Main Articles

Getting started without a system: From phonetics to phonology in bilingual development

Marilyn May Vihman

University of Wales, Bangor

Abstract

The common formulation which proposes that bilingual children enter into language production with either a single or a dual phonological system is questioned. Instead, it is suggested that implicit learning allows the child to develop considerable distributional knowledge about each of the languages to which he or she is exposed even before the first words are produced, but that explicit learning and use of particular words and phrases establishes the foundation from which more detailed phonological knowledge will be induced. Once the child has produced some 50–100 different words (initially based on "item learning"), word templates can often be identified, reflecting the individual child's development of readily accessible production patterns that may constitute a rough match to words of one or both languages. The proposed course of development is supported by analysis of early word patterns drawn from three bilingual children. The item learning of early words, which reflects "selection" of word targets with few changes, is distinguished from the template-based later words, which may depart more radically from the targets. The word templates of the bilingual children are found to assimilate words of both languages, sometimes in contravention of adult language patterns.

Key words

bilingual phonology

implicit learning

word template

1 Is "one system versus twoý the right question?

The issue of whether bilingual children have one system or two "from the beginning" has dominated the bilingual language development literature at least since the early 1970s.[1] The formulation of this issue provided by Volterra and Taeschner (1978) has served as a baseline for subsequent debate, even though the "linguistic stages" that they posited have received little if any empirical support in the nearly 25 years of subsequent research. Essentially, they argued that, in the first stage, the child has a single "lexical system" which includes words from both languages, but translation equivalents are rare, if they

[1] For reviews of the literature on "one system versus two" in the earliest stages of bilingual development, see Lanza (1997), who focuses on morphosyntax and the discourse context, and Deuchar and Quay (2000), who also include a chapter on bilingual phonology.

Address for correspondence

School of Psychology, University of Wales, Bangor, Gwynedd LL57 2AS, Wales, U.K.;
e-mail: <m.vihman@bangor.ac.uk>.

occur at all; in the next stage "the child distinguishes two different lexicons but applies the same syntactic rules to both languages" (p. 311). Volterra and Taeschner saw the use of words from both languages in a single utterance as the consequence of a lack of translation equivalents.

With reference primarily to the acquisition of morphosyntax Genesee (1989) characterized this account as "the unitary language system hypothesis", while Meisel (1994) proposed the term "fusion" to refer to cases in which language mixing, or juxtaposition of elements from each of the languages within a single production unit, is ascribed to "a failure in separating the two grammars" (p. 414). Neither these expressions nor the Volterra and Taeschner "stage model" make any specific reference to phonology, but the "one system versus two" issue has nevertheless generally been formulated with reference to that model.

Attempts to test Volterra and Taeschner's first claim, that children begin with a single lexicon that includes word forms from both languages but that lacks — or even actively excludes — cross-language synonyms, include Vihman (1985), based largely on diary data collected in a single (Estonian language) context, as well as Deuchar and Quay (2000), who make use of recordings in both English and Spanish contexts as well as diary notes. The findings of both studies constitute a disconfirmation of the "unitary system" proposed for Stage I: Cross-language equivalents or synonyms do occur early on. In fact, many words are deployed in both languages soon after the first occurrence in one of the languages, even within the period of the first 50 words. (See also Mikes, 1990, who reports early translation equivalents in the lexicon of four children acquiring Serbo-Croatian and Hungarian, in a situation in which both languages were used both in the home and in the community.)

On the other hand, Deuchar, & Vihman (2002) establish that in early two-word productions the children they observed both made use of a high proportion of utterances drawing on both languages in combination, even excluding all cases in which the child lacked a translation equivalent for the word that failed to match the discourse context. Thus, careful studies of the early bilingual lexicon fail to support the hypothesis of an early "unitary lexical system," yet analysis of the first steps in syntactic learning in the same children fail to support the idea of "two separate systems from the start" either. What can we learn from the study of emergent phonology in the bilingual child?

2 Implicit and explicit learning

Recent experimental work provides good reason to believe that there are two independent but mutually supportive routes to learning phonology. *Implicit learning* begins in the womb, with infants attuning to the characteristic melodic patterns of the native language, particularly their mother's speech rhythms (Hepper, Scott, & Shahidullah, 1993; Moon, Panneton-Cooper, & Fifer, 1993). Exposure alone — whether to one language or to more than one — has an ongoing and cumulative impact on *what is familiar* over the course of the first months of life and thus can be expected to affect what is easily and quickly learned as the child's memory for speech patterns increases. It is important to note that even *overhearing* language not intended for the learner (and not consciously registered) can result in implicit learning in adults (Saffran, Newport, Aslin, Tunick, & Barrueco, 1997). Effects such as those shown in perception studies by Jusczyk (1997) and his

colleagues, revealing sensitivity to coherence in ever smaller prosodic units (clauses, as early as 4.5 mos., then phrases at 9 mos., and finally words at 11 mos.), can be taken to be the result of implicit learning. The effect of implicit perceptual learning on *production* can also be seen, for example, in the subtle ambient language effects on vowel quality at 10 months, as revealed by acoustic analyses of the vocalizations of infants exposed to Arabic, Cantonese, English, or French (Boysson-Bardies, Hallé, Sagart, & Durand, 1989). This kind of learning, which is probabilistic rather than categorical, appears to involve the ongoing registering or "tallying" of frequencies of occurrence of potential linguistic units at different levels — segments, syllables, prosodic units, words, phrases, clauses (Bybee & Hopper, 2001). The earliest outcome of exposure to language, then, would be a sense of the prosodic patterns and the segmental sequences characteristic of the input language. It would mean the accumulation of distributional knowledge in advance of the laying down of specific representations of words.

Explicit learning, on the other hand, is here taken to mean learning with *attention*, and sometimes also with an *intention* rooted in a social (communicative) or cognitive (learning) agenda. For one-year-olds at the onset to language, it may involve a more or less conscious goal to replicate adult verbal behavior in given situations by matching their sound patterns with vocal productions of a comparable kind (Locke, 1993). Thus the origin of phonological system — at least for production — may not be found in the minimal units of phonology (Ingram, 1992; *pace* Jakobson, 1941/68), whether those are conceived of as phonemes, phonemic oppositions, or distinctive features, but in the lexicon, in the word or phrase units "given" by the input speech, whole prosodically marked units available to be matched (Croft, 1995). The sound system of the adult language or languages will necessarily begin to crystallize out of this first explicit lexical learning, however approximate or inadequate the child's first word attempts may be. There will be nothing to call a "system" at the beginning, but isolated remembered "bits" instead, words and phrases understood and sometimes identifiably reproduced in a suggestive situational context (McCune & Vihman, 2001; Vihman & McCune, 1994). Such lexical representation is a necessary foundation for functional knowledge of phonological contrast: For a child to develop a systematic representation of contrast in production, individual forms must begin to be linked to meanings and thus come to have lexical status.[2]

Motoric practice also leads to implicit learning. It is generally natural and even necessary for adults as well as children to engage in repeated exercise of a new skill (writing, typing, swimming, driving: Logan, 1988) before it can be called upon voluntarily, in the service of a specific goal. The most striking evidence for this kind of learning comes from studies of amnesic patients. Such patients have been shown to be capable of learning new skills despite their impaired ability to lay down new (explicit) memory traces. This sometimes means an inability to recognize the very training situation in which repeated exposure or practice has led to learning of the new skill (Poldrack & Cohen, 1994). Whereas such patients cannot voluntarily call up the skill in the absence of the associated context, however, normally

[2] Perceptual sensitivity to the bimodal distribution of voice-onset time variants has been demonstrated for 6- and 8-month-old infants (Maye, Werker, & Gerken, 2002). The results are taken to provide a mechanism for distributional learning that would account for infants' shift away from the discrimination of sounds not contrasted in the native language, late in the first year; they do not provide a sufficient basis for phonological contrast in production, however.

functioning people of any age can be expected to experience a gradual transformation of implicit into explicit knowledge, such that a voluntary choice of action patterns becomes possible, leading to intentional behavior outside of any determinative context.

3 The construction of a phonology

We suggest that children do not have a linguistic system to begin with. Instead, we see a phonological system as the emergent product of whole word learning. From this perspective the child's first word production is supported only by (1) the implicit knowledge of the ambient language(s) that grows out of the capacities for speech perception available at birth or very soon thereafter and (2) vocal practice based on the capacities for production that emerge in the middle of the first year (Vihman, 1996).

For phonological development, implicit learning through production as well as perception must be factored in. The gradual increase in motoric skills, range of "vocal motor schemes" (VMS) or phonetic patterns that the child can produce at will, depends in part on practice, that is, on recurrent production of the same schemes (McCune & Vihman, 2001). In other words, in the course of babbling infants develop a range of VMS, differing from one child to the next but clearly informing their progress in early word learning. The first word forms are learned as (approximate) whole word patterns; the child represents and then deploys specific phonetic sequences, whole words or phrases, typically based on patterns already motorically and auditorily familiar from frequent production in the prelinguistic period (Vihman, Macken, Miller, Simmons, & Miller, 1985). This is "item learning," which has been well established as the limited, input-frequency-based starting point for syntax (Lieven, Pine, & Baldwin, 1997) and for inflectional morphology (Gathercole, Sebastián, & Soto, 1999).

The item learning exhibited in the first forms produced constitutes the foundation for an initial accumulation of vocabulary; it also provides the basis for the induction of regularities from the child's existing production patterns (Beckman & Edwards, 2000). Once the child begins to represent a larger number of word forms for production — perhaps 20 to 50 — it is typically possible to identify one or more "word templates," or characteristic production patterns ("structures" or "schemas" (Waterson, 1971); "canonical forms" (Menn, 1983)).

Word templates can be recognized in two ways: On the one hand, the majority of the child's word forms begin to conform to one or more patterns; on the other hand, more dramatically, some adult words begin to be "adapted" or restructured to fit into these patterns. Whereas the earliest identifiable words a child produces tend to show errors of omission only, and have thus been described as relatively "accurate" (Ferguson & Farwell, 1975), later words often exhibit "errors of commission," subjecting adult word targets to harmony patterns and metathesis, for example. The occurrence of word templates has been taken to mark the first steps in phonological organization or "system" (Velleman & Vihman, 2002; Vihman & Velleman, 1989). For some children, a single pattern may dominate at first, affecting well over half of all word tokens produced (see Vihman, Velleman, & McCune, 1994, Fig. 1–4); such a pattern may be highly specific, such as the "palatal pattern" documented in Vihman et al. (1994), or quite general, such as the CV(CV) patterns developed by the child Timmy as detailed in the same paper. For other children,

such as Waterson's son "P" (Table 1) and my son Raivo (Table 2), a number of subpatterns can be identified, each characterizing a small group of words, yet with all of these conforming to one or two more general phonotactic structures. (Here and elsewhere the postulated template form is given in angle brackets after the heading.)

Table 1

P's Early Word Templates: "Nasal Structure" (age 1;6) <ŋVŋV>

Child form	*Adult target*
[ŋaŋa]	another
[ŋeːŋeː], [ŋiːŋɪ]	finger
[ŋaŋø]	Randall
[ŋeːŋeː]	window

(Adapted from Waterson, 1971)

Table 2

Raivo's Early Word Templates: "Nasal Structure" (age 1;3.18–1;3.24) <nVN>

Child form	*Adult target*
[ĩn(+) ~ næ(+)] (im.); [nɪŋ]	*lind* 'bird'
[nənən ~ nən]	*rind* 'breast' (nursing)
[næniŋ ~ næŋ]; [nɪŋ ~ nɪn]	*king* 'shoe'
[niniŋ ~ ninin ~ niŋ]	*kinni* 'closed'

(Adapted from Vihman, 1981)

To the extent that children's babbling patterns are similar cross-linguistically, early word forms — and the phonological patterns which derive from them — can be expected to be similar as well. Thus in Tables 1 (English) and 2 (Estonian) we see both children drawing on repeated use, across individual word forms, of a nasal stop, a segment well attested in babbling in most language environments (Locke, 1983). The "harmonic" syntagmatic recurrence of a single consonant in the child forms, in contrast to the changing consonants of the adult models (*finger, king*), constitutes another common characteristic, well attested cross-linguistically.

Nevertheless, word templates can be expected to reflect at least some aspects of the phonological patterning of a particular adult language, since they derive from the item learning of the child's first forms. They should thus differ somewhat from one language to the next. The small samples characteristic of child production studies are a limitation here, since patterning has been found to differ from one child to the next. For example, final consonant production is common enough in English, yet in one study only two out of five American children with a productive lexicon of some 50 words or more made regular use of them (Vihman & Boysson-Bardies, 1994). On the other hand, in the same study none of the five French children did so at that lexical level (see also the paucity of final consonants produced by 10 children acquiring Finnish: Kunnari, 2000).

In contrast, omission of an initial consonant is rare in English but not in Finnish (Savinainen-Makkonen, 2000), where the salience of medial geminates may be a contributing

factor (Vihman & Velleman, 2000). Interestingly, Bhaya Nair (1991) reports regular initial consonant omission in her bilingual son's Hindi at 19 months (20/59 first word types), with some instances in his English as well: *cover* [ʌbə], *monkey* [ʌŋki], *water* [ɔtə] (3/39). Hindi too has medial geminates, which, with medial clusters, account for most of the child's disyllables with missing onsets (13/20).

Cross-linguistic production studies have shown that children learning the same language differ most at the outset of identifiable word production. This is the period in which we expect to see item learning only. We presume that implicit matching of the child's own vocal productions to prosodic and segmental patterns in input speech triggers or facilitates the first explicit lexical learning. Once the child has begun to learn a range of different words, word templates will begin to be induced or abstracted out of those words. The differences between such templates in individual children exposed to the same language may be taken as evidence for the role of focused attention, guided by each child's personal interests and sensitivity to phonological patterning (including the potential individual match between the child's own VMS, or most often used phonetic patterns, and the shapes of adult word forms) (Vihman, 1993). By the end of the single word period the language of the input exerts a "channeling" effect, leading to greater between- than within-group differences in the phonetics of children's words (Boysson-Bardies & Vihman, 1991), including their rhythmic patterns (Vihman, Nakai, & DePaolis, 2002).

4 Emergent phonology in the bilingual child

What is the implication of such an account for the bilingual child? As regards "language differentiation," first of all, many studies published in the 1980's failed to distinguish between knowledge of the language attained through exposure alone — perceptual and distributional knowledge or representation — and knowledge expressed in language production, particularly differential production according to linguistic context (Genesee, 1989; Ingram, 1981; Johnson & Lancaster, 1998). At the current stage of our understanding of the very considerable learning that occurs over the first ("prelinguistic") year, it seems critical to distinguish between the store of knowledge attained in the first months of language exposure, in the probable absence of specific linguistic representations, and the later months, in which representations of particular words and phrases begin to form (Hallé & Boysson-Bardies, 1994). Based on implicit perceptual learning, it can be assumed that the bilingual child has the foundations for learning each of the languages at this point, and that they may be represented in such a way as to allow independent access on the basis of various situational triggers, although independent phonological *systems* (for production) will not be in evidence for some months.[3] It is also possible that, under conditions of exposure to two (or more) languages, a child's phonological development is always subtly different from that of monolingual children. This would account for the frequent observation that the production of a bilingual child is in some ways unlike that of mono-

[3] For the child adopted away from the native culture — for example, Romanian orphans adopted by British families, or Chinese orphans adopted by Americans — the situation will be quite different. In the absence of those first months of exposure we can expect such children to be slow to acquire English, as has indeed been reported informally, on the CHILDES network. In the absence of continuing exposure to the first language we cannot expect these children to develop into bilinguals at all.

lingual children acquiring either of the two languages (e.g., Deuchar & Quay, 2000; Johnson & Lancaster, 1998; Khattab, this volume).

The production patterns exhibited in first words, based on item learning, or the matching of existing production patterns to input forms, can differ only to the extent that the adult languages differ in ways that can be reproduced by a one-year-old. For example, Ingram (1981/82) reports that an Italian/English bilingual child produced mainly monosyllabic forms in English but disyllabic forms in Italian, which he takes to reflect the child's "two systems." Alternatively, under an item learning account of first word production, we could conclude that the child was merely reproducing within-repertoire sound patterns after learning their associations with situations of interest. That is, bilingual exposure will have led the child to develop a rich store of implicit knowledge of the phonetic patterning of each of the languages to which she had been regularly exposed. The learning of particular word forms will first be manifested as the child identifies (or unconsciously "selects") adult forms that constitute a match for her existing production patterns. Monosyllabic reproduction of monosyllabic English words and multisyllabic reproduction of multisyllabic Italian words are the expected result of item learning in a bilingual context.

If word templates constitute the "origins of system," then the patterning of word forms in a bilingual child's repertoire should help us to see whether the child, generalizing from the individual lexical items s/he has learned, first develops a single production system encompassing words from both languages or two independent systems, one for each language. Either is plausible, if we assume that item learning is the basis for the induction of patterns. Both paths could be found in particular cases, since children acquiring a single language show extensive individual differences, not only in the specifics of their phonological paths (Vihman, 1993) but also in their general approach to learning (Ferguson, 1979; Vihman & Greenlee, 1987). In what follows I will explore this idea by considering the early phonological patterns of three bilingual children, examining word productions to see whether patterns are applied to one or both languages.

5 Some analyses of early bilingual phonology

Waterson (1971) introduced the notion of "whole word phonology," drawing on diary data from her son P at a time when he was well into word production. At 1;6 he had some 155 words, of which 104 were monosyllables. Waterson identified five different "structures," based on "correlations at the phonetic level" between adult and child forms. The child word forms provided in Tables 1 and 2 (above) illustrate the sense in which the child is in each case reproducing a "whole word" rather than substituting segments. The target words for both children's words have in common only the presence of a medial nasal, a pattern to which the child may have been sensitive, at least in part, because nasal-vowel(-nasal) patterns were already in his production repertoire. In Raivo's case (Table 2) a nonoverlapping range of variant forms were produced for each of the words. However, after a few days the child settled into producing the single form [nən] for all of the words, suggesting that a process of abstracting away or induction from the individually learned word forms had led to the formation of a single pattern that he could readily access. This I take to be the prototypical origin of word templates.

A word template can be operationally defined as a consistent phonological pattern that reveals both (1) selection of target words on the basis of the child's existing phonetic forms and (2) adaptation of less narrowly selected target words to fit the pattern (see Schwartz, 1988, for a review of the evidence for word selection on phonological grounds). Following Vihman & Velleman (2000) we distinguish between words whose child form matches the adult form relatively closely, termed *selected*, with errors of omission only, and words whose child form departs from the adult form by changing segments or sequence in such a way that it conforms more closely to the child's other word forms than to the adult model, termed *adapted*, with possible errors of commission as well as omission. The proportion of "selected" versus "adapted" word forms differs by individual child (Vihman, 2001). We will make the working assumption that phonological systematicity is emergent when we begin to find one or more patterns dominating the child's output, with errors of adaptation as well as selection. Thus, I will distinguish between "first words," which are typically *selected only*, and later words, which appear to be based on a template that has emerged over a period of one or more months of word production. At that point *both selected and adapted* exemplars will be noted, since some target words will conform to the child's template as they stand and thus need no adapting.

For my analyses I will draw on data from three bilingual children who have English as one of their languages: Raivo (+ Estonian: Vihman, 1981, supplemented from diary notes), Shelli (+ Hebrew: Berman, 1977), and Tom (+ French: Brulard & Carr, submitted). Details on each child's bilingual situation, developmental course, data collection and so on can be found in those sources (for Raivo, see also Vihman, 1985).

5.1
Raivo: Estonian / English

In Table 3 some of Raivo's very first words are presented in the order in which they appeared — first several words with syllabic sibilants (1;1–1;2), then more adult-like CVC forms involving a final voiceless fricative that varied between [f], [ɬ], [s] and even [ʍ] (1;2–1;4). In the last month the first disyllabic forms with sibilants appeared (1;4), as both "selected" and "adapted" forms.

Although the first sibilant words are hardly accurate renditions of the structure of the adult forms, they constitute "selections" in the sense that they substitute or reorder nothing but merely reproduce subparts of the adult form. Of the first CVC sibilant forms that Raivo produced, some show minor omissions or common substitutions, such as [d] for [ð], while others show bolder changes, adapting the structure of the adult form so that it is more similar to Raivo's existing forms (reducing clusters to singletons, disyllables to monosyllables). At the point at which the child begins to assimilate adult forms to fit a pattern that characterizes many of his other words, we can recognize an emergent word template (indicated here as the point at which an "adapt" column begins to supplement the "select" column). In Raivo's production of sibilant target words the CVC pattern, which is congruent with his nasal pattern (Table 2), emerged first ([dɪs] 'this', [küs] *küpsis* 'cookie'), followed by a CVCV(C) template ([pɪsi] '(make) pee', [kɪzɪs] *küpsis* 'cookie').

The key point about these data, for present purposes, is the fact that both English and Estonian adult models appear as both "selected" and "adapted" forms. That is, Raivo appears to be consistently attempting to match his existing repertoire of production

Table 3

Raivo (Estonian / English) <(C)VS>, <(C)VSV(S)> [S = sibilant]

Child age	*Child form: SELECT*	*Adult target* [ɪ = imitated]
1;1.15	[ʃ ~ ç]	*shoe*
1;1.17	[iś ~ ɪɬ ~ ɬ]	*viska* 'throw'
1;1.21	[s]	*suur* (ɪ) 'big' (raises hands: "so big" routine)
1;1.25	[s]	*vesi* (ɪ) 'water'
1;2.2	[ts ǀ ts]	*klotsid* (ɪ) 'blocks'

Child age	*Child form: SELECT*	*Adult target*	*Child age*	*Child form: ADAPT*	*Adult target*
1;2.20	[dɪs]	*this*	1;2.7	[kyś]	*küpsis* (ɪ) 'cookie'
1;3.27	[zös], [jös], [ʒuś]	*juice*	1;3.10	[mə s]	*müts* (ɪ) 'hat'
1;4.2	[if], [piˬ]	*piss* 'pee'	1;3.10	[mə s]	*musi* (ɪ) 'kiss'
1;4.4	[af:]	*ahv* 'monkey'	1;4.2	[duɬˈ]	*juust* 'cheese'
1;4.4	[pɪsi]	*pissi* '(make) pee'	1;4.3	[kɪ zɪ s]	*küpsis* (ɪ) 'cookie'
			1;4.3	[ə zɪ s]	*what's this?*

(Adapted from Vihman, 1981; supplemented from diary notes)

patterns to adult targets regardless of the source language. This is not to say that Raivo could not *hear* the difference between the two languages of his environment. Although he was not formally tested for this, there is sufficient evidence from studies of both monolingual and bilingual infants to convince us that any language to which a child is regularly exposed will become familiar and readily discriminable from other languages, even within the first six months of life (Bosch & Sebastián-Gallés, 1997; Mehler, Jusczyk, Lambertz, Halsted, Bertoncini, & Amiel-Tison, 1988). Thus, I do not wish to claim that Raivo could not distinguish the two languages. Rather, I argue that in beginning to construct a phonological system, his first steps moved from item learning in both languages (*shoe, viska*) to more general patterns (one- and later two-syllable forms with a sibilant), which he at first deployed whenever the adult target lent itself to the pattern. The system is emergent; it can be expected to grow into two separate phonological systems as increasing numbers of patterns and of linguistic units crystallize out of the child's (increasingly well defined) lexical representations (see Macken, 1979).[4]

5.2 *Shelli: Hebrew / English*

Berman (1977) presents phonological data from her daughter Shelli, acquiring English and Hebrew (Table 4). The data cover the period from Shelli's first words (ca. 15 mos.) to a lexicon of about 175 words (ca. age 2), although no complete list is provided. Shelli's "adapted" patterns are particularly striking because they often involve metathesis (shown in bold), which constitutes a radical departure from the adult form. In contrast, her "selected"

[4] Note that Deuchar and Quay (2000) report the emergence of a system of voiced/voiceless contrasts in utterance-initial stops in their subject's English only at 2;3, with the Spanish voice contrast still emergent at that age. This child already had over 300 recorded words by age 1;9.

forms show only minor departures from the adult model (vowel or consonant change, initial cluster reduction, final consonant omission).

Table 4

Shelli (Hebrew / English) <vel–non–vel>. Forms occurring in an earlier versus a later form are indicated by '> '

Child form: SELECT	Adult target		Child form: ADAPT	Adult target	
gan	*gan*	'nursery school'	do > god	*dog*	
kele	*kelev*	'dog'	gabi	*buggy*	
kem > keŋ	*ken*	'yes'	gala	*agal'a*	'buggy'
ket	*cat*		gila, gida	*glida*	'icecream'
kin	*cream*		kali	*Alex*	
kini	*skinny*		kami	*monkey*	
kise	*kise*	'chair'	kati	*mastik*	'chewing gum'
kova	*kova*	'hat'	keni	*candy*	
kudu	*kadur*	'ball'	kibi	*piggie*	
(h)am > xam	*xam*	'hot'	kiti	*chicken*	
			kolo > kola	*Sokolad*	'chocolate'
			koto	*Soko*	'cocoa'
			kuc > gut	*juk*	'cockroach'
			kuti > kuni	*Tunik*	(a name)
			xon	*naxon*	'right!'
			xali	*Mixali*	(a name)

(Adapted from Berman, 1977)

Like Waterson, Berman invokes perception to explain the child's radical adaptation of certain adult words but provides no independent evidence for this interpretation. This is only one of several interpretations that have been proposed to account for the "errors" or adaptations reflected in children's early production patterns; alternative interpretations include difficulties in representation or memory for language (Macken, 1979; Vihman, 1978), articulatory difficulties (Labov & Labov, 1978) or articulatory gesture coordination (Studdert-Kennedy & Goodell, 1995), speech planning (Chiat, 1989), and processing (Berg & Schade, 2000). Although we cannot presume to resolve this difficult issue here, what is clear from Table 4 is that Shelli (a) has developed a "melody" template consisting of velar consonant in initial position, nonvelar in second position (cf. the labial–coronal pattern of Si: Macken, 1979), and (b) applies the pattern to words deriving from either language (as Berman also notes, p. 20).

5.3 *Tom: French / English*

Brulard and Carr's son Tom, acquiring French and English (2001), made use of a pattern involving medial /l/, among others (Table 5); for comparison, we provide data from a monolingual French child, Laurent, who developed a similar pattern (Table 6). The incorporation of /l/ into an early word template has yet to be reported for English (based on published accounts of over 20 children). It is thus striking that Tom should extend the pattern to English, picking up on the presence of /l/ in *telly* and also fitting *cardie* into the pattern, with substitution of [l] for the later-learned English /r/.

Table 5

Tom (French / English) <(C)VIV>

Child form: SELECT (1;10)	**Adult target**
[ʔaˈle]	allez! 'come on! / go on!'
[dəˈlo]	de l'eau 'some water'

Child form: SELECT (2;0)	**Adult target**	**Child form:** ADAPT (2;0)	**Adult target**
[tɛˈli]	*telly*	[kaˈli]	*cardie (cardigan)*
[vwaˈla]	voilà 'there it is / there you are'	[baˈlo], [bəˈlo]	pantalon 'trousers'

(Adapted from Brulard & Carr, 2001)

Table 6

Laurent (French) <(C)VIV>

Child form: SELECT (0;10)	**Adult target**
[(h)ailo]	*allo* 'hello'
[[d(l)ə]	*donne (le)* 'give (it)'
[ljoljo]	*lolo* 'bottle'

Child form: SELECT (1;3.0)	**Adult target**	**Child form:** ADAPT (1;3.0)	**Adult target**
[alo]	*allo* 'hello'	[kola]	*canard* 'duck'
[dəlo]	*dans / de l'eau* '(in the / some) water'	[bølo]	*chapeau* 'hat'
[palõ]	*ballon* 'big ball'	[bəla]	*la brosse* 'the brush'
		[kola]	*la cuillère* 'the spoon'

(Adapted from Vihman, 1993)

It is worth noting some other instances of interaction, in which Tom's "solutions" to word production problems which derive from one language but are then applied to the other. Thus, at 2;0.15 for French /ʁ/ he begins to produce a final voiceless uvular fricative (also used by French adults) in *dort* 'he's sleeping' and *chaussure* 'shoe'; soon thereafter he produces English words with the same final segment (*more*, *door*). A second case is the production in English of [st] or [ʒt] for final sibilants and clusters with sibilants: *beast* [bist] ('selected'), *wash* [wɔst] ('adapted') at 2;2.7, *nose* [noʒt], *brush* [bɔst] (2;2.21) and *wasp* [wɔst] (2;4.0). At 2;2.21 the voiceless cluster was produced in French *mouche* [must] 'fly'.

As regards prosody, both Shelli and Tom were learning languages whose dominant accentual pattern differed: French accent is normally iambic, although it may be shifted for emphasis, while Hebrew is primarily iambic and English primarily trochaic. Interestingly, both children showed a tendency to follow a single prosodic model in production of their first few hundred words, but their "choice of model" differed: Shelli's words in the period in question were largely trochaic, including errors of stress placement in Hebrew, while Tom's were largely iambic, including errors of stress placement in English.

6 Conclusions

Previous studies of bilingual phonology have compared phonetic and/or phonological inventories (Ingram, 1981/82; Schnitzer & Krasinski, 1994), the application of phonological processes (Vogel, 1975), acoustic analyses (Deuchar & Clark, 1996), or phonotactic structures (Johnson & Lancaster, 1998; Paradis, 1996). Following Waterson (1971) and Macken (1979), among others, this paper took a different approach, analyzing early production patterns. These analyses have taken into account both (1) the commonalities across two or more child forms and (2) the relation of the child form to the adult target ("selected" vs. "adapted"). Although the study has examined only a handful of patterns, one or more from each of only three bilingual children, it is proposed as a way of looking at bilingual child data that might prove useful in future studies.

The available data have been marshalled to support the position implied by the title. At the start, and even well into production of the child's first word forms, we find no evidence of a phonological system as such. Instead, the phonetic patterns and situational application of individual words are learned holistically. Just as generalization across contexts of use begins to be found not with the first words but later in the period of the first 50 words (Barrett, 1995), induction of a phonological pattern is characteristically found not in the very first word productions but some time thereafter. By the time that a diarist has recorded 50–100 word types it is generally possible to identify one or more phonological patterns or word templates. We can take the existence of such patterns to signal that the child has begun the process of building a phonological system, as it appears to reflect implicit comparison and organization across the words the child has produced.

On this basis, all the bilingual data we have considered here show interaction between the two languages in the children's first phonological patterns. In Raivo's case the sibilant patterns he applied to both languages have parallels in the production of monolingual children learning each language (see Waterson, 1971, for the English parallel). Shelli's "velar first" melody has been reported elsewhere for Spanish only so far, although she extends it to English as well as Hebrew. Tom's medial /l/-based pattern happens to have been reported for a monolingual French child; its absence in English monolingual data was noted. Finally, the cross-sectional data reported by Bhair Naya for a Hindi-English learning child shows the omission in English of an onset stop and nasal, a pattern considered deviant in English but one which occurs in several children acquiring Finnish, another language with medial geminates (Vihman & Velleman, 2000).

After a period of some months, as the range of segmental and prosodic patterns attempted increases, word production should reveal increasing numbers of productive phonological patterns. Within a year of the first word production we expect a child's repertoire to look more adult-like, although some difficult segments, consonant clusters, or longer words may still be lacking. Even at that stage phonological processes which take the whole word as their domain may apply, suggesting continued reliance on a "whole word" or "long domain" strategy in dealing with particularly challenging word forms (Lleó, 1990; Vihman & Greenlee, 1987). A dual phonological system should gradually become established, based on the regularities among and interconnections between the words of each language, which should come to be better differentiated as a direct consequence of growth in the child's dual lexicon (see Beckman & Edwards, 2000).

By the time that a bilingual child can approximate the adult segmental repertoire, given adequate exposure to both languages, it should be possible to identify many respects in which the phonologies have evolved into "independent systems," although the control required for a contrast in production in particular subsystems, such as voicing, may not yet have been fully mastered. The dual phonological system of the adult bilingual is taken here to have its origin neither in an initial "unitary system" nor in a "dual system from the start" but in (asystemic) item learning, followed by the gradual emergence of a range of different production patterns, guided by the forms available in the input. The implementation of phonological contrast, implicit in and a defining characteristic of the adult system, will characterize the child's phonology only as the constraints on production planning, linguistic perception, representation and processing are gradually overcome.

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