To appear in International Encyclopedia of Language and Linguistics, Third Edition

Efficiency in language change

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Abstract
Efficient communication means not only saving time and effort but also ensuring that the intended results of interaction are achieved. There is substantial evidence indicating that language is shaped by a pressure for communicative efficiency. This article explores various aspects of language change through the lens of communicative efficiency, examining phenomena such as formal reduction and enhancement, semantic shifts, and alterations in word order. Additionally, it addresses the methodological challenges associated with testing these hypotheses and offers potential solutions.

Keywords
communicative efficiency, formal enhancement, formal reduction, grammaticalization, language change, reanalysis, semantic change

Key points

- Communicative efficiency in language refers to minimizing time and effort in language production and comprehension while maximizing communicative benefits.
- The principles of efficient communication can explain formal changes of linguistic units, such as reduction and enhancement, and semantic changes such as reanalysis.
- Although testing hypotheses about the role of efficiency in language change is challenging, primarily due to scarcity of diachronic text data for most languages, these problems can be mitigated through the use of innovative methods, such as artificial language learning and computational modelling.

1. **Introduction**

Generally speaking, efficiency refers to reducing the cost-to-benefit ratio in a specific task. We communicate efficiently when we save time and effort, while ensuring that we achieve the desired outcome of interaction – for example, prompting or preventing certain actions by the recipient. Research suggests that the structure and use of language patterns are influenced by the pressure for communicative efficiency (Levshina 2022). Efficient linguistic patterns develop through processes like formal reduction and enhancement, semantic change and change in word order. These innovations help to lower costs and enhance the benefits of using language.

2. Main principles of communicative efficiency

The benefits of communication are hierarchically organized: from the successful transfer of linguistic units at the most basic level to evoking desired cognitive effects in the recipient's mind and further changing their behavior as intended by the speaker. These cognitive effects are very diverse: they include not only acquiring new information about the world, but also understanding the speaker's emotional state and attitude toward the recipient, experiencing aesthetic pleasure and so on (cf.

Jakobson 1960). Regarding the costs of communication, these are illustrated in Figure 1. The most important costs are effort and time or space (for writing, signed languages and co-speech gestures). Effort comes in two flavors: physical effort involved in articulation (including signing) and writing, and cognitive processing effort, which is required for language production and comprehension.

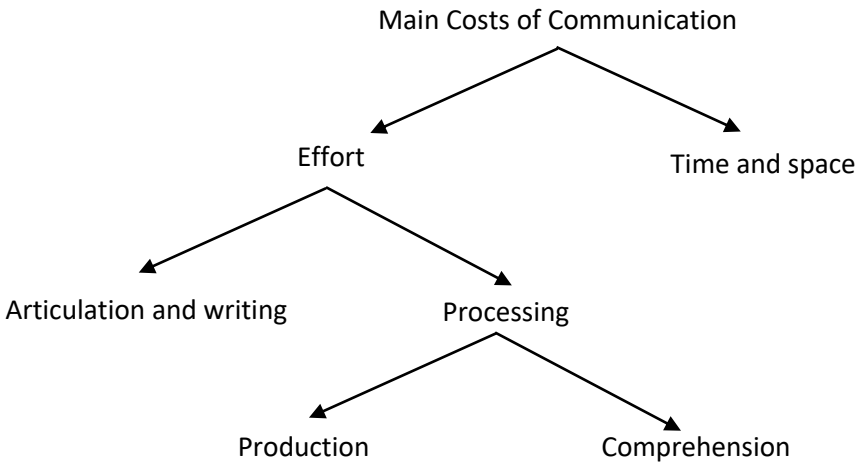

Figure 1. Main types of costs in linguistic communication.

Communication is efficient when language users adhere to several fundamental principles, which are as follows (Levshina 2022):

1) The principle of positive correlation between benefits and costs:
   - Spend time and effort if the communication creates benefits.
   - Do not spend time and effort on transfer of information that does not bring any communicative benefits.

2) The principle of negative correlation between accessibility and costs:
   - Spend more time and effort on inaccessible information.
   - Do not spend a lot of effort and time on accessible information.

3) The principle of maximization of accessibility:
   - Arrange your speech in such a way as to produce accessible information as soon as possible.
   - Choose the most accessible words and meanings whenever possible.

Accessibility plays a crucial role in efficient communication and can be defined as the ease with which linguistic forms and meanings are used, correlating with their level of neural activation at any given time. Accessibility is influenced by multiple factors, including frequency of usage, recency of mention, encyclopaedic knowledge, contextual predictability, the presence of competing interpretations, and so on (Levshina 2022). The relevance of these sources of accessibility varies depending on the specific linguistic phenomenon being considered. In what follows, I describe examples of formal and semantic change that can be accounted for by the principles of

communicative efficiency. Although formal and semantic changes are discussed separately for clarity, this division is primarily a matter of perspective. In reality, these processes are typically intertwined, as predicted by the theory of communicative efficiency.

3. Formal change

3.1. Formal reduction

When a certain concept expressed by a long and cumbersome form becomes more accessible due to social, technological, or other changes, the form often shortens. For example, the word 'car' superseded 'automobile' as the primary term in English (Zipf 1965[1935]: 33). This is an example of lexical replacement. In German, the common term for a car is 'Auto', a clipping of 'Automobil'. Similarly, as artificial refrigerators became common household appliances, the shortened form 'fridge' gained popularity. Other examples of technological abbreviations include 'phone', 'app', 'TV', 'photo', 'email', 'AI' and 'USB'. During the COVID-19 pandemic, shortened forms, such as 'corona' (in languages like German and Dutch) and 'rona' (in Australian English), emerged from 'coronavirus'.

Formal reduction also manifests itself as gradual phonological attrition (the loss of segments or articulation details), which is "omnipresent in language change" (Lehmann 2015: 135). Phonological attrition reduces articulatory costs and often the time required for language production. This process often accompanies grammaticalization. For instance, the Old English verb 'willan', meaning 'want', has evolved into a reduced form 'will' and even ''ll', becoming a future marker. According to Bybee (2003, 2010), such changes are driven by increasing usage frequency, making the form-meaning pairings more accessible. Furthermore, as a lexical unit transitions into a grammatical marker, it gains versatility across different contexts, which in turn increases its usage frequency even more, similar to a snowball effect. The reasons why some lexemes become more frequent, often leading to their reduction (in grammaticalization and elsewhere), remain not very well understood, however.

Differential reduction, a term discussed by Bybee (2010: Section 3.3.3) and Haspelmath (2008), often leads to efficient division of labor between the full and reduced forms – more exactly, the reduced form is used in contexts where its meaning is more accessible, while the full variant is retained for less accessible meanings. A notable example is the evolution of possessive pronouns in English. Historically, these pronouns ended with a final -n ('mine', 'thine') and were used both as determiners before nouns and as predicative forms. From Middle English through the eighteenth century (Hilpert 2012), the determiners underwent formal reduction, losing the final -n (as in 'my book'). However, this reduction did not extend to the predicative forms (e.g., 'This book is mine'). This selective reduction is efficient because predicative forms are less frequently used than determiners, making their meanings less readily accessible (Michaelis 2019; Ye 2020).

These linguistic changes are explained by the principle of negative correlation between accessibility and costs. But how does this principle operate at the level of language users? According to Fowler & Housum (1987), formal reduction is a signal to the listener that the linguistic unit is highly accessible. Similar ideas can be found in the Accessibility Theory by Ariel (2001), where short referential expressions (e.g., pronouns) signal that the referent is highly accessible. Additionally, the principle of positive correlation between costs and benefits appears relevant in the process of grammaticalization: as the meaning of a linguistic unit becomes more abstract and general due to

semantic bleaching (see below), the unit's semantic contribution, or its informativeness, diminishes. Consequently, there is a reduction in intonational and rhythmic emphasis (Bybee 2003). Therefore, by using a reduced form, the speaker may be signaling to the addressee that the meaning is either highly accessible or that there is less informative value (potential benefits), or possibly both. For illustration, consider again the case of 'willan': the meaning of a future marker is both more accessible and less informative (in the information-theoretical sense) because it is more frequent than the meaning 'want'. As a very rough proxy for the frequency of the meanings we can use the frequencies of the corresponding wordforms from the Corpus of American Contemporary English (COCA), in which the forms of the auxiliary verb 'will' (as 'will', ''ll' and 'won't') occur together more than 3.3 million times, whereas all inflected forms of the verb 'want' occur less than 1.7 million times.[1]

3.2. Formal enhancement

One representative example of formal enhancement is so-called renewal, where an existing lexical item or construction becomes functionally similar to an older one, potentially replacing it over time (Meillet 1975 [1915/1916]; Hopper & Traugott 2003).[2] One finds many illustrations of this phenomenon in the development of future markers. New constructions, which are longer than the already established markers, often originally express motion and modal or desiderative meanings. For instance, the English future marker 'will' has evolved from the desiderative verb 'willan' ('want'), as mentioned above. English also has a future construction with a motion verb, BE + 'going to' + Infinitive. Another example is the rise of longer progressive forms as an alternative to present simple forms for expressing ongoing events in Early Modern English (Petré 2017).

Why does this happen? I propose that the same two efficiency principles driving formal reduction also influence these changes. Firstly, language users opt for longer, more unusual forms because they seek to be expressive and attract attention, in contrast to the usual forms. Haspelmath (1999) suggests this can be explained by the principle of extravagance, which encourages speaking 'in such a way that you are noticed'. This explanation does not contradict the efficiency account because investing more effort and time to stand out is a clear manifestation of the principle of positive correlation between benefits and costs. The new, enhanced form is costlier, but brings additional cognitive effects, thus offering communicative benefits. Because the extravagant construction BE + Ving was associated with high speaker involvement, and high involvement in its turn can be associated with ongoingness, this led to the progressive interpretation of the construction (Petré 2017).

The principle of negative correlation between accessibility and costs may also play a role in these processes. For instance, progressive constructions in Present-Day English (with non-dynamic verbs), Dutch and French are sometimes selected to emphasize that the situation is non-canonical and surprising (De Wit et al. 2020) – in other words, less accessible –, which justifies the extra effort.

4. Semantic change

[1] According to www.wordfrequency.info (accessed 15.06.2025).

[2] My use of the term 'renewal' is purely descriptive and free from any assumptions about the underlying causal processes, such as recruitment or transfer (Reinöl & Himmelmann 2017).

Semantic change goes hand in hand with formal changes such as differential reduction, as predicted by the theory of communicative efficiency. When the longer form is retained, it tends to develop a more specialized domain of use, for example, it gets associated with a formal register or with irony. For instance, the German word 'Automobil' that has largely been replaced by 'Auto', has a usage note "elevated or humorous, otherwise outdated" in the Duden dictionary.[3] We observe thus an efficient division of labor: the less costly form serves as the default variant in everyday language use, representing typical instances of the category, while the costlier variant is semantically, pragmatically or sociolinguistically restricted. Such instances corroborate the principle of negative correlation between accessibility and costs, and, when additional cognitive effects emerge (e.g., irony or elevated style), the principle of positive correlation between benefits and costs.

As for grammatical change, it is often accompanied by semantic attrition, bleaching, or desemantization of linguistic units (Lehmann 2015). For instance, the Latin preposition 'de' originally meant 'down from the top', whereas its descendant in French translates simply to 'of', denoting a very abstract relation between two entities. The motion component and the specific delative semantics 'from the top down' have been lost (Lehmann 2015: 136). The evolution of the modal verb 'can' from Old English 'cunnan' illustrates this process through several stages: (1) a human agent's mental ability, (2) any kind of ability of a human agent, and (3) possibility, which does not necessarily involve an agent. At each stage, the meaning of 'can' has become increasingly generic, allowing it to be used in a broader range of contexts (Bybee 2003).

Semantic bleaching is an outcome of reanalysis – a more general process when there is a mismatch between the conventional interpretation of a linguistic form, and its actual interpretation by the recipient in language use. Over time, this new interpretation can become conventionalized. Reanalysis comes in two forms: re-analysis in the strict sense, where a familiar structure is reinterpreted by the recipient, and neo-analysis, where language learners typically use contextual cues to interpret an unfamiliar form (Mosegaard Hansen 2021). Reanalysis in the strict sense is pivotal for grammaticalization and semantic bleaching. For example, in many languages, object markers, such as 'bǎ' in Mandarin Chinese, originate in verbs meaning 'take'. Initially, a speaker would use a phrase like 'take X and VERB (X)'. Eventually, the 'take' verb might be understood as simply reinforcing the meaning of the main verb and reanalyzed as a case marker (Slobin 2002: 382). Importantly for grammaticalization, the meaning of units like 'take' becomes "communicatively peripheral" (Cristofaro 2024: 158). As Bybee (2003) writes, this is a case of habituation: a stimulus loses its impact when it occurs very frequently (and, as one could add, is highly predictable from context). Additionally, reanalysis is aided by chunking – formal fusion of frequently co-occurring elements. In this process, the cognitive links with the meaning of the chunk components are weakened and the chunk gains greater semantic and pragmatic autonomy, which facilitates the semantic change (Bybee 2003).

A pragmatic view of reanalysis (Detges & Waltereit 2002; Mosegaard Hansen 2021) is particularly suitable for interpreting it from the perspective of communicative efficiency. In what are called bridging contexts, where more than one interpretation is possible (Heine 2002), the recipient selects the most relevant interpretation, based on available contextual cues. According to Relevance Theory

[3] "gehoben oder scherzhaft, sonst veraltend", https://www.duden.de/rechtschreibung/Automobil (accessed 1.11.2024).

(Sperber & Wilson 1995), the most relevant interpretation is the one that brings the most contextual effects (benefits), while being highly accessible (easy to retrieve). Essentially, this means that the chosen interpretation is the most efficient from the perspective of the addressee.

5. Changes in word order

Research on efficient change of word and constituent order is limited, but existing studies illustrate the principle of maximization of accessibility through minimization of dependency distances (Ferrer-i-Cancho 2004; Liu 2008). Tily (2010: Ch. 3), who analysed word order changes from Old to Middle English, found a decrease in overall dependency distances over time, with the observed distances approaching optimal values. For example, in ninth-century manuscripts, the actual dependency distances were on average about 1.5 times longer than the optimal values in manuscripts from the ninth century, whereas by the end of the Middle English period they were about 1.35 times longer than optimal. Similarly, Gulordava and Merlo (2015) measured the differences between the actual dependency distances and the optimal distances in texts from Classical Latin and Late Latin of the fourth century AD, as well as texts by Herodotus (fourth century BCE) and the New Testament (fourth century CE) in Ancient Greek. In both Latin and Ancient Greek, the later texts exhibited smaller discrepancies between the actual and optimal distances. This indicates that over time, word order became more efficient as it increasingly adhered to the principle of maximization of accessibility, although this trend does not necessarily extend to the entire grammar.

6. Methodological challenges and solutions

It is often challenging to trace the processes discussed above in empirical data. However, at least in the case of lexical reduction, these processes can sometimes be observed in real time. For example, during the COVID-19 pandemic, speakers of German and Dutch rapidly shortened the word for "coronavirus" to "corona", due to the sudden and widespread increase in the concept's accessibility. Similarly, following Russia's full-scale invasion of Ukraine in 2022, new war-related abbreviations emerged in Russian, such as 'mobiki' from 'mobilizovannyje' meaning 'the mobilized'. These examples allow us to see efficiency in action: an increase in accessibility is promptly followed by formal reduction.

However, when it comes to grammar and long-term changes, the necessary data are often missing. While diachronic data from individual languages can be accessed, drawing conclusions about the corelations between accessibility and costs often must remain speculative. The more precious are then studies based on diachronic corpus data. Zehentner (2021), for example, discusses the loss of case endings in Middle English, which resulted in formal ambiguity between Agents and Recipients in ditransitive clauses. She shows that language users increasingly adopted the prepositional dative to avoid ambiguity – in particular, when the combination of Recipient and Theme deviated from the prototypical scenario (an animate Recipient and an inanimate Theme), and when the forms of Recipient and Agent did not help disambiguate the two – essentially, in contexts where the semantic macroroles were less accessible to the recipient.

Unfortunately, these data are typically only available for major languages and cover a limited time span. To compensate for that, researchers have turned to artificial language learning experiments that allow them to simulate language change in vitro. There are numerous studies supporting the principle of negative correlation between accessibility and costs. For example, Kurumada and Grimm

(2019) studied the evolution of number marking by presenting learners of artificial languages with two types of referents – some that more frequently appeared as singletons in the experiment, and others predominantly as multiples. During the language production task, learners were more likely to use plural marking on nouns that were less likely to occur with plural meaning – in other words, when the intended meaning was less accessible. Levshina (2019) observed similar trends with two types of causative events, one more frequent than the other. This approach has also been employed to explore the development of efficiency in the lexicon, as demonstrated by Kanwal et al (2019). A crucial aspect of these experiments is that the language input lacks the efficient patterns: they are created by language learners spontaneously.

Considerable attention in artificial language learning experiments has been directed toward emergence of differential case marking. For example, Fedzechkina, Jaeger and Newport (2012) had participants learn a miniature language with optional object case marking, observing that the learners used significantly more case markers on atypical (animate) objects than on typical (inanimate) objects. Unlike the experiments by Kanwal et al. (2019), Kurumada and Grimm (2019) and Levshina (2019), where the accessibility of referents was defined by the frequency of stimuli, the findings in Fedzechkina et al (2012) are attributed to the language learners' prior linguistic experience: the role of objects is less accessible for animate referents than the role of subjects (Levshina 2021a). Notably, Smith and Culbertson (2021) were unable to replicate these results. However, they did find that differential marking emerged as predicted when participants engaged in communication in the form of a guessing game. This indicates that the development of differential marking is influenced by communicative demands. Similarly, an online communication game in Levshina (2022) showed that differential subject and object marking emerged when there was a communicative need for disambiguation between the arguments. Moreover, Tal et al. (2022), exploring the role of information structure in the emergence of differential object marking – as suggested by Iemmolo (2010) and other cross-linguistic studies – found that atypical information structure caused changes in word order, subsequently increasing the chances of an object marker being used. These experiments collectively show that arguments are more frequently overtly marked if their thematic macroroles are less accessible, due to factors like semantic properties of the referents, the need for disambiguation, or non-canonical word order. At the same time, it remains unclear to what extent the results of such experiments, which involve very unrealistic languages and communicative settings, can be extrapolated to actual communication.

Another effective method for investigating how efficient form-meaning pairings develop is computational modeling. For example, Jäger (2007) used evolutionary game theory and rationalist game theory to account for the cross-linguistic distribution of differential argument marking. Peloquin et al. (2019) applied Rational Speech Act Theory to model the communicatively efficient behaviors of an idealized Speaker and Listener. One challenge with these approaches is their reliance on numerous assumptions about communicative and cognitive biases (e.g., Lestrade 2018), the impacts of which are usually unknown. Computational methods can also be used for inferring causal relationships between different variables, which are assumed to be in efficient trade-off relationships, using synchronic data (e.g., Fast Causal Inference in Levshina 2021b; phylogenetic causal graphs in Shcherbakova et al. 2024).Given the limitations of each method for studying the role of communicative efficiency in language change, the best practice would be to employ a combination of these techniques. Additionally, a greater focus on and more systematic appraisal of negative evidence is necessary (e.g., Pijpops & Zehentner 2022).

7. Conclusion

The investigation of the role of communicative efficiency in language change is still in its infancy. Yet, we see that a range of important processes align with an efficiency-driven perspective. The main principle of efficient communication can help us understand why formal and semantic changes happen. Of course, efficiency is only one of many forces that shape human language. Its effect can be modified by other factors, such as the number of adult learners (cf. Levshina 2021b) or phonological structure. For example, syllable-based phonology, as in languages of Southeast Asia, restricts clitization and further formal reduction of linguistic units (Bisang 2011).

Currently, most claims in this field remain theoretical, primarily due to methodological challenges: relevant data for testing the hypotheses is often unavailable. While formal changes are relatively well-documented, measuring the accessibility of meaning, which requires naturalistic data and, in some cases, even access to speakers and their knowledge of the world, is more complex. These problems can be mitigated with the help of new methods, such as artificial language models and computational modelling, as well as by integrating evidence from various data sources and methodologies.

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