Book Review

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The book *Communicative Efficiency: Language Structure and Use* takes the reader on a journey through various phenomena related to efficiency in language use and in grammatical structures. Efficiency is not a new topic in linguistics, and by now there is a large body of research on the topic from different linguistic angles, ranging from psycholinguistics to phonetics, pragmatics, corpus linguistics, typology, sign language research, language evolution, and information theoretic approaches.[1] Strikingly, a comprehensive overview that would integrate these different approaches and findings was still missing. Levshina fills this gap by connecting different research traditions, and by relating various insights that have existed in a more disconnected way until now. In doing so, this book goes beyond a mere summary and synthesis of previous findings, and integrates new empirical results from corpus linguistics, typology, and artificial grammar learning with other findings from the literature on efficiency. By combining various research questions from different sub-disciplines in linguistics, Levshina not only offers a new approach to old questions, but opens a number of questions that serve as an inspiration for future work.

Because of its wide scope and empirical and theoretical richness, this volume is likely to become the new standard reference for the topic of efficiency in language and communication. It is a valuable resource for phoneticians, phonologists, morphologists, corpus linguists, psycholinguists and typologists interested in efficiency in particular or in functional motivations in language use in general. For linguists from these various backgrounds, the book provides the larger context of research around efficiency and functional adaptation of linguistic structures to our communicative needs.

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1 See, for example, Aylett and Turk 2004; Börstell et al. 2016; Caselli et al. 2022; Coupé et al. 2019; Fedzechkina 2014; Gibson et al. 2019; Guzmán Naranjo and Becker 2021; Haspelmath 2021; Hawkins 2014; Jaeger and Buz 2017; Kanwal et al. 2017; Kurumada and Jaeger 2015; Levshina and Moran 2021; Pellegrino et al. 2011; Piantadosi et al. 2011; Piantadosi 2014; Seyfarth 2014; Stave et al. 2021; Yadav et al. 2021.

1 Part I: different types of efficiency in language

CHAPTER 1 establishes the relevant concepts around communicative efficiency and serves as a theoretical basis for the remaining chapters. Efficiency is defined in terms of the following principle:

(1)   *The Principle of Communicative Efficiency* (Levshina 2022: 30)
        Communicate in such a way as to minimize the cost-to-benefit ratio.

This principle is then elaborated on with a more detailed discussion of what costs and benefits can amount to. This is a very welcome discussion; for instance, Levshina clarifies how successful communication leads to evoking cognitive effects, which in turn is necessary to influence others or adjust our own behavior and which ultimately is what guarantees our survival as a group. Benefits and costs are thus spelled out in more detail compared to much of the previous literature.

Another notion introduced in Chapter 1 is that of ACCESSIBILITY, which remains a central notion throughout the book. Accessibility is an established concept in the literature on referentiality (e.g. Ariel 1988, 2001; Arnold 2010). Levshina extends its use to other contexts, referring to "the ease with which some mental representations or forms can be activated in or retrieved from memory" (Levshina 2022: 18).

The last central notions introduced in Chapter 1 correspond to three "principles of an efficient communicator": the principle of POSITIVE CORRELATION BETWEEN BENEFITS AND COSTS, the principle of NEGATIVE CORRELATION BETWEEN ACCESSIBILITY AND COSTS, and the principle of MAXIMIZATION OF ACCESSIBILITY. These principles are introduced in more detail in §1.4 and then taken up in relation to various phenomena discussed throughout the book. Levshina convincingly shows that they are indeed involved in accounting for many of the phenomena examined, forming a solid basis for developing a theory of communicative efficiency. To the best of my knowledge, this book is the first one to do so. Therefore, Levshina should be commended for formulating three principles that can account for a wide range of phenomena related to efficiency in language use.

CHAPTER 2 deals with efficiency in formal length, a pattern also known as coding efficiency or form–frequency effects. The chapter offers an overview of phenomena related to coding efficiency from various areas of grammar: referential expressions, grammatical markers, clause connectors and other complex syntactic phenomena, shortening of lexical material (Zipf's law of abbreviation), as well as phonetic reduction/enhancement. Chapter 2 is probably the most extensive overview of phenomena that can be (at least in part) accounted for by communicative efficiency in terms of formal length. Levshina keeps the discussions of previous literature concise, but includes many pointers to the literature on specific phenomena so that the reader can easily look up more details if needed. This is generally very reader-

friendly. Only in §2.7, a more thorough discussion would have been desirable, especially for readers who may not be very familiar with the literature in this research area. The section presents evidence for coding efficiency from the acoustic phonetics and phonological literature, and its main focus lies on the theories of audience design (cf. Bell 1984) and chunking (cf. Bybee 2007). Here, it would have been helpful to explicitly include and present a relevant theory from the literature, namely the Smooth Signal Redundancy Hypothesis (cf. Aylett and Turk 2004, 2006).[2]

CHAPTER 3 discusses the factors that lead to efficiency in terms of the order of meaningful elements, which includes words in an utterance and morphemes in words. With much attention on word order in the literature on efficiency, an important innovation in this book is that Levshina also includes a discussion of morpheme order, namely the suffixing preference and the internal order of inflectional and derivational morphemes.

The first part of Chapter 3 (§3.2) offers a broad overview of the various factors identified in the literature to determine efficiency in order: the minimization of memory and surprisal costs (preference for minimal dependency lengths), the preference to produce accessible elements early in the utterance, the avoidance of syntactic ambiguity (e.g., garden-path constructions), iconicity (in terms of contiguity), and uniform information density. While uniform information density – the preference to distribute information as evenly as possible – is a relevant factor for efficiency in the order of linguistic elements, it also directly relates to many of the coding efficiency patterns discussed in Chapter 2. It may have been useful for readers who are less familiar with the theoretical background to elaborate more on the Uniform Information Density Hypothesis in Chapter 2.[3]

The second part of Chapter 3 (§3.3) then takes up many of these factors and relates them to findings in the literature. It combines insights from corpus linguistics, typology, and experimental linguistics and it discusses data from various languages.

The last part of Chapter 3 (§3.4) presents a case study dealing with word order in the speech of Yoda from the Star Wars movies. This is a very creative and intriguing section that shows how linguistic structures can be purposefully manipulated. In this case, the manipulation leads to more costly word orders, which provide additional effects or benefits according to Levshina. Relating word order and dependency length to popular culture is a refreshing new take on efficiency. At the end of this section, the reader may wonder, though, whether such word order manipulations can also occur in a more conventionalized form in natural languages.

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2 To be fair, the references are provided, but the section lacks an explicit pointer to the Smooth Signal Redundancy Hypothesis. The theory is mentioned in §1.3; the information is thus not missing but may be difficult to recover.

3 It is introduced in §1.3 and §3.2, however.

CHAPTER 4 provides an overview of four further strategies in language use that can be argued to save communicative effort. The first strategy discussed is the preference for accessible units. Based on findings from the literature, Levshina argues that there is a general tendency to prefer more accessible referents both in production and comprehension/interpretation. The second strategy concerns synthetic and analytic forms when different variants can be used, as for instance *cleverer* versus *more clever* in English. Levshina shows that analytic forms can save effort in contexts with a high cognitive load. The third strategy is concerned with the avoidance of formally or structurally similar elements in close proximity. The explanation given is that avoiding such structures avoids potential interference from similar elements and therefore saves processing effort. The final strategy is the introduction of new referents in the discourse. Here, Levshina provides a brief overview of previous findings, showing that common structures to introduce referents help to prevent cognitive overload and competition for memory. Although shorter than the previous two chapters, this chapter offers many important insights, as it connects different phenomena in a very innovative way to the overall framework of communicative efficiency developed in the book.

2 Part II: efficiency and language evolution

CHAPTER 5 provides an overview of the diachronic processes that can lead to efficient structures in language. The chapter focuses on differences in expression length in relation to frequency and accessibility, with word order optimization being addressed only briefly (cf. §5.7). Levshina distinguishes between efficiency-driven formal reduction and efficiency-driven formal enhancement. For formal reduction, Levshina focuses on differential phonetic (and following phonological) reduction as well as the omission of structure in high accessibility contexts. For formal enhancement, she discusses in more detail the development of new longer expressions for different grammatical expressions, arguing that they tend to develop in contexts of lower accessibility.

The last part of Chapter 5 (§5.4) deals with causal models of reduction and enhancement, focusing on the potential relations between (different types of) usage frequencies, meaning accessibility and articulation cost. Levshina discusses three models in more detail: a so-called pragmatic model of language change, a causal model of language change based on Zipf's Rational Artisan (Zipf 1949), and a causal model of language change based on Bybee's usage-based approach (e.g., Bybee 2007, 2010). It is important to note that this is one of the most detailed and innovative discussions in the literature on the relation between frequency, predictability, and length. Levshina examines potential causal relations by comparing and reviewing

models of language change that had not been discussed together in the light of efficiency before.

Chapter 6 then takes a small detour into a critical discussion of trade-offs in linguistics. The relation to the overall topic of communicative efficiency is probably clear for those readers who are aware of the typological literature on competing motivations (cf. MacWhinney et al. 2014). For readers less familiar with the literature, Chapter 6 could have benefited from a more detailed introduction. Nevertheless, it raises awareness for the complexity of linguistic relations that have been explained by efficiency and that run the risk of being viewed in a too simplistic way. After presenting examples of trade-offs from the literature, Levshina convincingly shows why taking binary negative correlations as efficient trade-offs can be dangerous or misleading. She shows that relations modeled as binary often involve (many) more factors. Another important point made in this chapter is that analyzing a relation between two factors as a trade-off poses the risk of ignoring an inherent directionality between those two factors. Based on a corpus study as well as previous findings from the literature, Levshina shows evidence for the "trade-off" between expressing information through morphology or word order being directional. Rigid word order allows for the loss of inflectional morphology, while rich inflectional morphology does not usually lead to increased word order flexibility.

3 Part III: case studies

Chapter 7 presents a number of case studies around the topic of causatives, combining methods and insights from corpus linguistics, typology, and artificial language learning. Levshina shows that the distribution of lexical, morphological, and analytic causative constructions can be accounted for by efficiency – i.e., the principle of the negative association between accessibility and costs. Using a typological sample and corpus data, she finds that the less compact form accounts for less than a third of the causative constructions across all functions distinguished, which makes it generally less frequent than the more compact form. Furthermore, Levshina presents an artificial language learning experiment that controls for iconicity effects. It shows the same associations between formal length and distribution: the less frequent event is more likely to be expressed by a longer variant than the more frequent event.

Chapter 8 similarly discusses empirical evidence from corpus data, typology, and an artificial language learning experiment to argue that differential case marking phenomena can also be accounted for by communicative efficiency. The chapter starts with a typological overview of differential marking with transitive subjects and objects using several typological datasets. Levshina relates various scales from

the typological literature to an efficiency account of differential marking: the hypothesis is that "it is efficient to mark an expression which is unlikely to function as A or P, given the available cues, and not to mark an expression with a high probability of performing that role" (Levshina 2022: 197). Based on the counts of different patterns, Levshina concludes that her data generally supports an efficiency-based account of differential case marking. She then discusses evidence from corpus data for different hypotheses about the functional motivation of differential argument marking. She finds that the data are most compatible with the hypothesis "Mark Weak Cues, Don't Mark Strong Cues", which assumes that formal marking of the arguments occurs with arguments that have properties (cues) that are atypical (probability < 0.5) for the argument in question. The last two sections of Chapter 8 then integrate her results with findings from the literature on the diachronic development of certain differential argument marking patterns and from artificial language learning experiments of differential argument marking.

CHAPTER 9 is a collection of corpus studies that deal with different alternations in syntactic constructions in English: stative verb + *(at) home*, *help + (to)* infinitive, and *go (and)*. With these three case studies, Levshina tests the "Hypothesis of Construction–Lexeme Accessibility and Formal Length, which predicts that longer forms will be used when the associations are weaker, and shorter forms when the associations are stronger" (Levshina 2022: 244). Measuring the conditional probability of a lexeme given the construction (besides other measures), Levshina shows that this hypothesis is borne out in all three cases.

CHAPTER 10 summarizes the main findings and arguments of this book, and also raises a few questions for future research. The issues mentioned range from how the framework proposed in this book can be extended to other grammatical phenomena, how additional measures of costs can be integrated for a more accurate quantification, the role of efficiency in language learning, how efficiency in communication relates to individual variation, and how new communication tools may come with new costs, affecting the efficiency of certain communication strategies.

4 Much food for thought

Besides providing a broad yet thorough overview of efficiency in language use, another strength of this book is that it opens a number of new questions and avenues for future studies concerned with efficiency in particular and the factors that shape language and grammar in general. I discuss a selection of those in more detail in this section.

4.1 Accessibility

As mentioned above, Levshina (2022: 18) builds on the notion of accessibility from the referentiality literature. By extending it to lexical and grammatical meanings and functions, her use of accessibility is innovative for what is usually referred to as expectedness or predictability in the literature. Using accessibility in such a broad way has two advantages. The first one relates to terminology: since both expectedness and predictability can refer to different formal measures (e.g., Ackerman and Malouf 2013; Cohen Priva and Jaeger 2018; Gries 2013; Seyfarth 2014), their use as informal conceptual notions may be confusing. Therefore, introducing a separate notion for the conceptual side leads to more clarity. Secondly and more importantly, Levshina does not simply extend terminology but relates phenomena with each other that have not been discussed together in the previous literature, i.e., referential phenomena as well as formal patterns in phonetics/phonology, morphology, and syntax. In doing so, Levshina turns accessibility into a broader cognitive notion, laying important groundwork for a promising way of capturing efficiency in language use. While this concept of accessibility may need further elaboration, exemplification, and explanation in future work, it certainly has the potential to form the basis for a theory of communicative efficiency.

4.2 Different levels of efficiency

Another distinction that Levshina makes is the opposition between descriptive versus explanatory levels of efficiency. She notes that it is "important to distinguish between efficiency as a descriptive parameter and as a factor that drives language change" (Levshina 2022: 107). Despite this being crucial for a better understanding of how efficiency shapes and interacts with communication and grammar, the distinction is often not explicit in the literature, which can lead to misunderstandings about the role of efficiency. Levshina thus provides an important start for developing a more fine-grained theoretical framework to investigate efficiency in language use. In particular her discussion about causal models and directionality between accessibility, frequency, and articulation costs is insightful for efficiency as an explanatory factor. By default, many studies assume a directional relation from frequency to accessibility. Levshina's discussion reminds us that the relations are likely not unidirectional but more complex, potentially including more than two factors as well as feedback loops. This is certainly an area that needs more research, for which the overview of causal models related to efficiency in Chapter 5 can serve as an important stepping stone.

Building on the distinction between a descriptive and an explanatory level of efficiency, one may even distinguish three separate levels. On the DESCRIPTIVE level, we simply establish whether or not a certain linguistic pattern corresponds to formal criteria that determine efficient, inefficient, and efficiency-neutral patterns. Descriptions on this level do not need to make reference to cognitive advantages or disadvantages, but simply classify patterns and structures. Furthermore, one could distinguish a COGNITIVE level of efficiency, where psycholinguistic methods are used to examine which cognitive processes are relevant for the speaker and the addressee when using patterns classified as (in)efficient. The final EXPLANATORY level would then relate to the explanatory role of efficiency in functional terms. This includes efficiency being the driver in the development of a given pattern as well as efficiency motivating its stability across time.

4.3 Development and stability of efficient linguistic structures

The literature on efficiency usually focuses on efficiency as the driver of the development of efficient patterns. The underlying idea is that efficiency can only be taken as a functional motivation of an efficient linguistic structure if it can be shown that it was involved in the development of that structure (cf. Bybee 1988: 357). In this vein, Levshina (2022: 217) notes that she "do[es] not exclude the possibility that efficient patterns can emerge due to processes that are not directly related to communicative efficiency, such as the habituation effects in Bybee's model." By now, there is a substantial body of work showing that we need to be careful in assuming that certain linguistic structures can be motivated by efficiency, since their development is not driven by efficiency per se. Examples include "harmonic" word order patterns such as relative clauses and adnominal possessives that consistently occur on the same side of the noun within languages. It was shown that this is often the consequence of both structures going back to a single origin (e.g., Aristar 1991; Cristofaro 2017). Thus, in addition to much evidence for efficiency shaping our communication and ultimately grammar, there is evidence for efficient structures as a by-product of other, unrelated processes in some cases. Levshina justifiably focuses on those linguistic patterns that are the result of functional adaptation towards efficient structures. Still, in order to gain a better understanding of the role of efficiency in shaping grammatical structures, more work will be necessary to elucidate the extent to which efficiency drives the development of efficient structures, and what patterns (can) develop in other ways, efficient outcomes being a by-product rather than a feature by design in such cases.

Related to this is the question of the stability and/or loss of efficient linguistic patterns, which is not much addressed in the literature on efficiency. Levshina

mentions this aspect in Chapters 5 and 6, e.g., regarding the diachronic development of word order in English, Greek, and Romance. This raises the question of whether efficient structures can be assumed to be generally more stable than other structures, or whether diachronic stability is less related to communicative efficiency.

4.4 Structural and phonetic enhancement

Regarding the association between the length of an expression and its accessibility, Levshina presents an insightful perspective on longer forms. Especially earlier approaches to efficiency in language have focused on the functional pressures to shorten frequent (and accessible) expressions (e.g., Bybee 2001; Zipf 1949). The fact that other forms remain longer is not necessarily discussed or taken to be the result of the absence of functional pressure (Cristofaro 2021; Haspelmath 2008; Petré 2017 being notable exceptions). In §5.4, Levshina takes up the perspective that efficiency effects can result from innovative forms that are longer than older forms. She notes that longer expressions are usually interpreted as being non-typical, which can be exploited by speakers to make the expression more salient or to be more expressive (Levshina 2022: 114).

In this book, Levshina largely follows the literature in discussing reduction on the phonological level and relating enhancement to the structural level, i.e., to the development of new (longer) construction. However, in principle, differential reduction as well as differential enhancement can happen on both levels, leading to the four-way distinction shown in Table 1:

Table 1: Four-way distinction of developments towards coding efficiency.

Accessibility	Form	Structure
High	Phonetic reduction	Structural reduction
Low	Phonetic enhancement	Structural development

As of now, there is not much evidence for structural reduction or for phonetic enhancement motivated by efficiency. While I am not aware of any diachronic evidence for phonetic or phonological enhancement driven by efficiency, there is evidence for synchronic probabilistic phonetic enhancement in contexts of lower accessibility (e.g., Tily and Kuperman 2012). This is also mentioned by Levshina (2022: 62). Another complication is that reduction is not restricted to acoustic reduction. Various types of articulatory reduction have been shown to be conditioned by the

predictability or frequency of an expression, e.g., that more predictable words feature more centralized vowels (Aylett and Turk 2006). Thus, the phenomena related to reduction and enhancement processes are more complex than is usually acknowledged in the efficiency literature. Empirical studies can often address a selected aspect only, and no systematic overview of the relevant mechanisms is available yet. The discussions of different diachronic reduction and enhancement phenomena by Levshina (2022) are therefore an important first step towards a systematic overview of the diachronic mechanisms that can lead to efficient coding.

5 Conclusions

This book offers a comprehensive overview of efficiency in language, which is long overdue. It is extremely rich in terms of linguistic phenomena as well as theoretical and empirical approaches, and this review hardly does justice to its breadth. Levshina successfully integrates various phenomena related to efficiency in language, incorporating perspectives from psycholinguistics, phonetic, morphology, syntax, pragmatics, corpus linguistics, typology, grammaticalization and language evolution in an impressive way. In addition, Levshina presents and discusses new results from the areas of typology, experimental and corpus linguistics. This book is a valuable resource for linguists from any sub-discipline, including typologists, to learn about efficiency in language use in general, as well as to connect their knowledge with insights on efficiency from other linguistic areas.

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