



**University of  
Zurich**<sup>UZH</sup>

**Zurich Open Repository and  
Archive**

University of Zurich  
University Library  
Strickhofstrasse 39  
CH-8057 Zurich  
[www.zora.uzh.ch](http://www.zora.uzh.ch)

---

Year: 2015

---

**Exploring diachronic universals of agreement: alignment patterns and zero marking across person categories**

Bickel, Balthasar ; Witzlack-Makarevich, Alena ; Zakharko, Taras ; Iemmolo, Giorgio

DOI: <https://doi.org/10.1515/9783110399967-003>

Posted at the Zurich Open Repository and Archive, University of Zurich

ZORA URL: <https://doi.org/10.5167/uzh-111194>

Book Section

Published Version

Originally published at:

Bickel, Balthasar; Witzlack-Makarevich, Alena; Zakharko, Taras; Iemmolo, Giorgio (2015). Exploring diachronic universals of agreement: alignment patterns and zero marking across person categories. In: Fleischer, Jürg; Rieken, Elisabeth; Widmer, Paul. Agreement from a diachronic perspective. Berlin: De Gruyter Mouton, 29 - 51.

DOI: <https://doi.org/10.1515/9783110399967-003>

Balthasar Bickel, Alena Witzlack-Makarevich, Taras Zakharko,  
and Giorgio Iemmolo

# Exploring diachronic universals of agreement: alignment patterns and zero marking across person categories

**Abstract:** Two principles shaping agreement paradigms have been implicitly assumed to constitute diachronic universals: (i) ergativity is assumed to be more likely to develop or be maintained in third than in non-third person; (ii) zeros are assumed to develop and be preserved more commonly in third than in non-third person. Estimating probabilities of diachronic change in a worldwide database and controlling for areal diffusion effects, we find no evidence for (i). Principle (ii) receives no support either when examining how paradigms develop as systems, but we observe a weak cross-paradigm effect which is likely to be caused by frequency patterns during grammaticalization.

## 1 Introduction

As has been repeatedly noted in the typological literature, most – perhaps even all – statistical universals are not really synchronic in nature, but are rather the result of underlying diachronic mechanisms that cause languages to change in preferred or ‘natural’ ways (e.g. Greenberg 1978, Bybee 1988, Hall 1988, Croft 2003, among others). Diachronic universals are not only of interest to typology and inquiries into the cognitive factors that shape human language, but they are also essential for historical linguistics and the reconstruction of the pre-history of individual languages or language families: when choosing between possible reconstructions, there is good reason to prefer ‘natural’ over ‘unnatural’ sound laws (Blevins 2004). A good illustration of this principle comes from work on Proto-Polynesian (Donohue & Oppenheimer 2012). The cognate word for ‘nose’ in Central Pacific languages shows an intervocalic /h/ in the majority of languages, as in Tongan *ihu*, while only one language of the group, namely Emae, shows intervocalic /s/, as in *isu*. If reconstruction were to follow a linguistically uninformed ‘majority-wins’ or maximum parsimony guideline, one would be tempted to reconstruct \*/ihu/. However, as noted by Donohue & Oppenheimer (2012:542), given what we know about the typology of sound changes, one would *ceteris paribus* reconstruct \*/isu/ and hypothesize a natural rule of lenition rather

than the other way around (also cf. Campbell 1999:116). ‘Natural’ here means in line with theoretically-motivated and universal expectations about diachrony.

Establishing diachronic universals is no trivial enterprise. Using only reconstruction is not a viable option, since reconstruction often relies on assumptions about what is natural and universal in the first place. Using historically attested changes gets us further, but quickly runs into a severe sampling problem because there are only very few families in the world of which we know the history with any confidence. One way out that is currently being explored (e.g. Maslova 2000, Dunn et al. 2011, Bickel 2015) is based on statistical explorations of synchronic data with the goal of estimating the most likely diachronic trends and biases in the histories behind these data.

In this paper, we will use one such method in order to evaluate the validity of two widely-known principles that have been claimed to affect the structure of agreement paradigms. These are principles that govern the distribution of patterns of role alignment (accusative, ergative etc.) and the distribution of zero marking in paradigms. In each case, we interpret these principles as candidates for diachronic universals. The first principle is what we call “Silverstein’s Law”. It predicts that paradigms naturally and universally develop in such a way that ergativity is more likely in the third than in the first and second person. The second principle we test is “Watkins’ Law”, which predicts that naturally and universally paradigms develop in such a way as to have zero forms in the third rather than in the first and second person.

Before proceeding, however, an immediate proviso is in order: although the original formulations of these principles might not have been assumed to have true universal validity (as in the case of Watkins’ Law), or true diachronic validity (as in the case of Silverstein’s Law) by their proponents, several scholars have taken their status as diachronic universals for granted (see for example Koch 1995, Siewierska 2009 on the distribution of zeros, or Kiparsky 2008 on the distribution of ergative alignment). Independently of these interpretations in the literature, we do find it interesting to assess the validity of such principles as diachronic universals: if they turn out to be valid, they could have far-reaching consequences for our understanding of how languages change over time.

The paper is organized as follows. Section 2 introduces the general method used to test the validity of the two principles and Section 3 describes our data source. Section 4 deals with the first case study, namely Silverstein’s Law, while Section 5 discusses Watkins’ Law. Section 6 summarizes the study and draws general conclusions.

## 2 Methods

Universal trends in diachrony can be estimated on the basis of synchronic distributions. One method for such estimates is the Family Bias Method (Bickel 2015). The basic idea is the following: each family is evaluated as to whether its daughter languages are biased towards a certain structure (such as paradigms with ergative alignment in the third rather than the first or second person), as revealed by a statistical test. If there is such a bias, this means that daughter languages have preferentially innovated in the same direction, or they kept what was already there in the proto-language. Either way, a bias suggests that – for whatever reason – there was a systematic preference in the development of the given family. The absence of a bias suggests random fluctuation in development.

The presence or absence of biases can be determined straightforwardly in families with enough representatives, using for example a binomial (or multinomial) test. But what about smaller families, or families with just one member, i.e. isolates? These constitute critical data because about half of the world's language families are small, mostly in fact having one member. A solution comes from extrapolation algorithms: for this, we can use the information on biases in large families in order to estimate the biases that are likely to have been behind small families as well: if, say, 60 % of large families are biased towards some specific structure (e.g., biased towards Silverstein-style alignment patterns in paradigms) rather than balanced between structures (i.e. with about as many daughters with such patterns as daughters that contradict the pattern), we estimate a rough .6 probability that the known members of small families come from larger unknown families with a bias as well, in whatever direction, as opposed to families without any bias. In some small families, the known or only members will be representative of the bias in the unknown larger family from which they ultimately derive, and so we can take their type to reflect the bias. In other cases, the known or only members will happen to deviate. The probability of being representative can be estimated from the strength of the bias in attested large families: for example, if among biased large families, biases tend to be very strong (e.g. on average covering over 90 % of members), we can estimate a high probability that the known members of small biased families are representative of the larger unknown family from which they derive, and only a small proportion is expected to be non-representative.

Using the probabilities of bias and of representativeness based on large families, we can estimate the proportion of small families that come from larger biased as opposed to unbiased families, and if they are estimated to come from biased families, we can estimate whether the known members represent indeed

the biases of their families or deviate from them. These extrapolation estimates introduce error, but through multiple extrapolation we can arrive at a mean value that is fairly reliable. The method as summarized here is described and justified in detail in Bickel (2013), and it is implemented in an R (R Development Core Team 2012) package (Zakharko & Bickel 2011ff.).

Principles are universal only if they hold independently of where families are located on the globe. This is particularly important with regard to abstract typological features, such as the distribution of zeros or of ergativity in agreement paradigms, because abstract patterns like these are known to have spread in large areas, often in the course of thousands – perhaps even tens of thousands – of years (Dryer 1989, Nichols 1992). Large areas constitute a confounding factor that needs to be controlled for. We will do this here by estimating family biases separately within large areas and conclude universality only if family biases show a significant trend that holds world-wide and that is statistically independent of areas.

### 3 Data

The data for the two case studies come from a survey of individual agreement paradigms in 314 languages. By ‘agreement’, we understand here only grammatical agreement in the sense of Bickel & Nichols (2007), i.e. verbal markers of argument properties that can in principle co-occur with a coreferential noun phrase in the same clause (regardless of whether this co-occurrence is frequent or rare in discourse). In contrast to such markers, cliticized or incorporated pronouns that cannot co-occur with co-referential noun phrases in the same clause were not analyzed as instances of agreement.

By ‘paradigm’, we understand here a set of agreement forms that shares a unique value in non-agreement categories, such as polarity, tense, aspect, direct vs. inverse, main vs. dependent clause status etc. When agreement patterns are conditioned by tense, aspect or polarity, a language is represented by two or more paradigms. For example, in Chortí (ISO639-3: *caa*; Mayan; Quizar 1994) completive and incompletive aspects have non-identical distribution of zeros and alignment patterns. For practical reasons, however, we limited our sample to the paradigms found in the main clause. Thus, for instance, in the case of Algonquian languages we considered only the independent order paradigms and excluded the conjunct order paradigms, etc. As a result of these considerations, our sample comprises more paradigms than languages, in total 352 paradigms.

When paradigms are split into several conjugation classes, we generalize over them as long as they show the same distribution of alignments and zero mark-

ers. When the distribution is not uniform, we choose the pattern that is most frequent, either because it is found in most conjugation classes or because the classes are the largest in the lexicon (depending on what information is available in the source). For instance, Latvian has three conjugation classes with several subclasses. Class II (also referred to as long) and the overwhelming majority of subclasses in class I (also called short) do not mark the second person singular present overtly, whereas the verbs of the class III (mixed) use the suffix *-i* in this context. In addition, the most productive and numerous classes are I and II. Thus, the exemplar paradigm selected for Latvian has no overt marker in the second person singular present (Holst 2001, Mathiassen 1997, Nau 1998).<sup>1</sup>

We limit our attention to agreement among lexical predicates that qualify as open, default classes of their language and exclude agreement paradigms of predicates that are deficient or deponent or that show special alignment patterns (such as experiencers coded like objects), any other special behavior or lexical constraints of any kind. There is only one language in our database, where no default intransitive predicate class can be established for agreement. This is Choctaw (ISO639.3: cho; Muskogean) and in order to keep the coding consistent, we excluded this language from further analysis.

A further restriction is that we only look at person distinctions, and even more simply at only a binary distinction between first and second vs. third person. When there are subdistinctions within person, such as gender or honorificity, we coded the category that is said to be unmarked in the source (usually masculine, non-honorific). We did this in order to factor out confounding effects from these categories.<sup>2</sup>

## 4 Silverstein's Law

### 4.1 Background and hypothesis

The alignment of generalized roles (S, A, P etc.) is well-known to be split sometimes within languages, so that some parts align ergatively, some accusatively. If

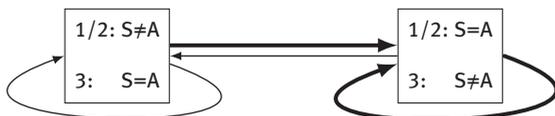
---

<sup>1</sup> We did not assess the relative frequency of paradigms in terms of discourse frequency. This would be a very expensive project, and we doubt that results would have a major impact on our general findings since the number of relevant splits is too rare to begin with.

<sup>2</sup> The dataset used in this study is available for download at <http://dx.doi.org/10.1515/9783110399967.suppl>, once coded for alignments and once coded for zeros, following the coding principles explained below.

such a split is governed by a difference in person, it is commonly expected that we find accusative alignment in the first and second and ergative alignment in the third person. This idea was developed in the 1970s (e.g. , Silverstein 1976) and was originally formulated in terms of a synchronic generalization.<sup>3</sup> Later on, it has also been rephrased in terms of an absolute, non-violable property of Universal Grammar (Aissen 1999) that constrains how languages can or cannot change (Kiparsky 2008).

Here we test this prediction as a statistical diachronic universal, calling it ‘Silverstein’s Law’. We expect that, if paradigms have a person-conditioned split in alignment, they are more likely to develop in such a way that ‘S=A’ alignment (i.e. accusative or neutral) is found in the first and second person and ‘S≠A’ alignment (i.e. ergative) in the third person, rather than the other way round. If a paradigm shows the preferred pattern, it is expected to be preserved as such over time; if a paradigm violates the pattern, it is expected to develop the preferred pattern. This is visualized in Figure 1, where paradigms are represented by boxes and where the thickness of arrows depicts the expected probability of diachronic developments between paradigms.



**Fig. 1:** Hypothesis of Silverstein’s Law as a diachronic universal affecting agreement paradigms

Apart from person, other features – especially animacy and number – are expected to affect the distribution of ergativity as well. However, we limit our attention in the following to person only because person is by far the most widespread agreement category in the world. If Silverstein’s Law leaves a detectable statistical signal anywhere, one would expect this to be first and foremost in person agreement.

<sup>3</sup> Note that not all claims about the distribution of alignment types over person focus on or even include agreement systems. Comrie (1981) for example limits the claim to case marking and does not consider agreement systems.

## 4.2 Alignment coding

For determining alignment types, we focus on the coding of S, A, and P argument roles and exclude arguments of three-argument verbs from our present purview. S, A, and P are defined by numerical valency and semantic entailment properties of lexical predicates, following earlier proposals of ours (e.g., Bickel & Nichols 2009, Bickel 2011, Witzlack-Makarevich 2011). We understand alignment type as a particular grouping of S, A, and P argument roles in a specific morphosyntactic operation, here agreement marking: if an agreement marker, or a set of agreement markers, treats S and A alike, as it does for example in English or Latin, S aligns with A, while P is kept apart insofar as it does not trigger agreement marking. In English, the third person triggers *s*-agreement with both S arguments (*he work-s*) and A arguments (*he see-s me*), but not with P arguments (*\*I see-s him*). Such a pattern (i.e.  $S=A\neq P$ ) is traditionally known as accusative alignment. Other possibilities are  $S=P\neq A$  (ergative alignment),  $S=A=P$  (neutral alignment),  $S\neq A\neq P$  (tripartite alignment), and, finally,  $S\neq A=P$  (horizontal alignment).

Determining alignment in agreement paradigms can be non-trivial, mostly because individual agreement markers can pattern in a way that differs from the basic question of which arguments ever trigger agreement (Siewierska 2003, Bickel et al. 2013). For example, in an agreement paradigm like that of Swahili (ISO639.3: *sw*; Benue-Congo) individual agreement markers pattern accusatively: the S and A arguments of the third person singular in noun class I require the agreement prefix *a-* ‘3s.I.S/A’, whereas the P argument requires the prefix *mw-* ‘3s.I.P’. On the other hand, when one asks which arguments trigger agreement, the answer would be S, A, and P alike (i.e. neutral) because they all trigger agreement of some kind:

- |     |    |                              |                |    |                      |
|-----|----|------------------------------|----------------|----|----------------------|
| (1) | a. | <i>a-li-mw-ona</i>           | <i>mbuzi</i> . | b. | <i>a-li-kimbia</i> . |
|     |    | 3sI.S/A-PST-3sI.P-see        | goat           |    | 3sI.S/A-PST-run      |
|     |    | ‘S/he (A) saw the goat (P).’ |                |    | ‘S/he (S) ran.’      |

Whenever there is such a discrepancy, we determine alignment on the basis of individual agreement markers as they appear or fail to appear in specific morphological positions/slots, following the procedure described in detail in Bickel et al. (2013). Thus, the data in (1) are coded as follows: in the first prefix position, we get accusative alignment for the third person since S and A are marked by *a-* while P is not marked. In the third position, i.e. after the tense marker, the third person is again accusatively aligned but for a different reason: here it is based on the fact that P is marked by *mw-* while S and A are treated alike by not being marked. The

pattern in (1) is not the only one in Swahili; under certain semantic and pragmatic conditions, there is no overt P agreement:

- (2) *a-li-ona mbuzi.*  
 3sI.S/A-PST-see goat  
 ‘S/he (A) saw a goat (P).’

In this case, Swahili has neutral alignment in the third position since now all arguments are alike in failing to show any agreement exponence in that slot. We determined alignment separately in each condition that a language may put on its agreement paradigms.

Computing alignments in this way has the advantage that the specific morphological structure of paradigms is respected. The disadvantage is that in languages like Swahili one loses the generalization that only S and A are marked in the first and only P argument in the third slot, so that one could derive the accusative alignment in the third slot from the accusative alignment in the first slot. However, the situation in Swahili is very special, and generalizations of this kind are far from being universal. There are many languages where the distribution of S, A and P markers is not tied to specific positions. In Pipil (IS0639.3:pp1; Uto-Aztecan; Campbell 1985) or Puma (IS0639.3:pum; Kiranti branch of Sino-Tibetan; Bickel et al. 2007), for example, the same positions cover S, A and P markers alike. Consider first person singular agreement in the Puma past affirmative paradigm:

- |     |   |  |
|-----|---|--|
| (3) | a. <i>cind-u-ŋ</i><br>teach[-PST]-3sP-1sA<br>‘I (A) taught him/her (P)’ | c. <i>pA-cind-ŋ</i><br>3sA-teach-1sS/P.PST<br>‘s/he (A) taught me (P)’ |
|     | b. <i>tA-cind-ŋ</i><br>2-teach-1sS/P.PST<br>‘you (A) taught me (P)’     | d. <i>phind-ŋ</i><br>jump-1sS/P.PST<br>‘I (S) jumped’                  |

First person alignment is neutral in the prefix position as all roles are alike in having zero realization, except for the second person, which is realized as *tA-* (3b), and the third person which is realized as *pA-* (3c). This differs from the final suffix position, where the first person shows ergative alignment: it is registered as *-ŋ* in S and P function (cf. 3b and 3c for P, and 3d for S) but as *-ŋ* in A function (3a). Unlike in Swahili, the alignment in the prefix position cannot be predicted from the alignment in the suffix position, or vice versa. Thus, in order to be able to capture alignment in all agreement paradigms, we coded alignment separately for each person in each morphological position. In order to achieve consistency, we do this

in all languages, including languages like Swahili, where one could in principle also characterize the alignment patterns in terms of generalized positions.

The Puma data point to yet another problem: the alignment pattern in a specific person category can depend on the presence of other person markers in the same form. For the second person, alignment in Puma is neutral in the prefix position since all roles show *tA-* here. Compare the following forms (and also 3b, which is parallel to 4a, with *tA-* marking A):

- (4) a. *tA-cind-i*  
2-teach-3sP.PST  
'you (A) taught him/her (P)'
- c. *tA-phind-a*  
2-jump-PST  
'you (S) jumped'
- b. *tA-cind-a*  
2-teach-PST  
's/he (A) taught you (P)'

These forms show that *tA-* occurs in all three roles. However, when the second person combines with a first person, the pattern is different, as there is no prefix in this case:

- (5) *cin-na-a*  
teach-1>2-PST  
'I (A) taught you (P)'

Here, second person P is realized by means of the suffix *-na* 'first person acting on second person'. This form contrasts with *tA-* which in the same first person context covers the A role (3b) and which also covers the S role (4c), thus constituting accusative alignment. This kind of split, which is conditioned by co-arguments, is very common in Puma and similar languages (Bickel et al. 2013). For example, third person in Puma shows ergative alignment in the prefix position when co-occurring with a first person: there is a marker *pA-* in the form for 's/he taught me' (3c) while the third person lacks overt marking in the prefix position when it is in the P function (as in the 'I taught him/her' form in 3a) or in the S function (*phind-a* 'jump-PST', i.e. 's/he jumped'). However, when the third person co-occurs with a third person, it also lacks overt marking in the prefix position (*cind-i* 'teach-3sP.PST', i.e. 's/he taught him/her'), and so, alignment is neutral here. (The distribution is again different in the suffix position, where third person aligns accusatively).

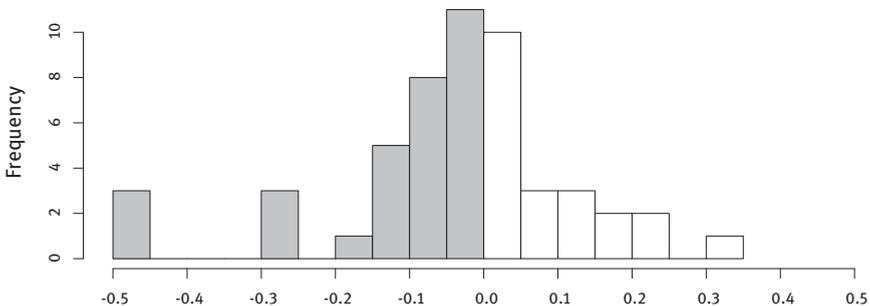
In response to these issues, we coded alignment not only per person in each slot but also relative to the co-arguments that a form might have. This increases

the number of alignment statements considerably, as combinations multiply. For example, third person S can be compared to third person A when co-occurring with first person P and to third person P when co-occurring with first person A; or to third person A when co-occurring with second person P and to third person P when co-occurring with first person A, and so on. Summary characterizations of paradigms then need to be statistical, e.g., via the empirical distribution of alignment types, or the proportion of accusative vs. ergative alignments, etc. In the following we focus on the distribution of  $S=A(=P)$  vs.  $S\neq A$  alignments, in line with the hypothesis put forward above.

### 4.3 Results

Of the 352 paradigms, only 52 show an  $S=A$  vs.  $S\neq A$  split, distributed over 42 languages. Almost all cases come from Algonquian (10 languages) and the Kiranti subgroup of Sino-Tibetan (19). The rest is found in Mayan (7 languages), Southern Nilotic (Teso, IS0639.3:teo), Pano-Tacanan (Reyesano, IS0639.3:rey), Macro-Ge (Bororo, IS0639.3:bor), Sepik (Namambu, IS0639.3:m1e) and in the isolates Ainu (IS0639.3:ain) and Zuni (IS0639.3:zun). In order to assess the distributions of the alignments, we computed for each paradigm the proportion of  $S=A$  vs.  $S\neq A$  alignments within all first and second persons and, separately, within all third person forms (i.e. across all number and other distinctions and across all co-arguments that they combine with). The results of this are reported in Table 1 and summarized in Figure 2.

The last column in the table reports whether  $S=A$  alignments are more common in the first and second person than in the third. According to Silverstein's



**Fig. 2:** Histogram of differences between the proportion of  $S=A$  alignments in the first and second vs. in the third person in Table 1. Negative values contradict the predictions of Silverstein's Law and are printed in grey.

Table 1: Proportion of S=A (as opposed to S≠A) alignments in paradigms with splits

Stock	Branch	Language	Paradigm	Prop(S=A) in 1/2	Prop(S=A) in 3	Diff.
Ainu		Ainu		0.811	1.000	-0.189
Algic	Algonquian	Arapaho	INDEP	0.762	0.719	0.043
Algic	Algonquian	Atikamekw	INDEP.NPST	0.879	0.789	0.091
Algic	Algonquian	Blackfoot	INDEP.AFF	0.814	0.923	-0.109
Algic	Algonquian	Cheyenne	INDEP.PRS.IND	0.801	0.690	0.111
Algic	Algonquian	Cree (Plains)	INDEP	0.887	0.691	0.196
Algic	Algonquian	Menomini	INDEP	0.845	0.846	-0.001
Algic	Algonquian	Micmac	INDEP.IND	0.868	0.639	0.229
Algic	Algonquian	Munsee	INDEP.NPST	0.806	0.676	0.130
Algic	Algonquian	Ojibwa (Eastern)	INDEP.PRS	0.832	0.799	0.033
Algic	Algonquian	Passamaquoddy	INDEP.PRS	0.839	0.788	0.051
Macro-Ge	Bororo	Bororo		0.000	0.500	-0.500
Mayan	Gr. Kanjobalan	Jacalteco		0.000	0.500	-0.500
Mayan	Gr. Tzeltalan	Chontal Maya	PFV	0.556	0.667	-0.111
Mayan	Gr. Tzeltalan	Chorti	NCOMPL	0.833	0.667	0.167
Mayan	Gr. Tzeltalan	Chorti	COMPL	0.333	0.333	0.000
Mayan	Quichean-Mamean	Quiche		0.000	0.250	-0.250
Mayan	Quichean-Mamean	Tzutujil		0.000	0.250	-0.250
Mayan	Yucatecan	Itzaj	COMPL	0.200	0.167	0.033
Mayan	Yucatecan	Yucatec	COMPL	0.200	0.167	0.033
Nilotic	Southern Nilotic	Teso		1.000	0.671	0.329
Pano-Tacan	Tacan	Reyesano		0.706	0.986	-0.281
Sepik	Middle Sepik (Ndu)	Mambu		0.000	0.500	-0.500
Sino-Tibetan	Kiranti	Athpare	IND	0.878	0.946	-0.069
Sino-Tibetan	Kiranti	Bahing	PST.IND.AFF	0.909	0.889	0.021
Sino-Tibetan	Kiranti	Bahing	NPST.IND.AFF	0.914	0.894	0.020

Table 1: (continued)

<i>Stock</i>	<i>Branch</i>	<i>Language</i>	<i>Paradigm</i>	<i>Prop(S=A) in 1/2</i>	<i>Prop(S=A) in 3</i>	<i>Diff.</i>
Sino-Tibetan	Kiranti	Bantawa		0.839	0.853	-0.013
Sino-Tibetan	Kiranti	Belhare		0.870	0.963	-0.093
Sino-Tibetan	Kiranti	Camling	IND.AFF	0.808	0.838	-0.030
Sino-Tibetan	Kiranti	Chintang	NPST.IND.AFF	0.847	0.905	-0.059
Sino-Tibetan	Kiranti	Dumi	NPST.IND.AFF	0.837	0.606	0.231
Sino-Tibetan	Kiranti	Hayu	PST.IND.AFF	0.937	0.915	0.021
Sino-Tibetan	Kiranti	Hayu	NPST.IND.AFF	0.898	0.879	0.019
Sino-Tibetan	Kiranti	Jero		0.756	0.768	-0.011
Sino-Tibetan	Kiranti	Köic	PST.IND.AFF	0.954	0.852	0.102
Sino-Tibetan	Kiranti	Köic	NPST.IND.AFF	0.972	1.000	-0.028
Sino-Tibetan	Kiranti	Koyi	NPST.IND.AFF	0.835	0.859	-0.023
Sino-Tibetan	Kiranti	Koyi	PST.IND.AFF	0.864	0.894	-0.030
Sino-Tibetan	Kiranti	Kulung	NPST.IND.AFF	0.854	0.964	-0.110
Sino-Tibetan	Kiranti	Kulung	PST.IND.AFF	0.844	0.964	-0.120
Sino-Tibetan	Kiranti	Limbu	PST.IND.AFF	0.855	0.946	-0.091
Sino-Tibetan	Kiranti	Limbu	NPST.IND.AFF	0.849	0.946	-0.097
Sino-Tibetan	Kiranti	Lohorung	NPST.IND.AFF	0.822	0.904	-0.082
Sino-Tibetan	Kiranti	Lohorung	PST.IND.AFF	0.822	0.904	-0.082
Sino-Tibetan	Kiranti	Puma	NPST.IND.AFF	0.877	0.870	0.007
Sino-Tibetan	Kiranti	Puma	PST.IND.AFF	0.877	0.870	0.007
Sino-Tibetan	Kiranti	Thulung	NPST.IND.AFF	0.911	0.949	-0.038
Sino-Tibetan	Kiranti	Thulung	PST.IND.AFF	0.917	0.949	-0.033
Sino-Tibetan	Kiranti	Wambule		0.756	0.657	0.100
Sino-Tibetan	Kiranti	Yakkha		0.881	0.953	-0.071
Sino-Tibetan	Kiranti	Yamphu	IND.AFF	0.836	0.961	-0.125
Zuni		Zuni		0.500	0.500	0.000

Law, this should tend to be the case. However, as the histogram of differences in Figure 2 shows, there are far more paradigms that contradict this, resulting in negative numbers, viz. 60 % paradigms (31 out 52). Only 40 % of the paradigms follow Silverstein's Law. The histogram also suggests that most differences cluster around 0, i.e. most paradigms simply show only a marginal difference between the proportions of S=A alignments across persons.

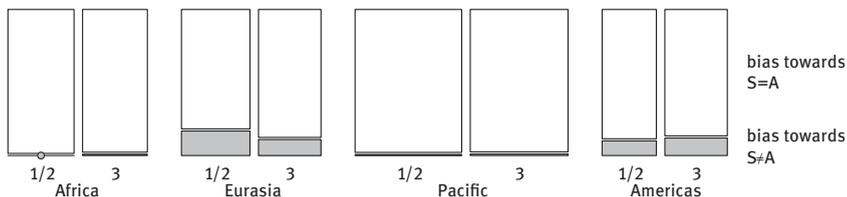
Aggregating the proportions per family allows us to estimate diachronic biases along the lines described in the methods section, although given the small number of relevant families, we do not extrapolate to small families here. The results show that Algonquian is the only large family with a bias towards obeying Silverstein's Law, with 8 out 10 paradigms following it. But even in Algonquian, the trend is only borderline significant (one-sided binomial test,  $p = .055$ ), and we are therefore reluctant to infer a diachronic bias in the family based on this. We conclude that there is no support for Silverstein's Law in agreement paradigms. The other families with splits do not show the slightest bias in line with the hypothesis from Figure 1. Mayan and Kiranti even have slight biases against the hypothesis. In Mayan, 5 out 8 paradigms contradict the hypothesis; in Kiranti, 19 out of 28 paradigms contradict it (which is in fact even statistically significant at a 5 % rejection level).

Among the families for which we have only one representative each, Ainu, Bororo, Reyesano, and Manambu also contradict the hypothesis (Table 1); only the Nilotic language Teso supports it, while Zuni is neutral in this regard (having S≠A in the plural in all persons and neutral alignment in the singular).

#### 4.4 A non-paradigmatic interpretation of Silverstein's Law?

While there is no support for Silverstein's Law as explicated in Figure 1, the question arises whether there is support for it under a different interpretation. So far we have looked at paradigm structures, counting different alignment types within each paradigm separately (Table 1) and assessing family biases on the paradigms in a second step only. Under an alternative, 'non-paradigmatic' interpretation, Silverstein's Law does not operate on paradigm structures but predicts a higher probability for S=A alignment in first and second than in third persons more generally and cross-cutting paradigms.

To test whether Silverstein's Law has more empirical support under such an interpretation, we performed a family bias analysis without respecting paradigms. We first split the data into data on alignment in the first and second person and data on alignment in the third person. Using the method explained in Section 2, we then estimated the extent to which there are family biases towards S=A align-



**Fig. 3:** Family bias estimates ignoring paradigm structures (based on all 314 languages)

ment in each dataset, controlling for large-scale macro-areas.<sup>4</sup> The results of these estimates (including now extrapolations to small families and isolates) is shown in Figure 3.<sup>5</sup>

The figure leaves out families that are diverse because the absence of any bias gives no evidence of the direction of diachronic developments (Bickel 2013). The figure shows that, in each area, there are about as many families with biases in each direction in the first or second person as families with biases in each direction in the third person. This suggests that Silverstein’s Law has no empirical support under a non-paradigmatic interpretation either.

The findings confirm earlier conclusions by Bickel (2008), which were based on a different and smaller dataset (that of Bakker & Siewierksa 2006), adopted a different method for coding alignments (focusing on overall types of splits, rather than on alignment proportions), and relied on a more qualitative than quantitative approach.

## 5 Watkins’ Law

### 5.1 Background

In its original formulation, Watkins’s Law concerns the analogical reanalysis and subsequent reorganization of inflectional paradigms on the basis of the third person singular. The law was proposed by Watkins (1962) for a number of ancient

<sup>4</sup> We did this by running the `familybias` function (Zakharko & Bickel 2011ff) directly on a binary re-code of the alignment statement, differentiating only between  $S=A$  vs.  $S\neq A$ . We used the default setting of the function.

<sup>5</sup> Here and in all other figures below, we use the ‘mosaic’ visualization technique of Meyer et al. (2006), so that the sizes of tiles in the graph are proportional to the number of families in each condition.

Indo-European languages as well as in the reconstruction of Proto-Indo-European (see Watkins 1969). Watkins (1962:90–96) proposes a scenario according to which third person markers are reanalyzed as part of the verbal stem, thus giving rise to zero marking in the third person. An illustration of this process comes from the reanalysis of the third person singular ending *-t* as part of the verbal stem from Proto-Iranian to Persian (cf. Watkins 1962:94). The process is represented in Table 2.

**Table 2:** Singular agreement forms of ‘to be’ from Proto-Iranian to Persian

	<i>Proto-Iranian</i>		<i>Persian</i>	
1sg	<i>*as-mi</i>	> <i>*as-m</i>	> <i>*ast-m</i>	> <i>hast-am</i>
2sg	<i>*as-i</i>	> <i>*as-i</i>	> <i>*ast-i</i>	> <i>hast-i</i>
3sg	<i>*as-ti</i>	> <i>*as-t</i> > <i>*ast-∅</i>	> <i>*ast-∅</i>	> <i>hast-∅</i>

The reanalysis comprises several aspects. First, *-t* is reanalyzed as part of the verbal stem *ast*. The new stem then becomes the basis for the rest of the paradigm. This in turn leaves the third person form *ast* identical with the stem, i.e. without a proper ending. The paradigmatic opposition to the first and second person finally establishes a zero exponent in this form, specialized for third person agreement. The same analysis applies, *mutatis mutandis*, to other languages across the Indo-European family (see for example Bybee & Brewer 1980 on Provençal, Haiman 1977 on Vallader Rumantsch, among others).

As stated by Watkins (1962:178), the reanalysis of third person as having zero exponence constitutes a “general linguistic phenomenon”. Koch (1995:64) has indeed proposed that such processes should be seen as driven by a general diachronic principle, according to which a form which expresses via non-zero marking a feature that is typologically expected to be zero marked (such as a third person) is likely to be reanalyzed as having zero exponence. The validity of this process as a general diachronic principle, however, has been questioned by, e.g., Hock (1986:218–222), who considers the evidence for the reanalysis of third person as “meager”.

Reanalysis is not the only possible process through which zero exponence arises. Another possibility is that a language never developed overt marking for the third person. In some language families the evidence in fact points towards a “non-development” scenario, that is a scenario where overt marking for third person never arose. Such a scenario is exemplified by Uralic languages. In Proto-Uralic, only first and second person suffixes are reconstructable for S/A (Collinder 1965:58, Körtvély 2005). Third person is very often unmarked in modern Uralic

languages: when overtly marked, there is considerable heterogeneity in the innovated markers (see also Comrie 1981).

The classical explanation for the lack of overt marking in the third person goes back to Jakobson's (1932) and Benveniste's (1946:227–232) characterization of the third person as a “non-person”, negatively defined. Zeros are more likely to be found in the third person as opposed to first and second because of its “impersonal, non-referring nature”, as Benveniste has it. The restructuring of paradigms based on Watkins' Law is explained, e.g., by Koch (1995), in terms of iconicity: this is due to the tendency for paradigms to encode via zero the “non-person” as opposed to first and second.

Under either the reanalysis or the non-development scenarios outlined above, Watkins' Law predicts that languages should preferentially develop and maintain paradigms with zero-marked third person, as for example in the Persian Aorist or in the Puma Intransitive Past, summarized in Table 3 (cf. Section 4.2 for details on Puma). Watkins' Law should disfavor paradigms such as the one found in the English Present tense, where only the third person is overtly marked, as well as paradigms such as the one in the Persian present tense, where all persons have overt exponence (cf. the rightmost columns in Table 3). Note that the reason for being disfavored are different in the English and the Persian Present tense paradigms: the English paradigm is disfavored because it has zeros ‘in the wrong place’; the Persian paradigm is disfavored because it would be expected to undergo reanalysis along the lines sketched in Table 2 – not categorically, but as a worldwide trend.

**Table 3:** Favored and disfavored paradigms according to Watkins' Law

	<i>Favored</i>		<i>Disfavored</i>	
	<i>Persian Aorist</i> (‘go’)	<i>Puma Intransitive Past</i> (‘jump’)	<i>English Present</i>	<i>Persian Present</i> (‘go’)
1sg	<i>raft-am</i>	<i>phind-on</i>	<i>like-∅</i>	<i>mi-rav-am</i>
2sg	<i>raft-i</i>	<i>ta-phinda</i>	<i>like-∅</i>	<i>mi-rav-i</i>
3sg	<i>raft-∅</i>	<i>∅-phinda-∅</i>	<i>like-s</i>	<i>mi-rav-ad</i>

Following the scheme used to visualize Silverstein's Law in Section 4, Figure 4 visualizes Watkins' Law as a diachronic universal operating on paradigms (where again paradigms are represented by boxes and probabilities of diachronic development by arrow thickness; ‘x’ stands here for any overt marker).



Fig. 4: Hypothesis of Watkins' Law as a diachronic universal affecting agreement paradigms

## 5.2 Coding

For this study, we specified for each person feature whether or not it has any overt marking in its agreement morphology. If paradigms also register number, we limit our attention to the way person is marked in the singular number. Non-singular number strongly tends to induce overt marking because it is a structurally marked category (Greenberg 1966b). Any such effect would cancel out possible signals from Watkins' Law.

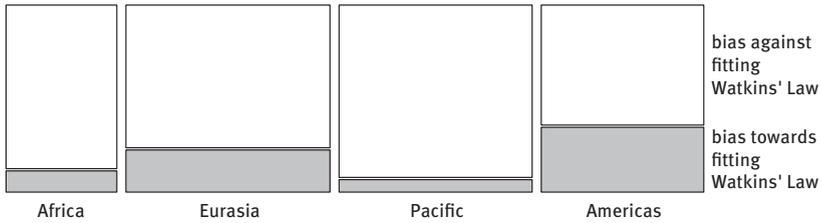
When agreement is sensitive to co-arguments in the way explained in Section 4.2, we coded all relevant singular forms, for example third person singular, when occurring as S, when occurring as A acting upon first person singular, dual, etc. P, or on second person singular, dual etc., when occurring as P being acted open by a first person singular, dual, etc. A argument, and so on. Like in the previous study, this has the consequence that, for some paradigms, there is a substantial number of entries in the database.

## 5.3 Results

For each agreement paradigm, we computed the proportion of overt markers in first and second person as opposed to third person and then determined for each paradigm whether it obeys Watkins' Law, i.e. whether it has more zero markers in the third than in the other persons. Only 35 % of the paradigms in our dataset follow the law. All others have what is expected to be a disfavored structure in Table 3 and what appears on the left side in Figure 4. This is in line with what Cysouw (2003:53) observes in a survey of paradigms involving syncretism (like English, where first and second person syncretize): there is no evidence for zeros to be more common among third than among non-third persons.

Estimates of family biases on whether paradigms obey vs. violate Watkins' Law are given in Figure 5. The results show that there is no support for Watkins' Law as a diachronic universal: families are not more likely to be biased towards developing and maintaining paradigms in line with the law than they are likely to be biased in the opposite direction. In terms of the visualization in Figure 4, this means that all arrows should have about the same thickness, or that indeed

the arrows from the favored (on the right-hand side) to the disfavored (on the left-hand side) paradigm should be thicker than those from the disfavored to the favored paradigm type (except perhaps in the Americas where this trend seems to be weaker).



**Fig. 5:** Family bias estimates on paradigm structures

The only large families (taken here to be families with at least five members) in our sample that abide by Watkins' Law are Mayan and Kiranti. For Mayan, the bias is complete: all Mayan paradigms in our dataset comply with Watkins' Law. For Kiranti, the bias is incomplete, but strong and statistically significant (90 % fit,  $N = 30$ ,  $p < .001$  under a one-sided binomial test). In addition, there is a borderline trend in Algonquian (75 % fit,  $N = 12$ ,  $p = .073$ ). Beyond these three cases, all other large families in our dataset show a bias against Watkins' Law (e.g. Oceanic, Berber, Chimbu-Wahgi, Dravidian, Nakh-Daghestanian, Omotic, Torricelli, Tucánoan, Uralic, West Papuan). This also includes Indo-European, the family for which it was originally formulated. Of all the 28 Indo-European languages in our dataset (sampled from all branches except Tocharian), only 5 languages (Latvian, Slovene, Provençal, Nepali, and of course Persian) have at least one paradigm that complies with Watkins' Law. All others are of the type that would be disfavored by the law, as illustrated above in Table 3, most of them with overt agreement markers in all persons (like in the Persian Present tense paradigm in the table).

We conclude that Watkins' Law receives no support when tested against a large cross-linguistic sample: there is no cross-linguistic tendency for languages to develop paradigms with zero-marked third person and overt marking for first and second either via reanalysis or by non-development. Note that this does not invalidate Watkins' Law as a description of what happened in individual paradigms such as the Persian Aorist; but it means that such a process is not motivated by a universal principle – that is, it cannot be said to be a “natural” development.

## 5.4 A non-paradigmatic interpretation of Watkins' Law

Like in the study of Silverstein's Law, the question arises whether Watkins' Law has better support if it is interpreted differently. In its original formulation and in the way we approached it so far (cf. Figure 4), the law is interpreted as a force driving the structuring of paradigms. However, it is also possible to interpret the law as affecting the distribution of zero marking independently of paradigm structures. The hypothesis then is this: zero markers are more likely to be found in the third than in the first or second person, across all paradigms in a family.

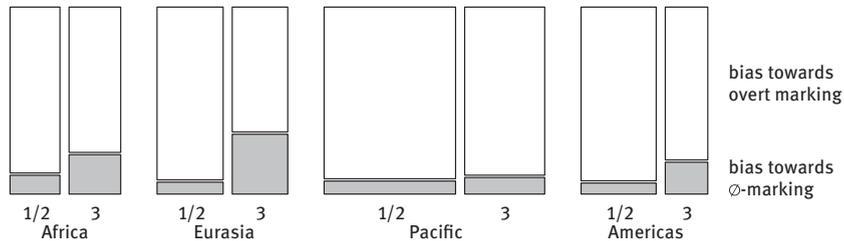
The motivation for such a hypothesis derives from grammaticalization theory. It has often been proposed that agreement markers develop from independent pronouns (see, e.g., Givón 1976, Ariel 2000). The distribution of third person pronouns leads one to expect that they end up as zeros when they grammaticalize into agreement morphology. Bybee (1985) suggests that this higher likelihood for zero agreement markers in third person is due to the lower frequency of overt third person pronouns in discourse. An alternative account, making opposite assumptions on frequency, is given by Greenberg (1966a:65–69). According to this account, third person forms are usually realized as zeros because of their higher frequency in discourse, given that third person forms accompany lexical NPs while first and second do not. Then, higher frequency leads to phonetic reduction and loss or reanalysis of overt marking. In a third account, elaborated by Ariel (2000), third person forms are more frequently zero not because of their relative frequency, but rather because of their lower accessibility in discourse compared to first and second person. Whatever explanation has ultimately the best empirical and theoretical support, a grammaticalization-based theory is plausible and worth testing.

To test the hypothesis, we proceeded in the same way as with the non-paradigmatic version of Silverstein's Law: we split the data on individual agreement makers into a set for first and second person and a set for third person. Within these, we estimated family biases towards the development or persistence of zero marking. Figure 6 shows the results.

Like before, we leave out families that are diverse, i.e. families that lack a bias in any direction, because they give no support for or against the hypothesis.<sup>6</sup> For families with a bias, the hypothesis predicts that there should be significantly more families biased towards zero-marking among third person forms than

---

<sup>6</sup> Note that the number of diverse families is different when looking at first and second as opposed to third person forms. As a result, the total counts of biased families differs in some areas. This is reflected by unequal tiles in the plot.



**Fig. 6:** Family bias estimates on individual agreement forms

among first or second person forms, independently of areas. This is statistically supported, although the effects are relatively weak (as the figure shows). A likelihood ratio test on loglinear models shows that the interaction between PERSON  $\times$  BIAS DIRECTION is significant ( $\chi^2 = 5.26, p = .022$ ) and at the same independent of a further three-way interaction with area ( $\chi^2 = .79, p = .85$ ).

## 6 Conclusions

In this paper we assessed the validity of two hypotheses on possible principles that shape agreement morphology over time. Our data lend no support for what we call Silverstein's Law in agreement morphology: the distribution of  $S \neq A$  and  $S = A$  alignment in the structure of agreement morphology does not appear to be subject to general principles but seems to be the result of individual processes. Watkins' Law, by contrast, shows more empirical success but only if the law is interpreted not as a factor that operates on paradigms but as a factor in the grammaticalization of individual agreement markers, independently of and cutting across paradigms: across the board, third person markers are more likely to develop and maintain zero exponence than first and second person markers.

This finding suggests that paradigm structures are perhaps generally less open to universal factors than individual markers (or constructions). A possible explanation for this could come from the observation that paradigm structures tend to be simultaneously affected by a vast range of independent developments, from phonological change to analogical leveling. As a result of this, general principles cannot easily exert systematic effects that leave clear and detectable signals in daughter languages. The grammaticalization of individual markers, by contrast, can proceed in a relatively independent manner, so that general principles can channel these developments along universal pathways. It is an

open issue for future research to determine whether this difference is of relevance beyond the phenomena we looked at in the present study.

Our finding also invites further research on the theoretical background of why the grammaticalization of third persons tends to end up in zeros more often than the grammaticalization of first and second person. As the discussion in Section 5.4 suggests, progress in this crucially depends on a better understanding of frequency distributions in discourse and their effects on language change. This ultimately requires large-scale corpus research across a larger variety of languages and genres than have traditionally been looked at so far.

## Acknowledgement

This research was supported by Grant Nrs. BI 799/3-1/2 and BI 799/5-1 from the *Deutsche Forschungsgemeinschaft*. A previous version was presented at the workshop on ‘Agreement from a diachronic perspective’, Marburg, October 3–5, 2012 and at the 21<sup>st</sup> International Conference on Historical Linguistics, Oslo, August 5–9, 2013. We thank these audiences as well as two reviewers, the editors, and Michael Cysouw for insightful comments and helpful questions. All remaining shortcomings are our own.

## Bibliography

- Aissen, Judith. 1999. Markedness and subject choice in Optimality Theory. *Natural Language and Linguistic Theory* 17. 673–711.
- Ariel, Mira. 2000. The development of person agreement markers: from pronouns to higher accessibility markers. In Michael Barlow & Suzanne Kemmer (eds.), *Usage-based models of language*, 197–260. Stanford: CSLI.
- Bakker, Dik & Anna Siewierksa. 2006. The agreement database. <http://www.lotschool.nl/Research/ltrc/agreement.htm>; accessed August 7, 2006.
- Benveniste, Émile. 1946. Structure des relations de personne dans le verbe. In *Problèmes de linguistique générale*, 1, 225–236. Paris: Gallimard 1966.
- Bickel, Balthasar. 2008. On the scope of the referential hierarchy in the typology of grammatical relations. In Greville G. Corbett & Michael Noonan (eds.), *Case and grammatical relations: papers in honor of Bernard Comrie*, 191–210. Amsterdam: Benjamins.
- Bickel, Balthasar. 2011. Grammatical relations typology. In Jae Jung Song (ed.), *The Oxford handbook of language typology*, 399–444. Oxford: Oxford University Press.
- Bickel, Balthasar. 2013. Distributional biases in language families. In Balthasar Bickel, Lenore A. Grenoble, David A. Peterson & Alan Timberlake (eds.), *Language typology and historical contingency*, 415–444. Amsterdam: Benjamins.

- Bickel, Balthasar. 2015. Distributional typology: statistical inquiries into the dynamics of linguistic diversity. In Bernd Heine & Heiko Narrog (eds.), *The Oxford handbook of linguistic analysis, 2nd edition*, 901–923. Oxford: Oxford University Press.
- Bickel, Balthasar, Martin Gaenszle, Arjun Rai, Prem Dhoj Rai, Shree Kumar Rai, Vishnu S. Rai & Narayan P. Sharma (Gautam). 2007. Two ways of suspending object agreement in Puma: between incorporation, antipassivization, and optional agreement. *Himalayan Linguistics* 7. 1–18.
- Bickel, Balthasar, Giorgio Iemmolo, Taras Zakharko & Alena Witzlack-Makarevich. 2013. Patterns of alignment in verb agreement. In Dik Bakker & Martin Haspelmath (eds.), *Languages across boundaries: studies in memory of Anna Siewierska*, 15–36. Berlin: De Gruyter Mouton.
- Bickel, Balthasar & Johanna Nichols. 2007. Inflectional morphology. In Timothy Shopen (ed.), *Language typology and syntactic description*, 169–240. Cambridge: Cambridge University Press (Revised second edition).
- Bickel, Balthasar & Johanna Nichols. 2009. Case marking and alignment. In Andrej Malchukov & Andrew Spencer (eds.), *The Oxford handbook of case*, 304–321. Oxford: Oxford University Press.
- Blevins, Juliette. 2004. *Evolutionary phonology: the emergence of sound patterns*. Cambridge: Cambridge University Press.
- Bybee, Joan. 1988. The diachronic dimension in explanation. In John A. Hawkins (ed.), *Explaining language universals*, 350–379. Oxford: Blackwell.
- Bybee, Joan L. 1985. *Morphology*. Amsterdam: Benjamins.
- Bybee, Joan L. & Mary Alexandra Brewer. 1980. Explanation in morphophonemics: changes in Provençal and Spanish preterite forms. *Lingua* 52. 201–242.
- Campbell, Lyle. 1985. *The Pipil language of El Salvador*. Berlin: Mouton de Gruyter.
- Campbell, Lyle. 1999. *Historical linguistics: an introduction*. Cambridge, Mass.: MIT Press.
- Collinder, Bjorn. 1965. *An Introduction to the Uralic languages*. Berkeley: University of California Press.
- Comrie, Bernard. 1981. *Language universals and linguistic typology*. Chicago: University of Chicago Press.
- Croft, William. 2003. *Typology and universals*. Cambridge: Cambridge University Press [2nd edition].
- Cysouw, Michael. 2003. *The paradigmatic structure of person marking*. Oxford: Oxford University Press.
- Donohue, Mark, Tim Denham & Stephen Oppenheimer. 2012. Consensus and the lexicon in historical linguistics. Rejoinder to “Basic vocabulary and Bayesian phylolinguistics”. *Diachronica* 29. 538–546.
- Dryer, Matthew S. 1989. Large linguistic areas and language sampling. *Studies in Language* 13. 257–292.
- Dunn, Michael J., Simon J. Greenhill, Stephen C. Levinson & Russell D. Gray. 2011. Evolved structure of language shows lineage-specific trends in word-order universals. *Nature* 473. 79–82.
- Givón, T. 1976. Topic, pronoun, and grammatical agreement. In Charles N. Li (ed.), *Subject and topic*, 149–188. New York: Academic Press.
- Greenberg, Joseph H. 1966a. *Language universals, with special reference to feature hierarchies*. The Hague: Mouton.

- Greenberg, Joseph H. 1966b. Synchronic and diachronic universals in phonology. *Language* 42. 508–517.
- Greenberg, Joseph H. 1978. Diachrony, synchrony and language universals. In Joseph H. Greenberg, Charles A. Ferguson & Edith A. Moravcsik (eds.), *Universals of human language: method and theory*, 61–92. Stanford: Stanford University Press.
- Haiman, John. 1977. Reinterpretation. *Language* 53. 312–328.
- Hall, Christopher J. 1988. Integrating diachronic and processing principles in explaining the suffixing preference. In John A. Hawkins (ed.), *Explaining language universals*, 321–349. Oxford: Blackwell.
- Hock, Hans-Heinrich. *Principles of historical linguistics*. Berlin: de Gruyter.
- Holst, Jan Henrik. 2001. *Lettische Grammatik*. Hamburg: Helmut Buske Verlag.
- Jakobson, Roman. 1932. Zur Struktur des russischen Verbums. In *Selected writings*, vol. 2, 3–15. The Hague: Mouton 1971.
- Kiparsky, Paul. 2008. Universals constrain change; change results in typological generalizations. In Jeff Good (ed.), *Linguistic universals and language change*, 23–53. Oxford: Oxford University Press.
- Koch, Harold. 1995. The creation of morphological zeros. In Geert Booij (ed.), *Yearbook of morphology 1994*, 31–71. Dordrecht: Kluwer.
- Körtvély, Erika. 2005. *Verb conjugation in Tundra Nenets*. Szeged: SzTE Finnugor Tanszék.
- Maslova, Elena. 2000. A dynamic approach to the verification of distributional universals. *Linguistic Typology* 4. 307–333.
- Mathiassen, Terje. 1997. *A short grammar of Latvian*. Columbus, Ohio: Slavica Publishers.
- Meyer, David, Achim Zeileis & Kurt Hornik. 2006. The `strucplot` framework: visualizing multi-way contingency tables with `vcd`. *Journal of Statistical Software* 17. 1–48.
- Nau, Nicole. 1998. *Latvian*. Munich: Lincom Europa.
- Nichols, Johanna. 1992. *Linguistic diversity in space and time*. Chicago: The University of Chicago Press.
- Quizar, Robin. 1994. Motion verbs in Ch'orti'. *Función* 15–16. 211–229.
- R Development Core Team. 2012. *R: a language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing, <http://www.r-project.org>.
- Siewierska, Anna. 2003. Person agreement and the determination of alignment. *Transactions of the Philological Society* 101. 339–370.
- Siewierska, Anna. 2009. Person asymmetries in zero expression and grammatical functions. In Franc Floricic (ed.), *Essais de linguistique générale et de typologie linguistique offerts au professeur Denis Creissels à l'occasion de ses 65 ans*, 425–438. Paris: Presses de l'École Normale Supérieure.
- Silverstein, Michael. 1976. Hierarchy of features and ergativity. In R. M. W. Dixon (ed.), *Grammatical categories in Australian languages*, 112–171. New Jersey: Humanities Press.
- Watkins, Calvert. 1962. *Indo-European origins of the Celtic verb. Vol. I. The sigmatic aorist*. Dublin: Institute for Advanced Studies.
- Watkins, Calvert. 1969. *Geschichte der indogermanischen Verbalflexion*. Heidelberg: Carl Winter.
- Witzlack-Makarevich, Alena. 2011. *Typological variation in grammatical relations*. Leipzig: University of Leipzig dissertation.
- Zakharko, Taras & Balthasar Bickel. 2011ff. *familybias*: Family bias estimation. R package, <https://github.com/IVS-UZH>.