroflex][12] → [-retroflex]/____(C)(C).

[taịgə] ~ [taịgɚ]	tiger
[bəɾ'i] ~ [bɚɾ'i]	birdie

Laterals in syllable onset become laminal (as do other anterior, coronal consonants, specified in process (5)). Laterals in this position have a very definite palatal or "clear" quality to them, but they are not as palatal as the adult Portuguese /ʎ/. To the ear they are intermediate between /l/ and /ʎ/.

[l̪aịt]	light
[bo.l̪u][13]	bolo 'cake'

(16) American English r in syllable initial position

deretroflexes, leaving a slightly palatal, roundea non-syllabic, which may be represented as [y̯] or [ø̯].

[+retroflex] → [-retroflex]/.____

[y̯ɑky̯ɑk]	rock rock

(17) Non-nasal flaps become non-flapped laterals.[14]

$$\begin{bmatrix}+\text{flap}\\-\text{nas}\end{bmatrix} \rightarrow \begin{bmatrix}+\text{lat}\\-\text{flap}\end{bmatrix}$$

[pɑl̯ɑl̯ɑ][15]	arara [ɑrɑrʌ] 'macaw'
[nkɛlu]	não quero 'I don't want (it)'
but [ɑfɑ̃ũɾɪ]	I found it
[kɑ̃ɾɾɪ̃]	candy

Especially at later stages, the lateral which is substituted for a flap is much more lenis than the lateral which is substituted for /l/ or /ʎ/. This indicates that the processes are ordered (5) then (17). [kɛl̯u] at a later stage becomes [kɛlu].

(18) Non-nasal flaps become lateral flaps when adjacent to high front vowels.

$$\begin{bmatrix}+\text{flap}\\-\text{nas}\end{bmatrix} \rightarrow +\text{lat} / \underset{\text{V}}{\begin{bmatrix}+\text{high}\\+\text{front}\end{bmatrix}}$$

[kɪɾˈi]	kitty

At 1;8, when Sylvia deleted flaps, kitty was pronounced [ki:]. By 1;9 the process had been suppressed.

(19) Liquids in syllable onset consonant clusters are deleted.

[+liquid] → ∅/.C(C)____

[pis]	please
[bɑsu]	braço [brɑsu] 'arm'
[tʃi]	tree

1.4. Nasals

(20) Nasal consonants nasalize adjacent sonorants.

[-obs] → [+nas]/[+nas]

[nɪ̃]	knee
[fɪ̃ŋgə]	finger
[mɔ̃ɾ̃ɾɪ̃ŋ]	morning

In adult English and Portuguese this process is limited to sonorants preceding the nasal segment. At 1;9 Sylvia has not limited it, but rather it applies to segments preceding or following the nasal. At Stage II nasalization has been limited to a regressive manner.

(21) Nasal consonants optionally delete before obstruents (leaving behind their nasality, as specified by (20)).

$$\text{OPT} \quad [+\text{nas}] \rightarrow \emptyset / \underset{C}{\_\_\_\_} [+\text{obs}]$$

[fɪŋgə] ~ [fɪgə]	finger

(22) Short vowels are optionally denasalized.[16]

$$\text{OPT} \quad [+\text{short}] \rightarrow [-\text{nas}] \quad (\text{V})$$

[dʌp] ~ [dʌ̃p] ~ [dʌ̃mp]	jump
[mʌki]	monkey
but [fɪgə] (never *[fɪgə̃])	finger

1.5. Vowels.

At this stage I shall limit the discussion to some general observations, due to the high frequency of variation. Thus, for process (23) below, variation occurs within the range between the adult representation and the output produced by the process. For example, (23) can bleach [æ] to [ɑ] but also various intermediate variants occur, namely [a] (a laxer front vowel than [æ]) and [ɑ˂] (a low central vowel).

Paradigmatic Processes

(23) Low and mid lax vowels are optionally bleached. (See section 0 for definitions of terms).

$$\text{OPT} \quad \left\{ \begin{matrix} \text{V} \\ [+\text{low}] \\ \left[\begin{matrix} +\text{mid} \\ -\text{tense} \end{matrix} \right] \end{matrix} \right\} \rightarrow [-\text{chrom}]$$

[bæf] ~ [bɑ˂f]	bath
[mɔ] ~ [mʌ˃][17]	more
[mɑrsɛlo] ~ [mɑrsɑlo]	Marcello [mɑrsɛlo]
[ɛu̯zʌ] ~ [ɑu̯zʌ][18]	Elza
[kɑu̯][19]	cow

Bleaching does not occur for high and mid tense vowels.

[kek]	cake
[kok]	Coke

Syntagmatic Processes

Vowels tend to assimilate in terms of height and color. These processes have been limited as follows:

(24) Diphthongs with members having the same color monophthongize (assimilate in terms of height), the non-syllabic assimilating to the syllabic.

$$\begin{bmatrix} V \\ -syl \\ \alpha color \end{bmatrix} \rightarrow [\beta height] / \begin{bmatrix} +syl \\ \alpha color \\ \beta height \end{bmatrix} \_\_\_\_$$

[keik] → [kek]	cake
[kouk] → [kok]	Coke
[bɔ̂l] → [bɔu̯] → [bɔ]	ball

At 1;7 two chromatic vowels of the same height were optionally assimilated in terms of frontness.

[mɪlk] → [mɪu̯k] → [mɪɯk] → [mɨk] milk

At 1;8 only [mɪu̯k] occurred.

(25) A neutral vowel plus a labial glide, i.e., [əu̯], assimilate to [ɵ].[20]

$$\begin{bmatrix} V \\ -chrom \\ -low \end{bmatrix}_1 \begin{bmatrix} V \\ +lab \\ -syl \end{bmatrix}_2 \rightarrow [+lab]\ \emptyset \qquad 1\ 2$$

(14) (21) (25)

[pɛ̃nsəl] → [pɛ̃nsəu̯] → [pɛ̃səu̯] → [pɛ̃sɵ] pencil[21]

(15) (25)

[taigər] → [taigəu̯] → [taigɵ] tiger

Other diphthongs do not assimilate.

[baibai]	bye bye
[kau̯]	cow
[dɔdɔi]	dodói [dɔdɔi] 'it hurts'

2. Stage II: Ages 1;9-2;1.

During this period Sylvia's utterances extend to two and three or more words. Although many are mixed (e.g., "Deixa alone my cocô mine", 'Leave my poo poo alone'), she has apparently become partially aware that there are differences between the two languages. On several occasions I asked her the same question successively in Portuguese and then in English. The responses were negative in both cases but she used the Portuguese negative when responding to the Portuguese question and the English negative when answering the English question.

"Você quer leite?" "Não." [nɐ̃ũ̯]
"Do you want some milk?" "No." [nou̯]

That the phonological processes are just beginning to become differentiated with respect to language is observable in affricate substitution and monophthongization of vowels. In the following, processes retained unchanged from Stage I are not mentioned.

2.1. Obstruents

Process (1), optional schwa release after voiced stops, persists although (2), devoicing of word final obstruents, has been suppressed.

[pɪg] ~ [pɪgə] (not *[pɪk]) pig

Affrication of anterior coronal stops before high front vowels, process (6), becomes optional in English, but remains obligatory in Portuguese (as it does in many adult dialects).

[t͡ʃis] ~ [tis] teeth
[t͡ʃit͡ʃiʌ] titia 'aunty'

Process (7), which substitutes labial fricatives for dental fricatives, has been modified. Initially before r, which Sylvia pronounced [ɣ], dental fricatives become labiodental or even bilabial.[22] (Cf. Stage III when they become stops). Otherwise they become stops, which before [ɣ], are optionally palatalized by (6).

[fɣi] ~ [Φɣi] ~ [tɣi] ~ [t͡ʃɣi] three
[fɣutlups] ~ [Φɣutlups] Froot Loops
[tæŋkju] thank you
[dæt] (formerly [væt]) that

Finally, they become labiodental or the lax post-dental, slightly lisped s [s̪]--an ungrooved or very slightly grooved laminal fricative which Sylvia frequently substitutes for the adult sibilant.

[maʊf] ~ [maʊs̪] mouth

These processes can be described as follows:

(26) $\begin{bmatrix} +obs \\ +cnt \\ +dent \\ -sib \end{bmatrix} \rightarrow \left\{ \begin{array}{l} [+lab]/\_\_\_\_[+lab]\ OPT \\ [-cnt]/.\_\_\_\_ \\ \left\{ \begin{array}{l} [+lab] \\ [-dent] \end{array} \right\} OPT\ /\_\_\_\_. \end{array} \right\}$

(27) OPT [+lab] → [-dent]/____[+rnd]

Processes (9) and (10), which syllabify or delete sibilants in syllable onset, have been suppressed, enabling tautosyllabic sequences of sibilant plus stop to be realized as one syllable.

[spun] (formerly [spun] or [pun]) spoon

2.2. Liquids.

Processes (17) and (18), which lateralize flaps, still operate, but when a word is pronounced in a slow prolonged manner, with

nearly equal stress on the syllable preceding (or including) and following (or including) the flap, the flap is realized as a voiced, laminal stop, instead of a lateral. Thus, (28) below bleeds (17) and (18).

(28) OPT [+flap] [+stop]

[wɔ́lə̌r] ~ [wɔ́d̪ə́r]	water
[pà̰lá̰lã̌] ~ [pà̰d̪á̰d̪á̰]	arara 'macaw'
[nə̃ũ̯kɛ́lũ] ~ [nə̃ũ̯kɛ́d̪ù]	não quero 'I don't want (it)'

Deletion of liquids in syllable onset cluster, (19), has been partially suppressed in the following manner:

(29) Liquids in syllable onset consonant cluster are delaterализed, deretroflexed, and deflapped, leaving behind a round glide [u̯] or [y̯].

$$[+liq] \rightarrow \begin{bmatrix} -lat \\ -retro \\ -flap \end{bmatrix} / .C(C)\_\_\_\_$$

[puiz]	please
[tʃyi]	tree, three
[gu̯ə̃ndʒi] ~ [gɣə̃ndʒi][23]	grande 'big'
[bu̯asu] ~ [bɣasu]	braço 'arm'

American r in syllable offset is now pronounced everywhere, i.e., (13) and (15) have been suppressed. Laterals are still delateralized as specified in (14).

	[taigə] (not *[taigə])	tiger
	[kard]	card
but	[mɪu̯k]	milk
	[bɔu̯]	ball

2.3. Nasals

Process (22), denasalization of short vowels, has been suppressed.

[dʌ̃mp] ~ [dʌ̃p] (not *[dʌp])	jump

Progressive and regressive nasalization, (20), has been limited to regressive (as it is in adult English and Portuguese).

(30) [-obs] → [+nas]/____[+nas]

[nou̯] (formerly [nõ])	no
[spũn]	spoon
[mɛu̯/meu̯]	meu 'my, mine'

2.4. Vowels

Diphthongs of the same color in English no longer monophthongize, i.e., (24) has been suppressed.[24] For Portuguese utterances, (24) remains optional through Stave IV.

[keik] (not *[kek])	cake
[nou]	no
[bɔu]	ball
[bouʃʌ] ~ [boʃʌ]	bolsa [bouʃʌ] 'purse'

Process (25), which substitutes [ɵ] for [əu], has been suppressed.

[pɛ̃səu] (not *[pɛ̃sɵ])	pencil

(note: *[taigɵ] is no longer possible for tiger since syllable offset r is now always pronounced).

3. Stage III: Ages 2;1-2;3.

The utterances at this stage consist mainly of three or more words with very few mixed utterances. ("Quero mamãe" but "I want Mommy"). During this period the phonological processes become even more differentiated with respect to language. Voiceless stops, liquids, as well as the vowels begin to be realized differently in the two languages, indicating the systems are becoming separate. This phonological differentiation appears gradually and can proceed as follows: For segments in which there exists an alternation between the correct (i.e., the adult) and the incorrect pronunciation, the incorrect variant is gradually eliminated, while the correct one persists. This differentiation is readily observable in the case of aspiration of voiceless stops. In Stage I aspiration of voiceless stops was random in both languages, but by Stage III aspiration has been virtually eliminated in Portuguese (as it is in adult speech) while in English it frequently occurs in places where it would be expected in adult pronunciation.

3.1. Obstruents.

Aspiration of voiceless stops, as stated above, has largely been eliminated in Portuguese utterances. Although in English it still remains variable, gradually toward the end of Stage III it appears with increasing frequency in places it would in adult utterances.

[papai]	papai 'Daddy'
[pʰeipər] ~ [pʰeipʰər] ~ [peipʰər] ~ [peipər]	paper

Process (6), affrication of anterior coronal stops before high front vowels, has been suppressed in English but not in Portuguese. (In adult Portuguese it is an active process in most dialects).

[tʰyi] (formerly [tʃyi])	tree
[dis]	this
but [tʃitʃiʌ]	titia 'aunty'

Process (4), which substitutes stops for affricates, has been modified. Affricates before non-high front vowels are beginning to appear as palatalized stops but not as full affricates. Thus, chair sounds phonetically between the adult pronunciation of chair and tear. These "partial" affricates persist through Stage IV.

(31) [+del rel] → [+palatalized, -del rel]

[tʃɛr/cɛr]	chair
([c] is a palatalized palatal stop)	
[tʃutʃu]	choo choo

Word initial dental fricatives have changed to stops, even when followed by r (eliminating the first optional part of (26) which substitutes labials for dentals). [ð], which has now entered Sylvia's speech, is also realized as a stop. No intervocalic [θ] occurs. Word finally there has been no change. Thus (26) has been revised to:

(32) [+obs, +cnt, +dent, -sib] → { [-cnt]/____[+son] ; [+lab] OPT [-dent] /____. }

[t^{h}y̆i]	tree
[bɑdər]	bother

Process (27), which de-dentalizes labials, persists for [fr] sequences; e.g., Fruit Loops is still often pronounced [Φy̆utlups].

At this stage we can propose to derive the flap in English from /t/ and /d/ rather than starting with a flap in the underlying representation as suggested in Stage I.[25] (In adult Portuguese, flapping of dental stops does not occur. In addition, /t/ and /d/ are distinct from /ɾ/). However, on a few rare occasions I have observed Sylvia flap a Portuguese /d/ but never a /t/.

(33) [-cnt, +ant, +cor] → [+flap]/[-cns]____

Condition: the segment must be [+voi] for Portuguese in order to flap.

(34) [+flap] → [+voi]/____[+voi]

	[mæd] ~ [mæɾ]	mad
	[æt] ~ [æɾ̥]	hat
but	[ɑi̯gɛlɪt]	I get it
	[bu̯igɑdʌ] ~ [bu̯igɑɾʌ]	brigada 'thanks'

Process (17), lateralization of flaps, is now optional in both languages, as well as (28), hardening of flaps to stops.[26]

	[wɔlər] ~ [wɔdər] ~ [wɔɾər]	water
	[kɛlu] ~ [kɛdu] ~ [kɛɾu]	quero 'I want'
	[dəmun]	the moon
but	[siləmun] ~ [siɾəmun]	see the moon

The relative rarity of Sylvia's flapping of stops in Portuguese and the relative frequency in English indicate that phonological differentiation is proceeding.

3.2. Liquids

The flap in Portuguese (as discussed above) continues to be realized as [ɾ], [d], or most frequently as [l].

[kɛɾu] ~ [kɛdu] ~ [kɛlu]. quero 'I want'

In English intervocalic [l], [r], [u̯](=[w]), and [i̯](=[j]) optionally geminate while in Portuguese gemination is limited to [u̯] and [i̯]. ([+voc] refers to [l], [r], [i̯], and [u̯]).

(35) English

$$\text{OPT}\quad V\begin{bmatrix}+\text{voc}\\-\text{syl}\end{bmatrix}V \rightarrow 1\ 2\ 2\ 3$$

1 2 3

(36) Portuguese

$$\text{OPT}\quad V\begin{bmatrix}+\text{voc}\\-\text{syl}\\-\text{lat}\end{bmatrix}_{<}V \rightarrow 1\ 2\ 2\ 3$$

1 2 3

(Note: the retroflex r does not occur intervocalically in Portuguese and therefore need not be specified)

[mai̯jænd] ~ [mai̯ænd]	my hand
[mai̯jæpəu̯] ~ [mai̯æpəu̯]	my apple
[juu̯wɑr] ~ [juu̯ɑr]	you are
[mʌryiə] ~ [mʌyiə]	Maria

([y] is a front rounded glide which results from deretroflexing r by process (29)).

[tai̯jadu] ~ [tai̯adu] tá errado 'it's wrong'

Condition on process (35) (English): If 2 = [+lat] the process is inapplicable if 1 = [-low, +pal]; otherwise the process is obligatory for laterals. After gemination the first segment delateralizes to [u̯] as specified by (14) and the second becomes laminal as specified by (5). As stated in (36), laterals in Portuguese never geminate.

	[dɑu̯.l̪i]	dolly
	[æu̯.l̪əgeɾər]	alligator
	[sæu̯.l̪i]	Sally
but	[dʒɛ.li]	jelly
	[sɪ.l̪i]	silly
	[fɑ.l̪ʌ]	fala 'talks'

Because the presence of (5) and (14) is demonstrated by such cases as [fɔu̯] fall and [l̪ɑi̯t] light, Sylvia's pronunciation of intervocalic l reflects the difference in syllable structure of the two languages. In Portuguese l occurs in syllable onset whereas in English l may be ambi-syllabic and thus be doubled across a syllable boundary, especially after stress. Given this syllabification, the application of processes (5) and (14) explain the English examples above.[27]

It is noteworthy that (17), lateralization of flaps, must follow lateral gemination since the laterals which result from flaps are never geminated.

[pɑdi] ~ [pɑɾi] ~ [pɑli] (never *[pɑu̯li]	potty
[dæɾi] ~ [dæli] (never *[dæu̯li])	Daddy
[dɑu̯li] ~ [dæu̯li][28]	dolly

3.3. Nasals

There has been no noticeable change from Stages I and II.

3.4. Vowels.

At this stage Sylvia's vowels become very different from those in Portuguese. In many of her English utterances the vowels diphthongize by developing (or maintaining) a corresponding glide of the same color and by dissimilating the nucleus. (Cf. dolly above and process (40) in Stage IV). This is especially true of utterances which are produced slowly or lengthened, as in calling from a distance, and utterances with extra heavy stress and/or rapidly rising or falling intonation. Such phenomena do not occur in her Portuguese utterances.

	[pɛi̯ŋki]	Pinky
	[mɑmei̯]	Mommy
	[kʊkei̯]	cookie
	[spou̯n]	spoon
	[bɛi̯bɛi̯] (At 1;4 often [bibi])	baby
--	[dɑu̯li] ~ [dæu̯li]	dolly

[seɨ]	see
but [se] (not *[seɨ])	(vo)sê [se] 'you'

The significance of the different vowel substitutions will be discussed under Stage IV.

4. Stage IV: Ages 2;3-2;8.

There is very little mixing of utterances at this stage except for an occasional vocabulary item which is known only in one language, (e.g., "I want a bala." 'pill'). A continuing differential treatment of superficially identical segments in the two languages indicates increasingly distinct systems for processing English and Portuguese speech. This is most dramatic in the treatment of the vowels.

4.1. Obstruents

Except for a few minor exceptions, aspiration of voiceless stops in English occurs where it does in adult speech and never occurs in Portuguese.

[kɑkɑ]	caca 'dirt, yucky'
[kʰɑt]	cot

Flapping of stops in English continues but lateralization of flaps, process (17), has decreased word internally. Flaps are still frequently lateralized across word boundaries if the first word ends in a flappable stop, but not if it begins the second word. However, if the flappable segment is preceded by a dental plus vowel, instead of lateralizing, the segment will flap, even across word boundaries.[29] In Portuguese, flapping of stops no longer occurs, i.e., (33) has been limited to English.

[ɑɨgɛlɪt]	I get it
[ɑɨdɪɾɪt]	I did it
[ʔɛɹɾæɹn]	fell down
[pɑɾi] (now never *[pɑli])	potty
[du(ə)ləgɛn]	do it again
but [bɹigɑdʌ] (not *[bɹigɑɾʌ])	(o)ɦrigada 'thanks'

Process (12), deletion of non-anterior non-coronal fricatives ([χ] and [h]), has been limited. At 2;3 [χ] and [h] are pronounced utterance initially but not intervocalically and/across word boundaries.

[hænd]	hand
[mɑɨjænd][30]	my hand
[t(ɑ)eɨjɑdu]	tá errado [tɑexɑdu] 'it's wrong'

By 2;4 [x] and [h] are pronounced every; e.g., [mɑi̯hænd] my hand and [tɑeχ/hadu] tá errado.

4.2. Liquids

In English partial suppression of flap lateralization has occurred (as noted above), but Portuguese [ɾ] is still most frequently realized as [l].

[kɛlu] ~ [kɛɾu] quero 'I want'

(29), which substitutes [u̯] for liquids in syllable onset clusters, has been suppressed by the end of Stage IV for laterals. English r and the Portuguese flap in these positions are realized as [y̯] and [l] respectively. The order of appearance of laterals in syllable onset clusters was as follows: At 2;6 [u̯] was substituted for the liquids in these positions (except r for which [y̯] was substituted). A few weeks later class was pronounced [kʰlæs][31] beside [gu̯æs] glass, [gu̯ẽndʒi] grande 'big', [su̯ip] sleep [fu̯ɑi̯] fly, [pʰu̯ei̯] play, [bu̯æk] black, and [bu̯ɑsu] braço 'arm'. A few days later glass became [glæs][32] and grande [glẽnʒi]. About a week after this sleep and fly were pronounced [slip] and [flɑi̯] but [u̯] continued to substitute for the [l] of play and black, and the [ɾ] of braço. At 2;7 play was [pʰlei̯] beside [bu̯æk] black and [bu̯ɑsu] braço. Finally, a week later black and braço were [blæk] and [blɑsu].

A stressed syllable in English tends to attract non-syllabic. Since Sylvia's syllable offset r is pronounced [r] while syllable onset r is pronounced [y̯] or [ø], different stress placements result in different pronunciations of r:

[mʌ.y̯íə] Maria
but [mér.i] Mary
[ér.ən] Aaron

Extra slow pronunciations are [mɑr.y̯iʌ] and [mɛr.y̯i].[33]

4.3. Nasals

/n/ and /ɲ/ in Portuguese have now become distinct in Sylvia's utterances, indicating a suppression of (5), the process which laminalizes anterior, coronal consonants. /l/ and /ʎ/, however, are not yet distinct.

[siu̯vĩɲʌ] ~ [siu̯vijʌ][34] Sylvinha 'little Sylvia'
[pɑnu̯] pano 'cloth'
but [molɑdu] molhado [mo du] 'wet'
[fɑi̯ʌ] fala [fɑlʌ] 'talks'

4.4. Vowels.

The fact that Sylvia's vowels continue to be remarkably different in the two languages suggests there is a fundamental difference in the nature of English and Portuguese vowels. This difference can not be ascertained merely by consulting a chart of phonemes--many "identical" vowels (from the phonemic standpoint) are realized quite differently phonetically. Although Sylvia's modifications somewhat exceed or exaggerate those expected or observed in adult dialects (just as she sometimes over-flaps, e.g., my Daddy [maɪ̯ɾæɾi]), they are changes of the type that would be expected in the respective languages. Although Sylvia's [meɪ̯] for me is probably not a common pronunciation in American dialects[35] her [mɪi̯] is widespread in American English. She does not say [mi$_{\text{ɪ̯}}$] and [mi$_{\text{ə̯}}$], which are pronunciations foreign to English, yet in Portuguese she pronounces aqui [ɑki] 'here' as [ɑki] and quite frequently as [ɑki$_{\text{ɪ̯}}$] and [ɑki$_{\text{ə̯}}$]. The latter are very common pronunciations in Rio de Janeiro, especially in casual speech of young adults (personal observation). To further demonstrate that her changes correspond with expected or observable change in the respective languages, I will give examples of these changes which occur in their respective dialects--dialects which she has not heard. Finally, I will suggest some reasons why the two languages are developing in such diverse fashions.

4.4.1. English Vowels.

(37) Vowels optionally become tense before r, i.e., lax vowels are raised to the next higher tense vowel. This pronunciation is observable in the speech of Baltimore, Md. (Donegan, personal observation).

OPT V → [+tense]/____[+retroflex]	
[mor]	more
[swithɔ/ɔrt][36]	sweetheart
[deɪ̯ər]	there

In the last form [ɛ] tenses and diphthongizes to [eɪ̯], then [r] syllabifies and diphthongizes to [ər].

/ɑi/ and /ɑu/ optionally dissimilate to [ɔɪ̯] and [æʊ̯], and then raise to [ɔɪ̯] and [ɛʊ̯], while /ɔi/ may raise to [oɪ̯]. Thus, an achromatic vowel first dissimilates to the opposite color of a following glide (a paradigmatic process) and then it raises (a syntagmatic process of assimilation in term of height). These two processes are stated as follows:

$$(38)\quad \text{OPT} \begin{bmatrix} +\text{syl} \\ -\text{chrom} \end{bmatrix} \rightarrow [\alpha\text{color}] / \underset{\text{V}}{\_\_\_\_} \begin{bmatrix} -\text{syl} \\ +\text{chrom} \\ \beta\text{color} \end{bmatrix}$$

(where if α = labial, β = palatal and conversely)

(39) OPT $\begin{bmatrix} +syl \\ +chrom \\ \alpha color \end{bmatrix} \rightarrow$ [+higher] / ____ $\begin{bmatrix} V \\ -syl \\ \beta color \end{bmatrix}$

[yɔi̯itnɛu̯] right now
[boi̯] boy

(where if α = labial, β = palatal and conversely)

Similar changes have been observed in the Outer Banks of North Carolina (Miller, 1973 and Labov et al. 1972).

Sylvia's production of the other vowels maintains the English tense/lax distinction. For example, me is either [mi] or [mei̯] while bit is either [bɪɛ̯t] or [bɛt] (never *[bet]).

The tense vowels /i/, /e(i)/, /u/, and /o(u)/ which can be represented as outgliding diphthongs, [VV̯], with segments of identical color, optionally dissimilate in the following manner:

(40) OPT $\begin{bmatrix} +syl \\ +chrom \\ \alpha color \end{bmatrix} \rightarrow$ [+lower]/____ $\begin{bmatrix} V \\ -syl \\ \alpha color \end{bmatrix}$

[mii̯] ~ [mei̯] me
[buu̯t] ~ [bou̯t] boot
[dei̯] ~ [dɛi̯] day

The degree of lowering is not specified because various degrees have been observed; e.g., me can be [mii̯], [mɪi̯], [mei̯] and [mɛi̯]. An even more dramatic example of lowering occurs when Sylvia imitates a cartoon tiger in a television commercial. She pronounces it's great as [ɪtsgrrrrɑi̯t].

The syllabic part of labial vowels may also bleach (in addition to lowering):[37]

(41) OPT $\begin{bmatrix} +syl \\ +lab \end{bmatrix} \rightarrow$ [-chrom]/____ $\begin{bmatrix} V \\ -syl \\ +lab \end{bmatrix}$

[buu̯t] ~ [bɨu̯t] boot

The achromatic may lower also:

(42) OPT $\begin{bmatrix} +syl \\ -chrom \end{bmatrix} \rightarrow$ [+lower]/____ $\begin{bmatrix} V \\ -syl \\ +lab \end{bmatrix}$

[buu̯t] ~ [bɨu̯t] ~ [bəu̯t] boot

(40), (41), and (42) may apply in any order since all of the following have been observed.

[buu̯t] ~ [bɨu̯t] ~ [bəu̯t] ~ [bou̯t] boot
[bou̯t] ~ [bəu̯t] ~ [bʌu̯t][38] boat

The lax vowels /ɪ/, /ɛ/, /æ/,[39] /ʊ/, and /ɔ/ behave quite differently:

(43) OPT $\begin{bmatrix}+\text{syl}\\-\text{tense}\end{bmatrix} \rightarrow$ [+lower][40]

[bɪt] ~ [bɛt] (not *[be(i̯)t]) bit

(44) Lax vowels optionally develop a neutral vowel offglide.[41] (This is widespread in the U.S. midlands, especially for lax mid and low vowels).

$$\text{OPT } \emptyset \rightarrow \begin{bmatrix}-\text{syl}\\-\text{chrom}\end{bmatrix}^{V} \; / \; \begin{bmatrix}+\text{syl}\\-\text{tense}\end{bmatrix} \text{——}$$

[bɪ̯ɪ̯t] ~ [bɪə̯t] ~ [bɛə̯t]	bit
[fʊə̯t] ~ [fɔə̯t]	foot
[dɔə̯g] ~ [dɑɑ̯g] ~ [dɔɑ̯g]	dog
[bæə̯d] ~ [bɑɑ̯d]	bad

(45) After an offglide has developed non-high vowels are optionally raised or tensed.

$$\text{OPT } \begin{bmatrix}+\text{syl}\\+\text{chrom}\\-\text{high}\\-\text{tense}\end{bmatrix} \rightarrow \left\{\begin{matrix}[-\text{low}]\\[+\text{tense}]\end{matrix}\right\} \; /\text{——} \begin{bmatrix}-\text{syl}\\-\text{chrom}\end{bmatrix}^{V}$$

[mæə̯d] ~ [mɛə̯d] ~ [meə̯d]	mad
[dɔə̯g] ~ [doə̯g]	dog
[hɛə̯d] ~ [heə̯d]	head

(44) feed (45) since a neutral glide is necessary for raising, e.g., bad and dog are never *[bɛd] and *[dog]. The condition [+chrom] is necessary because the achromatic low vowel /ɑ/ is never raised, e.g., cot is [kɑt] and [kɑɑ̯t] but never *[kʌɑ̯/ə̯t] or *[kɔɑ̯/ə̯t].

4.4.2. Portuguese Vowels.

Unlike the English diphthongs which show the paradigmatic processes of lowering and bleaching, Sylvia's Portuguese diphthongs show a tendency toward the syntagmatic process of assimilation in terms of height, frontness and color.

(46) OPT /ɑi/, /ɑu/, /ãĩ/, and /ãũ/ tend to slightly assimilate in terms of frontness and color.

[pɑpɑ<i̯]	papai 'Daddy'
[mãmã<ĩ̯]	mamãe 'Mommy'
[pã>ũ̯] ~ [põũ̯]	pão 'bread'
[pɑ>u̯lu] ~ [pou̯lu]	Paulo

The assimilation may proceed even further (especially in fast speech) for vowels followed by labial glides,[42] probably by successive stages of assimilation in terms of backness and color, e.g., [meu̯] → [məu̯] → [mɤu̯] or [mɣu̯]; or [meu̯] → [mø̞u̯] → [məu̯] → [mou̯]. Then by (24), monophthongization, [mou̯] becomes [mo]. The process which produces the final output (excluding (24)) is summarized below:

(47) OPT [+syl] → [+lab]/____ $\begin{bmatrix} V \\ -\text{syl} \\ +\text{lab} \end{bmatrix}$

[ɛme/ɛu̯][43]	é meu [ɛmeu̯] 'it's mine'
[kɛlumopupai̯]	quero meu papai 'I want my Daddy'
[kɛlupõũ̯]	quero pão [pɐ̃ũ̯] 'I want (some) bread'

Unlike her English uni-colored diphthongs which undergo lowering and bleaching (cf. (40), (41) and (42)), Sylvia's Portuguese uni-colored diphthongs still monphthongize (cf. (24)). That monophthongization is still an active process in her speech can be seen in the examples just given above as well as the one cited below.

[bou̯sʌ] ~ [bosʌ]	bolsa [bou̯sʌ] 'purse'

(48) Monophthongs optionally develop a neutral offglide (especially in slow speech or on heavily stressed syllables), but never lower as English lax vowels do. This process is identical to (44) in English except it is not limited to lax vowels.

OPT Ø → $\begin{bmatrix} V \\ -\text{syl} \\ -\text{chrom} \end{bmatrix}$ / [+syl]____

[ɑkíə̯]	aqui [ɑki] 'here'
[kokóə̯]	cocô [kokɑ] 'poo poo'

A tendency toward monophthongization and schwa offgliding are active processes in adult Portuguese. The name Roberto is usually pronounced [xobɛxtu] but on too many occasions I heard from my apartment in Rio de Janeiro the mother of a Roberto calling her son from a distance. Phonetically it was [xobɛxtoə̯]

Monophthongization is also observed especially in informal speech in unstressed positions. Não [nɐ̃ũ̯] becomes [nũ] when unstressed and Maurício [mau̯risiu̯] becomes [morisiu]. A neutral offglide may even occur on phonemic diphthongs through an intermediate process of monophthongization. This is especially noticeable among the "jet set", "hip" or "in" group of teenagers and young adults in Rio de Janeiro (personal observation).

[madéi̯ɾʌ] → [madéɾʌ] → [madéə̯ɾʌ]	madeira 'wood'
[falóu̯] → [falóʊ] → [falóə̯]	falou 'you said it man'
[bíʃu] → [bíə̯ʃu]	bicho 'guy, dude, bug'
[alóʊ] → [alóə̯]	alô 'hello' (telephone vocabulary)

The different treatment of tense vowels in the two languages poses an interesting question for phonological theory: Why do tense vowels in Portuguese develop inglides whereas in English they develop outglides? What are the conditioning factors?

If one considers all vowels in Portuguese as lax then inglides would be expected. However, /ei/ and /ou/ (as well as /i/, /u/, /e/, and /o/ are very tense sounding to the ear throughout their production, yet they often monophthongize and develop neutral offglides. (Only /ɛ/, /a/, and /ɔ/ sound lax to the ear. Cf. (48)). Tense vowels in English are usually considered phonetically as [V=VV̯] or [V̆V̄] (where [V̄] = [+tense], [V̆] = [+lax] and [V̯] = [-syllabic]). From this representation, diphthongization as it occurs in English (with lowering of the first segment and outgliding of the second) would be expected because less tense vowels (i.e., less colorful) tend to lower or bleach more readily than tense vowels. (Cf. process (g) and (k) in section 1). However, the [V̆V̄] would not be expected to develop a neutral schwa offglide (cf. (44), (47), and (48)). However if we consider the Portuguese tense vowels (including the unicolored diphthongs /ei/ and /ou/) as having the more tense element first (i.e., [V̄V̆]) then a schwa offglide would be probable. Phonetically, this would mean the target position is reached much sooner in Portuguese than in English, or that the first element is more peripheral (i.e., has more color) than in English. English tense vowels seem to work into a more peripheral position, while Portuguese tense monophthongs start out more peripheral. This would explain why in English [oʊ̯] → [əʊ̯] but in Portuguese [oʊ̯] → [o] → [oə̯]. Some acoustic analysis should be done to determine if this is so. On the other hand /ɛi/ and /ɔu/ in adult Portuguese never monophthongize nor subsequently develop offglides; rather they may slightly lower to [ɛ̆i̯] and [ɔ̆u̯]. This observation suggests that these vowels may be represented as [V̆V̄].

Evidence that Portuguese tense vowels have the tensest part in the onset comes from data comparing how vowels affect preceeding consonants in the two languages. If the first part of a vowel is tenser (i.e., more peripheral or more color) than the second part, the vowel would be expected to color the preceeding consonant more than if the first element were lax or achromatic. The following examples indicate how Portuguese vowels color the preceeding consonant in ways unlike English.

Palatalization or affrication of dental stops before high front vowels can be considered consonant coloring. (See Stage I, process (6) which discusses this anticipatory or regressive assimilation).

The process is very prevalent in many dialects of Brazil, /diɑ/ and /tiɑ/ becoming /dʒiʌ] and [tʃiʌ]. In English, palatalization and affrication occur but with a following /j/ but not /i/ or /ɪ/. Compare /dɪdʒu] did you with the impossible *[dʒɪdʒidʒiitʃɛt] did Edie eat yet.

Palatalization is also observable in other consonants. The name Márcia in slow speech is [mɑxsiiʌ] but in fast speech the following changes are observed: [mɑxsiiʌ] → [mɑxsiʌ] → [mɑxsʲʌ]. By desyllabification, palatalization, and affrication Rogéria becomes: [xoʒɛriiʌ] → [xoʒɛriʌ] → [xoʒɛɻʌ] → [xoʒɛɾʒʌ]. ([ɾʒ] is a super short flapped affricate).

Labialization of consonants is also evidence that Portuguese consonants anticipate the color of following vowels: sua [suɥʌ] in a highly reduced form (e.g., in the sentence sua terra é muito bonita 'your land (country) is very pretty') becomes [sɥʌ] or [sʌ].

In some English dialects the labial vowels are often preceded by an achromatic, e.g., [dɨʷu] do, [nɨʷu] new and [lɨʷu] Lou. These examples suggest that the labial part of the vowel /u/ is reached very late after syllable onset. If this is true then a central vowel would be expected as an intermediate in the transition toward a backward, labial tongue position. If, however, the back labial position is reached very soon after syllable onset, a neutral vowel intermediate would not be expected. In Portuguese, dental plus labial vowels are never pronounced as in the English examples above. Dudu 'Eddie', nu 'naked' and Lu (girl's name) are [dʷudʷu], [nʷu], and [lʷu].

5. Conclusion.

Up to the age of 1;9, the same phonological substitutions applied to Sylvia's production of phonetically identical segments in both English and Portuguese. After the age of 1;9, phonological differentiation developed and with it a distinct set of substitutions became associated with each language.

Sylvia's phonological differentition has developed in two basic ways. The first involves segments in which free fluctuation exists between correct and incorrect pronunciations. The incorrect variant in each language is gradually eliminated while the correct variant is maintained. The noticeable increase in frequency of voiceless aspirated stops in her English and the corresponding decrease in her Portuguese clearly illustrate this first mechanism (see Stage III).

The second mechanism consists of the appearance of language specific phonological processes previously not observed. The appearance of different processes for each language does not in any way imply that the processes were not present previously, but only that they did not surface, probably because at an early stage other processes took precedence. In English, the suppression of the syntagmatic process of monophthongization allowed the paradigmatic process of diphthongization to operate overtly. (See Stages III and IV, processes (24), (40), and (42)). However, since in Portuguese

monophthongization is never completely suppressed, the diphthongization characteristic of English does not take place.[44]

One other explanation of why English type diphthongization does not take place in her Portuguese is that if it did, many phonological distinctions would be lost. For example if the process which changes /au/ to [æu̯] or [ɛu̯] were allowed to operate in Portuguese as it does in her English, the two words sal [sau̯] 'salt' and céu [sɛu̯] 'sky' would become homophones. (See Appendix B for description of Portuguese phonology).

The emergence of language specific vowel processes suggests there is a basic difference in the timing of target positions of the two languages. I have suggested in section 4 that the Portuguese tense vowels reach their target positions much sooner after syllable onset than in English. If this is true, the tensest part in Portuguese (i.e., more peripheral or more colorful part) occurs soon after onset (and would be represented as [V̆V̄]), while in English the tensest part occurs late after onset (and correspondingly would be represented as [V̄V̆]).[45] This fundamental difference predicts the frequent outgliding in English, e.g., /e/ → [ei̯], and the ingliding in Portuguese, e.g., /e/ → /e̯e/. (Cf. section 0 on vowel processes).

In addition to the basic difference in timing of Portuguese and English vowels, the appearance of language specific phonological processes perhaps suggests that there is a muscular posture characteristic of each language and a whole set of processes is associated with each posture.[46] There is indirect evidence that is some entity or articulatory posture which operates at a higher than segment level. Sylvia occasionally inserts a Portuguese word into her English utterances but typically the Portuguese word has an "English" pronunciation. However, the same word in her pure Portuguese utterances has a "Portuguese" pronunciation. For example, bala 'pill' can have quite different pronunciations depending on whether the utterance is part of English or Portuguese discourse. "I want a [bau̯.lʌ]" but "Quero [ba.lʌ]". (See discussion of liquids at Stage III). Her inability to switch postures quickly suggests that there is something operating on a higher than segment level--perhaps it is on the sentence or even the discourse level. Further support for the existence of an "articulatory posture" comes from adult language. On several occasions I have observed that certain Brazilians, when talking Portuguese, typically pronounce an English word with much more Portuguese "accent" than when they are talking pure English.

Additional evidence for a higher posture can be deduced from my own experiences with English and Portuguese. While living in Brazil, I took a trip alone in which I spent a week without talking any English. Upon returning home and after conversing with my wife in English, I experienced great fatigue and physical discomfort in my whole articulatory musculature. In addition, I experience the same type of discomfort when talking Portuguese for the first time after a short period of abstension. My wife has noted a similar phenomenon with her English and Portuguese.

I suggested before that each posture has associated with it a whole set of phonological processes and from these processes one may reasonably predict what the trend is for future sound change in the language. As Sapir has noted "this direction may be inferred, in the main, from the past history of the language" (1921:151), but it may also be inferred from close examination of active processes in adult and child speech. That Sylvia's pronunciation follows the adult trend of the language is evidenced by the fact that many of her processes are those which actually occur in modern Portuguese and English dialects which she has not heard. (See especially Stage IV).

Although this study involves only one child, it does suggest that child phonology can reveal significant things about the adult system. For example, Sylvia's differential treatment of tense/lax vowels suggests this distinction is significant in English. Finally, the study suggests that the two languages have quite different "grooves" or trends for future change. Evidence for this can be found from dialect comparisons as well as from Sylvia's different treatment of the two languages. Perhaps a language's tendency toward a specific type of change is governed by a language specific speech posture and a specific set of phonological processes which is a natural consequence of such a posture.

Appendix A

Irregularities, Assimilation, Consonant and Vowel Harmony, Metatheses

[tuvi]	TV
[ɑɯskɣim]	ice cream
[gĩntɑ̂r]	guitar
[stoɯ]	throw
[pɑlɑlʌ]	arara [ɑɾɑɾʌ] 'macaw'
[ʃɪgər]	sugar
[dɔik] ~ [dɔ̃ɚ̃k]	dark
[pikinindu]	piquininho [pikiniɲu] 'small'
[biki]	bico [biku] 'pacifier'
[bibi]	baby
[pɪnando] ~ [pɪnæno]	piano
[hɪpənəpɑɾəməs]	hypopotamus
[lɛmə̃leid]	lemonade
[mʌnænə]	banana
[bɑdedʌ]	mamadeira 'baby bottle'
[vɣɪvər]	river
[wæigwən]	wagon
[lɪlər] ~ [lˈɾr]	little
[dɯʌmp]	jump
[sɪrrr]	cereal
[pərpər]	purple
[kɛrfər]	careful
[stɣɛstyit] ~ [stɛrmistyit]	Sesame Street
[fɑ̂lər]	flower
[nækwɪn]	napkin
[pɔrkədiz]	Portuguese [? or Português)
[æmɪnəl]	animal
[bɣɛkstəs]	breakfast
[tebər]	table
[wɪndər]	window
[wɔrm]	arm

Appendix B

Portuguese Phonemes

p	t	k	i	iu	ĩ				u	ui	uu	ũ	(ũĩ)	
b	d	g	e	ei	eu	ẽ			o	oi	ou	õ	õĩ	
f	s	ʃ	χ	ɛ	ɛi	ɛu		ə	əĩ	əũ	ɔ	ɔi	ɔu	
	z	ʒ						ɑ	ɑi	ɑu				
	l	ʌ												
	ɾ													
m	n	ɲ												

Sibilants and Shibilants

Syllable final /s/, /z/, /ʃ/, and /ʒ/ distinctions are neutralized. The segment is voiced when followed by a voiced segment and voiceless if followed by voicelessness. In Rio de Janeiro the segment in this position is [ʃ] or [ʒ] while in São Paulo, Paraná, and generally in the South it is [s] or [z].

mais 'more'	
[maiʃ]	(Rio)
[mais]	(São Paulo, Paraná, and South)

/χ/ (in orthography r initially and finally, rr medially)

In Rio de Janeiro /χ/ is [χ] in all positions (see note 8). In São Paulo and Rio Grande do Sul the segment is realized as the alveolar trill [r]. In Paraná it is generally [χ] in initial and medial positions but in final position [ɾ], [r], or more commonly the retroflex [ɻ] (similar to American English r).

o rato morreu na porta	'the rat died at the door'
[uχatumoχeunapɔχtʌ]	(Rio)
[uratumoreunapɔrtʌ]	(São Paulo, Rio Grande do Sul)
[uχatumoχeunapɔɻtʌ]	(Paraná)

/l/

Syllable final l is [ɫ] in Rio, Paraná, and São Paulo (in São Paulo it may also be a very velarized l). In Rio Grande do Sul it is [l] or velarized to [ɫ]. In Minas Gerais it is often the retroflex [ɻ].

falta 'lack'	
[faɫtʌ]	(Rio, Paraná, São Paulo)
[faɫtʌ]	(Rio Grande do Sul)
[faɻtʌ]	(Minais Gerais)

Footnotes

*This is a revised version of my 1976 Ohio State M.A. Thesis, I wish to express my sincere appreciation to my advisor Professor David Stampe for his many helpful suggestions, comments, and encouragement; to Particia Donegan for her help with the vowels; to Professor Michael L. Geis for his comments; to Professor Olga K. Garnica for her comments and for first encouraging me to undertake this study; and to my wife Elza for her patience. I also wish to give my special thanks to Sylvia for many wonderful hours of pleasure.

1. [ʌ] represents the central vowel of English *but* which occurs in many American dialects. IPA considers it back.

2. This obviously does not mean physically identical but rather refers to segments which are usually transcribed the same for both languages, e.g., [i] in *feet* and *fita* 'tape'.

3. If (1) and (3) both applied then [pɪɣə] for *pig* would be expected. However, I have not ever heard this pronunciation.

4. This syntagmatic process of anticipatory assimilation is fairly common in the languages of the world. For example Japanese *hati* 'bee' is [hɑtʃi]. Portuguese *titia* is pronounced in some dialects (including my wife's) as [tʃitʃiʌ].

5. Even though Sylvia's adult model of *titia* is [tʃitʃiʌ], process (6) is necessary since (4) (which stops affricates) would have already applied.

6. An alternate pronunciation of *Sylvia* occurred several times: [sɪrvʌ]. This suggests *l* and *r* are quite closely related. In fact, in a dialect in the state of Minas Gerais syllable final *l* is pronounced [r]. (See Appendix B). In addition, when I was teaching English in Rio de Janeiro, some students, when attempting to make syllable final *L*'s in English, produced [r], even though their syllable final *l* in Portuguese was [u̯] rather than [r].

7. Just how great a difference is necessary to call [s] distinct from [ʃ] depends on the speaker. In Portuguese, sibilants never contrast syllable finally, although they do contrast syllable initially. In Rio de Janeiro syllable final sibilants are pronounced [ʃ] (or [ʒ] if followed by a voiced segment) while in São Paulo they are pronounced [s] (or [z]). However, standard Portuguese used on national radio and television dictates syllable final sibilants be [s] (or [z]). Announcers from Rio try to suppress this "shibilantization" process, sometimes not too successfully. The result is an intermediate between [s] and [ʃ]. But how their speech is interpreted varies. A native of Rio will hear it as an [s], while a speaker from São Paulo will hear it as an [ʃ].

8. Conceivably these deletions consist of two processes: lenition of the uvular or velar fricative to [h] and then deletion. However, since in Sylvia's mother's speech /x/ is usually [h] we may assume that [h] is Sylvia's representation for the segment. In other adults *ri* 'I laughed' is often [xi] or [χi] while *rua* 'street' is frequently [huʌ].

9. According to this process, doggie would become [dɔi̯] (since the input for (12) would be [dɔɣi] from (3)). However, since I have not observed this pronunciation, this could indicate the ordering of (12) before (3).

10. Many similar process affecting liquids have been described in detail by M. L. Edwards (1970).

11. See discussion of process (24) for an alternative pronunciation of milk.

12. [+retroflex] for r shall refer to the r-coloring of American r, whether it be a true retroflex or a bunched r.

13. In adult Portuguese the l of bolo occurs in syllable onset: [bo.lu].

14. It is questionable whether a flapping rule should have been proposed. In my speech the flap occurs and I have no reason to believe Sylvia would at this age realize (possibly from morphology) that flaps in English are derived from underlying /t/ and /d/. In Portuguese /ɾ/ is distinct from /t/ and /d/.

15. To my knowledge this is the only word in which a consonant was inserted. Possibly this could h ve resulted from confusion with English parrot.

16. Smith noted a similar process in his son's speech. He stated it as one process, i.e., nasals are deleted before voiceless stops, leaving no nasality. (N. Smith 1973:13).

17. [ʌ˃] is considerably more retracted than [ʌ] of but; it is the sound which would result if [ɔ] were unrounded.

18. Since /ɛ/ elsewhere did not bleach (e.g., bear was never [bɑ]), perhaps the [u̯] caused the lowering and retraction. Other evidence is that meu 'mine' is pronounced [mɛu̯] by Sylvia. Also see note 19 concerning cow.

19. This example is cited here since the adult pronunciation of cow is either [kɑu̯] or [kæu̯].

20. The sequence schwa plus palatal glide, [əi̯] does not occur in my dialect of English. In Portuguese, the nasal /ə̃i̯/ occurs as [ə̃ĩ̯] in Sylvia's speech, e.g., [mə̃mə̃i̯] mamãe 'Mommy'.

21. An alternative analysis would be to start with [pɛ̃si]. Then by delateralization, [ɵ] would be the result without having to propose process (25). However, since at Stage II [pɛ̃səu̯] does occur, (25) seems necessary.

Another alternative would be to start with [pɛ̃sɪl] but this is rejected since [ɪu] → [i̱] and not [ɵ], e.g., milk was [mi̱k] but never *[mɵk].

22. Presumably the labial articulation of r is responsible for the labialization of [θ]. Although there were no examples like thwart ([θw]) to check this, David Stampe (personal communication) reports a similar change in his son's speech which affected [sw], e.g., [fwɪm] swim. Also see Stage III where [θ] becomes [d] before [r].

23. The substitution of [ɣ] for [ɾ] after obstruents if fairly common in the speech of residents of the state of Minas Gerais, Brazil (personal observation). In addition, I have observed several

native speakers of Rio de Janeiro substitute [ɣ] for [ɾ] everywhere. Thus carro [kaxu] 'car' and caro [kaɾu] 'expensive' were distinguished on the basis of voicing, i.e., [kaxu] and kaɣu] respectively.

24. An alternative in English would be to start with a monophthong as the underlying representation and state a diphthongizing process.

25. See note 14 concerning Stage I.

26. Although flaps in English are frequently realized as lateral, the flap which results from Portuguese /d/ is never lateralized by Sylvia. But since she flaps stops so rarely in Portuguese, I hesitate to propose the ordering of (17) before (33). For her English utterances, an unconstrained order of (17), lateralization of flaps, (32), stopping of dental fricatives, and (33), flapping, would explain all of Sylvia's pronunciations of [ð] in don't bother me, namely [dɾ], [ɾ], and [l].

27. See Stage IV for significance of r on syllable structure.

28. See Stave IV for explanation of [aɣ] → [aɣ].

29. Did it [dɪɾɪt] possibly indicates an instance of consonant harmony since consonant harmony has been observed for other consonants, namely nasals and laterals, e.g., [lɛ̃mə̃leid] lemonade. See Appendix A for further examples.

30. The glide gemination is a result of process (35).

31. Also at this time like this (formerly [laikɣɪs]) became [laiklɪs]. This is from a progressive assimilation of the l of like rather than the sequence [ð] → [d] → [ɾ] → [l] → [ɣ] as I had originally thought. Evidence for this is that on several occasions in echoic productions Sylvia said [laiklɪs] like this but [pækdɪs] pack this.

32. Possibly the more lenis articulation of /g/ vs. /k/ explains this. A similar reason would explain why [pl] appeared before [bl].

33. Again resonant gemination is a result of (35).

34. The process [ɲ] → [j̃] is common in Munda languages in syllable offset positions. (Stampe, personal communication). [j̃] is also an acceptable pronunciation of [ɲ] in adult Portuguese.

35. Patricia Donegan and David Stampe report that they have heard this pronunciation in lower-class London kid speech (personal communication).

Paradigmatic processes are also readily observed in singing. In Ray Charles' recording of "Working for the City" (c. 1975) his pronunciation of city changes from [sɪtɪ] to [sɪte/ɛi] and even to [sɪtæi].

36. Consider rounding of back vowels as a form of tensing.

37. Bleaching does not occur in the syllabic segment for palatal vowels, e.g., me and day never become *[məi] and *[dʌi].

38. Since the lower vowels are more likely to bleach (cf. (23)) this may explain the non-occurrence of [b ut].

39. If /æ/ is treated as [+tense], then (23), bleaching of low or mid lax vowels, would explain [æ] → [a].

40. Since the specification [-tense] does not change, this process implies the vowel is lowered to the next lax vowel.

41. The height specification is not given since it depends on the syllabic which preceeds.

42. Pão [pɐ̃ʊ̯] becomes [põ] but mãe never becomes *[mẽ].

43. [eɣ̯] → [ɛɣ̯] can be viewed as assimilatory retraction since [ɛ], although being lower, is more central than [e].

44. In fact monophthongization operates in adult Portuguese (See section 4).

45. Cf. section 4, pp. for further discussion. Also see Lehiste and Peterson's acoustical comparisons of English tense and lax vowels (Lehiste and Peterson 1961).

46. Cf. Drachman (1973) for a discussion of "basis of articulation".

47. [b̃] is a "cold" m or the nasal one makes when his nasal passages are blocked.

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