LINGUISTIC DIVERSITY AND COMPLEXITY

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ABSTRACT: This paper provides an overview of the research done on language complexity, focusing on aspects of complexity that bear relevance to the topic of linguistic diversity. Different approaches to and possible definitions of complexity are first discussed. The diversity and variation that languages show in structural complexity is then addressed, and the equicomplexity hypothesis predicting that all languages are equally complex is critically evaluated with respect to attempts to measure global complexity empirically. The effects of diverse sociolinguistic factors on complexity is an active field of enquiry and a review of this discussion is provided. The relationship between culture and complexity is touched upon and, finally, complexity is discussed from the point of view of areal and genealogical diversity.

KEYWORDS: language complexity, linguistic diversity, language contact, language typology, sociolinguistics.

1. INTRODUCTION[1]

Recent years have seen a significant growth of interest in the topic of language complexity in the field of linguistics. In some subfields, e.g. in research on language acquisition and learning, grammatical complexity has been a relevant notion for a long time. During the last one or two decades, these questions have gained importance in many other subfields, too, and in typology and language contact research, for example, complexity has become a visible topic of inquiry. These recent research developments have made it possible for us to include complexity in the topics to be discussed in this context and the paper is a review of the current state of the art in research on language complexity from the viewpoint of linguistic diversity. The overarching general question is: how and why do languages differ in terms of complexity?

[1] I wish to thank the two anonymous referees for their valuable comments on the manuscript.

Going further back in history, we encounter the 19th century views on the primitiveness of certain types of morphological structure. The types of classical morphological typology were tied to the level of sophistication of languages: isolating languages were seen as the most primitive while inflectional languages represented the most advanced type (see, e.g., von Schlegel 1808). Unsurprisingly, the more advanced types of linguistic structure were those found in European languages. As linguists became aware of a growing number of languages from different parts of the world and as structuralism gained ground as a general approach to language, the ideas of some languages being primitive and others more sophisticated in their grammar were gradually abandoned. By the latter half of the 20th century, it had become a commonly held view that languages do not differ from each other in terms of global (overall) complexity. The so-called equicomplexity hypothesis predicts that if one language is simpler in a given domain, it will be more complex in another, and the global complexity of the language is equal to that of all other languages.

Recently, this received view of the equal complexity of languages has been challenged by a number of linguists. The equicomplexity hypothesis is a widely shared view, but it has never really been tested. Now more and more linguists are asking what evidence do we have for the hypothesis and how can it be put to test. A key publication, initiating a lot of debate, was McWhorter's (2001a) article in *Linguistic Typology*, which proposed an explicit metric of global complexity and claimed that creoles can be identified as showing the simplest overall grammar according to this metric. From this contribution focusing on creoles, the interest of the scientific community extended to a more general typological discussion of whether and how languages can be compared in terms of global complexity. The reasons behind the alleged simplicity of creoles have been seen in the sociolinguistic history of these language varieties, and even in the more general discussion going beyond creoles, sociolinguistic factors and language contacts have played an important role. In recent years, several monographs and article collections have been devoted to language complexity and its extralinguistic correlates, e.g., Miestamo et al. 2008, Sampson et al. 2009, Szmrecsanyi & Kortmann 2012 and Baechler & Seiler 2016.

In this contribution, I will focus on complexity from the point of view of linguistic diversity, asking two fundamental questions: 1) What kinds of diversity and variation do languages show in terms of complexity, and 2) How does complexity correlate with dimensions of linguistic diversity such as sociolinguistic variation and areal and genetic diversity. I will begin by discussing and defining the notion of complexity in Section 2. I will then, in Section 3, delve into the diversity and variation languages show in complexity, discussing the equicomplexity hypothesis in more detail and addressing different

attempts to measure global complexity. In Section 4, I will address the correlation between complexity and diversity, discussing also its links with relevant sociolinguistic aspects and the role and fate of complexity in language change and spread. Section 5 will conclude the paper with some future prospects.

2. DEFINING COMPLEXITY

In common parlance, the word COMPLEX has two main uses: either to refer to something that is rich in internal composition (i.e. contains many parts as well as multiple and intricate connections between them), or to something that is difficult to do or to understand. These two uses of the word are also reflected in how the notion of complexity has been defined and used in linguistics. On the one hand, complexity has been seen as an objective property of the linguistic system, considering as complex such systems and subsystems that have many parts and multiple connections between these parts; in Miestamo's (2006, 2008) terms, this is the absolute approach to complexity. On the other hand, complexity has been connected to the cost and difficulty that a given linguistic system or structure causes to the users of the language; in Miestamo's (2006, 2008) terms, this is the relative approach to complexity. What is said about defining complexity in this section holds for linguistic complexity generally, although at many points reference is made more narrowly to grammatical complexity, which has been in the focus of recent discussions in the complexity literature.

The absolute (or theory-oriented, objective) approach to complexity pays attention to the number of parts in a system and to the number of different connections between these parts. To take an example, the phoneme inventory of a language is the more complex the more phonemes it contains. Thus the Sinitic language Wutun, which has 44 phonemes in Sandman's (2016: 19) analysis, exhibits a more complex phoneme inventory than the Papuan language Savosavo, which has only 22 phonemes according to Wegener (2012: 13). Or Finnish, with its 14 cases, has a more complex case system than German, which has only four cases. These are very simple examples (assuming of course that we can agree on the number of phonemes or cases in a given language) and it is clear that many aspects of grammar are not as easily and straightforwardly countable and quantifiable. Looking at linguistic complexity from the absolute point of view naturally presupposes an analysis or description of the linguistic phenomenon in question, and it is the components established in this analysis or description that are counted. Such components may be members of an inventory or grammatical categories as in the examples above, but they may equally well be constructions or rules, or whatever units

the grammatical description identifies. Furthermore, attention can be paid to the number of connections and interrelations between such components.

To couch this idea in more general mathematical terms, applicable across disciplines, we may turn our attention to the notion of Kolmogorov complexity or Algorithmic Information Content (see Li & Vitányi 1997). In this notion of complexity, the complexity of an object is equal to its shortest possible description. Consider the strings in (1) (see Dahl 2009: 51 for a similar illustration).

(1) a. hahaha b. hahhah c. hrampf

Each string consists of six characters. However, they differ as to how much regularity they contain and thus in the extent to which they are compressible. The strings in (1a-b) can be rewritten as in (2a-b), but (1c) does not contain any regularity that compression could be based on.

(2) a. 3ha b. 2hah c. hrampf

Comparing the forms in (2), we may note that (2a) with its three characters is shorter than (2b) that has four characters and (2c) is the longest retaining its length of six characters. The complexity of (1a) is thus the lowest and that of (1c) the highest.

Applying this notion to grammatical complexity, Dahl (2004: 21-24) argues that the complexity of a grammatical structure or system is equal to the length of its shortest possible description. Coming back to our simple examples, the complex phoneme inventory of Wutun requires a longer description than the simpler one found in Savosavo. Similarly, the complex case system of Finnish has a longer description than that of German.[2] As a general idea, we may say that if the grammar of language A requires a longer description than that of language B, then language A has a more complex grammar overall. Imagine we had a grammar book that described the grammar of a language in an optimal, comprehensive and exhaustive way. The thickness of that grammar book would then be a measure of the global complexity of the grammar of that language, and we could compare the grammatical complexity of languages by measuring the thickness of their grammar books. Obviously, we do not have such optimal and comprehensive grammars, but this fictive example serves to illustrate the idea of the information-theoretic principle of description length as complexity measure applied to grammatical complexity. More

[2] In this simplified example I am only referring to the number of members in the phoneme or case inventories and not saying anything, for example, about how the German and Finnish cases systems are used or how they interact with other domains of grammar, or how they are morphologically realized. The length of description of these aspects need not directly correlate with the number of case categories.

realistic examples of the application of this notion will be discussed further below. Note that some researchers have applied the idea directly to linguistic products and used data compression algorithms to measure the complexity of texts and to make inferences about the complexity of the structural systems underlying these texts; cross-linguistic comparisons have been made by comparing parallel texts across languages (see Juola 2008; Ehret & Szmrecsanyi 2016, for examples).

Coming back to the examples in (1) and (2), we may note that the most complex string is the one that has no regularity in it, i.e. total randomness and chaos (entropy in thermodynamic terms) are maximally complex. When there is no regularity, there is no way to compress the information, and the description of such a system needs to list every component in the system. Now, grammar is about regularities and generalization, and when speaking about grammatical complexity, it is not interesting to look at mere chaos as complexity. What we are interested in are the regularities in the system – the grammar – and thus we are to pay attention to the length of the description of these regularities. Thus, we are in fact dealing with what Gell-Mann (1994) calls effective complexity – the complexity of the regularities within a system – and leaving out idiosyncrasies that would belong to the lexicon rather than to grammar. The notion of effective complexity is equally applicable to linguistic and grammatical complexity as it is to the subject matter of other disciplines such as physics and biology.

It should be noted that the length of description is naturally dependent on the theory and metalanguage in which the description is being presented. Different theories and metalanguages give different descriptions and for some grammatical phenomena these may differ significantly in their length. It is unlikely that two theories would differ as to which one of the two case systems – the German four-case system or the Finnish one with 14 cases – they see as more complex. But other grammatical phenomena, such as passivation may receive very different treatments in different theories. In any case, when taking an absolute approach to complexity, one has to be explicit about the choice of metalanguage. The absolute approach to complexity is not absolute in the sense that it would be atheoretical or completely theory-neutral. What is meant by absolute is that complexity is not defined with respect to how language is processed or learned, i.e. complexity is not relative to language users.

The relative (or user-oriented, subjective) approach to complexity pays attention to how costly or difficult linguistic systems or structures are for language users to process or learn. The more costly or difficult a grammatical structure is from the point of view of the language user, the more complex it is according to the relative approach. To determine what is costly to process

or difficult to learn, we must, ultimately, turn to psycholinguistic experimentation and acquisition research. I have used the deliberately vague and general expression LANGUAGE USER. One important aspect to be taken into account here is that language users have varying roles in situations of language use, most notably alternating between the role of speaker and hearer. Similarly, the perspectives of first and second language learners are quite different when it comes to learning difficulty. A given grammatical structure may be costly or difficult for language users in one of these roles while at the same time being easy for users in another role. For example, fission, the expression of one meaning by more than one form on the syntagmatic axis (e.g., the discontinuous expression of negation in French *je ne sais pas*) is an extra burden for the speaker producing language but may be helpful for hearers in decoding the message (see Kusters 2003: 56). Therefore, when taking a relative approach to complexity, one should always ask "costly/difficult to whom?". Cost and difficulty cannot be defined generally for all language user roles.

Kusters (2003), who takes a relative approach to complexity, is aware of these problems. In his work on complexity in verbal inflection, he goes through different aspects of inflection, such as fusion, allomorphy, homonymy etc., looking at psycholinguistic literature on these phenomena in order to determine how each of them affects speakers, hearers, L1 learners and L2 learners. He defines as complex those aspects of grammar that pose difficulties to L2 learners.[3] This is motivated by the sociolinguistic perspectives of his study: he is interested in how language contact affects linguistic complexity. Given that language users in different roles perceive different things as costly or difficult, the relative approach to complexity does not offer us a general definition of complexity independent of user roles, but this approach may be justified in studies in which one class of language users, e.g. L2 learners, is especially relevant for the research questions. A further problem is that there might not be enough psycholinguistic background research on the processing cost and learning difficulty of a given grammatical phenomenon the complexity of which one is interested in.

As argued, e.g. by Dahl (2004) and Miestamo (2008), language complexity should be defined in the absolute sense, i.e., independent of language users. It will be only confusing to talk about complexity when what is meant is cost and difficulty of processing and learning. Defining linguistic complexity in absolute terms, referring to the length of description of the linguistic phenomenon, will also keep the talk about linguistic complexity compatible with complexity theory in other fields, and allow for a cross-disciplinary understanding.

[3] Naturally, linguistic background will affect what is easy and difficult for each learner. Kusters pays attention to features that are easy/difficult irrespective of the learner's linguistic background (i.e. to a "generalized outsider", Kusters 2008: 9).

When talking about cost and difficulty, one should use these terms and not complexity. This is not to say that cost and difficulty should be abolished from the agenda of complexity researchers. Quite the contrary: to what extent complexity correlates with processing cost and learning difficulty for different types of languages users is a very interesting and scientifically highly relevant question that will require common efforts from linguists and psycholinguists.[4]

Linguistic complexity can be observed from the point of view of the system, on the one hand, and from the point of view of the product, on the other. We can talk about the complexity of a system, paying attention to properties such as the number of grammatical or lexical distinctions, allomorphy, the number of rules etc. Dahl (2004) calls this type of linguistic complexity system complexity. We can also look at the complexity of a linguistic product: a word, a phrase, an utterance, a sentence or a whole text or discourse and pay attention to its length, the number of structural elements in it, its hierarchical structure etc. In Dahl's (2004) terms, we are then dealing with structural complexity. In this paper, we are mostly dealing with system complexity.

Two central principles can be proposed for measuring complexity in the absolute sense (Miestamo 2008): the Principle of Fewer Distinctions (FD) and the Principle of One-Meaning–One-Form (1M1F). By FD, a linguistic system in which, other things being equal, fewer semantic/pragmatic distinctions are made is less complex than a system in which a higher number of distinctions is made. 1M1F pays attention to the relationship between meaning and form, and shows as less complex systems and structures in which, other things being equal, each meaning is expressed by one form and each form corresponds to only one meaning. Violations of these two principles increase complexity. FD can be illustrated by the two examples we have seen above: the higher complexity of the Finnish (vs. German) case system and the Wutun (vs. Savosavo) phoneme inventory are violations of this principle. By the Principle of One-Meaning–One-Form, we can identify a higher degree of complexity in a case system in which: (a) the formal expression of one or more cases is combined with other categories in one morpheme (fusion, multiple exponence); (b) one or more case categories are expressed with multiple/discontinuous morphemes (fission); (c) the markers of one or more case categories show two or more variants (allomorphy); and/or (d) the markers of some case categories are identical in some grammatical contexts (syncretism). Note that FD is close to what Kusters (2003) has termed the Principle of Economy (restriction of the number of explicitly marked categories) and 1M1F corresponds to his

[4] Cysouw (2016) addresses the question how to measure learning difficulty, but he does not link the discussion to the complexity literature in any way.

Principle of Transparency (clarity of the relationship between meaning and form).[5]

In the following sections, concrete applications of these and similar criteria will be discussed.

3. CROSS-LINGUISTIC VARIATION IN COMPLEXITY: THE EQUICOMPLEXITY HYPOTHESIS AND BEYOND

This section will look at cross-linguistic diversity and variation in language complexity. Our main focus will be on global (overall) complexity and the equicomplexity hypothesis. As noted above, the equicomplexity hypothesis assumes that all languages are equally complex overall and that complexity in one domain is compensated for by simplicity in another. As a historical background for the equicomplexity hypothesis, it is interesting to recall that in the 19th century some (=non-European) languages were seen as inferior to others (European ones). We can quote, e.g., von Schlegel (1808: 56):

> "Daß die amerikanischen Sprachen im Ganzen auf einer niedern Stufe stehen, wird man nicht läugnen." [That American languages are, as a whole, at a lower level, cannot be denied.]

Such views were gradually abandoned, as linguists became familiar with a growing number of non-European languages, learning to appreciate their properties as merely different but not as defective as compared to European languages. Sapir (1921) makes a clear distinction between linguistic complexity and cultural sophistication. His famous quote is worth repeating here:

> "[A]ll attempts to connect particular types of linguistic morphology with certain correlated stages of cultural development are vain. Rightly understood, such correlations are rubbish. Both simple and complex types of language of an indefinite number of varieties may be found spoken at any desired level of cultural advance. When it comes to linguistic form, Plato walks with the Macedonian swineherd, Confucius with the head-hunting savage of Assam." (Sapir 1921: 219)

[5] Kusters (2003) has a third principle, namely that of Isomorphy, which has to do with similarity of order in different domains. As discussed in Miestamo 2008, Kusters's examples of violations of this principle can be dealt with 1M1F/Transparency or in some cases they do not appear as complexity in the absolute sense, and consequently, FD/Economy and 1M1F/Transparency suffice as general principles for measuring complexity.

This did not, however, become the general view in the linguistic scholarly community. By the latter half of the 20th century, instead of analytically distinguishing between simplicity and primitiveness, the politically correct reaction to the 19th century views took the form of the equicomplexity hypothesis. A well-known formulation of the hypothesis is found in Hockett (1958):

> "Objective measurement is difficult, but impressionistically it would seem that the total grammatical complexity of any language, counting both morphology and syntax, is about the same as that of any other. This is not surprising, since all languages have about equally complex jobs to do, and what is not done morphologically has to be done syntactically. Fox, with a more complex morphology than English, thus ought to have a somewhat simpler syntax; and this is the case.
> Thus one scale for the comparison of the grammatical systems of different languages is that of average degree of morphological complexity – carrying with it an inverse implication as to degree of syntactical complexity." (Hockett 1958: 180-181)

As the opening words of the quote testify, Hockett does recognize that it is difficult to verify the hypothesis empirically. Some other, even rather recent, formulations found in the literature seem less concerned with this matter:

> "[M]odern languages, attested extinct ones, and even reconstructed ones are all at much the same level of structural complexity or communicative efficiency." (McMahon 1994: 324)

> "All languages have a complex grammar: there may be relative simplicity in one respect (e.g., no word-endings), but there seems always to be relative complexity in another (e.g., word-position)." Crystal (1997: 6)

The equicomplexity view is at least partly motivated by political correctness – the fear that claiming that some languages are less complex than other could be interpreted as implying that their speakers are less sophisticated cognitively or culturally. Interestingly, however, in his list of "83 things that linguists can agree about", Hudson subscribes to the equicomplexity view, while explicitly detaching linguistic complexity from the level of cultural advancement:

> "There is no evidence that normal human languages differ greatly in the complexity of their rules, or that there are any languages that are "primitive" in the size of their vocabulary (or any other part of their language), however "primitive" their speakers may be from a cultural point of view." (Hudson 1981)

The equicomplexity hypothesis is also very much compatible with such universalist views on the nature of language that see all languages as manifestations of a genetically specified innate Universal Grammar, e.g., Chomskyan UG. Within such approaches, it becomes more difficult to accept complexity differences between languages. Functionalist approaches, in which the structural properties of a language are seen as shaped by external factors such as cognition, language use, culture and other factors in the ecology of the language, are much more compatible with the view that languages can show variation in their global complexity. It is thus no surprise that the equicomplexity hypothesis has been challenged in functionalist circles rather than in formalist ones.

A key contribution in this respect is McWhorter's (2001a) article that tries to approach the question whether creoles are indeed less complex as compared to non-creoles in empirical terms. He proposes a metric for measuring the global complexity of a language. The metric consists of the following four criteria (McWhorter 2001a: 135-137):

1. Size of the phoneme inventory: a phonemic inventory is more complex to the extent that it has more marked members.
2. Number of syntactic rules: a syntax is more complex than another to the extent that it requires the processing of more rules.
3. Number of semantic/pragmatic distinctions: a grammar is more complex than another to the extent that it gives overt and grammaticalized expression to more fine-grained semantic and/or pragmatic distinctions than another.
4. Amount of inflectional morphology: inflectional morphology renders a grammar more complex than another one in most cases.

Note that markedness, explicitly mentioned in the phonological criterion, is intended in the Greenbergian implicational sense: a larger inventory is more likely to contain marked sounds in addition to unmarked ones, and the criterion is primarily about the number of distinctions in the system rather than about difficulty of production or perception. In later publications, e.g., McWhorter (2007), the criteria have been reformulated as follows: the grammar of a language is more complex than that of another to the extent that it contains:

1. Overspecification (marking of semantic categories left to context in many or most languages, such as evidential marking).
2. Structural elaboration (number of rules mediating underlying forms and surface forms, such as morphophonemics).
3. Irregularity.

An important point in McWhorter's approach is that these complexities go "beyond communicative necessity". The idea is thus that the "overspecified" semantic categories that can be left to context are such that they are not communicatively necessary and need not be expressed in every language. Similarly, the structural elaboration that is paid attention to involves phenomena that do not convey meaning, e.g., morphophonological alternations. And, naturally, irregularity is not necessary for communication, either. However, defining something as communicatively necessary is not straightforward. What are the grounds for saying that the marking of evidentiality is not necessary for communication? What about tense – in what sense is it more important for communicative purposes than evidentiality? A lot can be communicated with telegraphic style without grammatical markings. Where should we draw the line? In any case, taking a strictly absolute view of complexity, considerations of communicative necessity are irrelevant. Complexity is measured in terms of the number of elements in a system and connections between them, ultimately based on description length, and if ever there is a way of objectively measuring communicative necessity, it is a separate notion, whose possible correlations with complexity can be examined.

Another proposal for measuring the global complexity of languages is made by Nichols (2009). She uses a set of criteria covering different domains of grammar:

- Phonology: number of contrastive manners of articulation; number of vowel quality distinctions; tone system; syllable structure.
- Synthesis: inflectional synthesis of the verb; polyagreement; noun plural marking; noun dual marking.
- Classification: numeral classifiers; overt possessive classes; agreement gender; overt inherent gender.
- Syntax: number of different alignments; between noun arguments, pronoun arguments, and verb; number of different basic word orders.
- Lexicon: inclusive/exclusive opposition in independent personal pronouns; number of distinct roots in plain and semantically causative verbs; number of different overt derivations in these verb pairs.

Whereas McWhorter's criteria operate on a general level and are, in principle, applicable to the grammatical encoding of any functional domain, Nichols's criteria are more specific in the sense that many of them refer to particular features within given functional domains. In her choice of features, Nichols aims at covering the main domains of grammar as evenly as possible, but the concrete choice is to a large extent based on what is already available in databases or easy to gather from grammars and other sources (see Nichols 2009: 113).

McWhorter engages in comparisons of usually just two languages at a time and shows that one of them is more/less complex than the other according to the metric. The simpler one in the comparisons is usually a creole or some other language with heavy contact history, see Section 4 for more discussion. Nichols operates in a broader comparative perspective with an extensive language sample and quantitative analysis. Her sample contains 130 languages, 68 of which were coded for all features and the rest for all other but the ones under lexicon. Other quantitative sample-based studies (Shosted 2006; Sinnemäki 2008; Miestamo 2009) have tested trade-offs in particular domains, or focused on creoles (Parkvall 2008), but Nichols's study is the only one that aims at measuring global complexity in a general perspective. In order for the equicomplexity hypothesis to be supported by Nichols's data, the global complexity scores of the sample languages should form a very steep bell curve whereas the bell curves for the individual features could be much flatter. This turns out not to be the case. The curve for global complexity is not steeper than those of the individual components and it is in fact somewhat flatter, showing a rather wide range of variation in the global complexity scores. Furthermore, no negative correlations between the complexity scores of the different domains are found and thus no support for the equicomplexity hypothesis.

As e.g. Hockett (1958) pointed out, see the quote above, objective measurement of global complexity is difficult. The two metrics discussed above are interesting approaches to a very difficult problem, but as also acknowledged by the authors themselves, they provide rather coarse approximations of the global complexity of the grammar of a language. Miestamo (2006, 2008) identifies two fundamental problems with any metric of global complexity: the problem of representativity and the problem of comparability. The problem of representativity refers to the difficulty of accounting for all aspects of grammar in such detail that a truly representative measure of global complexity can be obtained. However, a sufficient level of representativity to show very clear complexity differences may be attainable. The problem of comparability is about the incommensurability of the different criteria used to measure the complexity of grammars. On a general level, there is no way to quantify the complexity of, for example, syntax and morphology so that the numbers would be comparable in some useful sense. Or more concretely, if we take any of the criteria in Nichols's metric, how can we be certain of their relative contributions to the overall complexity score of a language? Therefore, only in cases where one language is more complex than another on (almost) all criteria, and we need not weigh the criteria against each other, can we identify differences in global complexity on a more solid basis. Given these problems,

more interesting results on cross-linguistic variation in complexity can be obtained by focusing on the complexity of specific areas of grammar, i.e. local rather than global complexity. And this is the approach that most comparative studies have taken. For further discussion on the problems of measuring global complexity, see Deutscher 2009.

Gil's (1994, 2008, 2009) observations on the structure of Riau Indonesian are highly relevant to any discussion of global complexity. His famous multiply ambiguous example is shown in (3).

(3) Riau Indonesian (Gil 2008: 114)
Ayam *makan*
chicken eat

The combination of these words can get various readings depending on the context in which they are uttered: 'the chicken is eating', 'someone is eating the chicken', 'someone is eating with the chicken', 'the chicken that is eating', 'the place where the chicken is eating', 'the time when the chicken is eating', 'the place where chicken is eaten [i.e. a chicken restaurant]' and so on and so forth. According to Gil (2008), the words *ayam* and *makan* are combined with the Association Operator that establishes an association between the meanings of the words, but does not specify the nature of the association in any way. The nature of the association – and the meaning of the utterance – must be inferred from context. Furthermore, he claims that the two words do not belong to different parts-of-speech – monocategorial languages do not make any parts-of-speech distinctions in their grammar (e.g. between nouns, verbs or adjectives) but possess only one lexical category. Gil proposes an extreme language type: Isolating-Monocategorial-Associational (IMA) languages. In this language type, there is no bound morphology, there are no categorial distinctions in the grammar, and the only grammatical construction is the combination of two words which has the semantics of the Association Operator. Gil points out that IMA is an ideal language type, not attested as such in any existing natural language, but languages like Riau Indonesian come very close to it. Gil's claim is that such languages are simpler overall than languages with more bound morphology, categorial distinctions and syntactic constructions. I will not go any deeper into the critical discussion triggered by Gil's proposal (see, e.g., Riddle 2008 and Bisang 2009), but only point to the most common reaction to the claim that IMA languages are less complex overall than other languages: namely to the view that more IMA-like languages put much more weight on pragmatics, and that complexity then lies in pragmatics rather than in grammar proper. Clearly, pragmatics has a different role when some aspects of meaning are not explicitly expressed. We may, however, ask, as Gil (2008: 124-128) does, what it is that pragmatics does in these

cases. Is there necessarily a full compensation of grammatical simplicity by pragmatics? Are all the meaning distinctions that, e.g. English expresses explicitly, always conveyed implicitly through pragmatics? Subscribing to this view would mean, more generally, that whenever a language makes a distinction explicitly that another language does not make, the latter language would make this distinction implicitly. Thus, for example, speakers of German or English would pay attention to all the possible distinctions of metrical tense found in the world's languages every time they use a past or future form. Such a view would explode the inventory of implicit distinctions in languages and is clearly not feasible from the point of view of processing. A more plausible account, following Gil, is to talk about vagueness rather than implicit disambiguation. Different languages cut semantic space in different ways. A language may leave vague what another language codes explicitly. On the vagueness account, more associational languages are indeed less complex in this respect. Surely pragmatics does its work to fill in what is necessary for understanding an utterance in context, but this does not mean full compensation by pragmatic disambiguation of every semantic detail another language might mark explicitly.

Compensations or trade-offs between different domains of grammar are a central ingredient in the equicomplexity hypothesis. As argued above, the contributions of different domains to global complexity are difficult to quantify and compare. However, looking at the complexities of individual domains can be interesting not only to learn about these specific domains but also from the point of view of global complexity – if we can observe trade-offs between the domains across the board, then we are a step closer to confirming the equicomplexity hypothesis. A few researchers have taken up this idea and examined correlations between selected variables in a broad cross-linguistic perspective.[6] Within the domain of core argument marking, Sinnemäki (2008, 2011, 2014) finds negative correlations between case marking and rigid word order, but agreement does not seem to correlate with these two in any meaningful way. Shosted (2006) examines the relationship between syllable count and inflectional synthesis on the verb and finds no negative correlation between them (in fact, he finds a statistically non-significant positive correlation). Miestamo (2009) examines complexity trade-offs along two pairs of implicational hierarchies: the copula and verbalization hierarchies and the case and agreement hierarchies, finding a negative correlation between the former but

[6] The studies I mention in the text address the equicomplexity hypothesis explicitly. Correlations between the complexity of domains have been examined by other researchers in other contexts, too, e.g. by Maddieson (1984), who observed that in phonology, the correlations between different variables (e.g. inventory size, supra-segmental complexity, syllable structure) are often positive rather than negative.

not between the latter ones.[7] Noting that "only some linguistic variables participate in complexity trade-offs", Sinnemäki (2014: 179) concludes that "the trade-off hypothesis is not an all-encompassing principle in human languages"; for a similar result, based on the examination of a much higher number of variables coming from different domains, see Coloma 2017. In sum, the equicomplexity hypothesis does not get support from recent studies of trade-offs between specific domains.

This section has addressed cross-linguistic variation in global (i.e. overall) complexity discussing attempts to test the equicomplexity hypothesis and concluding that cross-linguistic research on linguistic complexity must proceed via the examination of one or a few more narrowly defined domains of grammar at a time. Looking at the type and range of complexity variation in individual domains is, however, beyond the scope of this paper. A good place to start such an examination is to look at the World Atlas of Language Structures (Dryer & Haspelmath 2013) database, in which many of the typological classifications introduced can be interpreted in terms of complexity (see also the discussion of Parkvall's 2008 study below). Attention will now be turned to the correlation between complexity and different kinds of linguistic diversity.

4. CORRELATING COMPLEXITY AND DIVERSITY

While the previous section looked at the diversity and variation that languages show in their degree of complexity, this section will focus on how genealogical and areal diversity and sociolinguistic variation correlate with linguistic complexity. Some authors had pointed to the possible correlation between complexity and type of community early on (e.g. Jakobson 1929; Hymes 1975; Werner 1975; Braunmüller 1984; Trudgill 1983, 1992), higher complexity correlating with low contact, tightly-knit social networks, isolation and peripheral location with respect to other communities, and lower complexity with high contact, looser social networks, larger number of speakers and more central location; see Baechler & Seiler 2016 for a brief historical overview. With the publication of McWhorter (2001a), complexity and its possible correlations with extra-linguistic factors became a hot topic in typology and other fields of theoretical linguistics.

[7] The copula and verbalization hierarchies deal with the expression of different types of predications either by copulas (LOCATION < OBJECT < PROPERTY < ACTION) or by verbal coding (LOCATION > OBJECT > PROPERTY > ACTION), and the case and agreement hierarchies are about the coding of arguments either by case (SUBJECT/ABSOLUTIVE > OBJECT/ERGATIVE > OBLIQUE) or by agreement (SUBJECT/ABSOLUTIVE < OBJECT/ERGATIVE < OBLIQUE), see Miestamo 2009: 86-91 for more detailed definitions.

McWhorter's (2001a) complexity metric was discussed above and it was pointed out that although such metrics of global complexity have their problems, his metric seems to work for the purpose that it was designed for, namely for showing that creole grammars tend to be, overall, less complex than the grammars of non-creoles. If all criteria used in the comparison of two languages point in the same direction, showing language A to be less complex than language B, then there is no need to weigh the criteria against each other and the problem of comparability does not arise. This is overwhelmingly the case in the concrete comparisons that McWhorter makes using his metric. He compares Saramaccan against three non-creole languages, one at a time: Tsez, Lahu and Maori, and finds Saramaccan less complex on all criteria. There is thus relatively strong support for saying that Saramaccan has less complex grammar than any of these three non-creole languages. Now, comparing two languages at a time and four languages altogether surely does not count as a broad cross-linguistic study, and several people have criticized McWhorter's results on various grounds. He has challenged his critiques to provide examples of non-creole languages that would be as simple according to the metric as Saramaccan and other creoles, but no-one has been able to come up with a language that would genuinely satisfy these criteria. Nevertheless, McWhorter's one-by-one comparisons are not a fully satisfactory empirical demonstration of the simplicity of creoles vis-à-vis non-creoles.

A more systematic and broadly cross-linguistic survey of the complexity of creole vs. non-creole languages is provided by Parkvall (2008). He takes the data in the WALS database, selects all features that can be reinterpreted in terms of complexity ending up with 53 features, and translates them into a complexity score between zero and one. 155 languages have data for at least 30 features and are thereby included in the study. Each language gets an overall complexity score which is the average of the complexity scores of the features for which the language has data in the database. The complexity scores range between 0.62 and 0.15. The two creoles included in the study are found in the least complex end: Ndyuka (150th, score 0.22) and Sango (155th, score 0.15). There being only two creole languages in the sample, Parkvall goes on to survey an additional 30 contact languages (pidgins and creoles) and the results confirm the earlier observations: all these languages appear in the least complex end of the attested complexity range, creoles showing an average complexity of 0.24 (while pidgins show the even lower score of 0.14). Given the breadth of the survey, Parkvall's study can be seen as giving rather strong additional support to the creole simplicity hypothesis.

Creoles are languages reborn in extreme contact situations, with language transmission from one generation to the next being broken leading to significant restructuring of the language. The influence of incomplete acquisition by

adult learners has been extreme in the case of creoles. Thus, quite unsurprisingly, the current complexity discussion started with observations on complexity differentials between creoles and non-creoles, but quite soon the discussion extended beyond creolistics to comparisons between languages in different sociolinguistic situations. McWhorter has applied his metric of complexity to a number of other languages that are used as *linguae francae* globally or more locally: English, Mandarin, Persian, Colloquial Arabic and Malay (McWhorter 2002, 2007). For all these languages, he argues that they are less complex than their sister languages in the same immediate genealogical group. Thus English is less complex as compared to other Germanic languages, Mandarin less complex than other Sinitic varieties and so on. He argues against seeing these varieties as creoles and there is no claim about their simplicity in a broader cross-linguistic perspective. He proposes the term Non-hybrid Conventionalized Second Language (NCSL) to refer to them, and points to widespread acquisition by adults at some point in their history as the factor behind the structural reduction. Note that Malay is one of McWhorter's NCSL languages, and Gil's observations on Riau Indonesian become readily understandable against this background: varieties of Malay/Indonesian in general, have a rather strong component of language contact in their more or less recent history, and Riau Indonesian is one of the most contact-affected ones among them; McWhorter (2001b) actually calls it a creole.

In a similar vein, Kusters (2003) presented four case studies comparing varieties of Arabic, Scandinavian, Quechua and Swahili in terms of the complexity of verbal inflection. In each case, he was able to show complexity differences among the closely related varieties he compared. The varieties that showed less complexity shared a sociolinguistic profile quite different from the ones identified as more complex. Kusters proposes two ideal types of communities: Type I communities, on the one hand, are speaker-oriented in the sense that speakers' needs override hearers' needs, there is a lot of shared background knowledge,[8] L1 learners outnumber L2 learners and the language has an important symbolic identity function. Type II communities, on the other hand, are hearer-oriented in the sense that hearers' needs override speakers' needs, the members of the community differ as to their command of the

[8] As an anonymous reviewer points out, it may appear counterintuitive that this factor should correlate with high complexity – one might rather expect a high degree of shared information to lead to more simple expressions when more can be left to the context. In Kusters's (2003) view, a speaker with little shared background with the other members of the community will make progress with a language that is relatively easy to perceive and understand (p. 6) whereas when a lot of the information transmitted is shared with the interlocutors, more attention is paid to production difficulty (p. 37), which can then lead to fusion and other violations of transparency; see also Trudgill (2011: 108) for a brief note on this issue.

language, L2 learners outnumber L1 learners, and the main function of language is communicative (while other languages may serve identity purposes). According to Kusters, varieties with more complex verbal morphology are associated with communities that come closer to Type I while varieties that show lower complexity are spoken in communities with Type II characteristics.

Kusters's types of societies conform to Trudgill's well-known views on the relationship between linguistic and social structure (see, e.g., Trudgill 2009, 2011, 2016). Relevant factors for the increase/decrease of complexity in Trudgill's sociolinguistic typology are isolation vs. contact, tight-knit vs. loose-knit social networks, social stability vs. instability, community size and amount of shared information. Trudgill identifies two types of contact situations: long-term contact involving bilingual L1 learning favors the growth of complexity whereas contact involving (imperfect) L2 learning favors simplification. The most favorable environment for complexity are small isolated[9] communities that have little L2 contact, high-degree of social stability, small community size, tight-knit social networks, and a high degree of shared information. In such communities, the uninterrupted transmission between generations, which is a prerequisite for complexity growth, is guaranteed to the highest degree. Furthermore, as language often serves an important identity function in such communities, complexity may become a bearer of this function and a semi-conscious goal for the community. A nice example of the higher complexity of a more local and isolated variety is Dahl's (2009) comparison between Standard Swedish and the Elfdalian variety. For a study of the simplification of an individual feature and its social correlates, see Janda & Antonsen's (2016) work on the loss of possessive suffixes in North Saami. Larger-scale comparative studies between varieties of a single language have been made by Szmrecsanyi & Kortmann (2009, 2012), who compared the complexity of different varieties of English around the world; their results show traditional L1 varieties as more complex than high-contact L1 varieties and L2 varieties of English, which conforms to the findings by Trudgill, Kusters and McWhorter.

Dahl's (2004) view of the growth and maintenance of linguistic complexity involves a metaphor evoking the life-span of languages: mature linguistic phenomena are such that presuppose a non-trivial prehistory, that can only exist in a language that has passed through specific earlier stages. They arise gradually, typically through processes of grammaticalization. They include,

[9] It is interesting to draw an interdisciplinary parallel from more general complexity theory, noting that in accordance with the second law of thermodynamics, entropy (disorder) will grow in a closed, isolated, system.

e.g., complex word structure (inflection, derivation, incorporation), lexical idiosyncrasies (grammatical gender, inflectional classes), agreement, Germanic V2 rules etc. Such features need time to develop and presuppose a continuous transmission from generation to generation. Languages that have been radically restructured due to contact relatively recently, most notably creoles, have not yet had the time to develop such complexity and can be seen as young languages in that sense. Use as *lingua franca*, involving a significant proportion of L2 users, may also slow down maturation processes.

Some of the studies exploring the relationship between complexity and sociolinguistic features discussed so far were qualitative in nature and those that were quantitative, involving larger samples, only quantified linguistic features. Including sociolinguistic variables in a quantitative broad cross-linguistic study has proved to be very difficult as comparable data is not readily available. Questionnaires addressing sociolinguistic factors and language ecology more broadly are needed to collect such data, but distributing questionnaires in large enough scale and receiving replies on a sufficient number of languages is not trivial. Di Garbo (under review) has used such questionnaire-based data in an exploratory qualitative study of the development of complexity in gender systems (36 languages forming 15 pairs/triples of closely related languages). The only type of sociolinguistic data that is available in a large scale and that is in some sense comparable is number of speaker figures, i.e. data on community size, in databases such as the Ethnologue (Simons & Fennig 2017). There are well-known problems with speaker figures, and the accuracy of the data in the Ethnologue has been rightly criticized. Despite these problems, correlations between speaker numbers and linguistic complexity have been tested with some interesting results. Community size is only one of the sociolinguistic variables that has been deemed relevant for complexity. It can, however, be assumed that it goes hand-in-hand with the other variables (amount of contact, network strength, shared information) so that community-size can be used as a proxy for type of society. This approach has been taken recently by, e.g., Sinnemäki (2009), who found a negative correlation between community size and complexity in the marking of core arguments as measured by 1M1F. Similarly, Nichols (2009) found a negative correlation between population size and overall complexity in the study discussed in more detail above. Lupyan & Dale (2010) conducted a large-scale study correlating number of speaker figures and several morphological complexity variables; a significant negative correlation was found again. They attributed the correlation to similar sociolinguistic factors as Trudgill, Kusters and McWhorter, and couch this in the form of the Linguistic Niche Hypothesis, which sees languages as "adapting to the learning constraints and the unique communicative needs of the speaker population" (Lupyan & Dale 2010: 7).

All these large-scale studies find a negative correlation between community size and complexity. One study deviates from this pattern, namely Hay & Bauer 2007, in which a positive correlation is found between the number of speakers and the size of the phoneme inventory. This seems to go against the trend of large communities favoring simplification and shows that the correlation is more nuanced than that. At least some types of complexity in some domains of language structure may be affected by sociolinguistic factors in different ways. Trudgill (2004) examined the relationship between community size and phoneme inventories in the Austronesian language family and suggested that small communities tend to have either small or large phoneme inventories, whereas inventories tend to be medium-sized in large communities, medium-sized inventories being easier to learn and therefore favored in adult language contact (see Trudgill 2004 for further discussion and details).

The studies reported on thus far have paid attention to community size measured as number of L1 speakers. This is in itself one of the sociolinguistic factors that Trudgill considers relevant for complexity and it is also a proxy for the other factors such as network structure and amount/nature of contact. Contact and the effect of L2 learners on the structure of a language can be measured more directly by looking at L2 speaker figures to the extent they are available. L2 speaker numbers are, however, even harder to assess and obtain than L1 speaker figures. Consequently, studies looking at L2 figures have remained scarce. Bentz & Winter (2013) and Bentz & al. (2015) draw L2 speaker data from the Ethnologue and a few other databases, and correlate these figures with complexity measures. Bentz & Winter (2013) conclude that languages with more second language learners tend to have simpler case systems, and Bentz et al. (2015) find a similar association between number of L2 speakers and what they call Lexical Diversity, i.e. the distribution of word forms that languages use to encode essentially the same information (languages with lower lexical diversity typically employ fewer word forms to encode the same information content). These studies thus provide additional support to the hypothesis that complexity is reduced by a high degree of contact involving adult learners.

The preceding discussion has addressed complexity in relation to diversity in the sociolinguistic sense, i.e. how different sociolinguistic types affect structural complexity. In a broader perspective, sociolinguistic variation is one aspect of the ecology of a language. Another aspect of ecology that has been taken up in connection with complexity is culture. Going back in time, we find the 19th century views on cultural and linguistic primitiveness, and Sapir's explicit rejection of these in the early 20th century, see Section 3 above. A more recent perspective on the relationship between culture and language complexity is provided by Everett's (2004) work on the Pirahã language spoken in

Brazil. In short, Everett's claim is that Pirahã lacks a number of features that languages generally possess, such as embedded structures, quantifiers, numerals, color terms, etc., and its pronoun inventory and kinship systems are extremely simple. According to Everett, this can be explained by cultural constraints: "Pirahã culture constrains communication to nonabstract subjects which fall within the immediate experience of interlocutors" (Everett 2005: 621). It should be noted that in some domains, Pirahã is very complex, e.g. in its verbal morphology, so there is no claim of the language being simple across the board. Everett's views on Pirahã have been hotly debated by linguists and scholars in neighboring fields, not least because they pose a challenge on the central tenets of Chomskyan generative theory. The relationship between culture and complexity is touched upon also in Perkins's 1992 study, in which the presence of selected deictic categories is correlated with a measure of cultural complexity (Murdock 1967). An inverse correlation is found between cultural complexity and the number of grammaticalized deictic categories. Explanations for the findings are proposed in terms of the different communicative needs in different types of cultures. Perkins's study did not receive very much attention at the time of its publication, but its relevance to the more recent discussions of language complexity is obvious.

A final aspect of diversity that will be addressed before concluding this paper is areal-genealogical diversity. We can identify some geographic areas as containing more linguistic diversity than others. The diversity of an area is increased by the number of linguistic varieties spoken in that area and by the distance between these varieties. Areas that have a higher number of language varieties are more diverse than areas with fewer varieties. Furthermore, the bigger the distance between the varieties, the more diverse the area, i.e. an area where the varieties are identifiable as separate languages is more diverse than an area where the differences between the varieties are dialectal only, and diversity is further increased to the effect that the languages belong to different genealogical groupings – lower level branches or language families. What lies behind identifying varieties as separate and as genealogically more or less distant are of course linguistic (structural, lexical, etc.) properties so ultimately areal-genealogical diversity is about diversity in the linguistic properties of languages.

Nichols (1992) examined the distribution of diversity in a global perspective. One of her key findings was the identification of spread zones and residual zones. Spread zones are areas over which one or more languages have spread in the relatively recent history, whereas in residual zones, languages have remained in the same place for a longer period of time. According to Nichols (1992: 16-17, 21), spread zones are characterized, e.g., by low genealogical diversity, low structural diversity, shallow language families, and no

net long-term increase of diversity, whereas the opposite characteristics are typical of residual zones: high genealogical diversity, high structural diversity, deep language families, and accretion of languages and long-term increase of diversity. A prime example of a spread zone is the Eurasian Steppe and a prime example of a residual zone is the Caucasus. In examining the diversity of different areas across the globe, Nichols relies on a number of structural features that she correlates with each other as well as with areal and genealogical affiliation. Interestingly for the present paper, one of the variables is complexity – more specifically morphological complexity measured as the extent of overt marking of core arguments in simple clauses and of possession in NPs. This a rather simple measure of complexity as it focuses on the marking of just a few types of grammatical relations and only pays attention to whether or not they are marked (FD) but not how they are marked (1M1F). Nevertheless, it gives interesting results alongside the other variables in the world-wide quantitative analysis. Complexity seems to correlate positively with areal-genealogical diversity and since residual zones typically show higher diversity, residual zones tend to be areas of higher morphological complexity. Relatively more isolated language communities are found in residual zones than in spread zones, in which languages enter into contact with each other more readily and, typically, wide-spread *linguae francae* are used. The higher degree of complexity found in such areas conforms to what was said above about the relationship between complexity and social structure.

Nichols (2016) continues the same line of investigation, focusing on the Caucasus and the Eastern Eurasian Steppe. Within the Caucasus, lowlands show more spreads than highlands and in the steppe a center with significant spreads can be distinguished from the peripheries of these spreads. The spreading languages involve a significant portion of L2 language users and are therefore more likely to simplify whereas the more isolated languages in the peripheries and highlands are predicted to be more complex. The higher degree of isolation of the highland languages is directly attested in some cases and for others, altitude is used as proxy for isolation. Two kinds of complexity are measured: inventory size (FD-based) and opacity (1M1F-based). The predictions are borne out as higher levels of complexity are found in the peripheries/highlands than in the centers/lowlands. More specifically, spreading languages that have functioned as vehicles of inter-ethnic communication tend to show small inventory sizes and languages spoken in isolated communities correlate with high levels of opacity. In showing how complexity levels and the social dynamics behind the increase and decrease of complexity can be connected to language spreads, Nichols has made complexity an important variable for studies of linguistic prehistory.

Inferences from complexity to prehistory have also been made by Bentz (2016), who examines a sample of 1050 languages across the globe, measuring complexity as lexical diversity in parallel corpora. His statistics show languages spoken just above the Equator (between 0 and 30 degrees N) as less complex than languages in other geographic areas. He proposes that this lower complexity is due to pre-historic contacts across the low latitudes, one central argument in support of this being that the correlation holds in the global areal perspective but not within families, which means that causes of low complexity must predate the branching of the families.

5. CONCLUSION

This paper has reviewed the research done on language complexity from the perspective of linguistic diversity. We started by defining what complexity is, how it can be and has been defined. Attention was then shifted to the equicomplexity hypothesis and attempts to test this hypothesis empirically. It was concluded that empirical testing is difficult if not impossible and metrics of global complexity can only reveal very large complexity differences. The latter part of the paper brought up diversity and variation along different dimensions – sociolinguistic, cultural, areal-genealogical – and examined their relation to language complexity. Certain sociolinguistic factors were shown to be especially relevant for the increase/decrease of complexity, and a link from the sociolinguistic dynamics of complexity was made to areal and genealogical diversity.

The work done on defining and measuring complexity and on the sociolinguistic underpinnings of complexity has laid a good foundation for more detailed, larger-scale quantitative studies of the areal distribution of language complexity and its correlates with other aspects of linguistic diversity. This line of research will continue to open promising paths and windows to linguistic prehistory.

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