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Learning to construct verbs in Navajo and Quechua*

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ABSTRACT

Navajo and Quechua, both languages with a highly complex morphology, provide intriguing insights into the acquisition of inflectional systems. The development of the verb in the two languages is especially interesting, since the morphology encodes diverse grammatical notions, with the complex verb often constituting the entire sentence. While the verb complex in Navajo is stem-final, with prefixes appended to the stem in a rigid sequence, Quechua verbs are assembled entirely through suffixation, with some variation in affix ordering.

We explore issues relevant to the acquisition of verb morphology by children learning Navajo and Quechua as their first language. Our study presents naturalistic speech samples produced by five Navajo children, aged 1;1 to 4;7, and by four Quechua-speaking children, aged 2;0 to 3;5. We centre our analysis on the role of phonological criteria in segmentation of verb stems and affixes, the production of amalgams, the problem of homophony, and the significance of distributional learning and semantic criteria in the development of the verb template. The phenomena observed in our data are discussed in light of several proposals, especially those of Peters (1983, 1995), Pinker (1984), Slobin (1985), and Hyams (1986, 1994).

INTRODUCTION

Navajo and Quechua, both morphologically rich languages, present an interesting testing ground for proposals regarding the acquisition of inflectional systems. Of particular interest for these languages is the development

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of the verb, which encodes not only tense, aspect, and number-/person-of-subject, but also such grammatical notions as transitivity, causation, modification and internal arguments. In fact, the complex verb forms which characterize these languages often constitute the entire VP or, indeed, the whole sentence. The languages are all the more fascinating because, typologically, the structure of the verbs in Navajo is roughly the mirror image of Quechua verbs: while complex Navajo verbs are formed by appending prefixes to the root or stem, Quechua verbs are formed entirely through suffixation. This is illustrated in the Navajo and Quechua equivalents of the English sentence, 'They were feeding it to me, too':

(1a) Navajo:
Shí - *áłdo'* - *shá* - *da* - *'í* - ø - ł - *tsóód*
1OBJ-also-for-PL-OBJ-SUBJ-CL-IMPF STEM:feed

(1b) Quechua:
Mikhu - *chi* - *sha* - *wa* - *rqa* - *n* - *ku* - *pis*
eat-CAUS-PROG-1OBJ-PAST-3SUBJ-PL-ADD

In the Navajo verb form, the disjunct prefixes (those furthest from the stem) include oblique object, adverbial, postposition, and plural, and the conjunct prefixes (those closest to the stem), the direct object, subject, and transitive classifier. The stem 'feed' occurs in final position and its form indicates imperfective aspect. By contrast, in the Quechua verb shown in (1b), the stem created by affixing the causative suffix to the root means 'cause to eat' or 'feed', and the final element, the Additive suffix, is an independent enclitic meaning 'also.' The morphemes occurring between the causative stem and the final bound enclitic are part of the inflectional set.

In both languages, a verb must minimally consist of a root and a person-of-subject affix; that is, adult speakers do not produce bare verb roots or stems. However, in Navajo, the ordering of the prefixes in relation to the verb stem is quite rigid, whereas, in Quechua, some of the suffixes attached to the verb stem may occur in varied order. While the Quechua suffixes have unique and identifiable meanings, the rules for their combination often have no basis in semantics: they are idiosyncratic, including ordering restrictions which must be formulated as negative filters (Muysken, 1986, 1988).

In the present study, we undertake an exploration of the acquisition of verb morphology by children learning Navajo and Quechua. We centre our analysis on acquisition issues that are especially relevant to morphologically complex languages: the importance of phonological aspects in the extraction of verb stems and affixes, the early production of (partially) unanalysed amalgams as well as bare verb stems, the problem of homophonous affixes, and the role of distributional learning and semantic criteria in the development of the verb template. Although our data provide largely converging evidence with respect to the phonological and perceptual aspects of

verbs that serve as segmentation clues, we find that young children learning both Navajo and Quechua produce bare verb stems/roots. In fact, the verb root or stem is the only part of the verb that these children produce in isolation. The early production of bare verb stems contradicts the prediction set forth in one nativist proposal, Hyams' STEM PARAMETER (1986, 1994), while lending support to another, Pinker's hypothesis-testing model (1984). However, Pinker's model fails to address the challenge children face in learning the homophonous affixes and allomorphic variants that pervade the verb morphology of languages such as Navajo and Quechua. Before presenting the highlights of Navajo and Quechua verbs, the data collection procedures, and the child language data, we discuss relevant proposals regarding the acquisition of verb morphology.

THE PROPOSALS

The role of phonological criteria in morpheme extraction

Over the past two decades, several researchers have explored how children first segment and extract portions of the verb complex, largely relying on phonological criteria. In a number of studies on the acquisition of synthetic and agglutinative languages, the phonological salience of particular syllables is cited as a vital cue in segmentation. One of Slobin's (1985) OPERATING PRINCIPLES stipulates the importance of perceptual salience, whereby children pay attention to the ends of words. Peters (1983) has proposed that children store unanalysed 'one-unit' amalgams. It is commonly observed that children learning a variety of synthetic languages may insert novel filler syllables into the affixal string, (e.g. Aksu-Koç & Slobin, 1985; Saville-Troike, 1996), and Peters views the insertion of such 'placeholder' syllables as evidence of unanalysed amalgams. Peters' segmentation clues extend beyond Slobin's notion of perceptual salience. They include the last syllable, the first syllable, stressed syllables, rhythmically salient places, intonationally salient places, repeated sub-units, and portions shared by different stored amalgams. To this list, Peters later added semantic salience (1995). Peters has further asserted that children apply a set of heuristics, akin to Slobin's Operating Principles, as they undertake the segmentation of stored amalgams. Among the investigations that have provided supporting evidence for parts of these proposals, four are particularly relevant to the present study: Pye's observation of children learning Maya K'iché (1983), Aksu-Koç & Slobin's study of early Turkish development (1985), Mithun's description of the acquisitional sequence in Mohawk (1989), and Crago, Allen & Pesco's investigation of child acquisition of Inuktitut (Crago & Allen, 1998; Crago, Allen & Pesco, 1998). For example, Aksu-Koç & Slobin have noted that Turkish children never produce bare verb roots/stems. They attribute this

phenomenon to the nature of the input: since parental speech always consists of inflected forms, they conclude that Turkish children's early inflected verbs are unanalysed amalgams produced imitatively. By contrast, Crago & Allen report that Inuktitut-speaking children typically produce (non–adultlike) uninflected verb root morphemes at the one-word stage.

Hyams' Stem Parameter : a nativist account

While both Slobin and Peters have maintained that children approach the task of extraction by applying a set of heuristics, neither has proposed that children are endowed with innate grammatical principles such as those set forth in parameter-setting models of language acquisition. By contrast, Hyams offers a parametrized account of the acquisition of inflectional morphology (1986, 1994) based on observations of children learning English and Italian. Noting that very young English speakers produce bare verb stems while their Italian counterparts do not, Hyams has proposed the Stem Parameter, with two possible settings: a verbal stem is (+) or is not (–) a well-formed word. Accordingly, a language like English takes a positive setting of the parameter because verbs can surface as bare stems; a language like Italian takes the opposite value because uninflected Italian stems do not constitute well-formed words. A clear prediction may be drawn from Hyams' theory: children learning morphologically complex languages will not produce bare verb stems. In Hyams' discussion of child Italian and in a subsequent critique of the Stem Parameter by Pizzuto & Caselli (1994), it is not clear what is meant by bare verb stem. For the Italian verb *parlare* 'to speak', for example, the verb root is *parl-*. Children would naturally not produce such bare verb roots because of phonotactic constraints; that is, well-formed Italian words do not end in certain single consonants or in consonant clusters. Hyams surely does not consider *parla-* to be the verb stem, for, in that case, the stem would be identical to an inflected form, third-person singular *parla* 'he speaks': the stem would thus constitute a well-formed word.

Pizzuto & Caselli have sharply criticized Hyams' proposal, noting, above all, that Hyams' prediction is unfalsifiable: since Italian children never hear bare stems, they may merely be reproducing only what they hear rather than adhering to a principle of well-formedness. They reject nativist models in general, having observed in their own investigations that Italian children learn inflections gradually, in a piecemeal fashion, and that development varies from child to child. They assert that a nativist account based on triggered parameters predicts deterministic acquisition that occurs in an all-or-none fashion. Pizzuto & Caselli therefore claim support for a non-nativist, information-processing model of acquisition, one that attributes to children cognitive mechanisms for exploiting distributional regularities.

Pinker's hypothesis-testing model of inflectional learning

Outright dismissal of nativism based solely on the rejection of parameter-setting models amounts to throwing out the proverbial baby with the bath water. Pinker's (1984) model of inflectional learning is nativist in approach, and yet it readily explains the gradual and varied nature of inflectional development observed by Pizzuto & Caselli. Pinker's proposal is a hypothesis-testing model that posits innately given grammatical features, or 'dimensions', such as tense, aspect, person, and number, as well as learning mechanisms that constrain children's hypotheses as they map features to forms. The outcome of the process is a set of rules for the concatenation of verb roots/stems and affixes yielding a verb structure template that specifies the order of affixes. The primary learning constraint is the Unique Entry Principle, which blocks children from hypothesizing more than one form for a particular feature.

On Pinker's approach, children initiate paradigm-learning on the basis of whole verbs they have extracted from the speech stream. (They have already categorized each as a VERB through semantic bootstrapping.) Children first construct verb-specific mini-paradigms, only later to abstract general patterns of inflection. In this part of the proposal, Pinker acknowledges developmental evidence that children first produce inflections on just a few verbs, gradually extending their usage to more and more verbs. In order to abstract general inflectional patterns, children must identify the verb roots or stems within the verb-specific paradigms through separation of the phonetic material that they share. According to Pinker, children label the unique portion of each verb isolated in this way as ROOT, an innate grammatical substantive.

The proposals regarding extraction strategies based on phonological features are helpful. Phonological and perceptual salience must surely play a role in the task of drawing children's attention to morphological constituents within complex verbs. Indeed, Pinker would have to allow for strategies such as these as a means of enabling children to strip away the 'phonetic residue' from the verb root or stem. However, one must agree with Pinker (1989) that Slobin's Operating Principles fail to explain how language acquisition works because they merely describe WHAT children are doing rather than explaining HOW they are doing it. For example, what exactly is the process for mapping grammatical features to the extracted forms? And how does the child recognize grammatical features in the first place? An implication in many of these proposals is that morphological analysis proceeds in a top-down fashion, starting from whole words or amalgams stored holistically. Is this always the case?

	0	I	II	III		IV	V	VI	VII	VIII	IX	X	Enc
DISJUNCT PREFIXES	Object of postposition	Postposition; Adverbial Thematic	Iterative mode	Distributive plural	CONJUNCT PREFIXES	Direct object pronoun	Subject pronoun (usually fourth person; impersonal; indefinite)	Thematic and adverbial elements	Modal Conjugation marker	Subject pronoun	Classifier	**STEM**	Enclitics (negative, relativizer, 'usually', etc.)

Fig. 1. Classes of prefixes in the Navajo verb complex.

VERB MORPHOLOGY IN THE TWO LANGUAGES: HIGHLIGHTS

Navajo

The Navajo language is a member of the Athabascan family, which is spoken primarily in northern sections of Arizona and New Mexico. It is closely related to nearby Apache and more distantly to several indigenous languages of Alaska, Canada, and the Pacific coast. Although currently spoken by more individuals than any other American Indian language in the United States (estimates up to 100,000), it is being acquired by a rapidly diminishing number of children.

We first present a chart (Figure 1) showing the classes of prefixes which may occur in Navajo complex verb forms. The Roman numerals indicate the positions of these prefixes with respect to the stem, which appears in Position X. The inflected verb is thus typically stem-final, except for a few enclitics which may follow the stem. Since there is little allowable variation in the ordering of these affixes, the chart represents a relatively rigid template.

Sentences (2–4) illustrate some of this complexity, with different combinations of prefixes. Neither Navajo nor Quechua indicates gender on pronominal affixes; gender in the English glosses is inferred from context. We therefore use 'he' as the unmarked referent in the English glosses. The diacritic (′) in the Navajo forms indicates high tone, and an apostrophe represents a glottal stop, as in (3). The Navajo stem, while linearly indivisible, may vary according to aspect and mode, for instance. Morphophonemic changes sometimes obscure the transparency of the morphological composition of forms, raising questions regarding the isolability of the stem;

that is, the Navajo stem, unlike the Quechua stem, may vary, encoding more than the semantic reference. This is shown in (4a) and (4b). Whereas both stems exhibit high tone, the perfective stem in (4a) has a nasal vowel, and the imperfective stem in (4b) does not. (The reader is referred to Young (2000) for further information about the Navajo verb complex.)

(2) *akǫ - dii - sh - yeed*
I VI VIII stem
there-INCEPTIVE-1SUBJ-run
'I will go over there.'

(3) *sh - aa - d - oo - t - ˈáá*ɬ
o I VI VII IX stem
1OBJ-TO-INCEPT-PROG-CLASSIFIER-give
'(It) will be given to me.'

(4a) *a - sh - chį́*
IV VII stem
OBJ-IMPF-gives birth
'She gives birth (to an indefinite object).'

(4b) *da - nighi - sh - chí*
III IV VII stem
DIST/PL-1OBJ-PF-gave birth
'She gave birth to us.'

The canonical order of major constituents in Navajo is SOV, or OSV with the object in focus or otherwise 'outranking' the subject. (See Creamer, 1974). The verb complex is almost always in sentence-final position.

All roots and affixes are monosyllabic in underlying form, but there is a great deal of fusion, with a single syllable representing two or more morphemes. For example, the verbal root *ˈa* 'move a solid or compact roundish object' has different derived stem forms with changing aspect, such as addition of high tone and nasalization for perfective, and addition of vowel length, high tone, and final ɬ for future; the transitivizing classifier is often realized as glottalized onset or voicing of the initial stem segment. A sequence of prefixes such as *-shi-* 'me' plus *-a-* 'to/about' is contracted as *-sha-*. With respect to the phonological contour of the Navajo verb, tone prominence can occur on prefixes and suffixes, as well as on the verb stem. This can include medial elements. For instance, second person subject is often realized as high tone added to another (usually medial) prefix.

Quechua

Quechua, the lingua franca of the Inca empire, is today spoken in several distinct varieties by over eight million people in Peru, Bolivia, Ecuador, Argentina, and Colombia (Cerrón-Palomino, 1987). The Cuzco-Collao

variety of Quechua spoken in southern Peru is one of several similar varieties classified together as Quechua A (Parker, 1963; Cusihuamán, 1976). What is called Quechua A also comprises the varieties spoken in Bolivia and northern Argentina.

Quechua verbs consist of a leftmost root to which a number of suffixes may be appended. The adults in the present study produced verbs with up to five suffixes in child-directed speech, not including verb-final independent suffixes such as evidential markers. Figure 2 shows the morpheme order for

ROOT	Derivational	Derivational	Progressive	Person of Object	(PAST) Tense	Person of Subject	Number	Conditional	Independent Suffix(es): evidential, interrogative, contrastive, additive, etc.
			SHA	WA	RQA				

Fig. 2. Morpheme order for a Quechua past progressive verb.

a Past Tense verb with a first-person singular Object in the Cuzco-Collao variety. Although Quechua morphology is generally agglutinative, there are a few fusional elements, especially in Future Tense forms and in some combinations of the Subject and Object markers. The rightmost affixes constitute the inflectional set. Minimally, a well-formed Quechua verb must have a root and a Person-of-Subject suffix. The verb root does not vary, with complex stems constructed through suffixation rather than modification of the form of the root.

Quechua verbs differ from Navajo forms in exhibiting some variation in the ordering of affixes, usually (but not always) with semantic consequences. This is illustrated in (5)–(6), utterances produced by Chalhuancan adults in child-directed speech that illustrate variation in the sequencing of two suffixes, Causative *-chi-* and Exhortative *-r(q)u-*. In general, the causative suffix serves to create causative stems, e.g. *mikhu-* 'eat'+*-chi-* resulting in *mikhuchi-* 'cause to eat', or 'feed'. The Exhortative suffix modifies the meaning of the verb root by adding the notion of suddenness, brusqueness, or violence to non-imperative forms. Calvo Pérez (1993) also classifies the suffix as a marker of perfective aspect. In (5), the suffix directly modifies the root, while in (6), it modifies the causative stem. (The Exhortative allomorph *-ra-* must precede Directional *-mu-*.) We present these suffixes in boldface, as elsewhere, in order to highlight the focus of the examples.

(5) *Qechu* -***rqu-chi***-*ku-waq*.
take away-EXH-CAUS-REFL-2COND
'You would let (him) suddenly take it way from you.'

(6) *Waqa* -***chi-ra***-*mu* -*su-nki*.
cry-CAUS-EXH-DIR-3SUBJ-2OBJ
'He suddenly (went and) made you cry.'

Some pairs of suffixes are rigidly ordered with respect to each other. As shown in (7), for example, the causative always precedes the object-marking inflections. This combination is ambiguous, with the object marker representing either the lower SUBJECT, as in 'He makes me wash someone', or the lower OBJECT, as in 'He makes someone wash me.'

(7) *Maqchhi* - ***chi - wa*** - *n*.
wash-CAUS-1OBJ-3SUBJ
'He makes someone wash me.' / 'He makes me wash someone.'

While the canonical order of major constituents in Quechua is SOV, the word order in matrix clauses is flexible, with all six possible orders commonly produced by both adults and children.

Quechua verbal affixes are mostly one or two syllables in length, while the roots usually consist of two syllables, the latter always ending in a vowel phoneme. (There are a few three-syllable roots, primarily those that have been borrowed from Spanish, e.g. *trawahu-* 'work' from Spanish *trabajar*.) However, the third-person singular subject inflection is the single phoneme /*n*/ and the allomorphs of some affixes are also single phonemes. For example, Directional -*mu*- reduces to /*m*/ preceding Regressive -*pu*-. As for the phonological contour of Quechua verbs, primary word stress regularly falls on the penultimate syllable.

We have presented only the highlights of verb morphologies which are extremely complex. In what follows, we introduce further relevant details of Navajo and Quechua verb affixes as required in the discussion of specific issues.

PROCEDURES

Navajo

The Navajo corpus for this study totaled 762 nonduplicate verbal utterances produced by five children from the Kayenta and Shonto regions of Arizona in the period from 1990 to 1992. The five children were recorded three or four times each during that period. On Table 1, the children, identified by pseudonyms, are listed in ascending order of proficiency as judged from (1) their Mean Length of Verb (MLV), or average number of morphemes

TABLE 1. *Navajo children by age at recording and in ascending order of proficiency*

	Age 1;1 to 1;5	Age 2;11 to 3;0	Age 3;5 to 3;8	Age 4;0 to 4;7
Nora	1;1			
	1;3			
	1;5			
Alice		2;11	3;6	4;0
		3;1		
Rose			3;6	4;0
			3;8	4;7
Albert		2;10		
		2;11		
		3;0		
Lucy			3;5	
			3;6	
			3;7	

TABLE 2. *Quechua-learning children by age at recording and in ascending order of proficiency*

	Age 2:0 to 2;2	Age 2;5 to 2;9	Age 2;10 to 3;1	Age 3;2 to 3;5
	2;0			
Max	2;1			
	2;2			
Ana		2;5	2;10	
		2;6		
		2;7		
		2;8		
		2;9		
			2;10	
Hilda			2;11	
			3;0	
			3;1	
				3;2
Ines				3;3
				3;4
				3;5

produced in the verbal complex (a range of 1·0 to 3·9), (2) their total production of elements in each constituent position, and (3) their percentage of accurate production in each constituent position (as reported in Saville-Troike, 1996). Adult complex structures addressed to the children ranged from 2 to 6 morphemes per utterance. The table also shows the ages at which each child was recorded, ranging from 1;1 to 4;7.

A total of approximately fifteen hours of audiotape recording was collected and transcribed. All recording was done by a female relative or friend of the family in a familiar setting with no non-Navajo or stranger present. The audiotapes were transcribed by three native speakers of Navajo who were from the same geographical region as the subjects. The corpus of 762 child verbal utterances breaks down as follows: Nora, 25; Alice, 134; Rose, 204; Albert, 215; and Lucy, 184.

Quechua

Three children from Chalhuanca, an Andean community in the Caylloma Province of Arequipa, Peru, were each recorded in Chalhuanca for an approximate total of five to six hours from June through the beginning of October, 1996. A fourth child, Ana, was recorded for eleven hours from June through December, 1996. The age range for the children, as shown on Table 2, is 2;0 to 3;5, and the four children are listed in order of ascending age and proficiency. All the recordings were carried out in the homes of the children or in a one-room home/daycare facility, with the researchers sometimes present and usually with older siblings or cousins. The audiotapes were transcribed by native speakers of the Cuzco-Collao variety of Quechua that prevails in Chalhuanca and the rest of southern Peru.

The child corpus for the present analysis included 832 nonduplicate verb forms: Max, 81; Ana, 314; Hilda, 184; and Ines, 253. In addition, a total of 279 adult verb forms were taken from child-directed speech as a basis of comparison and for the analysis of input frequency.

THE DATA

Early extraction of the verb root/stem

For both Navajo and Quechua, children's early verb forms often consist of uninflected roots or stems. This is surprising, since these children never hear such forms in the input. There are no instances of bare roots or stems in the corpus of child-directed speech.

The youngest Navajo child, Nora, produced the bare stems shown in (8–9) below at ages 1;1 and 1;3. Target adult forms are included in parentheses. Although vowel length, tone, and nasalization are phonemic in adult Navajo, no systematic differentiation of these features was found in the production of any children in this sample. The bare stem *teeh* 'move an animate object' was used for homophonous utterances in (9), meaning both 'Lie down' and 'Pick me up'. (Interpretation of the meanings in context was provided by Nora's mother.) The third utterance in (9) is a two-word, four-syllable utterance which does not include a verb form. Since it occurred in Nora's speech at the same age as consistently bare stems in verb constructions, the example

indicates that her productive constraints in the verb were not simply due to length of utterance.

Navajo:

(8) Nora (1;1)

Da.	(*ní-daah.*)
'Sit.'	THEME/2SUBJ-sit
Go.	(*há-go.*)
'Come here.'	here/2SUBJ-come

(9) Nora (1;3)

Teeh.	(*ní-teeh.*)
'Lie down.'	PF/2SUBJ-move
Teeh.	(*ná-shi-dii-l-teeh.*)
'Pick me up.'	around-1OBJ-FUT(IMPER)-CL-move
Haagi gaagi?	(*háá-jí gáa-gi?*)
'Where is the crow?'	'which-place caw-RELATIVIZER'
	(*gaa-* is onomatapoetic)

The youngest Quechua speakers also produced bare roots and stems. The examples in (10) show Max, at ages 2;0 to 2;1, producing a partial root in the first utterance, and an uninflected reflexive stem in the second. At ages 2;5 to 2;6, Ana's sentences are three or four words in length, and yet she persists in often producing bare roots. In (11), the bare roots produced by Ana are *muna-* 'want' for second-person *qan*, *kani-* 'bite' for third-person *waka* 'cow', and *pusa-* 'take, lead' for first-person *noqa*.

Quechua:

(10) Max (2;0–2;1)

Mu chicha.	(*muna-ni chichasara-ta*)
'I want chichasara.'	want-1SUBJ chichasara-ACC
Noqa laqaku.	(*noqa-q laq'a-ku-n*)
'Mine fell down.'	1PRON-GEN fall-REFL-3SUBJ

(11) Ana (2;5–2;6)

Chay muna qan.	(*chay-ta muna-nki qan*)
'You want that.'	that-ACC want-2-SUBJ 2PRON
Chay kani waka chay.	(*chay-ta kani-n waka.*)
'The cow bites this.'	this-ACC bite-3SUBJ cow
Noqa pusa wawata.	(*noqa pusa-ni wawa-ta.*)
'I take the baby.'	1PRON take-1SUBJ baby-ACC

In these Quechua examples, the children are dropping not just the final consonants but also whole CV syllables. In the Navajo examples, it is the prefixes that are missing. It should also be mentioned that the Quechua examples are not isolated instances. Of the total of 81 non-duplicated verb forms produced by Max, 46, or 57%, are bare roots or stems, even though,

at this stage, Max is already producing some two-word utterances of up to three or four morphemes. At ages 2;5 to 2;6, Ana produces such forms in 27% of her verb forms, even though she is already producing three- and four-word utterances with variable word order.

The four Navajo children who used verbal prefixes also produced a few bare stems, but these constituted a small percentage of their utterances: Alice, 10 (7·5%); Albert, 4 (1·9%); Rose, 3 (1·5%); and Lucy, 1 (0·54%). Only Alice produced bare stems when there was no lexical content word preceding the verb. All other bare stems in the production of these four children occurred in contexts where there was lexical content preceding the verb, probably because of either redundance or processing limitations. While Albert and Lucy made no errors in the production of obligatory subject prefixes, Alice and Rose omitted or made inappropriate selection of first- and second-person subject prefixes in 28·6% and 13·3% of obligatory contexts, respectively. Since both of these children produced bare stems as well as errors in the subject prefixes, they have clearly extracted the verb root/stem BEFORE attaining the full paradigm of subject prefixes.

Ana's production of Quechua bare roots and stems in the age range, 2;5 to 2;6, also coincided with unstable production of the Person-of-Subject affixes. For example, during this period, Ana produced a total of 38 utterances with intended first-person subjects, and yet, only 55% of the verbs in these utterances exhibited first-person subject morphology. The remaining 45% of the verbs were either bare roots/stems or inappropriately inflected in third-person singular. At this point, in fact, Ana has a productive repertoire of only three Person-of-Subject inflections: third-person *-n*, first-person Future *-saq* (a rare instance of fusion in Quechua paradigms), and Imperative *-y*. Nevertheless, the verb forms she produced during this period included 46 different roots. Ana stopped producing bare forms at age 2;7, when the singular Person-of-Subject paradigm emerged, and the older children did not produce any bare roots at all. However, even the older children produced very few verb forms with plural subject inflections. What all this reveals is that children extract the verb root/stem BEFORE they have developed whole-word paradigms for the Person-of-Subject inflections.

The role of perceptual salience and phonological prominence

In both Navajo and Quechua, the verb root/stem occurs at the periphery of the verb, so that perceptual salience, following Slobin (1985), may aid children in extraction of this portion of the verb. There is also evidence from Navajo that perceptual salience plays a role in the segmentation of prefixes. Navajo thematic and modal prefixes appear in Positions I and VI in the verb complex, and the meaning of these prefixes is often opaque. The most proficient pair of children, Albert and Lucy, produced verb forms with these prefixes in both positions. Example utterances produced by these two

children are shown in (12) and (13), with the appropriate adult prefix forms indicated underneath the glosses and full adult forms presented to the right. (INCEPT = INCEPTIVE; DPL = DUOPLURAL). Once again, boldface is used to highlight the relevant prefixes.

Navajo:

(12) Albert (2;11)

***N**-da.*	(*ń- daah.*)
'(Pretend) he sits down (in the back of the car).'	THEME-sit
(*ni-* [POS VI] = terminative)	
*Da **di**-l-tal.*	(*dah dii-l-taaɬ.*)
'He's dashing off.'	off INCEPT-CL-run
(*dii-* [POS VI] = relates to arms and legs)	

(13) Lucy (3;5)

*Bi-ɬ-ch'e'- **ya**-dii-l-te.*	(*bi-ch'į'yá-di-i-l-tih.*)
3OBJ-ʔ-TO-THEME-INCEPT-DPL-CL-talk	3OBJ-TO-THEME-INCEPT-DPL-CL-talk
'Let's talk to this.'	
(*ya-* [POS I] = relates to speech)	
***Ha**-nééh.*	(*haa-nééh.*)
'Is (the blood about to) come out?'	THEME-move
(*ha-* [POS I] = flows out)	

By contrast, Alice's and Rose's productions of the Position I thematic prefix were far more reliable than those of Position VI. Alice produced 80% of the prefixes appropriately for Position I and only 25% for Position VI (a medial conjunct position), which is closer to the stem. Rose's errors and omissions were confined to Position VI. In other words, given morphemes with the same grammatical function and similar meaning, those occurring at or near the beginning of the verb complex (Position I) are mastered before those which occur closer to the stem (Position VI). The order of accuracy in the production of prefixes clearly relates to prefix position and thus to perceptual salience.

Although perceptual salience may help children learning both languages segment verb stems and some affixes, there are no instances of children producing isolated affixes. In both languages, phonological prominence can fall on any syllable except the last in Quechua (tone prominence in Navajo; primary stress in Quechua). Since both stems and affixes may be phonologically salient in both languages, one might expect children to produce bare affixes as well as bare verb stems. Nevertheless, neither Navajo children nor young Quechua speakers produce single affixes or syllables WITHOUT the corresponding verb stem. This finding converges with the production facts reported by Crago *et al.* (1998) for Inuktitut-speaking children. The Inuit

children produce neither isolated affixes nor syllables with primary stress. However, it contrasts with observations made by Mithun (1989) for Mohawk & Pye (1983) for Mayan Quiché. Children's earliest verb forms in both Mohawk and Quiché consisted of the syllable bearing primary stress, regardless of its morphological status. Returning to Slobin's notion of perceptual salience, one might expect Navajo children to produce bare initial prefixes or Quechua children to produce isolated final inflections. There are no occurrences of this in either set of data.

Pye further observed that children learning Mayan Quiché always observed the syllable divisions in their words, rather than the morpheme boundaries. In Navajo, syllable division and morpheme boundaries coincide. In Quechua, verb suffixes may consist of one or two syllables. While the data yield no segmentation errors in the extraction of the Quechua suffixes, children tend initially to favor monosyllabic allomorphs over those that straddle two syllables. For example, the Exhortative morpheme has two allomorphs, *-rqu-*, which spans two syllables, and monosyllabic *-ru-*. Of the fifteen exhortative verbs produced by Ana, the first ten all bear monosyllabic *-ru-* . Ana does not produce a verb form with the *-rqu-* allomorph until age 2;9. With respect to the extraction of verb roots, the youngest child, Max, produced three incomplete roots consisting of only the first syllable: *mu-* for *muna-* 'want'; *pha-* for *phawa-* 'fly, run'; and *wik-* for *wikch'u-* 'throw away'. No instances of incomplete roots occurred in the verb forms produced by the three older children.

Early production of unanalysed or partially analysed amalgams

Do children produce unanalysed amalgams or 'chunks', following Peters (1983; 1995)? We find evidence of this from the Quechua data. In examples (14–19), we find a set of utterances produced by Ana at ages 2;5 to 2;6. Ana's utterances are responses to the questions posed by the INTERLOCUTOR (IL), all direct questions except for (17). In all of these utterances, Ana's verbs end in the combination *-ku-sha-*, which comprises the Augmentative allomorph *-ku-* with Progressive *-sha-*. The Augmentative suffix, like the Exhortative, is a 'modifying' suffix that adds the notions of intensity, care, or courtesy. Three of its allomorphs occur in free variation: *-yku-*, *-yu-*, and *-ku-*. The *-ku-* allomorph is homophonous with Reflexive *-ku-*, and it is not always clear which morpheme is intended in the verbs produced by the youngest children, who produce both the *-ku-* and the *-yku-* allomorphs. It is possible that young speakers of Quechua may meld together the semantic notions of intensity and personal involvement, expressed by means of the Augmentative and the Reflexive, respectively.

If Ana's responses seem inappropriate in the English glosses, they seem even more so in the original Quechua, since Quechua speakers charac-

teristically respond to direct questions by repeating the exact verb stem provided in the question. Example (15) is particularly revealing. Here, the question contains a verb with the resultative suffix *-sqa*. In her response, Ana produces an ill-formed verb containing the root, part of the resultative suffix, and *-ku-sha-n*. Ana clearly overuses this suffix combination, the most frequent contiguous combination produced by all the children in the present study. While adults frequently produce progressive verb forms (21% of the corpus of child-directed verbs), they rarely produce Progressive *-sha-* in combination with the Reflexive or the Augmentative. Perhaps Ana is making use of the *-kusha*(*n*) amalgam as an all-purpose aspect marker. Significantly, in the next age range, (2;7–2;8), Ana does not produce this combination.

Quechua:

(14) IL: *Mama-yki tusu-n-chu toka-ka-qti-n?*
mom-1POSS dance-3SUBJ-INTERR play-REFL-SUB-3
'When it is played, does your mom dance?'
Ana: *Toka-n. *Tusu-ku-sha-#.* (*Tusu-n-mi*)
'play-3SUBJ dance-AUG-PROG-?SUBJ dance-3SUBJ-AF
'(Yes), she dances.'

(15) IL: *Ña-chu chaya-sqa?*
already-INTERR cook-RES
'Is it already cooked?'
Ana: **Chaya-s-ku-sha-n.* (*Chaya-sqa-n.*)
cook-*RES-AUG-PROG-3SUBJ cook-RES-AF
'(Yes), it is already cooked.'

(16) IL: *Puklla-n-chu?*
play-3SUBJ-INTERR
'Does she play?'
Ana: *Puklla-ku-sha-n.* (*Puklla-n-mi.*)
play-AUG-PROG-3SUBJ play-3SUBJ-AF
'(Yes), she plays.'

(17) IL: *Ima-ta ruwa-sha-ni?*
what-ACC do-PROG-1SUBJ
'What am I doing?'
Ana: *Kuchu-ku-sha-n.* (*Kuchu-sha-nki.*)
cut-AUG-PROG-3SUBJ cut-PROG-2SUBJ
'You are cutting.'

(18) IL: *Noqa-chu sipi-ru-saq?*
1PRON-INTERR kill-EXH-FUT/SUBJ
'Shall I kill it?'
Ana: **Tu sipi-ku-sha-n.* (*Qan-mi sipi-nki.*)
you(SP) kill-AUG-PROG-3SUBJ you-AF kill-2SUBJ
'(Yes), you'll kill it.'

(19) IL: *Hayta-ku-sqa-su-nki?*
kick-REFL-RES-2OBJ-3SUBJ
'Had he kicked you?'
Ana: *Hayta-ku-sha-n.* (*Hayta-wa-sqa-n-mi.*)
kick-AUG-PROG-3SUBJ kick-1OBJ-RES-3SUBJ-AF
'(Yes), he'd kicked me.'

Peters has proposed that children produce novel, 'placeholder' affixes because they have acquired a phonological template for the verb form without having fully analysed the individual affixes in the string. If this is the case, we find further evidence of stored, unanalysed amalgams. This phenomenon is observed in both the Navajo and the Quechua data. The Navajo children sometimes produce verbs with novel prefixes, that is, Navajo-sounding nonsense fillers. Both of the utterances in (20) to (21) were produced by Rose at age 4;0. For (20) to (23), the questions marks in the glosses indicate that it is not clear what the adult target form might be.

Navajo:
Rose (4;0)
(20) *Money* ***na-na****-jaa-leh.* (*Money sh-aa-né-i-jih-* ɬ*eh.*)
money?-?-give-usually money 1OBJ-to-ITER-3OBJ-give-usually
'He usually gives me money.'
(21) *Líí'* ***na-na****-zi.* (ɬɣɣ'*yíi-ghah-gi si-z*'ɣ́)
horse?-?-stand horse 3OBJ-beside-the one PF-stand
'It is standing by the horse.'

The only Quechua-speaking child who produced such verb forms was Ines (3;2 to 3;5), the most proficient of the four children. No target forms are presented in (22) and (23), since the '*-a-a-*' placeholder affixes in these examples could be filled by many possible suffix combinations.

Quechua:
Ines (3;2–3;5)
(22) *Chura* ***-a-a*** *-wa-n-mi.*
put-?-?-1OBJ-3SUBJ-AF
'She has put it on me.'
(23) *Regala-****a-a****-wa-n-mi.*
give-?-?-1OBJ-3SUBJ-AF
'He has given (it) to me.'

This child already produces adult-like complex verbs with up to five affixes appended to the root, as illustrated in (24) to (26).

Quechua:
Ines (3;2–3;5)

(24) *Puklla -chi -wa-rqa-n.*
play-CAUS-1OBJ-PAST-3SUBJ
'He let me play.'

(25) *Regala-chi-ku-y-man.*
give-CAUS-REFL-1SUBJ-COND
'I would make (someone) give (it) to me.'

(26) *Willa-rqa-rqa-mu-ra-ni.*
tell-EXH-EXH-DIR-PAST-1SUBJ
'I went and told him quickly, suddenly, etc.'

Given this child's level of competence, it is clear that she has acquired most of the individual suffixes as well as many suffix combinations. The verb forms in (22) and (23) must merely be lapses in performance; that is, the inserted nonsense morphemes are probably filling in for suffixes that Ines is not able to assemble during production because of processing load.

The observations discussed so far may be summed up as follows:

A. Children learning both Navajo and Quechua produce bare roots and stems, but neither group of children produces isolated affixes. Perceptual salience may help these children extract the verb roots and stems. Other phonological criteria such as tone (Navajo) and primary word stress (Quechua) do not confer any special prominence on verb roots, since both may fall on both verb roots/stems and affixes. For this reason, we might expect children to produce both bare roots/stems AND isolated affixes. They do not. With respect to children's preference for extraction of phonologically prominent syllables, reported in other studies, we find that Quechua children prefer monosyllabic allomorphs. Virtually all Navajo morphemes are monosyllabic.

B. Children do produce amalgams that they have not yet fully analysed. However, the insertion of placeholder affixes in the production of complex verbs does not necessarily indicate incomplete analysis. Instead, this phenomenon may reveal performance difficulty.

C. Clearly, the verb root/stem has a special status for children learning Navajo and Quechua. Moreover, they extract the root/stem BEFORE developing the full set of Person-of-Subject affixes. This suggests that children do not necessarily proceed from word-specific paradigms to generalized patterns of inflections. This hypothesis is discussed in the next section.

Early production of affixes: verb-specific or generalized?

Pinker (1984) bases his proposal that inflectional learning proceeds from verb-specific mini-paradigms to abstraction of generalized patterns on developmental evidence: children first produce inflections on just a few verbs, gradually extending their usage to more and more verbs. Data from

Navajo and Quechua reveal that this is the case for some affixes and not for others. In both languages, the derivational affixes are those which children tend initially to produce on only a few verbs.

Navajo children appear to learn some affixes in relation to specific lexical items, although this is more likely to be the case for derivational than for inflectional elements. The Navajo utterances provided below suggest that the stem shape change for aspect and mode, the thematic and modal prefixes, and the modal-conjugation marker are all learned in relation to specific roots. In contrast to these affixes, the Navajo argument prefixes appear on all stems at once, as evidence of abstraction of generalized patterns of inflection.

With respect to stem shape change for aspect and mode, Albert voiced the final consonant for perfective forms of *'áázh* 'two subjects go', but not for *gizh* 'cut':

Navajo:
Albert (2;10–2;11)

(27) *Di-it-'ash.* (Future: *'ash*)
INCEPT-DPL-2GO
'(Now) let's go (outside).'

(28) *Ch'i-n-iit-'a**z**.* (Perfective: *'áá**zh***)
out-PF-DPL-2GO
'(Pretend that) we went out.'

(29) *K'i-ji-ɬ-geesh.* (Momentaneous/Imperfective: *géésh*)
off-4SUBJ/PF-CL-cut
'When one is cutting (the sheep).'

(30) *Iniɬge**sh**.* (*k'ínígi**zh**.*)
off-PF-CL-cut
'I cut it off.'

As for the thematic prefixes (Position VI), Alice categorically either produced or omitted the thematic prefix associated with a particular stem multiple times without variable occurrence. In other words, a thematic prefix either always occurred with a stem (e.g. *daa-* with 'die') or was always omitted (e.g. *ni-* with 'look'), strongly suggesting that these are lexically-linked elements.

Navajo:
Alice (3;6)

(31) *B-ee-**daa**-tsa.* (*b-ee-**daa**-z-ts ą́*)
'It died with it (my father's gun).' 3OBJ-with-THEME-PF-die

(32) ***Daa**-tsa.* (***daa**-z-ts ą́*)
'It died.' THEME-PF-die

(33) # -ɬ- *ní.* (***ni*** -ɬ- *'į́.*)
'Look at (something).' THEME-CL-look

(34) # *-sh -'ɬ́* (***ní*** *-sh -'ɬ́.*)
'I'm looking for it.' THEME-1SUBJ-look

Alice's overall 50% accuracy rate in the production of the modal-conjugation marker (Position VII) was also far from random: she always used *si-* appropriately with 'sit', for instance, but never used it with 'die'.

Verb-specific acquisition in Navajo thus appears to be more likely of derivational affixes, such as thematic elements, while inflections in argument positions appear with all verb stems simultaneously.

For children learning Quechua, verb-specific usage of affixes also appears to depend on their status as more inflectional or more derivational. In this regard, both Muysken (1981) and Cerrón-Palomino (1987) assert that Quechua suffixes cannot be clearly labelled as derivational or inflectional; rather, they represent a continuum. We consider certain types of Quechua suffixes to be more inflectional along this continuum, e.g. the subject inflections, the object markers, the reflexive morpheme, the progressive suffix, and the 'modifying' suffixes. The modifying suffixes include Exhortative *-r(q)u-* and Augmentative *-(y)ku-* or *-y(k)u-*. Three suffixes that might be considered more derivational on this continuum are Regressive/Benefactive *-pu-*, Directional *-mu-*, and Causative *-chi-* . Directional *-mu-* adds the notion of direction TOWARDS the speaker on verb roots denoting motion or transfer (*apa-* 'carry' + *-mu-* means 'bring'); on non-motion verbs, it signals movement AWAY FROM the speaker (*ranti-* 'buy' + *-mu-* means 'go and buy'). The suffix *-pu-* denotes regression (*ri-* 'go' + *-pu-* means 'go back') or a benefactive relation (*-pu-* + first-person Object *-wa-* means 'for me'). It is Regressive *-pu-* which is more derivational.

There is no evidence that children learning Quechua produce the more inflectional suffixes on a limited number of verb roots/stems. Recall that 57% of the verbs produced by the youngest child, Max (2;0 to 2;2), were bare verb roots or stems. The Person-of-Subject inflections on the remaining 47% of Max's verbs were three: Imperative/Infinitive *-y*, third-person *-n*, and first-person *-ni*. These 35 verb forms represent 26 different verb roots or stems. The total of 89 nonduplicate verb forms produced by Ana at ages 2;5 to 2;6 represent 46 different roots. With respect to Exhortative *-r(q)u-*, Ana produced 15 verb forms bearing this suffix between the ages of 2;5 and 2;10, with 11 different roots. In like manner, Hilda (2;10 to 3;1) produced 8 Exhortative verbs with 6 roots. The most frequently produced non-subject suffixes for all three children were the Progressive, the Augmentative, and the Reflexive. All the children produced these suffixes on a wide variety of verb roots.

By contrast, the earliest production of the more derivational suffixes was verb-specific. Max produced no causativized verb forms, but Ana produced 17 between the ages of 2;5 and 2;10. Of the 17 verbs bearing Causative *-chi-*,

8 were stems constructed from only two verb roots: 5 instances of *toka-chi-* 'cause to play' (a tape-recorder or radio) and 3 instances of *qhawa-chi-* 'cause to look' or 'show'. However, Hilda produced 24 Causative verbs with 14 different roots. The production of Directional *-mu-* is also verb-specific at first. This is shown in Table 3. The table reveals that for each child, 50% of

TABLE 3. *Summary of Quechua stems with Directional -mu- produced by Max, Ana, and Hilda*

Verb stem	Max (2;0–2:1)	Ana (2;5–2;10)	Hilda (2;10–3;1)	Total
apa-mu- 'bring'	1	8	2	11
ayku-mu- 'enter'	1	1	1	3
quechu-mu- 'take away'	0	2	0	2
Stems with other roots	0	5	1	6
Total	2	16	4	22

the non-duplicate verb forms bearing the Directional suffix had the same stem: *apa-mu-* 'bring'. Regressive/Benefactive *-pu-* exhibits a similar developmental pattern, as shown in Table 4. It is very likely that children

TABLE 4. *Quechua stems with Regressive/Benefactive -pu- produced by Max, Ana, and Hilda*

Verb stems	Max (2;0–2:1)	Ana (2;5–2;10)	Hilda (2;10–3;1)	Total
qo-pu- 'give back'	1	7	0	8
pasa-pu- 'go back'	0	1	2	3
apa-ka-pu- 'take back'	0	2	0	2
Stems with other roots	0	1	5	6
Total	1	11	7	19

first learn common stems with *-mu-* and *-pu-* holistically, only later to extract the suffixes for productive use.

The oldest child, Ines (3;2 to 3;5) has not been mentioned in this section because the complexity of her verbs is already adultlike. This complexity makes it difficult to discern frequently occurring suffixes and their combinations. Table 5 presents a summary of the verb complexity observed in the forms produced by all four children and by the adults in child-directed speech. The table shows that the bare verb forms produced by Max and Ana without subject inflections were all either roots or stems consisting of a root and one suffix. The table also reveals that the complexity of Ines's verbs is comparable to that of the adults.

TABLE 5. *Summary of Quechua verb complexity in forms produced by four children and adults*

	Max 2;0–2;2	Ana 2;5–2;6	Ana 2;7–2;8	Ana 2;9–2;10	Hilda 2;10–3;1	Ines 3;2–3;5	Adults
ROOT+ø (no subject)	36	10	—	—	—	—	—
ROOT+1 (no subject)	10	11	—	1	—	—	—
ROOT+ø (+subject)	20	23	30	32	18	25	30
ROOT+1 (+subject)	13	19	54	47	82	101	88
ROOT+2 (+subject)	2	22	22	29	65	80	74
ROOT+3 (+subject)	—	4	3	8	19	43	57
ROOT+4 (+subject)	—	—	—	—	—	4	30
Total:	81	89	109	116	184	253	279

To sum up this section, we find, in both languages, that the morphological expression of arguments reveals the abstraction of generalized patterns of inflection. By contrast, in both Navajo and Quechua, children first produce the more derivational suffixes on just a few verbs. In this regard, Mithun (1989) observed that children learning Mohawk never used derivational affixes innovatively, and she concluded that most of the derived forms were learned and stored as lexical units.

DISCUSSION

The significance of early production of bare verb stems : support for Pinker's model

The verb root or stem has a special status for children learning Navajo and Quechua. Like their Inuktitut-speaking counterparts (Crago & Allen, 1998), the children extract this portion of the verb before they achieve stable production of the complete paradigms of subject inflections. This, together with evidence of early generalized use of inflectional elements, suggests that the acquisition of inflections does not proceed from verb-specific paradigms after all. Inflectional learning is clearly not a totally top-down process dependent on the analysis of entire stored complex verb forms. In light of these findings, why is it that Italian and Turkish children never produce bare verb stems? As previously mentioned, the Italian verb 'stems' either violate phonotactic constraints or are well-formed words, depending on which part of the verb is designated as the verb stem. As for the Turkish data reported by Aksu-Koç & Slobin (1985), it may be that children always produce the

verb-final inflection because it coincides with both end perceptual salience and primary word stress. Navajo and Quechua verb stems do not violate phonotactic constraints, and they do not constitute well-formed words. Furthermore, unlike Turkish, not all the elements of phonological salience converge on the inflectional affixes.

Children's early production of bare verb roots or stems in Navajo and Quechua provides support for Pinker's model (1984). Isolation and use of bare verb roots/stems suggests that the grammatical notion of ROOT may indeed be an innate substantive available to children in the acquisition of verb morphology. Otherwise, why would children produce bare forms they never hear in adult speech even before they have fully analysed the inflectional 'residue'? It is also plausible that the UNIQUE ENTRY PRINCIPLE (UEP) proposed by Pinker constrains the process of mapping from function to form, preventing children from hypothesizing two forms for one grammatical feature. This mechanism provides children with a strategy for analysing fusional elements. For example, the Quechua inflection *-saq* encodes both Future Tense and first-person (singular) subject. Ana initially uses it as an all-purpose first-person marker and does not attend to the tense dimension. On hearing first-person *-ni*, she is forced by the UEP to differentiate the two forms.

The problem of homophonous affixes

Unfortunately, Pinker does not address another problem faced by young learners of both Navajo and Quechua: homonymity, i.e. a single form encoding different grammatical features. Homophonous affixes are pervasive in both languages. Both Pinker and Peters (1995) cite homonymy as a problem for learners, but neither explains how children deal with the problem. Our data suggest that children learn the meanings of homophonous affixes one-by-one, starting with the most semantically transparent features.

In Navajo, the *yi-* prefix has numerous functions. It indicates third-person direct object in Position IV when the subject is also third person and the subject is topical. (The *bi-* prefix occurs in this context when the subject is not third person or the object is in focus, as in 'passive' constructions.) The *yi-* prefix also indicates third-person object of postposition in Position o. In Position VII, *yi-* is a progressive prefix which has a common variant, *oo-*; *oo-* occurs when an underlying *yi-* progressive combines with a preceding conjunct prefix in the third person. With some stems, *yi-* also functions as a perfective prefix, as does *si-* with others. Finally, the prefix serves as a 'peg element', inserted if there is no other syllable preceding the stem. Our data suggest that the earliest function assigned to *yi-* is third-person direct object in Position IV.

Positions o and IV may be compared because they encode similar

TABLE 6. *Navajo direct object Position IV and object of postposition Position o prefixes*

Direct Object Position IV		Object of Postposition Position o	
sh-	1st	sh-	1st
nihi-	1st plural	ni-	2nd
bi-/yi-	3rd	bi-/yi-	3rd
'a-	indefinite	ał-	reciprocal
'ahi-	reciprocal 'each other'		

TABLE 7. *Accuracy of four oldest children in production of Navajo IV and o prefixes*

	sh-	nihi-	yi-	'a-	'ahi	sh-	bi/yi	ni-	ał-
Alice			+	+		+	X		
Rose			+	+		+	X		
Albert			+	+		+	+	+	X
Lucy	+	+	+	+	X	+	+	+	+

TABLE 8. *Child and adult performance in production of Quechua Object-marking morphology*

Person of Subject	Person of Object	Inflect.	Ana 2;5–2;6	Ana 2;7	Ana 2;8	Ana 2;9–2;10	Hilda 2;10–3;1	Ines 3;2–3;5	Adult
Imperative	1	-wa-y		+	+	+	+	+	+
3	1	-wa-n	*	*	X	+	+	+	+
3	2	-su-nki		*	+	+	X	+	+
2	1	-wa-nki			*	X	+	+	+
1	2 Fut	-sayki						+	+
1	2 Pres	-yki			*				+

\+ Consistently accurate production.
* Consistently inaccurate (omissions and errors).
× Partially accurate production.

grammatical functions and meanings, i.e. object. Table 6 shows a list of the direct object Position IV prefixes in Navajo, as well as the object of postposition Position o prefixes. In Table 7, we present a summary of the accuracy attained by each of the four oldest children in the production of these prefixes. The children are presented in ascending order of proficiency. The plus signs (+) indicate consistently accurate production, while the X's represent only partially accurate production. A blank space means that the child did not produce the prefix.

Note that all the children accurately produced the *yi-* prefix in direct object Position IV; only 13% of those produced in object of postposition Position o were *yi-*. In fact, the less proficient pair of children, Alice and Rose, frequently substituted *bi-* in Position o contexts requiring *yi-*. Examples of these errors are presented in (35)–(36).

Navajo:

(35) Alice (3;6)

Ale'e ****bi**-naa-ne.*	(*t'áadoo le'é* ***y**-**e**e-naa-né.*)
something 3OBJ-around-play	something 3OBJ-with-around-play
'He is playing with something.'	

(36) Rose (4;0)

Alice ****b**-ee-naa-ne.*	(*Alice* ***y**-ee-naa-né.*)
Alice 3OBJ-with-around-play/tease	Alice 3OBJ-with-around-play/tease
'He is making Alice cry.'	

The aspectual functions of *yi-* emerge relatively late (Position VII). With respect to the perfective prefixes, which occur with different verb categories, the *si-* prefix (indicating stative result) emerges first, even though *yi-* (indicating non-stative result) occurs more frequently in adult Navajo. As for the progressive function of *yi-*, Alice and Rose do not produce the prefix at all. As shown in (37)–(38), Albert at age 2;11 appropriately produced the *oo-* variant but not the *yi-* progressive form.

Navajo:

Albert (2;11)

(37) *B-i*ɬ*-oo-l-wo*ɬ.
3OBJ-with-PROG-CL-move
'He is riding along.'
(lit. 'The vehicle is moving with him.')

(38) *Dii #-jah.*	(*dii* ***yi**-jah*)
these run	these PROG-run
'These they are running.'	

If Albert initially prefers the *oo-* variant, it may be that he hypothesizes only this form for the progressive function, in accordance with the UEP, since he has previously assigned to *yi-* the function of object in Positions o and IV. The absence of *yi-* as a progressive prefix in the verbs produced by Alice and Rose may be attributable to the same phenomenon, i.e. initial mapping of *yi-* only to the object function. In their case, however, the *oo-* variant of the progressive is not yet available.

Moving on to relevant Quechua data, we now consider the suffix *-yki*. This suffix is used to mark the second Person-of-Possessor on Quechua nouns (*wasi-yki* 'your house'), as well as second Person-of-Subject in nominalized

verb forms (*hamu-sqa-yki* 'your having come'). On verbs, it encodes first-person Subject/ second-person Object (*riku-yki* 'I see you'). In Table 8, we first present a summary of the object-marking morphology produced by the three oldest children. (The youngest child, Max, did not produce any object markers at all.) On the table, the plus signs (+) indicate accurate production, while the X's represent only partially accurate production. A blank space means that the child did not produce the suffix. Asterisks (*) represent consistently inaccurate production, and most of these indicate omissions of the object markers in obligatory contexts; one indicates an error. As shown on the table, not one of the the children produced any verbs forms with *-yki* expressing the first-person Subject/ second-person Object relationship, although Ines produced the fusional counterpart, *-sayki*, which encodes the additional feature of Future Tense (*riku-sayki* 'I will see you'). The complete absence of the *-yki* subject-object inflection in the children's verb forms is remarkable, since adults produce this suffix very frequently, especially in child-directed speech.

The earliest production of *-yki* occurs on nouns as a marker of second-person possessor. There are no examples of this suffix in the speech of the youngest child, Max (2;0 to 2;2). It first emerges in the speech of Ana, the second-to-youngest child. However, Ana does not make productive use of *-yki* as a noun inflection expressing second-person possessor until the age of 2;9. Sample utterances, produced by Ana are presented in (39)–(40).

Quechua:
Ana (2;9)
(39) *Apa - mu - ni karta - **yki** - ta.*
carry-DIR-1SUBJ letter-2POSS-ACC
'I have brought your letter.'
(40) *May - taq sombriru - **yki**?*
where-CONT hat-2POSS
'And where is your hat?'

These production facts suggest that children may avoid producing homophonous affixes even though they figure prominently in the adult input. The Quechua data also reveal that children may initially assign to a suffix that function which is the most transparent. For example, the nominal Person-of-Possessor function of *-yki* is more transparent than the verbal subject/object-marking function. Yet another strategy apparently available to children learning Quechua is the aforementioned fusion of the grammatical notions encoded in distinct morphemes; thus, *-ku-* is initially assigned a combination of features corresponding to the Reflexive and to the Augmentative.

Clearly, children are guided by a learning principle, based on contrast, that is more far-reaching than the Unique Entry Principle. They avoid not only assigning multiple forms to a single function, but also multiple functions to

a single form. We should add that the assignment of multiple forms to a single function is sometimes unavoidable, as in the case of dual progressive forms in Navajo (*oo-* and *yi-*), as well as multiple allomorphs of a single affix (e.g. *-r(q)u-/-r(q)a* for the Quechua Exhortative and *-y(k)u-/-(y)ku-* for the Augmentative). It is difficult to account for the acquisition of such multiple forms, which challenge the UEP.

Accurate morpheme order : evidence of stored templates?

Quite remarkably, none of the Navajo children ever made any errors in the sequencing of prefixes within the verb complex. There was not a single instance of inverted order among prefixes in the production of any of the children; the ordering of constituent positions within the inflected verb was inviolate. Nor did the Turkish children observed by Aksu-Koç & Slobin (1985) make any errors in the ordering of grammatical morphemes. Mithun (1989) reported the same finding for Mohawk. How might we account for this error-free performance? Mithun stresses the importance of the memory of existing words (the lexicon). Bybee (1985) has argued that children's error-free performance in the production of highly complex forms shows that children store entire strings of morphemes: 'children's speech also demonstrates the productive use of rules, but the fact that the affixes are rarely attached to stems of the wrong category, and rarely placed in the wrong order, suggests that the rules are constructed on the basis of previously acquired rote forms' (114). Peters (1983) notes that the role of analogy in morphologically complex languages may be greater than it is in analytic languages such as English. However, Pinker (1984) asserts that children do not undertake 'blind' correlations of patterns, which would require enormous amounts of memory; rather, they undertake distributional learning that interacts with inductions that are semantically driven.

The three youngest Quechua-speaking children, Max (2;0–2;2), Ana (2;5–2;10), and Hilda (2;10–3;1), produced no errors in the suffixal sequence; nor did they produce any of the sequencing variations and suffix duplications that are permitted in Quechua. Error evidence from Quechua suggests that proficient speakers, both adults and older children, rely on stored complex forms in the construction of verbs. In (41)–(43), we present verb forms produced by adults and by the very proficient oldest child, Ines, that exhibit errors in the ordering of affixes.

Quechua:

(41) Ines (3;2-3;5)

*Chura - **pu** - rqu - wa - rqa - n.*	(*Chura-rqa-**pu**-wa-rqa-n*)
put-BEN-EXH-1OBJ-PAST-3SUBJ	put-EXH-BEN-1OBJ-PAST-3SUBJ

'He suddenly put it (there) for me.'

(42) Adult
Ukya - ***sha*** - *yu* - *ni*. (*Ukya-yu-**sha**-ni*)
drink-PROG-AUG-1SUBJ drink-AUG-PROG-1SUBJ
'I am carefully drinking.'

(43) Adult
Hap'i - ***sha*** - *ysi* - *su* - *nki*. (*Hap'i-ysi-**sha**-su-nki*)
hold-PROG-ASST-3SUBJ-2OBJ hold-ASST-PROG-3SUBJ-2OBJ
'He is helping you hold it.'

In each case, it is as if two forms, a frequent stem and the corresponding root, were retrieved simultaneously during production, resulting in a processing error of the blend type (Garrett, 1980). This type of error is consistent with Gürel's (1999) findings in an exploration of language processing in Turkish word recognition: lexical access of morphologically complex words with frequently used morphemes is whole-word, while that of complex words made up of less common morphemes entails morphological parsing before lexical access. This finding, in turn, supports models of dual representation of words.

Evidence for this phenomenon in the acquisition of Navajo is found in the near-mastery in Albert's and Lucy's retrieval of appropriate classifiers and thematic prefixes with each verb stem, even as they still make errors in other prefix selection. Alice and Rose were well below mastery of classifiers and thematic elements, but their pattern of production versus omission in relation to specific stems and not others also suggests retrieval of complex roots as lexical units. For example, Alice always produced the correct thematic prefix *daa-* with the stem *tsą́* 'single subject dies' (indicated with boldface in Example 44) and always omitted the thematic prefix *ni-* with the stem *-ɟæ* 'look, see' (indicated with # in Example 45). (Further examples are presented in Saville-Troike, 1996.)

Navajo:
Alice

(44) *B* - *ee* ***daa*** - *tsa*
3OBJ-with THEME-die
'It died with it (my father's gun).'

(45) # - *ɬ* - *í*
THEME-CL-look
'Look at (something).' (Omits thematic prefix *ni-*)

Productive use of suffixes, often revealed in errors, provides support for Pinker's premise that distributional learning interacts with inductions that are semantically-driven. The errors produced by Ana and Hilda in (46)–(48) reveal that hypotheses about the MEANING of affixes and their combinations, and not merely correlations of patterns, guide the acquisition of verb

morphology. In (46), we find that Ana has incorrectly analysed *-su-* as a second-person object marker. (The correct inflection here would be *-yki*; as discussed previously, none of the children produced this form to mark the relation of first-person Subject/ second-person Object.) She has done so because *-su-nki* encodes third-person Subject/ second-person Object. From this, she has incorrectly hypothesized that *-su-* encodes second-person Object instead of third-person Subject, based entirely on semantic criteria.

Quechua:
Ana (2;7)

(46) *Qan ni - nki, noqa ni - ***su** - ni - taq.* (VERB: *ni - **yki***)
2PRON say-2SUBJ, 1PRON say-**ʔ**-1SUBJ-CONT say-1SUBJ/2OBJ
'You say (your name), and I say (my name) to you.'

Hilda (2;10-3;1)

(47) *Kanchon - ta *saya - sha - n.* (VERB: *saya- **chi**- sha - n*)
corral-ACC stand-PROG-3SUBJ stand-CAUS-PROG-3SUBJ
'He's standing up the corral.'

(48) *Rikch'a - ra - ***ku** - sha - n.* (VERB: *rikch'a-ra- sha - n*)
awaken-EXH-REFL-PROG-3SUBJ awaken-EXH-PROG-3SUBJ
'He's waking up.'

Hilda's errors in (47)–(48) both involve the transitive variants of change-of-state verbs. For some Quechua change-of-state verbs, the transitive variant is a bare root (*kicha-* 'open'), whereas, for others, the transitive variant is a causativized stem (*rikch'a-chi-* 'awaken'). Young Quechua speakers appear to start off construing all change-of-state verbs as having basicially transitive roots, like *kicha-*. (See Courtney, 2002) Long after they have acquired productive use of the causative morpheme, they frequently omit *-chi-* in change-of-state verbs with intransitive roots, or they attempt to detransitivize basically intransitive change-of-state roots through reflexivization, as in (48). These errors reflect a process of hypothesis-testing based on semantic criteria. Moreover, since Quechua children in general start off construing all change-of-state verbs as basically transitive, it may be that this initial hypothesis results from an innate principle of markedness with respect to change-of-state verbs.

To sum up this section, we find converging evidence that children store portions of the verb template, with individual affixes subsequently extracted through distributional analysis. Navajo children produce no errors in the order of affixes. As previously discussed, Ana produced Quechua verb forms with only partially analysed amalgams of suffixes. Young Quechua speakers also appear to start off with a 'template' comprising suffixes ordered more rigidly than those observed in adult complex verbs. Sequencing errors in the verbs produced by competent Quechua speakers provide further evidence of

stored partial templates. Nevertheless, child errors in the productive use of individual affixes, together with early production of isolated verb stems, suggest that distributional analysis of stored complex verb forms does indeed interact with inductions based on semantic criteria.

CONCLUDING REMARKS

Our Navajo and Quechua child language data yield evidence in favor of proposals made by Slobin (1985) and Peters (1983, 1995) regarding the role of salience in segmentation and the storage of unanalysed or partially analysed amalgams. To some extent, our analysis converges with those of Pye (1983), Aksu-Koç & Slobin (1985), and Mithun (1989) for other synthetic and agglutinative languages. Nevertheless, it is significant that children learning both Navajo and Quechua isolate and produce bare verb roots and stems, just as Inuktitut-speaking children do (Crago & Allen, 1998; Crago, Allen & Pesco, 1998). This fact presents a challenge to Hyams' Stem Parameter (1986, 1994), while lending support to Pinker's (1984) premise that children are endowed with the innate grammatical substantive of VERB ROOT. Moreover, children appear to isolate the verb root/stem BEFORE they have acquired productive use of the full array of subject inflections. This phenomenon, taken together with our finding that children's early production of argument inflections is not confined to just a small set of verbs, suggests that children do not necessarily extract the verb root/stem from whole-verb paradigms they have constructed previously.

Further evidence in favor of Pinker's proposal derives from the Quechua data, since children clearly formulate hypotheses as to the function of specific affixes based on semantic criteria. Finally, with respect to Pinker's model of inflectional learning, the Unique Entry Principle is a viable constraint for the mapping process (function to form) on logical grounds. However, it falls short. It fails to account for the challenge faced by children learning languages characterized by pervasive homophony and allomorphy in the verb morphology. With regard to the problem of homophony, we propose that children learn the functions of homophonous affixes one by one, guided perhaps by a principle of contrast that is more far-reaching than the UEP. In this one-by-one learning process, children may first hypothesize those functions which are more semantically transparent.

This study yields compelling questions for further research. For example, how do children learning Navajo and Quechua isolate the verb roots and stems? Since Quechua roots are invariable, but Navajo stems vary according to aspect and mode, how does this affect the abstraction of bare stems from the input? In light of the Unique Entry Principle, how do children learn the allomorphic variants that pervade languages such as Navajo and Quechua? Although we believe the naturalistic production data reported in this study offer significant insight, the exploration of this and other issues requires

additional research and would profit from complementary formal measures of elicited production and comprehension.

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