From phylogenetic diversity to structural homogeneity – on right-branching constituent order in Mesoamerica

Volker Gast
Free University of Berlin
gast@zedat.fu-berlin.de
June 2001

Abstract

The Mesoamerican linguistic area shows a considerable degree of phylogentic diversity, in the sense that the ratio of language families to languages is relatively high. From a structural point of view, the four major families involved can be grouped into those with a predominantly right-branching constituent structure (Mayan, Otomanguean) and those that are or used to be predominantly left-branching (Uto-Aztecan, Mixe-Zoque). Given that right-branching and left-brancing constituent structure have met in a long term process of language contact, one might expect borrowing and interference to have taken place in both directions, leading to mixed type structures with both right-branching and left-branching elements. However, structural change in Mesoamerica has almost exclusively been towards right-branchingness. Left-branching languages have developed an increasingly right-branching syntax, while originally right-branching languages have remained remarkably stable with regard to their surface structure. In this paper, I argue that this development is actually predicted when we consider language contact in a linguistic area from the perspective of neo-Darwinian models of language change. Based on the theory of early immmediate constituents developed by Hawkins (1994), I argue that language contact is expected to give rise to structural homogeneity, i.e. to consistently right-branching or consistently left-branching surface structure. Structural homogeneity is favoured and promoted because language contact is a source and amplifier of structural variation on the higher level of the clause. The adaptive process is thus reinforced, for the existence of structural alternatives offers a choice and allows for the selection of those structures which optimise early immediate constituent recognition best.

1 Introduction: The Mesoamerican linguistic area

The term 'Mesoamerica' was first used in anthropology (Kirchhoff 1943).[1] It refers to an area that covers large parts of Mexico, Guatemala and El Salvador, and extends southwards on to the Pacific coast of Costa Rica (cf. Map 1). Kirchhoff characterises Mesoamerica as a *kulturbund* which manifests itself in a number of features from different areas of cultural life (agriculture, religion, garment, architecture etc.). The cultural convergence that can be observed is undoubtedly the result of long-term coexistence. Except for the Uto-Aztecan groups that migrated into Mesoamerica around 1000 AD, Mesoamerican peoples have been coexisting for several millennia (cf. Coe et al. (eds.) 1986 as well as references therein). Migration in the area has for the most part been either internal or inwards. To a certain extent, this can probably be attributed to the fertile soils and rich fresh water resources that are characteristic of the region (cf. West 1964). The northern border of Mesoamerica approximately corresponds to the dividing line between the dry lands in northern Mexico and the more fertile soils in the centre and the south. The south-eastern border does not have any topographical significance.

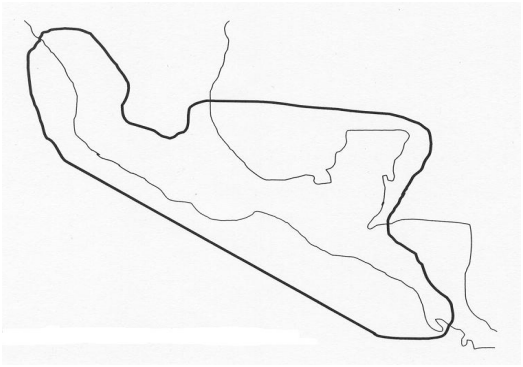


Figure 1: Mesoamerica (Kirchhoff 1943)

It is by now generally accepted that Mesoamerica is "a particularly strong linguistic area" (Campbell et al. 1986: 530). However, there is no general agreement on the geographical extent of the Mesoamerican sprachbund. Campbell et al. (1986) assume that Mesoamerica is bounded in the north by a dividing line that approximately corresponds to the tropic of cancer. Some of the languages that are spoken in northern Mexico are thus excluded (Cora, Huichol, Southern Tepehuan, Northern Tepehuan). Others have included some or all of these languages (e.g. Kaufman 1973). The different proposals have been reconciled by van der Auwera (1998) in terms of a quantitative approach to areal

[1] This paper was presented at the 23. annual meeting of the DGfS held at Leipzig (02/28 – 03/02/2001). I would like to thank Walter Bisang, Sebastian Drude, Carola Emkow, Daniel Hole, Anette Rosenbach, Peter Siemund, Stephan Töpper, and the auditorium of LiMo (Linguistik am Montag) at the FU Berlin for stimulating discussion and helpful criticism. Any remaining inaccuracies and mistakes are my own.

linguistics. Van der Auwera takes it that membership to a linguistic area is not categorical, and that linguistic areas generally have fuzzy boundaries. The degree of membership to a linguistic area depends on the number of areal traits that a given language exhibits. Consequently, some of the peripheral Mesoamerican languages - Cora, for example - are considered only "partly Mesoamerican" (van der Auwera 1998: 266). This means that they exhibit a few but not all of the Mesoamerican traits. Although van der Auwera's position is in principle adopted in the present paper, for the sake of the argument it is assumed that Mesoamerica is a categorical entity with clear-cut boundaries. As will be seen, nothing hinges on this since the present approach is quantitative very much like van der Auwera's. The boundaries adopted here are those of Kirchhoff (1943). Unlike Campbell et al. (1986), I consider Northern Tepehuan, Southern Tepehuan, Cora, and Huichol to be part of the Mesoamerican sprachbund (cf. Map 4 in the Appendix).

Mesoamerica has been characterised in terms of the following areal traits (cf. Campbell et al. 1986, Campbell 1997, van der Auwera 1998):[2]

⟨1⟩ a. VO word order[3]

b. Possessive constructions of the type [[POSS-[possessum]] [possessor]], e.g. Tzotzil *s-tot Šun* 'John's father' (lit. 'his-father John')

c. Relational nouns, which are typically associated with the semantics of spatial relations, e.g. Classical Nahuatl *i-nawak i-kal* 'close to his house' (lit. 'its-closeness his-house')

d. (Certain features characteristic of) vigesimal numeral systems

e. Loan words from Nahuatl (e.g. Totonac *kuluutl* < Nahuatl *kolootl* 'turkey') and semantic calques (e.g. 'stone' for 'egg', cf. Nahuatl *tetl* 'stone, egg', and Tzotzil *ton kašlan*, lit. 'stone hen', i.e. 'egg')

None of these five traits is without exception in Mesoamerica. Still, they represent a sample of features that are extremely

[2]Note that probably none of these traits is without exception in Mesoamerica. In view of the quantitative approach taken here, this does not affect the assumption that Mesoamerica is a linguistics area.

[3]Here, 'VO word order' merely means that the verb precedes the object. It is not meant to be a holistic characterization of the languages.

widespread in and characteristic of the region. In all cases, it can be demonstrated (via comparative evidence) that the features have spread by way of interference. Most of the traits are logically independent. However, VO word order, relational nouns (which are akin to prepositions), and the genitive construction illustrated in ⟨1b⟩ are certainly tightly interrelated both conceptually and empirically. These three features can be considered symptoms of two salient typological tendencies of Mesoamerican languages: Mesoamerican languages tend to be HEAD-MARKING and RIGHT-BRANCHING. The latter of these features will be central to the argument made in this paper.

It will be demonstrated that Mesoamerican languages are structurally highly homogeneous. Their constituent structure tends to be consistently right-branching in the sense that smaller constituents usually precede larger ones. This high degree of structural homogeneity is surprising if one considers that (a) the Mesoamerican linguistic area exhibits a high degree of phylogenetic diversity, and (b) two of the four major families involved (Uto-Aztecan and Mixe-Zoquean) were formerly heavily left-branching. Instead of developing a mixed type syntax, the Mesoamerican linguistic area seems to have 'opted for' right-branching constituent structure, leading to uniform branching structures. This fact is in need of an explanation since it is not *a priori* expected that phylogenetically diverse language contact should lead to structural homogeneity.

I will argue that a homogeneous constituent structure is actually predicted when we adopt Hawkins' (1994) theory of Early Immediate Constituents, embedded into a Neo-Darwinian model of language change: Syntactic diversity is expected to develop into syntactic homogeneity because the existence of structural variation on the higher level of the clause favours and 'boosts' the evolutionary process based on the interplay between variation and selection. Given that structural homogeneity facilitates parsing, this process can consequently be described as being adaptive, responding to the cognitive needs of speakers taking part in a situation of intensive language contact.

The paper starts with an explication of the notion 'branching direction' in Section 2. An indicator of the 'branching tendency' of a language (right-branching or left-branching) is defined: the 'branching index'. In Section 3 branching indices are determined for 44 Mesoamerican and 11 neighbouring non-Mesoamerican languages. The results are interpreted in terms of their areal dis-

tribution and checked against genetic relationships. It is shown that Mesoamerican languages are structurally highly homogeneous (heavily right-branching), and that this homogeneity cannot be attributed to genetic relatedness. Section 4 offers an explanation for the observed homogeneity in terms of processing ease. Hawkins' (1994) theory of early immediate constituents is briefly outlined and some exemplification is provided. In Section 5 it is shown how Hawkins' theory can be implemented into a Darwinian model of language change in terms of the interaction between variation and selection (cf. Kirby 1999). The role of functional and social factors in the process of selection is briefly discussed, and it is argued that uniform branching is the result of functional selection. Section 6 addresses the question of how and why variation in languages arises. It is pointed out that there are fundamental differences between internal and contact-induced mechanisms of innovation, and it is argued that language contact is a source of structural variation on the higher level of the clause. Consequently, it reinforces the adaptive interaction between variation and selection. The result is structural homogeneity. Section 7 summarises the conclusions and addresses some open questions.

2 Homogeneous constituent order in Mesoamerica

2.1 On the notion of 'branching direction'

One of the central claims made in this paper is that Mesoamerican languages are 'structurally homogeneous'. More specifically, they are claimed to be 'predominantly right-branching'. This claim calls for clarification in two respects: first, it should be made explicit what 'right-branching' exactly means; and second, the qualifying adverb 'predominantly' should be translated into a more falsifiable notion. These issues will be addressed in this section.

I will adopt the concept of branching direction that is commonly used in word order typology (e.g. Dryer 1992, Hawkins 1994, Kirby 1999). In this research tradition, branching direction refers to the order of shorter (lexical, non-branching) elements and larger (phrasal, branching) sister constituents in a surface constituent analysis. For example, the order VO is a right-branching structure because the verb is (usually) lexical and the object phrasal.

The reverse order OV, by contrast, is left-branching since here, the phrasal constituent (NP) precedes the lexical head (V). Thus, branching direction is regarded as a PROPERTY OF THE CONSTRUCTIONS OF A GIVEN LANGUAGE.[4]

If we assume that the branching direction of a constituent is a function of the order of phrasal and non-phrasal elements in surface syntax, we obviously have to make some basic assumptions about constituent structure. Constituent structure will be represented in terms of a standard version of X-bar theory.[5] Pronominal possessors, numerals, and adjectives are assumed to adjoin to N'. Lexical genitives are sisters of N' when they are modifiers and sisters of N when they are complements. The hierarchical structure of a (consistently right-branching) NP is thus assumed to be as in ⟨2a⟩. The order of Det, Poss, and Num may vary from one language to another. A German example is provided in ⟨2b⟩.

⟨**2**⟩ **a.** [$_{NP}$ DET [$_{N'}$ POSS [$_{N'}$ NUM [$_{N'}$ **A N**]]]]

b. [$_{NP}$ *diese* [$_{N'}$ *meine* [$_{N'}$ *zwei* [$_{N'}$ *lieben Töchter*]]]]
those my two dear daughters

lit. 'those my two dear daughters'

c. [$_{NP}$ *diese* [$_{N'}$ *zwei* [$_{N'}$ *lieben* [$_{N'}$ *Töchter* [$_{NP}$ *meines*
those two dear daughters my$_{GEN}$
Bruders]]]]]
brother$_{GEN}$

'those two dear daughters of my brother'

Word order typology in the tradition of Greenberg (1966) sometimes fails to distinguish between categorical and relational notions. For example, a statement such as "in language L the verb precedes the object" is, strictly speaking, inaccurate because

[4]This viewpoint contrasts with holistic approaches to branching direction, which are mostly associated with the generative paradigm. There, branching direction is conceived of as a PROPERTY OF LANGUAGES, not of constructions (cf. Chomsky 1995: 35). Languages fall into either of two categories: they are either right-branching (English) or left-branching (Japanese). It has even been claimed that there is no such .directionality parameter. and that .[h]eads must always precede their associated complement positions., while .[a]djunctions must always be to the left. (Kayne 1994: xiii). The difference between the generative and the typological approaches to branching direction is that generativists argue on the level of underlying syntax, whereas typologists refer to surface constituent order. The present paper is concerned with surface constituent structure only.

[5]I will not adopt the DP hypothesis for nominal projections (cf. Abney 1987). Nothing hinges on this.

		branching type					
C_n	order of ...	right-branching			left-branching		
C_1	verb and object	V	–	$[NP]_O$	$[NP]_O$	–	V
C_2	adposition and NP	P	–	[NP]	[NP]	–	P
C_3	possessum and lexical possessor	N_{PSM}	–	$[NP]_{PSR}$	$[NP]_{PSR}$	–	N_{PSM}
C_4	pronominal possessor and N'	PRO_{POSS}	–	[N']	[N']	–	PRO_{POSS}
C_5	demonstrative and NP	DEM	–	[N']	[N']	–	DEM
C_6	numeral and N'	NUM	–	[N']	[N']	–	NUM

Table 1: Order of elements and branching types

"verb" is a lexical category and "object" a syntactic relation. More accurately, we should say that "in language L, a verbal predicate (regularly) precedes a nominal object". Technically, the order of verbal predicate and nominal object could be represented by the formula "$[V]_{PRED}$-$[NP]_O$", where category labels are represented by capitals and relational notions by subscripts. For the sake of brevity, however, subscripts indicating syntactic relations will be used only where they are considered necessary. For example, 'V-$[NP]_O$' will stand for the traditional short label 'VO', since a verb is typically a predicate, whereas an NP is not always an object. In informal discussion, 'VO' will continue to be used as an abbreviation for "the verbal predicate precedes the nominal object". Likewise, 'NG' will stand for "the head noun precedes the genitive".

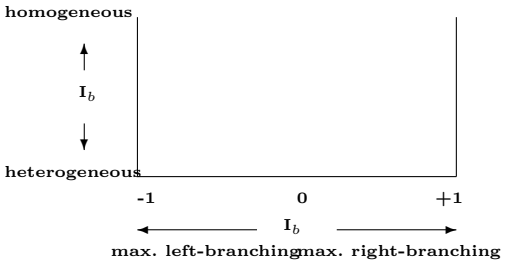
All constructions to be dealt with in this paper are summarised in Table 1. The first column assigns an ID to each construction for the sake of future reference. The rightmost columns specify which order of constituents corresponds to which 'branching type' (right-branching or left-branching).[6]

2.2 The branching index

If branching direction is regarded as a property of the constructions of a given language, it probably becomes transparent what it means for a language to be 'predominantly right-branching': it

[6]On C_2: adpositions are abbreviated 'P', which thus stands for both preposition and postposition. On C_3: The syntactic category of the possessor varies across languages. For example, in English the postponed genitive is a PP, while in other languages it is an NP. This difference is not crucial to the following discussion since both PP's and NP's are phrasal categories. Here, 'NP' should thus be read as 'NP or some projection higher than NP'.

means that the language in question has right-branching structures in most of its phrasal constituents. For example, Mixtec is right-branching in VP's since it is VO; it is right-branching in lexical genitive constructions since it is NG; it is right-branching in PP's since it has prepositions. Mixtec NP's headed by a demonstrative, by contrast, are left-branching since demonstratives follow N' (for example, [$_{\text{NP}}$[$_{\text{N'}}$ iʒa sí?í] ʒa?a] 'this goddess', lit. '[[god female] this]'). Thus, in most but not all of its phrasal constituents, Mixtec is right-branching; it is 'predominantly right-branching'. Otomí, on the other hand, is right-branching in all of the constructions mentioned above. We could say that it is 'very heavily right-branching' and 'more right-branching than Mixtec'. However, such fuzzy evaluations are hardly of any use in a cross-linguistic study claiming a certain degree of falsifiability. I will therefore propose a metric that is intended to indicate the branching tendency of a given language: the BRANCHING INDEX I_b. I would like to emphasize from the outset that the representation of the branching tendency of a language in terms of a numerical value is, of course, only an approximate heuristic device. Nevertheless, I believe that the branching index is a useful typological tool which allow us to (quantitatively) compare languages in terms of their branching tendencies, and thus provide a means of comparison.



The branching index is calculated on the basis of the sample of constructions shown in Table 1. It indicates how many of the six constructions at issue are right-branching in a given language, and how many are left-branching. The most simple way of calculation would thus be to work out the ratio of right-branching and left-branching constructions to the total of constructions for each language. For example, we could say that Mixtec is 4/6, or 67%, right-branching and only 2/6, or 33%, left-branching, since four of the six constructions under discussion are right-branching. However, the procedure to be proposed in the following is slightly different. First, the structural complexity of the different constuctions C_n will be taken into account by assigning a 'heaviness coefficient to them'. And second, I will use a mode of calculation that gives results between -1 (for maximally left-branching) and +1 (for max-

imally right-branching). The reason is that I would like to avoid the impression of a fundamental conceptual difference between right-branching and left-branching structure. For example, the statement that Mixtec is 67% right-branching while Otom is 100% right-branching gives the impression that the two languages are arranged on a scale of right-branchingness. The claims to be put forward below, however, are intended to apply to right-branching and left-branching languages alike. If the branching indices range from -1 to +1, this allows us to abstract away from the degree of either right-branchingness or left-branchingness, and to introduce the more general concept of STRUCTURAL HOMOGENEITY: the ABSOLUTE VALUE of the branching index (|Ib|) can be regarded as a metric of structural homogeneity, irrespective of the specific branching direction. Consider, for example, the cases of Otomí and Mískitu. Otomí is right-branching in all six constructions at issue, while Mískitu is left-branching in all constructions. What both languages have in common is that they are structurally homogeneous. The absolute values of their branching indices are both 1. Figure 1 provides a graphical illustration of the branching indices and their absolute values.

The branching index is calculated as follows: let C_n be one of the six constructions of our sample, and let L_r be a given language. The two-place function U stands for '... is the unmarked construction in ...', and takes construction C_n and language L_r as its arguments. The formula U(C_n,L_r) thus translates as 'C_n is the unmarked construction in L_r'. The function U has either the value 1 (for true) or 0 (for false). Let us suppose that C_n is the construction C_1 (i.e., V-[NP]$_O$), and that L_r is Chalcatongo Mixtec. The value of U(C_1,Mixtec) is 1, since VO is the unmarked order in information-structurally neutral sentences of Mixtec. U(C_5,Mixtec), by contrast, has the value 0 since in Mixtec, demonstratives follow the noun phrase. In this way, the U-values are determined for each of the six constructions C_1 - C_6. This is illustrated for Mixtec in Table 2.

	Construction	U(C_n,Mixtec)
C_1	V-[NP]$_O$	U(C_1,Mixtec) = 1
C_2	N_{PSM}-[NP]$_{PSR}$	U(C_2, Mixtec) = 1
C_3	Pr-[NP]	U(C_3,Mixtec) = 1
C_4	Pro_{PSR}-[N']	U(C_4,Mixtec) = 0
C_5	Dem-[N']	U(C_5,Mixtec) = 0
C_6	Num-[N']	U(C_6,Mixtec) = 1

Table 2: U-values of Mixtec

In a next step, the U-values are multiplied by a 'heaviness coefficient'. The heaviness coefficients are intended to reflect the

average length (measured in words) of the phrasal part of a branching node. In order to understand the relevance of the length of the constituents to the calculation of the branching index, I will anticipate some of the discussion to be presented in Section 5. As will be argued with Hawkins (1994), uniform branching facilitates parsing, whereas the co-occurrence of right-branching and left-branching structures gives rise to processing difficulties (and sometimes to garden-path structures). The degree of processing (in)efficiency of a structure crucially depends on the complexity of the constituents involved. Therefore, the (average) length of the different constituents needs to be taken into account in the calculation of the branching index.

Let us consider an example: a (right-branching) verb-initial VP that dominates a (left-branching) postpositional phrase is relatively difficult to process since the most important information about the higher level constituent structure (VP → V + PP) is available only at the end of the linear input – the postposition that heads the PP is the last word of the VP. Thus, the constituent tree cannot be constructed by the parser before the whole VP has been parsed. Hawkins refers to the minimal part of a construction that the hearer must process in order to recognize the immediate constituents as the "constituent recognition domain" (CRD). In a structure such as [$_{NP}$ *give* [$_{NP}$ *a book*] [$_{PP}$ [$_{NP}$ *my sister*] *to*]], the CRD extends over the whole VP. The three immediate constituents V, NP, and PP[7] can be recognized only after the (hypothetical) postposition to has been parsed. In the authentic English structure [$_{NP}$ *give* [$_{NP}$ *a book*] [$_{PP}$ *to* [$_{NP}$ *my sister*]]], the immediate constituent structure can be constructed as soon as the preposition to has been parsed. Thus, only four of the six words must be processed in order to recognize the highest nodes that are immediately dominated by VP. In a first attempt at quantifying the difference in 'user-friendliness' between the two structures, we can calculate the ratio of immediate constituents to the number of words that are in the CRD. Hawkins refers to this ratio as the "IC-to-word ratio" (cf. Hawkins 1994: 69ff.).[8] In our first (hypothetical) example, the CRD extends over six words, while in the second (authentic English) example, it contains only four words. The first example exhibits an IC-to-word ratio of .5 (=3/6, six words must be pro-

[7]Hawkins does not assume that branching is always binary.

[8]For illustration, cf. Hawkins (1994: 96) and Kirby (1999: 30).

cessed in order to recognize 3 immediate constituents), while the second one has an IC-to-word ratio of .75 (=3/4). The parsing efficiency of a construction is optimal to the extent that its IC-to-word ratio approaches 1.

The details of Hawkins' theory are much too far-reaching to be discussed here. The reader is referred to Hawkins' own work for details. Some general information and illustration will be provided in Section 5. For the time being, suffice it to notice that uniform branching facilitates parsing, and that the length of a constituent is in direct proportion to its impact on the processing (in)efficiency of a structure. When the branching direction a two-word constituent does not match with the overall sentence structure, the IC-to-word ratio of that sentence decreases only slightly. By contrast, when a longer segment - for example, a relative clause - does not match with the rest of the sentence, the IC-to-word ratio may decrease rather dramatically. Translated into the present framework, this means that longer (higher-level) constituents are better indicators of the branching tendency of a given language than shorter (lower-level) constituents. Therefore, the length of the respective constituents is taken into consideration in the calculation of the branching index, by incorporating the mentioned heaviness coefficient into the calculus.

How are the heaviness coefficients calculated, then? The six constructions listed in Table 1 can be divided into two groups, according to the structural complexity of their respective branching constituents: in the first group (C1 - C3), the branching nodes are NP's, while in the second group (C4 - C6), they are N'-constituents. Table 3 illustrates this point.

The branching nodes of C_1 - C_3, which are NP's, are structurally more complex than those of C_4 - C_6 (N'-constituents). Consequently, the branching types of these (higher-level) constructions have a stronger impact on the overall architecture of a sentence than those of the (lower-level) constructions C_4 - C_6. The heaviness coefficients assigned to each construction are intended to reflect the average length of the phrasal part of the constructions. I will assume that, on an average, N'-constituents consist of two words (A + N, Num + N etc.), while NP's contain one word more - namely, the determiner. Therefore, C_1 - C_3 are multiplied by the heaviness coefficient 3, while C_4 - C_6 are multiplied by the heaviness coefficient 2.

We are now in a position to determine branching indices. The various U-values, multiplied by the heaviness coefficient, are added and then divided by 7.5. From the result of this operation 1 is subtracted. This is the mode of calculation that gives results between -1 and +1. As is illustrated in ⟨3⟩, the branching index of Mixtec is 0.47.

$$\langle \mathbf{3} \rangle \quad I_b(L_r) = \frac{3(U(C_1,L_r)+U(C_2,L_r)+U(C_3,L_r))+2(U(C_4,L_r)+U(C_5,L_r)+U(C_6,L_r))}{7.5} - 1$$

$$\langle \mathbf{4} \rangle \quad I_b(Mixtec) = \frac{3(1+1+1)+2(0+0+1)}{7.5} - 1 = 0.47$$

The branching indices allow us to compare languages in terms of their branching tendencies. For example, we can now say that the branching index of Otomí - which is 1 - is higher than the branching index of Mixtec (.47). This is a more falsifiable form of saying that 'Otom is more right-branching than Mixtec'. Furthermore, the branching indices enable us to make statements about the STRUCTURAL HOMOGENEITY **and consequently** PROCESSING EFFICIENCY **of a language. Languages are efficient in terms of processing to the extent that the absolute value of their balanced branching index approaches 1. The branching index relates to the IC-to-word ratio insofar as the average IC-to-word ratio in a text of a given language is expected to approximately correlate with the branching index of that language.**[9]

3 The data

3.1 Branching indices inside and outside Mesoamerica

The sample of languages from which data will be presented comprises representatives from all families that are present in Mesoamerica. In addition to the major Uto-Aztecan, Otomanguean, Mayan, and Mixe-Zoque languages the following smaller families and isolates are included: Lenca, Totonac-Tepehua, Tarascan, Cuitlatec, Oaxaca Chontal, Xinca, and Huave. As regards the Mayan languages, some of them have been subsumed under major stocks (Greater Tzeltalan, Central Branch, K'iche'an, Mamean), since the languages of these stocks are very similar and do not exhibit much variation with regard to word order. Of the neighbouring

[9] I have not tested this prediction.

non-Mesoamerican languages only a smaller sample has been examined, since the main focus of this paper is the internal structure of Mesoamerica.

Table 4 shows the results. The languages are ordered according to their branching indices. The column 'MesAm' indicates whether the specific languages belong to Mesoamerica or not, according to the boundaries shown in Map 4 (Appendix).

Admittedly, assigning binary values to the presence or absence of (presumably unmarked) grammatical constructions involves a certain fuzzy tolerance. Therefore, some remarks are in order how Table 4 has to be interpreted. Word order in Mesoamerica is generally rather fixed, so that for most of the constructions the unmarked order (remember that the function U stands for 'is the unmarked construction in') is at the same time the only possible order. This is certainly related to the head-marking nature of Mesoamerican languages. Only a few languages have nominal case morphology,[10] and grammatical relations are in most languages indicated by verbal cross-reference morphemes.

Most of the non-branching categories of the constructions represented in Table 4 are phonologically independent words. Some exceptions can be found among the pronominal possessors (C_4). Here, some of the elements are clitics (e.g., in Mixtec) or even bound morphemes (Tzotzil, Nahuatl). The reason why some pronominal possessor affixes are included among the categories that count for the branching indices is that in spite of their affixal status, they are syntactical rather than morphological entities. Although they are phonologically dependent, they exhibit a certain degree of syntagmatic variability (cf. Lehmann 1995) and might thus best be viewed as "bound pronouns" in the sense of Bresnan (2001). As can be seen from (5) and (6), the possessor prefixes of Tzotzil and Nahuatl are in construction with N', not with N.[11]

⟨5⟩ **Tzotzil (Maya)**
sakil ka?

s-[sak-il ka?]
3POSS-[white-ATTR horse]

'his white horse'

[10] For example, Tarascan has a nominal accusative case and Zoque has a nominal ergative case.

[11] Most abbreviations used in glosses are self-explaining. 'LIG' stands for 'ligature'.

I_b	Language(L_r)	Language family	MesAm	U(Cn, Lr)					
				C1	C2	C3	C4	C5	C6
1	Nahuatl	Uto-Aztecan	+	1	1	1	1	1	1
	Nahual	Uto-Aztecan	+	1	1	1	1	1	1
	Pipil	Uto-Aztecan	+	1	1	1	1	1	1
	Cora	Uto-Aztecan	+	1	1	1	1	1	1
	Otom	Otomanguean	+	1	1	1	1	1	1
	Pame	Otomanguean	+	1	1	1	1	1	1
	Matlazinca	Otomanguean	+	1	1	1	1	1	1
	Mazahua	Otomanguean	+	1	1	1	1	1	1
	Chiapanec	Otomanguean	+	1	1	1	1	1	1
	Mangue	Otomanguean	+	1	1	1	1	1	1
	Oluta Popoluca	Mixe-Zoque	+	1	1	1	1	1	1
	Sayula Popoluca	Mixe-Zoque	+	1	1	1	1	1	1
	Sierra Popoluca	Mixe-Zoque	+	1	1	1	1	1	1
	Greater Tzeltalan	Mayan	+	1	1	1	1	1	1
	Huastec	Mayan	+	1	1	1	1	1	1
	Itzá	Mayan	+	1	1	1	1	1	1
	K'iche'an	Mayan	+	1	1	1	1	1	1
	Mamean	Mayan	+	1	1	1	1	1	1
	Mopan	Mayan	+	1	1	1	1	1	1
	Chort	Mayan	+	1	1	1	1	1	1
	Yucatec	Mayan	+	1	1	1	1	1	1
	Huave	Isolate	+	1	1	1	1	1	1
	Oaxaca Chontal	Isolate	+	1	1	1	1	1	1
	Totonac	Totonac-Tepehua	+	1	1	1	1	1	1
.73	Central Mayan	Mayan	+	1	1	1	1	0	1
	Chinantec	Otomanguean	+	1	1	1	0	1	1
	Mazatec	Otomanguean	+	1	1	1	0	1	1
	Popoloc	Otomanguean	+	1	1	1	0	1	1
	Subtiaba	Otomanguean	+	1	1	1	1	0	1
	Xinca	Xinca-Lenca	+	1	1	1	0	1	1
	Garfuna	Arawak	-	1	1	1	1	0	1
	Cuitlatec	Isolate	+	1	1	1	0	1	1
.60	Sthn. Tepehuan	Uto-Aztecan	+	1	1	0	1	1	1
	Mixe	Mixe-Zoque	+	1	0	1	1	1	1
	Zoque	Mixe-Zoque	+	1	0	1	1	1	1
	Tarascan	Isolate	+	1	1	0	1	1	1
.47	Mixtecan	Otomanguean	+	1	1	1	0	0	1
	Zapotecan	Otomanguean	+	1	1	1	0	0	1
	Amuzgo	Otomanguean	+	1	1	1	0	0	1
	Chatino	Otomanguean	+	1	1	1	0	0	1
	Cuicatec	Otomanguean	+	1	1	1	0	0	1
	Tlapanec	Otomanguean	+	1	1	1	0	0	1
	Trique	Otomanguean	+	1	1	1	0	0	1
.2	Huichol	Uto-Aztecan	+	1	0	0	1	1	1
	Nrth. Tepehuan	Uto-Aztecan	+	1	0	0	1	1	1
-0.2	Lower Pima	Uto-Aztecan	-	0	0	0	1	1	1
	Tarahumara	Uto-Aztecan	-	0	0	0	1	1	1
-0.47	Chichimec	Otomanguean	-	0	0	0	0	1	1
	Lenca	Xinca-Lenca	-	0	0	0	1	1	0
	Rama	Chibchan	-	0	0	0	1	1	0
	Matagalpa	Misumalpan	-	0	0	0	0	1	1
	Sumu	Misumalpan	-	0	0	0	0	1	1
	Tol	Isolate	-	0	0	0	1	1	0
-0.73	Paya	Chibchan	-	0	0	0	0	1	0
-1	Mskitu	Misumalpan	-	0	0	0	0	0	0

Table 5: Branching indices in Mesoamerica and some non-Mesoamerican languages

⟨6⟩ **Classical Nahuatl (Uto-Aztecan)**
in mokokoška tatsin

in mo-[kokoš-ka tatsin]
the 2POSS-sick-LIG father(HON)

'your sick father' Simon (1885[1996]: 348)

3.2 Areal distribution of branching indices in Mesoamerica

Some remarkable facts can be read off Table 4. First of all, it is interesting to notice that the branching indices cross-cut language families. Uto-Aztecan ranges from -0.2 (Lower Pima, Tarahumara) to 1 (Nahuatl), Otomanguean from -0.47 (Chichimec) to 1 (Otomí etc.), and Mixe-Zoque from .60 (Mixe, Zoque) to 1 (Popoluca). Only Mayan languages show little variation. With the exception of some members of the Central branch, they score 1. We can conclude that the branching tendency of a language cannot be predicted from its genetic affiliation.

Secondly, branching indices are clearly higher inside Mesoamerica than outside. The Mesoamerican average is .78, and the lowest score of a Mesoamerican language is .2 (Huichol, Northern Tepehuan). Most of the southern neighbours show a tendency to being left-branching, with an average score of -0.42. The northern neighbours likewise have balanced branching indices below zero. These numerical results confirm the pre-theoretical claim that Mesoamerican languages are predominantly right-branching, and that this feature sets them apart from their non-Mesoamerican neighbours.

However, the implications of the data presented in Table 4 reach farther. Map 2 demonstrates the areal distribution of branching indices in Mesoamerica (for a language key, cf. Map 4 in the Appendix).[12] The first remarkable fact about Map 2 is that certain branching indices cluster geographically. In the Central Highlands around the Valley of Mexico (A), there are a number of languages scoring 1. In the region around the so-called "Mesa del Sur" (B; in the following 'the Oaxaca Region'), we find a couple of contiguous languages scoring .47. Languages spoken in the eastern part and

[12]The maps are intended to reflect the geographical distribution of the languages at the time of contact prior to the conquest, based on the map provided by Moseley & Asher (1994, Map 13).

in the south-eastern periphery of Mesoamerica (C) score 1 or .73. Only in the north-western periphery (D) do we find a diversity of branching indices, ranging from .2 to 1. This is in accordance with van der Auwera's (1998) observation that this part of Mesoamerica is, in one way or other, peripheral.

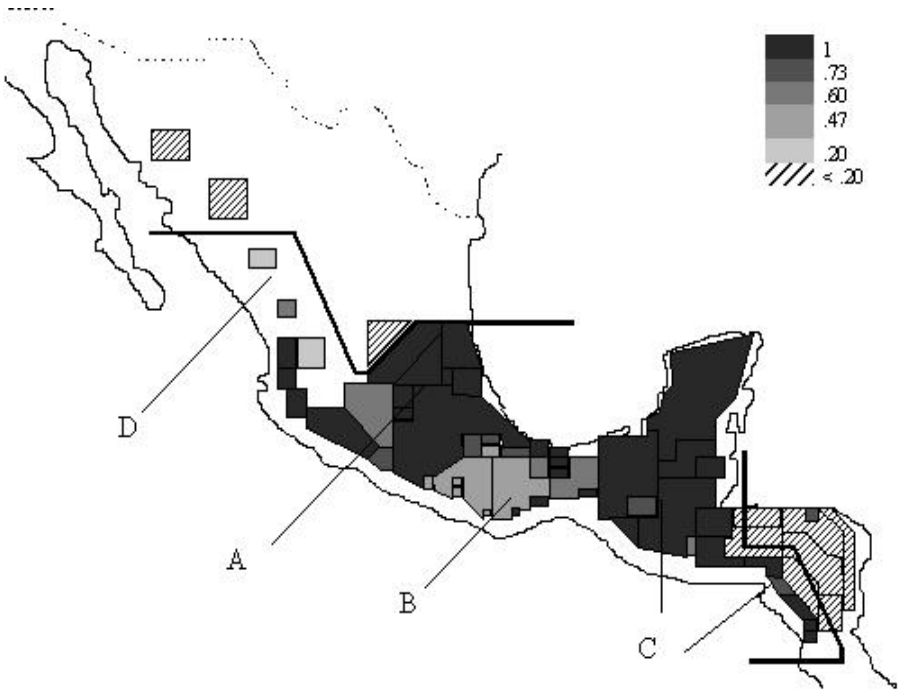


Figure 2: Branching indices in Mesoamerica

A further striking observation can be made when we check Map 2 against the data shown in Table 4: there are clear implicational relations in the areal distribution not only of branching indices, but also of specific word order patterns. This means that adjacent languages with identical branching indices generally have identical word order patterns too. If adjacent languages have different branching indices, the set of right-branching constructions of the language with the lower branching index is a subset of the set of right-branching constructions of the language with the higher branching index. In central Mesoamerica (A), all languages are consistently right-branching. Some of the south-eastern neighbours (Chinantec, Mazatec, Popoloc) differ only in one construction (C_4). In the Oaxaca Region (B), most languages are furthermore left-

branching in C_5. In the east and south-east of Mesoamerica, most languages are likewise consistently right-branching. Adjacent Mixe-Zoque languages deviate from that pattern only in C_2.[13]

The areal patterns displayed in Map 2 are not accidental. They closely parallel traditional archaeological sub-divisions of Mesoamerica, which are displayed in Map 3.[14] Among the seven regions that are distinguished in Map 2, three can reasonably be grouped together from a historical perspective: the Northern Region, the Central High Plains Region, and the Gulf Coast Region can be regarded as representing a unit within the larger historical context of Mesoamerica. I will refer to this area as the "Central Region" in the following (cf. the dotted line in Map 3).[15] The Central Region has been a centre of political power[16] and the target of migration movements[17] throughout the history of Mesoamerica. Consequently, it has been a focus of language contact. The archaeological divisions shown in Map 3 reflect settlement and migration patterns and can be used as an approximate indicator of regional coexistence. The match between Map 2 and Map 3 is a further indication that the regional clustering of branching indices is due to language contact.

The correspondences between the areal distribution of branching indices and the archaeological sub-divisions shown in Map 3 are summarised in Table 5. Furthermore, the areal distribution of language families relative to the regions of Mesoamerica and typical word order patterns are indicated. Note that Mixe-Zoque languages cannot claerly be assigned to any particular region. They are located in the peripheral parts of the Central Region, the Oaxaca

[13]The fact that adjacent languages are not only similar in terms of the branching indices, but also in regard to their specific word order patterns is relevant insofar as languages do not borrow branching indices, but constructions.

[14]For a similar map, cf. Garza & Tommasi (1987: 15). Note that the dotted line indicating the .'Central Region' has been added by the present author.

[15]The Central Region approximately corresponds to the core of the Aztec empire at the end of the XVth century. From a linguistic point of view, it is characterized by widespread devoicing of final sonorants and prefixal reflexivization strategies, among other things.

[16]The Central Region hosted the Olmec Empire (ca. 1200-300 BC), the Empire of Teotihuacán (ca 0-650 AD), the Toltec Empire (ca. 900-1200 AD), and the Aztec Empire (ca. 1325-1520 AD). It approximately corresponds to the extent of the Aztec Empire at the time of the conquest.

[17]This is certainly related to the volcanic and hence extremely fertile nature of the soils. Sanders (1971: 3) refers to approximately this part of Mesoamerica as the 'Central Mexican Symbiotic Region'.

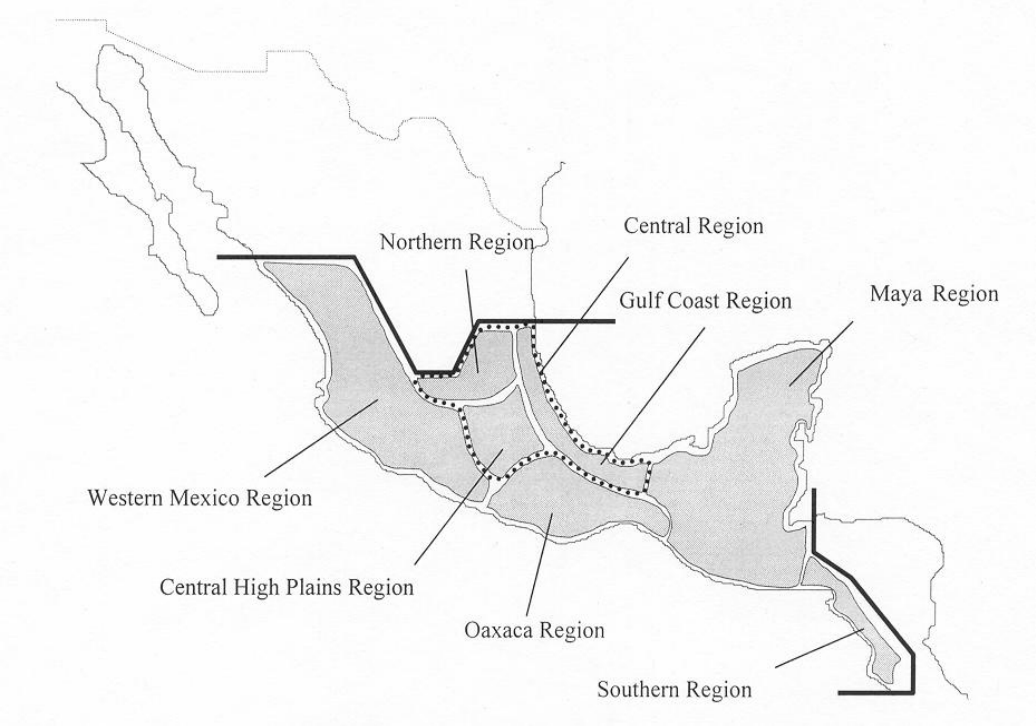


Figure 3: Archaeological map of Mesoamerica

Region, and the Maya Region. This is reflected in their branching indices (.6, on an average), which range between those of the Central Region and Maya Region (1) on the one hand, and those of the Oaxaca Region (.47) on the other.

Regions of MA	Is	Ib	Typical word order patterns	Language families
Western Mexico Region	0.33 - 1	0.2 - 1	various	Uto-Aztecan Otom enclaves
Central Region	1	1	VO, Prep, NG, PossN, DemN, NumN	Uto-Aztecan (Nahuatl) Maya (Huastec) Totonac-Tepehua Otomanguean (Otom etc.) Mixe-Zoque (Popoluca)
Oaxaca Region	0.33	0.47	VO, Prep, NG, NPoss, NDem, NumN	Eastern Otomanguean
Maya Region	1	1	VO, Prep, NG, PossN, DemN, NumN	Maya Nahuatl enclaves
Southern Region	1	1	VO, Prep, NG, PossN, DemN, NumN	Tlapanec-Mangue (Otomanguean) Nahuatl enclaves

Table 6: Regions, branching indices, constructions, language families

The rightmost column of Table 5 shows that the Central Region is distinguished from the other regions of Mesoamerica by a particularly high degree of "phylogenetic diversity" (for this term cf. Nettle 1999). The ratio of language families to languages is remarkably high in this area. While each of the other regions is associated with a preponderance of languages from a specific family, in the relatively small Central Region[18] languages from at least five different families are spoken: Uto-Aztecan (Nahuatl), Otomanguean (Otom, Pame, Matlazinca, Mazahua), Mixe-Zoque (Popoluca), Totonac-Tepehua, and Mayan (Huastec).

Taking into consideration this high degree of phylogenetic variety, it is remarkable that the languages of the Central Region are structurally so similar, and so homogeneous. This is even more so in view of the fact that at least two of the families involved - Uto-Aztecan and Mixe-Zoque - were formerly heavily left-branching and have adopted right-branching structure only as a consequence of language contact. Campbell et al. (1986) notice that "Proto-Uto-Aztecan is sufficiently well-known to make clear when Nahuatl has changed to become more MA [Mesoamerican, VG]" (Campbell et al. 1986: 555). Langacker (1977) demonstrates that Proto-Uto-Aztecan was OV, GN, and postpositional. In Popoluca, right-

[18]The Central Region corresponds to approximately a fifth part of the Balkans in size.

branching structure is also probably a consequence of language contact. Proto-Mixe-Zoque was predominantly left-branching, and verb-initial word order, genitive constructions of the type NG, and prepositions are relatively recent developments in Mixe-Zoque (for a comparative survey of Mixe-Zoque cf. Wichmann 1995).

As far as the other languages of the Central Region are concerned, we cannot reach any decisive conclusions as to their former branching tendencies. All Otomanguean languages spoken in the Central Region belong to the Otopamean branch of Otomanguean. It is thus difficult to decide whether their right-branching structure must be attributed to a common ancestor language (Proto-Otopamean) or whether it is an areal feature of the Central Region. In the case of Totonac-Tepehua, we cannot say anything about its former branching tendency since we lack comparative evidence. Huastec Maya has in all probability inherited its right-branching nature from Proto-Mayan.

The central question that arises when we consider the empirical facts presented in this section is: why have Mesoamerican languages, particularly the languages of the Central Region, become structurally so homogeneous?

The answer to this question must obviously be sought in the realm of language contact. I would like to argue, however, that the sociolinguistic aspects of language contact will not be very revealing in this context. Political dominance, prestige, and social networks cannot tell us anything about long-term areal convergence, since they are subject to change in the course of time. Mesoamerica has witnessed the hegemony of several different cultures and languages in the last two-thousand years. I would like to claim that the principles underlying structural homogeneity in the languages of Mesoamerica are of a different kind. They are functional, not social, in nature. By functional aspects of language use I refer to those factors that relate to the efficiency of language as a medium of communication. Unlike social factors, they do not change with time. They are a constant of language change.[19]

The explanation to be put forward in the next section is based on Hawkins' (1994) theory of early immediate constituents (EIC). Hawkins has demonstrated that consistency in branching direction improves the processing efficiency of languages, and that consequently, languages tend to be structurally homogeneous in the

[19]For the role of functional factors in convergence, cf. Bisang (1998, forthcoming).

sense outlined above. I would like to argue that this general tendency is particularly strong in convergence areas because language contact reinforces the impact of processing principles on language structure. The argument sets out with a brief illustration of some aspects of Hawkins' (1994) theory of early immediate constituents. Then, drawing on Kirby (1999), it is demonstrated how Hawkins' theory can be implemented into an evolutionary approach to language change. Here, language change is conceived of as the product of the interaction between VARIATION and SELECTION. In linguistic areas, so the argument goes, this adaptive process is particularly productive because language contact multiplies language-internal structural variation. Structural variation, in turn, offers a choice and allows for the selection of those structures that optimise early immediate constituent recognition best.

4 Optimization of Early Immediate Constituent recognition in Mesoamerica

4.1 Early Immediate Constituents

Hawkins (1994) has demonstrated that, in grammar and in performance, languages and speakers tend to arrange constituents in such a way that the human parser is able to recognize the higher-level constituent structure as early as possible. His theory correctly predicts both the cross-linguistic correlations found by Dryer (1992) and performance-driven rearrangement rules in single languages, such as heavy-NP shift in English. As was already mentioned above, one of the most important corollaries of Hawkins' theory is the fact that consistency in branching direction yields early immediate constituent recognition optimal. Structurally homogeneous languages are "user-friendly" insofar as they facilitate online-processing.

Hawkins' theory is based on the idea that the linear linguistic input is immediately transformed into hierarchical structures by the human parser. Each segment of speech is automatically analysed as to the information it contains about the higher-level constituent structure. In this process, specific segments uniquely identify their "mother nodes". For example, the occurrence of a verb gives the parser the instruction to construct a VP over V; a determiner uniquely identifies its mother node as an NP; prepositions identify their mother nodes as PP's. Hawkins refers to these promi-

nent segments as "mother node constructing categories" (MNCC, cf. Hawkins 1994: 62). Those segments that do not uniquely identify their mother nodes are, according to Hawkins, immediately attached to higher projections that are available in the syntactic environment. Thus, all segments of speech will be specified as to their position in the hierarchical sentence structure as quickly as possible. Those segments that cannot immediately be assigned a structural position are stored in a "look-ahead buffer" and will be attached as soon as a structural position becomes available.[20]

In order to illustrate how language change has actually optimised early immediate constituent recognition in Mesoamerica, let us briefly consider an example: the introduction of prepositions into the grammar of Nahuatl. Comparative evidence suggests that Proto-Aztecan was postpositional (cf. Langacker 1977). In the XVth century postpositions were still very common in Nahuatl and represented the unmarked choice as opposed to relational nouns, which gradually started to replace them. Example (7) illustrates the use of the postposition nawak 'close to'[21] **in the Madrid Codex.**

⟨7⟩ **Classical Nahuatl**
kinnetšikoa in ikal nawak

kin-netšikoa	in	i-kal	nawak
3PL/OBJ-gather	DET	3POSS-house	close.to

'He gathers them close to his house.' Sullivan (1992: 149)

Example (7) has the hierarchical structure [$_{VP}$ *kinnetšikoa* [$_{PP}$ [$_{NP}$ *in ikal*] *nawak*]]. The constituent recognition domain extends over the whole VP. Considering *ikal nawak* as two words, example (7) has an IC-to-word ratio of .5 (=2/4; four words must be processed in order to recognize two immediate constituents). The PP immediately dominated by VP can be constructed only after the postposition *nawak* has been processed. Until that point, the parser is exposed to a garden-path structure, since ikal could also be considered an immediate constituent of VP, in which case it would be interpreted as the direct object ([$_{VP}$ *kinnetšikoa* [$_{NP}$ *ikal*]], 'he gathered his houses').

[20]The 'look-ahead buffer' is also at work in the parsing of left-branching languages. For discussion, cf. Hawkins (1994: 66f.).

[21]Some Nahuatl specialists might prefer to analyze *nawak* as a suffix since it is phonologically quite closely attached to the noun. Semantically, however, it has scope over the DP. The most accurate term would probably be 'phrasal suffix' (cf. Anderson 1992).

In the course of its further development, Nahuatl gradually lost its postpositions. Forms like *nawak* were reanalysed as relational nouns and increasingly used as (head-marking) prepositions in combination with person markers (e.g. *i-nawak i-kal*, lit. 'its-closeness his-house'). In Tetelcingo Nahuatl, the form *nawak* has been lost, and the semantically more general form *-pa* is used. Interestingly, the third person form *i-pa* has been generalised to first and second person, so *ipa* is now used as a monomorphemic preposition (cf. Tuggy 1979: 62). ⟨8⟩ is the Tetelcingo Nahuatl translation of ⟨7⟩.

⟨8⟩ **kɪnsentlɔlɪa ipa ikal**

kɪn-sentlɔlɪa ipa i-kal
3PL/OBJ-gather at, close to 3POSS-house

'He gathers them at his house.'

From the perspective of processing ease, ⟨8⟩ is more efficient than ⟨7⟩. The VP [$_{VP}$ *kɪnsentlɔlɪa* [$_{PP}$ *ipa* [$_{NP}$ *ikal*]]] allows for the recognition of all immediate constituents after the preposition *ipa* has been processed. The verb form *kɪnsentlɔlɪa* constructs the VP, and *ipa* constructs the PP, which immediately attaches to VP. ⟨8⟩ has an (optimal) IC-to-word ratio of 1 (=2/2; two words for two immediate constituents). The innovative construction illustrated in ⟨8⟩ is thus more "user-friendly" than the conservative one illustrated in ⟨7⟩.

Developments such as the introduction of prepositions into the grammar of Nahuatl have occurred pervasively in the history of Mesoamerican languages and are still occurring. For example, Zoquean languages are recently witnessing a partial loss of postpositions at the expense of prepositions that are borrowed from Spanish. At the same time, some of the Zoquean languages are shifting from GN to NG word order. Both developments improve EIC recognition since probably all Zoquean languages are VO. Likewise, Tarascan has enlarged its inventory of prepositions by borrowing from Spanish (*para*, for example).

Hawkins' theory offers a natural explanation for structural homogeneity in Mesoamerica: Mesoamerican languages have become structurally homogeneous because early immediate constituent recognition has been improved in the long run. The central question that must be answered in order to demonstrate the validity

of this hypothesis is: why should the languages of a convergence area be particularly prone to respond to the principles of parsing efficiency? This question is going to be answered in terms of an evolutionary approach to language change in the next section. The two central claims to be put forward are: (i) language contact is a source and amplifier of structural variation, and (ii) structural variation gives rise to structural homogeneity. Before coming to these specific claims, evolutionary models of language change will briefly be outlined and some relevant details will be discussed.

5 Variation and Selection in Natural Language

One of the first authors who explicitly - though still programmatically - proposed to approach language change from an Darwinian perspective was Keller (1994, Chapter 6). According to Keller, language change "must be based on the interplay between variation and selection" (Keller 1994: 144]). This means that language change occurs in two steps: firstly, variation is generated, and secondly, specific variants are selected at the expense of others. This process is usually regarded as being ADAPTIVE in nature, i.e. as responding to specific environmental circumstances, and as improving the interaction of an organism with these circumstances. This model of language change is illustrated in Figure 2. At the initial state S_0, there is no variation. By innovation, (lexical or grammatical) variants are introduced into the language, and variation arises. Then, some of these variants are filtered out, while others are selected. This leads to the final state S_f. This process is cyclic, so that S_f is at the same time S_0 of a successive adaptive process.

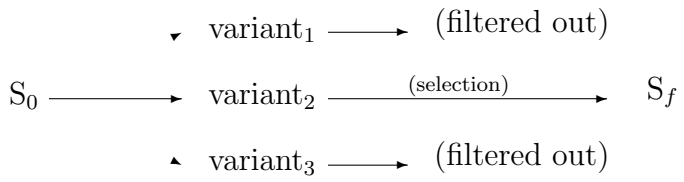


Figure 4: Variation and selection in natural language evolution

While this basic assumption of an adaptive interaction between variation and selection has been adopted by most if not all

authors pursuing an evolutionary approach to language change, there are considerable differences between the specific models as well.[22] One of the sources of disagreement which crucially pertains to the present discussion concerns the role of social and functional factors in the evolutionary process. While it seems to be widely accepted that functional factors of language use are central to the emergence of innovations in languages, their role in the process of selection has been debated. On the one hand, it has been claimed that selection in natural language evolution is basically a social phenomenon (Croft 1996, 2000). Croft assumes that the socio-linguistic instantiation of selection in natural language evolution is the propagation of a novel variant in a speech community. According to him, "[t]he mechanisms for innovation in language change involve both structure and function. The mechanisms for propagation, on the other hand, are essentially social [...]" (Croft 2000: 8). On the other hand, it has been argued by several others that selection is strongly dependent on functional factors of language use such as articulatory ease (Haspelmath 1999) or parsing efficiency (Kirby 1999). Put in a nutshell, the question at issue can be paraphrased as follows: are those grammatical variants selected that render a language more efficient as a medium of communication, or rather those that are used by members of a speech community with a prominent social status?

The most widely held assumption is that BOTH factors play a role. This standpoint is taken by Keller (1994), Bisang (1998, forthcoming), Nettle (1999), and Haspelmath (1999, 2000). Bisang puts it as follows:[23]

> **Although I do not deny the primary importance of sociolinguistic processes [...], I would like to argue that the selection of what changes are going to be propagated also must depend to some degree on other factors. No matter how stochastic changes as such may be, they are exposed to hearers who will apply the whole of their knowledge of language to make sense out of them. Those changes which somehow fit into that knowledge [...] are poten-**

[22] Basic issues are the questions of whether language change is abrupt (cf. Kirby 1999) or gradual (cf. Haspelmath 1999 and 2000, Croft 2000), and whether selection is hearer-based (Kirby 1999) or speaker-based (Haspelmath 2000). These questions are of minor relevance to the present issue.

[23] For a similar argument, cf. Haspelmath (1999: 254/5).

tial candidates for propagation. (Bisang 1998: 14).

I would like to subscribe to this view, and thus assume that functional aspects of language use MAY have an impact on selection in natural language evolution. It is hard to find compelling reasons why a filtering process that selects among several variants should NOT be sensitive to such factors. Furthermore, I would like to point out that the role of social and functional factors in language change can certainly not be accounted for without taking into consideration the specific historical circumstances under which language change takes place. As far as language contact is concerned, we certainly have to distinguish between situations of intensive short-term contact (which may result in creolization) on the one hand and moderate long-term contact (which leads to areal convergence) on the other. While in the first case, social factors might be much more prominent than functional factors, in the latter case we should expect that social pressures are blurred in the course of time since they are subject to change. Asymmetrical relations of political dominance, for example, may vary from one century (or decade) to another. As was already mentioned, Mesoamerica has witnessed the hegemony of several different cultures and languages over the last two-thousand years.[24] Functional pressures, by contrast, represent a constant of language change. They are inherent to language in use and are thus expected to manifest themselves in the long run. I therefore assume that in areal convergence functional factors are more prominent than social factors, although the latter do certainly have a considerable short-term impact.

Kirby (1999) is one of the authors who believes that selection depends to a great extent on functional factors. He demonstrates how Hawkins' theory of early immediate constituents can be implemented into a model of language change by adopting an evolutionary perspective. The main puzzle that has to be resolved is the question of how a PARSING preference for certain structures can result in a modification of the grammar. Kirby assumes that structures with optimal EIC metrics are preferentially accepted as "trigger experiences" in language acquisition, and that "the probability

[24]Note that the Nahuatl hegemony between the 14th and the 16th century is reflected in extensive lexical borrowing from Nahuatl. However, there are no indications that social factors of this kind should have influenced the grammars of either Nahuatl or the other Mesoamerican contact languages noticeably. This is in accordance with Thomason & Kaufman's (1988) claim that superstratum languages tend to be the source of lexical borrowing, but the target of structural interference.

of a particular utterance being used for acquisition will be proportional in some way to its EIC metric" (Kirby 1999: 36f.). This is designed as a process of functional selection. The child filters the raw linguistic input and separates out dysfunctional variants. One of the examples provided by Kirby is the selection of prepositions at the expense of postpositions in VO languages. This example is compatible with the development of Nahuatl from a postpositional language to a prepositional language which was outlined above:

> First, imagine a language with basic VO order and postpositions. According to Hawkins, such a language would suffer from a suboptimal EIC metric in structures such as $_{VP}$[V $_{PP}$[NP P]], since the CRD for the verb phrase stretches across the noun phrase. Now, if a minor variant - prepositions - were introduced into that language, perhaps through language contact, then we would expect it to be preferentially selected from the arena of use by hearers because of its improved EIC metric. (Kirby 1999: 45)

Kirby's model focuses on how linguistic variants are (functionally) selected in language acquisition. But now, selection requires that there should be at least two competing variants, i.e. two linguistic forms that may be used interchangeably to designate one and the same concept. In other words: selection presupposes variation. In order to fully account for the adaptive "interplay between variation and selection", we must consequently also address the question of how variation arises. Kirby gives us a first clue as to possible sources of variation. In his example, he conjectures that in his imaginary language, prepositions were introduced "perhaps through language contact". This brings us to the first claim that was made above: why should language contact be an amplifier of structural variation?

6 Language contact as an amplifier of variation

It is generally agreed upon that there are two basic sources of variation in natural language: EXTERNAL sources and INTERNAL sources.[25]

[25]Mufwene (2001) calls into question that a principled distinction between internally motivated change and externally motivated change can be maintained. If grammar is

Borrowing and interference are external sources of variation. They result from language contact (cf. Thomason & Kaufman 1988). As is well-known, they can have a considerable impact on grammars. The nature of internal sources of variation is somewhat more difficult to account for. If we assume that languages are in principle appropriate means of communication - why should they change at all, as long as no external factors interfere?

It is obvious that there ARE mechanisms of internal change that produce structural variation in languages. One kind of explanation for internal sources of variation relates to the imperfect mapping from semantics to syntax, and vice versa. According to Croft (2000), this kind of minimal discrepancy may lead to "form-function reanalysis". Since Croft assumes a model of (utterance-based) gradual language change,[26] form-function reanalysis manifests itself in grammar as a cumulative process (as an "invisible hand phenomenon", in Keller's terms). Reanalysis of the type assumed by Croft is related to another phenomenon that is often held responsible for the emergence of language change by scholars pursuing models of (acquisition-based) abrupt language change: the "discontinuity of language transmission" (Nettle 1999: 18ff., referring to Meillet 1926; see also Yang 2000). Advocates of this kind of approach take it that the grammars of the parents are replicated imperfectly in the children's competence. Variation may thus arise during the process of language acquisition, when the (target) structures that are assigned to specific inputs by children differ from the (source) structures that were generated by the input providers (parents).

The "interplay between variation and selection" can thus operate in the development of single languages even though these languages are not exposed to language contact. However, there is both a quantitative and a qualitative difference between internally motivated innovations and externally motivated innovations. The quantitative difference between both kinds of processes relates to the "speed of change": interference alters grammars more abruptly than reanalysis or grammaticalization. This is reflected in the well-known fact that often, languages that are spoken in secluded com-

encoded in idiolects, not in languages, then every act of communication can be regarded as an instance of language contact. However, Mufwene does not seem to deny that there is a considerable quantitative difference between both types of 'language contact'.

[26] I.e., a model in which replication of the 'linguemes.' – the linguistic correlates of the genes – occurs in every instance of an utterance.

munities are more conservative than languages which have been exposed to language contact (consider the standard example Icelandic versus continental Germanic or English). The difference in "speed" between internal and external changes can certainly be attributed to the fact that internal changes are the result of (cumulative) processes,[27] while externally motivated innovations are introduced "out of the blue".

The qualitative difference between internal and external changes concerns the relationship between the source and the target structure. In reanalysis, both structures are part of the grammar of the same language. There is always a certain degree of structural and conceptual overlap between them. Often, the linear order of elements remains the same - for example, when [*going* [*to play tennis*]] is reanalysed as [*going to* [*play tennis*]]. In contact-induced innovations, by contrast, the two constructions are part of different grammars. Structural innovations may thus be introduced in a rather unrestricted way.

In the present context, it is furthermore worth mentioning that in structural interference, it is typically the higher-level constituent order that is affected most. Thomason & Kaufman (1988) remark that "word order seems to be the easiest sort of syntactic feature to borrow or to acquire via language shift" (Thomason & Kaufman 1988: 55):

> The literature is full of examples, among them the change from SOV to SVO in Finnish (under Indo-European influence), SOV to SVO in Ma'a (under Bantu influence), VSO to SOV in Akkadian (under Sumerian influence [...]), and SVO to SOV in Austronesian languages of New Guinea [...]. (Thomason & Kaufman 1988: 55)

If we assume that the functional selection of specific word order patterns requires structural variation at the clause level, it probably becomes transparent why interference should promote structural homogeneity: language contact is a source and amplifier of structural variation and consequently "boosts" the evolutionary process. The greater the extent of structural variation is, the more choices are offered to the speakers, and those structures which optimise early immediate constituent recognition best can be selected

[27] In terms of an acquisition-based model of language change, internal changes are not cumulative, but they occur only once in each generation of speakers.

via functional selection. This model is depicted in Figure 3. The difference in size between the arrows pointing to "variation" is intended to reflect the difference in the (potential) impact of internal and external factors on structural variation, respectively.

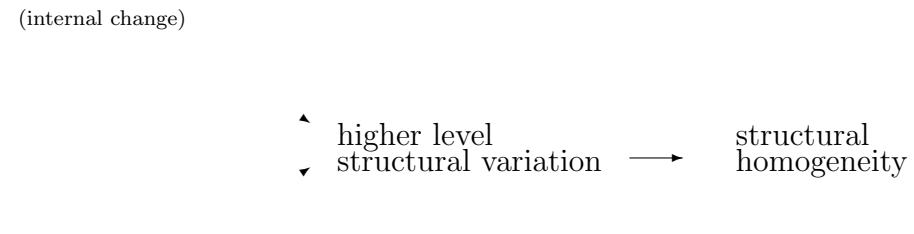


Figure 5: The impact of language contact on variation

Note that the relationship between language contact and structural homogeneity is a one-way implication. While it predicts that language contact leads to structural homogeneity in the long run, it does not predict that the absence of language contact results in structural heterogeneity. In other words: nothing is entailed about languages that are not part of a linguistic area.

Let me finally remark that the idealized model depicted in Figure 3 will certainly not be unanimously accepted by "evolutionary linguists". As was mentioned above, not all linguists subscribing to an evolutionary model - notably Croft - accept the role of functional factors in selection as assumed by Kirby (1999). However, my basic claim that language contact should lead to structural homogeneity is in principle not affected by this discrepancy. Croft supposes that functional factors of language use are operative in the production of novel variants, that is, in the process of innovation. If innovations are constrained by functional factors, there should be a preponderance of functional variants vis--vis dysfunctional variants in the "lingueme pool" of a language. If selection is indifferent to the functionality of a "lingueme", there is simply an arithmetic probability that more functional variants will be selected. As Croft himself puts it:

> If functional constraints operate to determine the frequency of innovations, and the novel variants undergo social selection, then the end result is going to be a pre-

> ponderance of optimal variants in the long run. (Croft 1999: 207)

The relationship between language contact and structural homogeneity can now be restated in terms of a syllogism: according to the present proposal, language contact is a source of structural variation. If innovations are typically functionally motivated, we can assume that language contact results in a preponderance of functional variants as opposed to dysfunctional variants. If selection is random, structural homogeneity will be improved according to the laws of probability. We can now conclude that language contact is expected to give rise to structural homogeneity.

7 Conclusion and open questions

The present examination has set out from the empirical observation that Mesoamerican languages are structurally very similar. Adopting a standard representation of constituent structure in terms of X-bar theory, it has been argued that Mesoamerican languages display a high degree of structural homogeneity insofar as they tend to be consistently right-branching. For illustration, a metric of the branching tendency of specific languages have been proposed: the 'branching index'. This metric allows us to make numerical statements about the branching tendencies of languages and provide a means of comparison.

The tendency of Mesoamerican languages to have homogeneous surface structure has been explained in terms of Hawkins' (1994) theory of early immediate constituents. An evolutionary model of language change has been adopted in order to account for the instantiation of parsing principles in actual language. It has been argued that an evolutionary model along these lines can also explain why structural homogeneity should be particularly noticeable in convergence areas: selection requires variation. Since language contact is a multiplier of variation in the higher-level constituent structure, it is expected to lead to structural homogeneity, since it offers a choice.

Some of the hypotheses put forward in this paper are certainly tentative. They are meant to encourage a reconsideration of the relationship between linguistic universals and areal linguistics. Many questions have to remain open, and some new questions

might have been raised. For example, the prediction that linguistic areas should be structurally homogeneous should be tested in other parts of the world. A first glance at Europe (which certainly must be considered a linguistic area) seems to confirm this basic hypothesis, since Central European languages are consistently right-branching, similar to Mesoamerican languages. Related to the empirical testing of the hypotheses put forward here is another theoretical question: in accordance with Hawkins (1994), I have assumed throughout the paper that right-branching constituent order is only one of two possible instantiations of structural homogeneity. Structural homogeneity could be instantiated by consistently left-branching languages as well. The present approach thus predicts that there should be left-branching linguistic areas as well. This is an empirical matter, but its testing is outside the scope of this paper.

I would like to conclude with some general remarks concerning the relationship between linguistic universals and areal linguistics. Most the areal linguistic work has so far been concerned with defining linguistic areas. Consequently, linguistic universals have not only been ignored, but reference to them has even strictly been avoided in order to secure that areal convergence is due to language contact exclusively. This neglect of linguistic universals is certainly legitimate, and even necessary, when one aims at establishing the existence of a linguistic area. Once we have accepted the existence of such an area - hopefully supported by non-linguistic evidence - it may, however, be useful to take the findings of linguistic typology into account. They may help us to detect the general laws of the diachrony and synchrony of linguistic areas, and to see better why and how such entities emerge and persist over centuries and millennia.

References

Abney, Stephen (1987). *The English Noun Phrase in its Sentential Aspect*. Doctoral dissertation, MIT.

Anderson, Stephen (1992). *A-morphous Morphology*. Cambridge: CUP.

Bisang, Walter (1998). Grammaticalization and language contact, constructions and positions. In: Giacalone Ramat, A. & Hopper,

P. (eds.). *The Limits of Grammaticalization*, 13-58. Amsterdam & Philadelphia: Benjamins.

– (forthcoming). Areality, grammaticalization and language typology. On the explanatory power of functional criteria and the status of Universal Grammar. In: Bisang, Walter (ed.). *Language Typology and Universals*. Berlin: Akademie-Verlag.

Bresnan, Joan (2001). The emergence of the unmarked pronoun. In: Legendre, G. & Grimshaw, J. & Vikner, S. (eds.). *Optimality-theoretic syntax*. Cambridge: MIT Press.

Campbell, Lyle & Kaufman, Terrence & Smith-Stark, Thomas C. (1986). Meso-America as a Linguistic Area. *Language* 62/3: 530-570.

Campbell, Lyle (1997). *American Indian Languages - the Historical Linguistics of Native America*. New York & Oxford: Oxford University Press.

Chomsky, Noam (1995). *The Minimalist Program*. Cambridge. MIT.

Coe, Michael D. & Snow, Dean & Benson, Elisabeth (eds.) (1986). *The Cultural Atlas of Ancient America*. Oxford: Andromeda.

Costenla Umaña, Adolfo (1991). *Las Lenguas del Área Intermedia: Introducción a su Estudio Areal*. San José: Editorial de la Universidad de Costa Rica.

Croft, William (1996). Linguistic selection: an utterance-based evolutionary theory of language change. *Nordic Journal of Linguistics* 19: 99-139.

– (1999) Adaptation, Optimality and Diachrony. *Zeitschrift für Sprachwissenschaft* 18/2: 206-208.

– (2000). *Explaining Language Change: An Evolutionary Approach*. Harlow, Essex: Longman.

Dryer, Matthew (1992). The Greenbergian word order correlations. *Language* 68/1: 81-138.

Garza, Silvia & Tommasi, Wanda (1987). *Atlas Cultural de México - Arqueología*. Mxico D.F.: Instituto Nacional de Antropología.

Greenberg, Joseph (1966). Some universals of grammar with particular reference to the order of meaningful elements. In Greenberg (ed.). *Universals of Grammar*, 73-113. Cambridge, Mass.: MIT Press.

Haspelmath, Martin (1999). Optimality and diachronic adaptation. *Zeitschrift für Sprachwissenschaft* 18/2: 180-205.

– (2000). Review of: Kirby (1999). *Linguistic Typology* 4/1: 163-168.

Hawkins, John (1994). *A Performance Theory of Order and Constituency*. Cambridge: Cambridge University Press.

Kaufman, Terrence (1973). Areal linguistics and Middle America. In: Sebeok, T. (ed.). *Current Trends in Linguistics* 11, 459-83. The Hague: Mouton.

Kayne, Richard S (1994). *The Antisymmetry of Syntax*. Cambridge: MIT Press.

Keller, Rudy (1994). *On language Change: The invisible Hand in Language*. London: Routledge (translation and expansion of *Sprachwandel: von der unsichtbaren Hand in der Sprache*. Tübingen: Francke, 1990).

Kirby, Simon (1999). *Function, Selection, and Innateness - The Emergence of Language Universals*. Oxford: Oxford University Press.

Kirchhoff, Paul (1943). Mesoamerica. *Acta Americana* 1: 92-107.

Langacker, Ronald W (1977). *An Overview of Uto-Aztecan Grammar*. Arlington: SIL.

Lehmann, Christian (1995). *Thoughts on Grammaticalization*. München & Newcastle: LINCOM (revised and expanded version of *Thoughts on Grammaticalization. A programmatic sketch. Vol. 1.* Arbeiten des Kölner Universalienprojekts, 48. Köln: Institut für Sprachwissenschaft der Universität zu Köln, 1982).

Meillet, Antoine (1926). *Linguistique historique et linguistique générale*. Paris: Honor et Champion.

Moseley, Christopher & Asher, R.E. (1994). *The Atlas of the World's Languages*. London: Routledge.

Mufwene, Salikoko (2001). *The Ecology of Language Evolution*. Cambridge: CUP.

Nettle, Daniel (1999). *Linguistic Diversity*. Oxford: Oxford University Press.

Nichols, Johanna (1986). Head-marking and dependent-marking grammar. *Language* 62/1: 56-119.

Sanders, William T. (1971). Settlement patterns in Central Mexico. In: Wauchope, R. & Ekholm, G. & Bernal, I. (eds.). *Handbook of Middle American Indians, Vol. 10 - Archaeology of Northern Mesoamerica, Part 1*. Austin: University of Texas Press.

Siméon, Rémi (1885[1996]). *Diccionario de la Lengua Náhuatl o Mexicana*. Mexico D.F. & Madrid: Siglo 21 (originally published as: Dictionnaire de la langue Nahuatl ou Mexicaine. Paris, Imprimerie Nationale, 1885).

Suarez, Jorge (1983). *The Mesoamerican Indian Languages*. Cambridge: Cambridge University Press.

Sullivan, Thelma D. (1992). *Compendio de la Gramática Nahuatl*. Mexico D.F.: UNAM.

Thomason, Sarah & Kaufman, Terrence (1988). *Language Contact, Creolization, and Genetic Linguistics*. Berkeley: University of California Press.

Tuggy, David (1979). Tetelcingo Nahuatl. In: Langacker, R. (ed.). *Studies in Uto-Aztecan Grammar, Vol. 2*, 1-140. Arlington: SIL.

van der Auwera, Johann (1998). Revisiting the Balkan and Meso-American linguistic Areas. *Language Sciences* 20/3: 259-270.

West, Robert C (1964). The Natural Regions of Middle America. In: Wauchope, R. & West, R. (eds.). *Handbook of Middle American Indians, Vol. 1 - Natural Environment and Early Cultures*, 363-282. Austin: Texas University Press.

Wichmann, Søren (1995). ***The Relationship among the Mixe-Zoquean Languages of Mexico.*** **Salt Lake City: University of Utah Press.**

Yang, Charles D (2000). Internal and external forces in language change. ***Language Variation and Change*** **12: 231-150.**

Yasugi, Yoshiho (1995). ***Native Middle American Languages - An Areal-Typological Perspective.*** **Osaka: National Museum of Ethnology.**

Zapata Alonso, Gualberto (1998). ***An Overview of the Mayan World.*** **Merida, Yucatán: Estigia.**