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SOUND CHANGE AS A COMPLEX DYNAMIC PHENOMENON AND THE BLURRINESS OF GRAMMAR STABILITY



MUDANÇA FÔNICA COMO UM FENÔMENO DINÂMICO COMPLEXO E A INDEFINIÇÃO DE ESTABILIDADE GRAMATICAL

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[ABSTRACT](#) | [INDEXATION](#) | [TEXT](#) | [REFERENCES](#) | [CITE THIS PAPER](#) | [AUTHOR](#)

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Abstract

Since the late 1980s, the study of linguistic knowledge has intensively congregated different areas in order to capture several issues related to language development, variation, and change. Many of these fields can be represented by the Complex Dynamic Systems Theory (CDST), an approach used to model and explain linguistic phenomena and their implications. The goal of this article is thus twofold: firstly, it aims to present the CDST paradigm applied to language studies; and, secondly, departing from a complex dynamic perspective, it discusses sound variation and change as paramount and integral parts of the essence of natural languages. This account sheds light on new ways to address language and is fundamental to the understanding that languages are living organisms whose properties are constantly changing and evolving.

Resumo

Desde o final da década de 1980, o estudo do conhecimento linguístico tem intensamente congregado diferentes áreas para captar com abrangência diversas questões relacionadas ao desenvolvimento, à variação e à mudança linguística. Muitos desses campos podem ser representados pela Teoria dos Sistemas Dinâmicos Complexos (CDST), uma abordagem utilizada para modelar e explicar fenômenos linguísticos e suas implicações. Assim, o objetivo deste artigo encontra-se em duas vias: primeiramente, visa a apresentar o paradigma da CDST aplicada aos estudos linguísticos; em segundo lugar, partindo de uma perspectiva dinâmica complexa, discute variação e mudança sonora como sendo partes básicas e primordiais da essência das línguas naturais. Essa perspectiva lança luz sobre novas formas de se abordar uma língua e é fundamental para a compreensão de que essa se trata de um organismo vivo cujas propriedades estão constantemente mudando e evoluindo.

Entradas para indexação

KEYWORDS: Complex Dynamic Systems Theory. Sound change. Usage-based models.

PALAVRAS CHAVE: Teoria dos Sistemas Dinâmicos Complexos. Mudança sonora. Modelos baseados no uso.

INTRODUCTION: DILUTING BOUNDARIES

Diessel (2007) states that one of the cardinal tenets of modern linguistics is the clear division between grammar and language use. Based on that premise, it is usually deduced that grammar is independent of its use or, in other words, it is taken as a complicated yet close and stable system that would not suffer effects of the interpersonal and psycholinguistic principles involved in language use. As a consequence, the current tradition in linguistics considers the existence of a set of general and regular principles governing language variation and change that is not dependent on the use speakers make of it.

By not considering the role of language use and context in language variation and change, we face what Niyogi and Berwick (1997) name "the paradox of language change". To the authors, supposing that children successfully acquire their parents' grammar from "impoverished" data available during the childhood from generation to generation, languages would never change. For that reason, linguists have been concerned about describing language phenomena related to change by using analogies from evolutionary theories, "but rarely going beyond that" (1997, p. 162). In addition, as Kretzschmar (2010) details, rules that are categorical misinterpret the facts of language in use, since linguistic phenomena are not absolutely consistent. That is the reason why rules are controversial when applied to sound change, to the author. If change is viewed as rule addition, when A turns into B in a given context, it is predicted that underlying forms remain unchanged. To Cilliers (2002, p. 112), "the obsession to find one essential truth blinds us to the relationary nature of Complexity, and especially to the continuous shifting of those relationships". However, languages are robust in being indifferent to rigid linguistic approaches and models, as they seem highly sensitive to the behavioral differences of their speakers (MARTELOTTA, 2011) and to the environment (KUPSKE; ALVES, 2016).

It is a fact that there is a great quantity of variation in the use of any language. According to Evans and Alshangiti (2011), for example, in multidialectal scenarios, speakers tend to accommodate their linguistic behavior so that communication is facilitated, and, as Evans and Iverson (2004) affirm, this dialectal alignment may lead to changes in speech production and perception. Even short-time interactions can lead to permanent sound changes, as also pointed out by Pardo (2006). For Evans and Iverson (2007), this process of language accommodation, in many cases, ends up lasting in future productions; therefore, to the authors, speakers are able to change their dialects throughout their lives, and contact with different accents can influence the production and perception of sounds. In addition, speakers can also consciously adapt the way they talk to match the communicative demands of specific contexts, switching between formal and informal varieties of the same language, for example.

Current experimental approaches to language research (e.g., SANCIER; FOWLER, 1997; SCHMID, 2011; KUPSKE, 2016; KUPSKE; ALVES, 2016) go further, gathering evidence about this sound/cognitive plasticity. To that body of research, fully stable languages would not be immune to the effects of environmental changes and frequency and recency of language use. Even adult first language (L1) grammars, in a "synchronic" fashion, present changes according to the environment plurilinguals are immersed in, a phenomenon now known as Language Attrition (KUPSKE, 2016). For example, Kupske (2016) explored the production of voiceless plosives in initial word position of twenty-two Brazilian immigrants living in London for varying periods of time as well as monolinguals of Brazilian Portuguese (BP), and, in a nutshell, reported that immigrants with a length of residence superior to four years produced BP plosive sounds with values statistically different from those produced by the BP controls, but aligned with the expected values for Standard Southern British English, the dominant language.

Data such as this confirm that the L1 system is not rigid and may exhibit changes over the lifetime of speakers, corroborating the position in favor of language as a complex dynamic system (BECKNER *et al.*, 2009). Studies of this sort have been demonstrating that languages change not only by the interference of different structural levels, but also through their relationship with the context. They highlight the dynamic nature of languages, and, as Martellota (2011, p. 37. Our translation) mentions, studies like these "have shown the ingenuity of the view that languages are completely uniform at a given moment in their evolution". To the author, languages cannot function unless they change. Humans evolve and change their conception about the world in which they live, which consequently ends up changing with them (2011, p. 27). Languages adapt. Adaptation is a constant aspect.

Functional linguistics, for example, has been presenting evidence, in grammaticalization studies, that changes do not come to light linearly in time, but reflect non-structural tendencies that manifest themselves in a timeless way (MARTELOTTA, 2011, p. 38). In this perspective, the traditional view to grammar has been challenged in recent years, both in psychology and linguistics, and models that take variation and change as inherent phenomena to the operation of any natural language have been incorporated to contemporary linguistics. Complex Dynamic Systems Theory (CDST), one of these more holistic perspectives to language variation and change, will be advocated here, as, to Lightfoot (1991), properties of language change are shared by other complex systems in the natural world. In other words, variation and change would be integral parts of what we take as language. In addition, to de Bot, Lowie and Verspoor (2011), the unilateral cause and effect relationship between language variation and change is difficult to be interpreted. To the authors,

On the one hand, variation permits flexible and adaptive behaviour and is a prerequisite to development. This is what we observe in evolution: Without variation, there is no selection. On the other hand, free exploration of performance generates variability. Trying out new tasks leads to instability of the system and consequently an increase in variation. Therefore, it can be assumed that stability

and variation are indispensable, interrelated aspects of human development. (2011, p. 58).

For CDST, languages are therefore not "just" complicated systems composed of several parts/agents; they are complex dynamic systems, as their components are interconnected and context-dependent (JUARRERO, 2000). To Cilliers (2002, p. 80), the success of these systems depends exactly and largely on the effectiveness of those interactions and their environment. For these reasons, this position article advocates language and sound change as complex dynamic systems.

The goal of this article is twofold: firstly, it aims to present the CDST paradigm applied to language studies; secondly, departing from a complex dynamic perspective, it discusses sound variation and change as paramount and integral parts of the essence of natural languages. As Martelotta (2011, p. 16. Our translation.) points out, "to adopt this principle means to accept that it is impossible to establish a distinction between language use and the grammatical rules that are in its foundation, since rules change, and the change is manifested in the use and is motivated by it", as languages are essentially dynamic and adaptive. As Lowie; Verspoor (2015, p. 76) point out, "variability is not a meaningless byproduct of development but is a driving force and a motor of change". In order to do so, this article is divided into three main sections. The first section is concerned with introducing and presenting language as a Complex Dynamic System. The second section deals with sound change and usage-based models and brings to light some of the work carried out in the Brazilian scenario, and the third section discusses the unclarity of grammar stability and sound change under a dynamic account.

LANGUAGE, LANGUAGE DEVELOPMENT AND COMPLEX DYNAMIC SYSTEMS

To Larsen-Freeman (2017, p. 51), although CDST has antecedents stretching back at least as far as the Greek philosophers, "it was only with the advent of quantum mechanics, the adoption of a non-reductionist approach, and the embrace of systems thinking" that we could settle the stage for the CDST tenets known today. Perhaps the most powerful insight from CDST, at least for this article, lies in its non-reductionist concept of emergence, as new patterns and behaviour in complex systems emerge out of the interaction of their constituents (LARSEN-FREEMAN, 2017, p. 53) among themselves and with the ecology in which they operate (VAN LIER, 2000, p. 246). Therefore, this paradigm does not assume that linguistic phenomena could be explained by segmenting natural languages into smaller or simpler components. As a matter of fact, to Cilliers (2002, p. 246), "Complexity cannot be simplified to direct relationships without losing exactly those capabilities of the system we are interested in - the capabilities that emerge as a result of the nonlinear, distributed relationships between the constituents and the system". For that reason, these systems are prone to change by means of internal reorganization and/or through their adaptation to changing contexts (LARSEN-FREEMAN, 2017).

Essentially, a complex dynamic perspective to language describes holistic, organic, and emerging systems that are composed of two or more interrelated systems, which may *per se* represent other complex dynamic systems (MERCER, 2013). The barriers between systems are therefore no longer clear, since a system is usually also part of other systems. All elements of a given system are at the same time influencing and being influenced by all others. As Paiva (2011) points out, every dynamic system is an open one and, as a consequence, energy can either enter or exit. In this sense, Lowie and Verspoor understand that:

[...] due to the potentially continuous change of all interacting subsystems over time, and the constantly changing interaction of all variables over time, the end result is not predetermined. The essence of nonlinearity of a relationship is that the outcome of the interaction of that relationship is not directly proportional to the input of the individual components. Consequently, some aspects of nonlinear systems appear to be unpredictable and chaotic. This does not imply that the behavior of a nonlinear relationship is random, but it does mean that the outcome is not predetermined (LOWIE; VERSPOOR, 2015, p. 69-70).

To Mercer (2013), complex dynamic systems are self-structuring and self-sustaining, having the ability to adapt according to the environment and to the energy received or expended. These systems then have the ability to constant transformation. To Willians (1997), a complex system is everything that moves, changes, or evolves over time. During this dynamic process, agents learn from each other, receive feedback, and gain experience. Thus, such systems are always dependent or sensitive to their initial conditions.

In regard to language development specifically, it is known that the patterns of use, as pointed out, for example, by Usage-based Phonology (BYBEE, 2001), affect how a language is developed, used, organized and even how it might vary during the life of an individual. These processes would thus be interdependent, according to Beckner *et al.* (2009). For these authors (2009, p.1), language as a complex dynamic system exhibits the following basic characteristics:

- (i) the system consists of multiple agents that interact with each other, such as, for example, speakers in a given community;
- (ii) the system is adaptive, since the behavior of speakers is based on their past interactions; however, such interactions, alongside current ones, are the factors that will delineate future interactions;
- (iii) the behavior of a speaker is the consequence of competing factors, ranging from perceptual constraints to social motivations;
- (iv) language structures emerge from interrelated patterns of experience, social interaction and cognitive mechanisms.

Usage-based theories, according to Larsen-Freeman (2013), provide language development with a direction by advocating that we learn languages by engaging in organic communication through interpersonal and cognitive processes (BYBEE, 2001). To Beckner *et al.* (2009), development entails complex and probabilistic analyses of language samples that involve the estimation of the norms of a given speech community through samples derived from the experiences perceived by our cognitive machinery, psychomotor capacities, as well as by the dynamics of social interaction itself.

Bybee (2001) and Heine and Kuteva (2007) assume that grammar is, in a way, a replication process. Since man was able to put two words into the same sentence, he has created the potential for the development of a grammar using sequential processing, categorization, conventionalization, and inference mechanisms. Therefore, grammar is seen as an uninterrupted process in all languages at all times. Language systems then result from dynamic cycles involving language use and change, perception and learning of the interactions between members of a speech community (ELLIS, 2008), as already indicated. It is the sequential processing, planning, and categorization skills that enable learners to build a system. However, these skills themselves do not demand the effective use of a language; people need to speak as a result of social interaction (KUPSKE; ALVES, 2016). Thus, although language is shaped by cognitive abilities, it is the social life that ends up demanding what is understood by language.

For Haugen (2001), languages are constantly being redesigned by the interactions of their speakers in order to reflect the communicational experiences of the past, and to project current and future ones. This way, any behavior of a speaker is the result of a range of competing factors, including physical as well as cognitive and social motivational ones. Over time, social interactions between speakers/agents produce language changes at all levels, since there is a relationship between an individual and the environment, which provides patterns (GIBSON, 1979). From this perspective, language is developed by engaging in real communicative acts through interpersonal communicative processes, in addition to the cognitive processes mentioned.

In a nutshell, language knowledge is the outcome of an estimative analysis of the norms of a speech community through the cognitive apparatus, the human body and the dynamics of social interaction. In this perspective, grammar is constructed and possibly changed only via the use of the language in question. To Bybee (2010), each experience with the language has an impact in our cognitive representations. The cognitive organization of a language is therefore directly driven by the linguistic experience of a speaker. In a complex dynamic coloring, language development is a nonlinear and emergent phenomenon that is open, self-structuring, adaptive, unpredictable and sensitive to initial conditions and feedback (FINCH, 2001).

SOUND CHANGE AND USAGE-BASED MODELS

Language systems constantly change, and the processes of language development and change are guided by the very same basic assumption: change is the result of the interaction of multiple variables within a complex dynamic system. In a usage-based perspective, grammar is considered a cognitive organization of our experiences with languages (BYBEE, 2010). To Hopper (1987), grammar has to be seen as emergent and non-fixed. Therefore, as exposed so far, we understand language as a living organism, complex, dynamic and adaptive in its own essence, which is constituted by a number of subsystems and whose main characteristic is constant change; for that reason, languages exhibit a great quantity of variation and gradience. In line with Rennicke (2015), we argue that each subsystem may simultaneously contribute to gradual development and changes in the system as a whole.

Opposed to a traditional view of sound system that derives a certain output from a static and impoverished input, we contend that language representations capture all the variability and acoustic-articulatory details conveyed in speech. Furthermore, we believe those representations are robust enough to dispense with phonological operations, which suggests a grammar that is devoid of derivations (ALBANO, 2001), and is surface-oriented (BYBEE, 2010). In this regard, no formal apparatus supports the relations established by the elements in a given language – especially those related to sound variation and change. Language use is thus crucial to the understanding of how we characterize the knowledge of sounds, their phonotactics, their synchronic variability, and their development across time towards change. To Bybee (2010, p. 30), each use occurrence affects language representation, variation and gradience, and has a direct impact on the user's linguistic system. Therefore, complex dynamic models of grammar emphasize that language frequency is determinant for language structure and use (DIESEL, 2007; BYBEE; HOPPER, 2001).

Language use and linguistic representations, as they concern phonetic-phonological aspects, are often brought together by what we call Usage-based Phonology (BYBEE, 2001, 2010), a model based on the tenets of the Exemplar Theory (PIERREHUMBERT, 2001), which represents a proposal related to the way humans categorize ideas and objects. Bybee (2001) establishes that representations are affected and driven by experience, and the use of forms and patterns, both in production and perception, impacts their storage in memory. Exemplar Theory, specifically when joined with linguistic sound phenomena, is consistent with complex dynamic systems, as it captures the interaction among several variables throughout and all the time.

According to Melo and C. Gomes (2018), usage-based models to sound variation and change depart from the notion that the variability observed in the use of any language is part of the representations of the words that form the speakers' lexicon. Those models propose that the phonetic details are located in the representations of linguistic forms, including socially indexed information. As the authors point out, this approach diametrically differs from the treatment of

variation as a process, frequently present in mainstream sociolinguistic studies. It is valid to point out that, according to Bybee (2010, p. 25), the existence of variation and gradience does not deny regular patterns in and within languages. However, it is important not to see regularities as primary and variation and gradience as secondary. Languages are not fixed mental structures, once they are in constant use.

Usage-based models essentially differ from traditional approaches in how it explains sound change. Bybee (2001), for instance, points out that in a generative perspective, the underlying representation is quite simple, demanding an extremely onerous processing, such as the application of rules. To Kupske and Ferreira-Gonçalves (2010), in a usage-based viewpoint, language representations are complex (and rich) and interact in a complex fashion, while language processing is simple and direct. Based on these tenets, in Brazil, some research studies conducted under the complex dynamic perspective may be exemplified by M. Gomes (2019), Melo and C. Gomes (2018), Mendes-Junior and Cristófaros-Silva (2018), Rennie (2015), and Vieira and Cristófaros-Silva (2015). These Brazilian studies bring to our scenario an approach to language that deals directly with the nature of grammar, taking into consideration its variance and gradience. They look for explanations to language phenomena in terms of recurrent processes that operate in language use.

Since sound changes occur during language use and they depend on use repetition and frequency, these Brazilian studies reexamine, in a way, the nature of grammar. According to these studies, it is fundamental to mention that high-frequency words and phrases have more robust representations - "they are more easily accessed and less likely to undergo analogical change" (BYBEE, 2001, p. 6). Additionally, the organization of the lexicon provides generalizations and segmentation in terms of several degrees of abstraction and generality. The author defends that "units such as morpheme, segment, or syllable are emergent in the sense that they arise from the relations of identity and similarity that organize representations" (BYBEE, 2001, p. 7). In other words, according to the view above, there is not a gap between representation or grammar, or rather a view through which representations are mapped through grammar. Representations are dynamic, gradual and rich, thus constituting language systems.

Gradualness is the key term when it comes to sound variation and change. We understand that, synchronically, exemplars may be more or less frequent than others, and phonetic-phonological forms related to them are in parallel, indicating sound variation. Diachronically, sound forms are updated and some of them give way to others, essentially representing the result of sound change. This considered, all lexical items are under development and adaptation, and it is not striking that different linguistic forms, regarding the same lexical item, coexist and correlate. Therefore, as new sounds emerge and overlap others, change is instantiated. Under this framework, it is assumed that sound variation is phonetically motivated and lexically particular, and sound change is implemented gradually by the lexicon. As stated by Bybee (2010, p. 36), "phonetic variation, whether lexically specific or generalized over many words or phrases, is represented directly". The author understands that direct representations admit the implementation of gradual

sound change. This assumption therefore leads us to conceive that both representation of phonetic detail and the range of variation of particular lexical items entail a model of sound change that potentially accounts for both phonetic and lexical gradualness (BYBEE, 2001).

Considering the outline we have traced, we highlight that modeling sound change through the perspective of language use not only makes representational forms into more realistic entities, intimately connected to the world we observe and experience, but also provides a reliable account of the sound patterns under the process of variation and/or change.

THE BLURRINESS OF GRAMMAR STABILITY: SOUND CHANGE AS A CEASELESS PHENOMENON

It is an undeniable fact that complexity entails change. Variables in a complex dynamic system are constantly interacting, to a greater or smaller degree, and this interaction accounts for modifications in the system as a whole, as already indicated. What remains to be considered is the rate of change: different phenomena imply different rates, as well as the fact that different interactions may lead to faster or slower changes. Interaction leads to variation, which in turn is a sign, a seed of language change. Regardless of how noticeable a sound change might be, all complex dynamic systems imply changes to a previous or initial state. In this sense, the more stable these systems seem to be, the slower their changes seem to take place. However, it should be considered that systems are never completely static all the way through. As stated by Opitz (2017), depending on the attractor state a given structure of the language settles in, it might be the case that this structure is not subject to change. Nevertheless, we do not conceive this supposed stability as plausible, as one structure might be interacting with others at that very same moment, or might be undergoing change at a given rate that we ourselves cannot notice.

In view of this scenario, an important theoretical and methodological issue concerns the adoption of an appropriate timescale so that these existing changes can be verified. As suggested by Larsen-Freeman (2017), different levels of scales may lead to the observation of different patterns in a complex dynamic system. Following de Bot (2015), we assume that language change takes place at different timescales, ranging from seconds to decades, for example. This considered, the adoption of different timescales in the analysis allows us to verify that, whereas a given structure seems to be static with regard to a given aspect of the language, not necessarily should it be regarding another one (LARSEN-FREEMAN, 2017; OPITZ, 2017). Language variation, therefore, refers to the fact that language units and structures exhibit variation in their synchronic use, normally over the ongoing trajectories of sound change (BYBEE, 2010), and a limited timescale for this trajectory may also represent a limited analysis. In other words, it is not that language change does not occur; it might be the case that researchers do not prove able to observe changes, given the adoption of a timescale that does not allow them to do so.

Although attractor states may give us the wrong impression of statisticity and stability, we reinforce once again that the subsystems are always in action: (i) they are always prone to change, depending on the level of perturbation suffered by this system; (ii) they are always interacting with other subsystems, and this demands that we consider an interaction between different timescales concerning different subsystems. The number of possible timescales could be infinite, and it is our job to find that one attractor which will prove sufficient to reveal the changes subsystems go through. From this perspective, sound variation and change are not the exception, but rather the common pattern. The abruptness of the change under verification would also depend on the timescale employed. However, we should keep in mind that any change is continuous, evolving in different rates given the nature of the subsystem and the multitude of variables at play. Language systems are always subject to change, be it in a scale of years or generations, depending on the subsystem/structure under analysis and on the interactions among each other.

That said, as Lowie and Verspoor (2015) state, in a complex dynamic account, language development and change all depart from the same core process and present the same inherent nature, since they are grounded on the very same basis, though each one of them can and should be analysed from a different timescale. In this sense, the nonlinearity of the process should be reinforced, as it goes much beyond a 'cause-effect' perspective, as many variables come into play. Indeed, variation and sound change are the result of the interaction among structural, cognitive, social, environmental, and many other factors, which in turn reinforce an analysis in different timescales, focusing on the interplay of many of these variables. One single timescale, therefore, would not provide a clear picture of all the changes in action.

Considering that variation and (consequently) sound change are fundamental parts of language systems, a series of questions, either related to the individual or the society as a whole, should be taken into account. They are particularly important when we consider the high number of different factors that impact a complex subsystem; due to that, the developmental route of an individual does not necessarily apply to the same interaction of variables that characterize another individual. Therefore, individual analyses show crucial importance in complex dynamic accounts: each individual trajectory and its singularities have to be taken into consideration, and will not necessarily express the developmental pattern found in the group this individual is inserted in. As Bybee (2010, p. 31) points out, in a usage-based model, in which grammar is directly driven by experience, we cannot exclude any data from the analysis, as they are all representative. It is noteworthy that it is the interaction of these single individuals that accounts for language change, as group patterns represent these complex relations. Contrary to traditional accounts, a complex dynamic perspective considers both the individual and the group levels, aiming to show similarities and peculiarities of each one of these objects of analysis (LIMA-JUNIOR, 2016; LOWIE; VERSPOOR, 2019). Changes should be taken as a continuous process and not as abrupt modifications. Grammar stability is thus a blurred concept, and sound change is a constant.

FINAL REMARKS

To Bybee (2010, p. 17), sand dunes have apparent regularities of shape and structure, yet they also exhibit considerable variation between individual instances, as well as gradience and change over time. Thus, to the author, if we want to understand phenomena that are both structured and variable, we need to look beyond the surface. That applies to language systems, as they exhibit apparent regular structures and, at the same time, show variation in each and every level. Therefore, in this article, we aimed to present the CDST paradigm applied to language studies, and discuss sound variation and change as paramount and integral parts of the essence of natural languages. As we have argued throughout this article, change is an inherent factor in natural languages. Human beings evolve and change conceptions and relationships they establish with the environment/world. These relationships are established culturally, with as people interact, with this interaction being the trigger, the seed for sound variation and change. In this complex dynamic perspective, variation and change are not generational processes, coming to light from generation to generation, but rather a constant process through the reorganization of the linguistic system by means of language use.

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