Lineage-based linguistics

William Croft
University of New Mexico

The idea to be articulated and defended here is that grammatical categories can be defined as lineages of linguemes—usages of linguistic units (Croft 2000)—used to communicate similar experiences. In looser terms, I will argue that grammatical categories are basically social histories of the use of grammatical forms in a speech community. This idea is quite different from the traditional definition of grammatical categories and constructions. It can be seen as an extension of the usage-based model from its origin in cognitive linguistics to an evolutionary model of speech communities, languages, and grammatical structures. I will trace out this idea here, and argue that it can address a number of problems in the study of grammar.

2. The usage-based model in cognitive linguistics

The usage-based model can be broadly thought of as starting from a reaction to Chomsky's separation of competence and performance (Croft 2024:193-94). In the narrowest sense, exemplified by Langacker's early paper (Langacker 1988), the usage-based model is a model of how linguistic knowledge is stored in the mind, analogous to Chomsky's preoccupation with a speaker's knowledge of language.

Langacker contrasts the "maximalist", "non-reductionist" and "bottom-up" character of Cognitive Grammar to the "minimalist, "reductionist" and "top-down" character of generative grammar (Langacker 2000:1). The "minimalism" of generative grammar is the minimizing of stored grammatical knowledge, with the rest being the product of innate structures and rules. In contrast, "maximalism" argues that much grammatical knowledge has to be learned. The "reductionism" of generative grammar is primarily that if there is a more general rule, then more specific instantiations would not be stored. In contrast, "non-reductionism" allows for more specific as well as more general rules/schemas to be stored. Finally, the "top-down" approach of generative grammar focuses on the most general rules for the language, while the "bottom-up" approach of usage-based models doesn't ignore low-level, restricted patterns and idiosyncratic constructions.

One consequence of this cognitive definition of the usage-based model is that there are a very large number of grammatical units that are assumed to be represented in the human mind. The organization as well as accessing of these grammatical units then becomes an important theoretical question. All cognitive usage-based models therefore propose that constructions are organized into a network (for a detailed explication, see Diessel 2019). Langacker and many other cognitive linguists represents the network such that nodes may represent more general or more specific grammatical units: both [SBJ VERB OBJ] and [*I love you*] are nodes in a taxonomic hierarchy (or more generally, a lattice). Bybee's (1985) theory of morphology and the lexicon, perhaps the seminal work on the usage-based model, represents only word forms (types) as nodes in the network. The word types are linked to other word types by similarity or identity both in phonological form—the individual phonemes, as in /walkt/—and in the components of meaning expressed by the word, as in [WALK + PAST]. Any more general construction is a pattern of similarity links among the words that instantiate that more general construction.

Bybee's network representation makes even clearer the "bottom-up" nature of the usage-based model.

An important empirical phenomenon that supports the usage-based model is the role of frequency in language processing and language change. Bybee and others have made the case for the role of both token and type frequency in dynamic processes associated with the storage of grammatical representations, including entrenchment, productivity, retrieval, and formal changes such as phonetic erosion of forms and analogical reformation (see also Schmid 2020).

The well-established role of token frequency leads logically to the question of how token frequency is to be represented in the mind. In exemplar models of linguistic representation, first proposed in phonology, each phoneme token is represented directly. The direct representation of exemplars accommodates the fact that productions of phonemes are highly variable phonetically, more or less within a region of phonetic space, e.g. the vowel space (Pierrehumbert 2003). Exemplar models allow for the representation of that variability directly as a network of instances mapped onto phonetic space. Bybee (2010) proposes an exemplar model that applies to syntax as well as phonology.

Another strand of usage-based cognitive linguistics is based on the analysis of the meaning or function of a word or construction. A survey of 'uses' or senses of a word or construction in discourse always reveals differences in meaning, analyzed as lexical and constructional polysemy. An early influential example is Lakoff's (1987) analyses of English *over* and the English *There*-construction. Lakoff's analysis organized different senses of *over* and of the *There*-construction into a network of relationships based on shared semantic and functional properties between the senses. Later case studies were based on actual occurrences of a particular grammatical form's 'uses' (i.e., senses) in language corpora. The polysemy network is also hypothesized as part of a speaker's knowledge of language. A polysemy network is not a classical or Aristotelian category, defined by necessary and sufficient conditions. That is, there is no set of conceptual properties that every meaning in the polysemy network has and every meaning outside the polysemy network lacks.

3. Essential categories (kinds) and populations: an ontological distinction emerging from evolutionary theory

3.1. Kinds and individuals

The usage-based model described in the preceding section has two salient features. The first is that it describes a cognitive phenomenon, namely knowledge of linguistic categories by a speaker. This is true even though that knowledge is proposed to be closer to language use in a social or interactional sense: utterances produced and comprehended by interlocutors in social interactions. This is a fairly standard cognitive science view of knowledge of language as mental representations. There are other approaches to cognition, such as (existential) phenomenology and embodied cognition, which eschew mental representations and reject Cartesian mind-body dualism. In these approaches, cognition is the ability to develop the skill to be perceptually open to and actively engage with affordances in the natural and cultural world that we are born into (Croft 2024:213-14). We will return to the relation between cognition and language in §4.2, albeit in a general way not specific to either the cognitive science or the phenomenological/embodied cognition theories.

The second feature of the usage-based model is that the organization of that information—its division into categories, and the relationships between those categories, is defined by similarity or possibly identity of the mentally stored exemplars. For both phonetic and grammatical exemplars and lexical/constructional polysemy, the unity of the category is built around similarity. The phonetic realizations of a phonological category are similar to each other, but generally cannot be reduced to a classical category. The meanings or senses of a grammatical category—word or construction—are similar to each other, but generally cannot be reduced to a classical category. Even so, the finer-grained categories of individual uses, or in phonological categories, points in phonetic space—what is sometimes called the 'etic grid', a term from American structuralism (Levinson et al. 2003:487; see also Haspelmath 2018:88)—are assumed to be classical categories, where identity rather than similarity is the appropriate relation between tokens. Even similarity between meanings and forms presupposes the ability to assign specific properties or values to a token, i.e. a location in a conceptual space—semantic, phonetic or otherwise.

This is not the only way that exemplars of use can be organized. In fact, there is a fundamental way in which this is not the way that linguistic categories should be organized. Instead, linguistic categories are better analyzed as populations, as defined in evolutionary biology. The theoretical concept of a population in evolutionary biology is introduced in §3.2, and contrasted with the older and better-known concept of a kind, also known as essentialism. The concept of a population is applied to different entities in linguistics in §3.3: languages, speech communities, and then linguistic categories.

In evolutionary biology, the term 'essentialist' or 'essentialism' describes a classical category (Mayr 1982:256; Hull 1976, 1988:215-16). An essentialist category is defined by a set of generally inherent properties of the members of a category, such that anything that has that set of properties belongs to the category, and anything that doesn't have all and only those properties doesn't belong to the category. For example, turquoise is a mineral that is a hydrous phosphate of copper and aluminum, with the chemical formula $CuAl_6(PO_4)_4(OH)_8{\cdot}4H_2O$. [1] Anything, anywhere, anytime satisfying that description is turquoise, and anything, anywhere, any time not satisfying that description is not turquoise. Something that is defined in an essential manner is also called a TYPE, or a natural kind (see for example Haspelmath 2018, though his definition is 'natural kind' is actually narrower—see §5.1).

Kinds can be distinguished from individuals. Individuals are spatiotemporally bounded, HISTORICAL entities: they exist only in a particular place and time. The individuality of a quartz crystal is its unique spatiotemporal existence: it was formed at a point in time, it exists in some location for some period of time, and it will pass out of existence when it is destroyed. In other words, individuals are historical entities. However, by virtue of their essentialist properties, individuals like a quartz crystal are INSTANCES of a kind that is spatiotemporally unbounded.

3.2. Populations, illustrated in biology

A spatiotemporally bounded set of historical entities, i.e. individuals, is also a historical entity, i.e. an individual. This is a POPULATION, in the biological sense (Ghiselin 1974; Hull 1976; Mayr 1982:272-75). By contrast, a kind as a theoretical concept, that is, an ontological category, is not a population. A kind is defined by inherent properties of its members (and in contrast, those of its non-members). Although in cosmic terms, turquoise must have arisen at some point after the Big

[1] https://en.wikipedia.org/wiki/Turquoise, accessed 20 March 2025.

Bang, and will come to an end if and when the universe comes to an end, the category 'turquoise' is not defined by its beginning and end. The relation between a kind and an individual which is an instance of the kind is described as a relation between a type and a TOKEN. A population, on the other hand, is finite, and it is defined in part by its spatiotemporal boundedness. The relation between a population and its members is not between a kind/type and its instance/token. The relation between a population and its individuals is between a whole and its PARTS (Hull 1976).

There is more to the definition of a population. I will describe it here with respect to how it is instantiated in evolutionary biology. Population thinking is one of the major insights of the neo-Darwinian synthesis (Mayr 1982:272; see Mayr 1982, chapter 6 for a brief history). Population thinking resolves serious problems with the essentialist theory of a biological species by abandoning the essentialist theory. A species such as a red-tailed hawk was defined in the essentialist theory in terms of inherent properties of the bird: its shape, size, physiology and so on. However, the essentialist definition suffers from a number of problems. There are sibling species: two species that have similar inherent properties but do not interbreed (Hull 1988:104). There are also polytypic species: a species that has a high degree of variation but whose members nevertheless interbreed. Many if not most species have a high degree of variation among inherent properties, making an essentialist definition impossible. Finally, species change over time, and their "inherent" properties that supposedly define them disappear. The "essential" traits of species therefore cannot define the species.

Population thinking takes a completely different approach to categorization from essentialist thinking. Populations are defined not by inherent properties of the individuals but instead by a relational property, a relation that holds the individuals in the population together. The relational property that defines a population is reproduction (cf. Hull 1988:470). In the population theory of biological species, a species is defined as a reproductively isolated population. Members of a species interbreed among themselves (although of course it is not necessary that every member breeds with every other member). More significantly, they do not interbreed with members of other species, for whatever reason: it is physiologically impossible, their ranges are fully separated, one species breeds in the spring and the other in the fall, and so on. And reproduction is how new individuals in the population are created. The more general description of this process is REPLICATION (see §4). Replication is how individuals are bound together in a population.

Biological populations are not entirely discrete. There are hybrid species, especially among plants. There are also chains of populations, where there is some interbreeding between neighboring populations but not between geographically distant populations. These are problematic cases in defining species in population terms. But the "problems" are phenomena that directly follow from the population definition of species. Sometimes reproductive isolation is not complete. Speciation happens: that is, populations split. But the speciation process, the loss of interbreeding, is a gradual process. Populations may also converge, as in hybridization. Hybridization is also a gradual process.

A species qua population is a historical, spatiotemporally bounded individual: 'Just as the name "Gargantua" denotes a particular organism from conception to death, "*Gorilla gorilla"* denotes a particular segment of the phylogenetic tree' (Hull 1988:215). Populations may be a grouping of individual entities, but they are very different type of grouping from an essentialist category. Since a species is itself an individual, a species name is a proper name, not the name of a type (Ghiselin 1974).

Populations are bounded spatiotemporally. They can be individuated by branching and extinction. When a population splits, that is, two or more parts of the population become reproductively isolated, the result are two or more new populations. The original population is bounded, that is, it has ended temporally. The initial temporal boundary of the original population is when it became reproductively isolated itself. The initial temporal boundary of the new populations is at the time of the split that terminates the parent population. Their final temporal boundary is when they split again, or if the population goes extinct. This is the sense in which a biological species is a particular segment of the phylogenetic tree of life.

3.3 Populations in language

Population thinking can be applied to language, or more precisely, the speech community (Croft 2000:13-20). The speech community is a communicatively (relatively) isolated population of speakers (Croft 2000:17-19). All of the familiar "problems" of defining languages are found in defining species, and can be addressed in the population theory of a language (Croft 2000:13-20). The "problems" are mostly due to the gradual process of speciation/language birth, and the incompleteness of reproductive/communicative isolation.

All languages vary to the point that one cannot identify a set of essential properties (rules, constructions, words) that holds for all speakers of the language. And languages change over time, even when they do not split up into daughter languages. A speech community may split, as happened with Latin and its daughter Romance languages. Communicative isolation is incomplete in many instances, perhaps more so than between biological populations.

The emergence of new languages is gradual. In some cases it is due to the gradual process of the splitting of a speech community, leading to sibling languages. The split is incipient in the case of Czech and Slovak, for example, or with Serbian, Bosnian and Croatian. In other cases it is due to the gradual integration of a nation state, leading to polytypic languages, that is, languages made up of distinct geographical varieties that have been unified under a new national identity but are still quite distinct, as with Modern Chinese and Modern Italian. That is, there is also convergence or even merger of speech communities, just as there are with species; it leads to multilingualism, language contact phenomena such as koinés and creoles, and language shift with contributions from the lost language as with Norman French in English.

A further complexity that is found in human societies but not biological populations is that a society is not a homogeneous population; human individuals belong to multiple overlapping and nested speech communities in a society, based on social domain and social categories (Clark 1998; Croft 2000:90-94, 166-73, 2009:403-4; Höder 2018:43-47): 'There is no limit to the ways in which human beings league themselves together for self-identification, security, gain, amusement, worship, or any of the other purposes that are held in common; consequently there is no limit to the number and variety of speech communities that are to be found in society' (Bolinger 1975:333).

In the evolutionary framework, a language such as Italian or Czech has a distinct identity to the extent that the speakers of the language form a distinct speech community based on a relatively high degree of communicative isolation. But what is that language? A linguist captures that language in a reference grammar, that is, descriptive generalizations about the phonology, grammar and lexicon of the language. Such a grammar accommodates phenomena such as phonetic variability in the realization of phonemes, lexical and constructional polysemy, and

variation in grammatical constructions. But what is the relation between a descriptive grammar and a language?

In formal language theory, a language is a set of sentences, and a grammar is a set of rules that generates those sentences, that is, specifies what sentences belong to the languages and what sentences do not. The grammar is then a sort of description generalization of the language, although in fact there are few published descriptions of the grammars of a human language following the precepts of formal language theory.

Formal language theory is insightful, but it is essentialist. The set of sentences is infinite, and the rules describe inherent properties of the sentences. But it can serve as a starting point for the reformulation of language in population terms (Croft 2000:25-27).

In the evolutionary framework, a language is not an infinite set of sentences, but an actual, finite population of utterances actually produced by the speech community—i.e., a corpus. Thus, the utterances that count as parts of a language are defined by the speech community that produces them. It is actually more complex than that. As noted just above, speech communities overlap and are defined by contexts of social interaction in addition to the actual speakers. These phenomena raise complex issues in multilingualism and multilectalism which we cannot go into here. For now, we will make the gross simplification that a speech community is socially uniform and speaks one language. This simplification is already a huge ontological shift away from the essentialism of formal language theory.

In the population approach, a description of the language does not consist of a fixed phonology, lexicon, or set of constructions of the sort implied by a formal grammar (in the formal language theory sense). Instead, sounds, words and constructions are finite populations of forms that are actually produced by speakers, contained in the finite population of utterances that make up the language—again, a part-whole relation. Of course, grammatical descriptions of languages by descriptive linguists make generalizations over these finite populations of utterances and their parts, based on recorded and digital corpora, that is, samples of the finite population of utterances. These descriptions recognize variability and change in progress, as well as the social dimensions of language use and variation that we are leaving aside in this chapter.

These populations—speakers in a speech community, utterances in a language, and sounds, words and constructions in those utterance—are finite. But the terminal boundary of these populations is in the future for languages that are still being spoken. Hence any description of a still-spoken language will be open-ended, and can at best capture the past and present of the language: “past performance may not be indicative of future behavior”.

In order to get a better idea of what sort of category a sound, word, or construction is, it is necessary to look more closely at the structure of a population and the relational property that defines it, namely replication. This will also allow us to discuss the role of a speaker’s knowledge about her language in a population theory of language and its structure.

4. Population structure: replication and lineages

4.1. Replicators and replication

In Croft (2000), I develop an evolutionary framework for explaining language change. More accurately, it is a framework for language, because in an evolutionary framework, variation and hence change is central to the nature of language. Here, I focus on replication and lineages and

how they structure the population of utterances and the populations of the linguistic units, or LINGUEMES, that make up utterances.

The fundamental idea in Croft (2000) is that language change happens in language use. Language change is an instance of change by replication. Every time I open my mouth to talk to you, I replicate sounds, words and constructions that I or my interlocutors have previously used. That is, I am reusing sounds, words and constructions that I am familiar with because I have heard them used before, or used them before myself.

Replication is a temporal process. Hence, a linguistic category, and a speaker's knowledge about that category, has a temporal dimension. Since replication happens every time we speak, the temporal dimension of categories is at a small time scale, well within the lifetime of a single speaker. Replication also extends beyond the lifetime of a single speaker, since one can (and does) replicate sounds, words and constructions from someone else's utterance that they heard or was addressed to them. This is possible because language use is public, not internal: it occurs in conversation, everyday talk, as well as other types of discourse—not inside the head (*pace* Dawkins' selfish meme model; see Croft 2013).

Replication forms LINEAGES, that is, a replication of a replication of a replication...In the evolutionary framework, replication lineages provide the relations between tokens. Replication lineages are known in historical linguistics under other names: a sound lineage is a sound change; a word lineage is an etymology; a construction lineage is a grammaticalization chain (Croft 2000:32-33).

All individuals in a population are related to each other, if only indirectly, via replication. Replication lineages branch when there are multiple replications from a single parent replicator. Replication lineages are interwoven when there are multiple parent replicators. In biological evolution, this happens in sexual reproduction: the child's genome is a recombination of parts of both parents' genomes. In language, this happens when an utterance recombines sounds, words and constructions from multiple parent utterances. This is how novel utterances are produced, just as sexual reproduction creates novel combinations of biological traits. Of course, in the evolutionary model, unlike formal language theory, what matters are the novel utterances that actually are produced—which may not follow general patterns or rules that linguists infer from prior utterances.

Finally, replication involves INHERITANCE. That is, replication is mostly faithful: replicates possess most of the structure of the parent replicator. Equally important, alterations of structure in the process of replication can also be inherited, that is, changes in a replicator can be cumulative. This is a reason why populations cannot be fully captured by an essentialist definition: cumulation of changes in replication means that some individuals in the population will come to lack properties that other individuals have, and come to have properties that other individuals lack.

Variation in a population happens because replication is not always perfectly faithful. There are reasons for this, but the reasons may be different from one domain to another. The standard, albeit simplified, view in biology is that variation is generated by random mutation and by recombination (in sexually reproducing organisms). In language, there is fundamental indeterminacy in the communication process that gives rise to variation. Ambiguities in auditory perception and the challenge of perfect motor control means that the phonetic realization of each phoneme hits a slightly different point in the phonetic space, as demonstrated by instrumental phonetics (Ohala 1989:176; Pierrehumbert 2003:184; this was a motivation for the exemplar model).

The replication of symbolic units—words and constructions—is even more fraught (Croft 2010:11-12). Replication of symbolic units is an act of communication between speaker and hearer. But the hearer cannot read the speaker's mind: this is precisely why a symbol or signal must be used for communication of fine-grained experiences to be successful. The speaker has their own construal of the experience to be communicated. Her construal shapes the choice of words and constructions they make (and also the choice of sounds, since phonological variants often carry social meaning). However, the hearer of an utterance, like the speaker, has his own alternative construals of the scene potentially available to him; nor can he be certain of the precise construal intended by the speaker. The speaker's choice of words and constructions are based on her prior exposure to and use of those words and constructions in other communicative acts, and are chosen by her to convey her intentions in the current situation. But the hearer's knowledge of the words/constructions is in turn based on his own past exposure to and use of them. And his past experience of use is different from the speaker's. On top of the indeterminacy of the speaker and hearer's knowledge about their language, no two experiences are identical. Hence any choice of words and constructions by the speaker will not precisely characterize the construal of the experience being communicated, since their prior uses were applied to different experiences. As a result, there is a fundamental indeterminacy in the construal of an experience and its interpretation in a communicative act. Both speaker and hearer must fall back on their experience of the current situation itself as well as prior experiences (see also Croft 2000: 99–114, 2001: 115, 124–130).

4.2. Interactors and selection: the role of speakers

Once there is variation in replication, there can be change by replication. While change can take place by random processes (drift—note that the genetic sense of 'drift' is not the same as Sapir's sense), the most interesting change processes occur via selection. The philosopher of science David Hull's General Analysis of Selection (Hull 1988) generalizes the theory of evolution, so that it abstracts away from particular structures and mechanisms of selection in biology. Hull applies the General Analysis of Selection to conceptual change in science in his 1988 book (see §5.4). It is a relatively short step from there to apply it also to language change (Croft 2000).

Hull argues, along with many other evolutionary biologists, that 'evolution through natural selection is (I repeat!) a two-step process' (Mayr 1978, cited in Hull 1988:217). The first step is the generation of variation through replication, as just described. The second step is what Hull calls selection: 'a process in which the differential extinction and proliferation of interactors *cause* the differential perpetuation of the relevant replicators' (Hull 1988:409). Selection introduces two other functional roles in evolution, the interactor and the environment: '*interactor*—an entity that interacts as a cohesive whole with its environment in such a way that this interaction *causes* replication to be differential' (ibid., 408). A cohesive whole interacts with its environment, and the result of that interaction—greater or lesser survival of different interactors—causes differential replication of the "relevant" replicators. The canonical selection process in neo-Darwinian evolutionary theory posits the organism as the interactor and the genes that the organism possesses and reproduces (if the organism survives and reproduces) as the relevant replicators.

Note that Hull's theory is highly schematic, in order to allow it to be applied to change by replication in domains other than biological evolution. For example, it only states that there is a "relevance" relation between interactor and replicator. Hence the fact that an organism's genes

determine many of the phenotypic traits of the organism is not part of the General Analysis of Selection. Nor does it specify what the mechanisms of replication or selection are. Also, Hull suggests that different types of entities function as interactors in biological evolution, not just organisms (Hull 1988:409). Replicators require structure that can be passed on more or less intact in replication; Hull argues that the gene is the clearest replicator in biology, though he suggests that populations might have structure that persists in replication (ibid.).

There are multiple logically possible ways to instantiate the General Analysis of Selection in language. In Croft (2000), I argue that the most useful instantiation is to treat the speaker as an interactor and tokens of linguistic structures in utterances—linguemes—as replicators (the Utterance Theory of Selection; Croft 2000:25-30). This allows us to represent linguistic categories (as well as speech communities and languages) as populations in a lineage-based linguistics, and return to the question of the speaker's role in a theory of language.

Replicators and replication play the most central role in lineage-based linguistics. Most but not all linguistic replicators are behaviors, that is, the production of signals (sounds, gestures, etc.) by interlocutors in communicative interactions. Individual speakers and their knowledge of language play a supporting but essential role. Speakers choose what experience to verbalize and what signals to use in their verbalizations. Hearers (including the speaker hearing herself) interpret those signals, and their interpretation becomes part of their knowledge about their language. Signals—linguemes—cannot replicate by themselves; speakers (re)produce linguemes. (It is no different in biology: meiosis involves cells hosting chemical processes, and those cells in turn exist by virtue of being functional parts of the organism.)

Of course, we cannot, or have not yet found a way to, see the cognitive part of the actual process of replication in action. We only observe the result—the signal produced. So we cannot assume that what is going on in a speaker's head is actually replication, that is, starting from traces of previously produced or heard linguemes and recombining those traces in order to produce the new utterance. But the usage-based and especially exemplar-based model, and the psycholinguistic evidence supporting it (see references in §2), suggests that it is plausible to assume that speakers are basing their current productions on knowledge of prior productions. Additional evidence that suggests that replication is the cognitive process in production is the phenomenon of priming, and the primacy and recency effects in psycholinguistics, all of which suggest that particular exemplars, not just some category abstracted from prior exposure to utterances, serve as the basis of speaker production. Likewise, the phenomenon of accommodation also suggests that speakers are using just heard utterances of their interlocutors as the basis for their own utterance productions.

4.3. Linguistic categories as populations

In order to explain the population definition of linguistic categories, we start with the definition of a single word, such as English *heart*. In an essentialist theory, English *heart* is a single individual abstract unit with a particular form and meaning, possibly multiple meanings, as in a dictionary entry. In the essentialist view, the word has as an essential property its word class, as asserted in introductory linguistics and syntax textbooks in various approaches, generative and otherwise (e.g., Carnie 2013:44; Fabb 2005:11; O'Grady et al. 1997:164; Finegan 2007:35).

In the population view, English *heart* is a population of uses of the word, replicated through the lifetimes of speakers of English and, thanks to the overlap of generations of speakers, through the history of the language. Thus, a word as a population has a historical (temporal) as

well as a spatial dimension. Of course, for a single speaker, the most relevant uses are those in that speaker's direct experience. But the uses that speaker is exposed to are replications of prior uses outside the speaker's immediate spatiotemporal experience, and those prior uses influenced the uses that the speaker experiences. The uses of *heart* in the English speech community form a lineage, or rather a set of intertwining lineages of replications of prior uses. These lineage structures may not seem very relevant to the analysis of a common word such as *heart*: we mostly pronounce it the "same" way and give it the "same" meaning. The lineage of uses is more obviously central to the understanding of a theoretical term such as *adjective* or *language universal.* The word's lineage is reflected in citations in the linguistic literature referring to prior uses of the term, tracing the history of its use and the evolution of its meaning.

The same appears to be true of sounds as populations. As noted in §2, in the exemplar model of phonology, a single phoneme is a cloud of exemplars mapped onto phonetic space. It is often the case, however, that the phonetic realizations of, say, different English vowel phonemes phonetically overlap. That is, the phonetic properties of the vowel in an utterance in themselves do not indicate to the hearer which vowel phoneme the vowel token belongs to. In some cases, the quality of a vowel is influenced by coarticulatory effects of neighboring phonemes. More generally, however, the phoneme category is defined by the word that the phoneme occurs in; this is why, for example, English dialectologists refer to a vowel by set of words that the vowel occurs in through history and dialect diversification, e.g. the TRAP vowel (see for example Gordon et al. 2004, chapter 6). In other words, the phoneme as a phonological category is partly defined by its grammatical context, namely the position in the phonological template of the word it occurs in (Vihman and Croft 2007:718-19). The phoneme population is defined as the relevant phonological part of replications of the set of words that contain that phoneme.

The same applies to word classes vis-à-vis constructions, mutatis mutandis. Word classes are distributionally defined. They are therefore language-specific and construction-specific (Croft 2001, chapters 1-2). What makes *heart* an English Count Noun is not some inherent property but rather its occurrence in the relevant role in the morphological [COUNTNOUN-PL] construction. The [COUNTNOUN-PL] construction is a population of replications of form-meaning pairings, including replications of *hearts*. Hence the English Count Noun class is a population of elements occurring in the corresponding population of the [COUNTNOUN-PL] construction. The [COUNTNOUN-PL] construction is in turn a recombinant part of the subpopulation of English utterances that contain that construction. The same applies to syntactically-defined word classes. The English Passive Subject, as in ***She*** *was fired by Musk*, is a population consisting of the phrases that occur in the relevant role in the population of the English Passive construction.

Since populations are individuals, not kinds, their names are proper names, not common nouns. In English, proper names are capitalized, as in *Joseph H. Greenberg*. Specific speech communities and languages are populations (see §3.3). Their names are also proper names, and capitalized: the Basque speech community and the Basque language. Language-specific word classes and other grammatical categories are populations as well. In typological practice, language-specific grammatical categories are capitalized: Russian Perfective, Warlpiri Ergative. This typological convention accurately reflects the fact that language-specific grammatical categories are individuals, specifically populations.

5. Kinds and populations in comparison and description

I have presented an ontology of entities and categories of entities that pertain to linguistic phenomena. Kinds, also known as types or essentialist categories, are categories of entities that are defined by a set of properties whose definitions in turn are unbounded in space and time. These properties are typically inherent properties of entities, applicable to the entity as a whole (e.g. turquoise as a mineral) or to its parts and structure (e.g. the chemical composition of turquoise). Individuals, also known as historical entities, are spatially and temporally bounded. Individuals have structure; some categories of individuals of interest here are cohesive wholes. A population is made up of individuals, and is defined relationally, specifically by the relation of replication. A population as a whole is itself an individual: it is spatiotemporally bounded.

In the preceding sections, I have argued that many linguistic phenomena, including linguistic structures and categories are populations, not kinds, contrary to assumptions made in most linguistic theories. In this section, I will discuss some recent proposals that pertain to the ontological distinctions summarized in the preceding paragraph.

5.1. Comparative concepts vs. language specific categories

There has recently been considerable debate around the contrast between what Haspelmath (2010, 2018) calls 'comparative concepts' applied across languages in typological analysis, such as 'adjective', and language-specific categories, which Haspelmath calls 'descriptive categories', such as 'English Adjective'. The positions range from assuming that there is no contrast between comparative concepts and language-specific categories, to the view that between the two there is an 'ontological difference: comparative concepts are a different kind of entity than descriptive categories' (Haspelmath 2018:84).

I have argued for the latter view, but not defined in quite the same way as Haspelmath, and not explicitly using the ontology presented here. Comparative concepts are kinds, while language-specific categories are populations. In the uniform view, both comparative concepts and language-specific categories are kinds.

Some issues arise in comparing the linguistic phenomena to nonlinguistic phenomena. Dahl discusses a philosophical contrast between 'Universal' and 'Individual' (Dahl 2016:427). He identifies the basic contrast as being between a Universal category defined independently of time and space (and named by a common noun) and an Individual entity, whose definition is bound to time and space (and named by a proper name). However, Dahl then discusses interpretations of the source of the defining properties (realist, conceptualist or nominalist). Haspelmath takes up this digression to argue that only 'natural kinds' are defined in realist terms ('properties independent of our minds', citing Dahl 2016:428), and therefore claims that comparative concepts are not kinds, or at least not what he calls 'natural kinds' (Haspelmath 2018:90). This is because, according to Haspelmath, comparative concepts are created by linguists; they aren't "there in nature" (the realist theory). Haspelmath goes on to say that this is what distinguishes natural kinds from comparative concepts: the latter are created by observers. He also suggests that nonlinguistic concepts like 'mountain' are comparative concepts, but not natural kinds.

I will return to this point in §5.3. The central point here is that what defines a kind is that the set of properties apply independent of space and time, not where those properties came from—"reality" or "our minds". Perhaps this is not a critical difference, because both comparative concepts, whether linguistic or non-linguistic, and "natural kinds" are kinds. This is usually

described by saying that comparative concepts must refer to cross-linguistically valid properties that can be applied to all languages, not properties that can only be defined with respect to a single language (Croft 2003). Haspelmath also describes comparative concepts in this way (Haspelmath 2018:88-89).

Haspelmath also includes biological species as 'natural kinds' in his sense, because a species is 'a category of animals that form a group regardless of any observers" (Haspelmath 2018:90). But species are not kinds, according to population thinking in biological evolution. Dahl (2016:433) and Spike (2020:477-78) criticize Haspelmath for including biological species as 'natural kinds', because their definition is not obvious. But Dahl does not discuss population thinking; Spike mentions it as just one way of thinking of species, without further discussion. As we will see in §5.4, both Dahl and Spike are correct in stating that the definition of species is controversial in biology and philosophy. But I wish to clarify here what is going on in languages before turning to nonlinguistic phenomena.

5.2. Language comparison and description, kinds and populations

Haspelmath and others, myself included, have focused on comparative concepts used in typology and language-specific categories such as word classes or phonemes. I have argued here (and elsewhere, albeit in different terms) that comparative concepts are kinds and language-specific categories are populations. But it would be incorrect to say that language comparison is, or should, only be done using comparative concepts (kinds), and single language description is, or should, only be done using language-specific categories (populations).

There is an entire subdiscipline of linguistics devoted to comparison of languages as populations: (comparative-)historical linguistics. In comparative historical linguistics, languages are compared to identify cognate forms, and to trace lineages from a parent language to the various descendant languages: sound changes, etymologies and grammaticalization chains and other paths of syntactic or constructional changes. It is just typology that primarily is based on comparison using kinds: cross-linguistically valid properties of linguistic function and even of linguistic form. This is what the term 'typology' indicates: comparison of languages with respect to types (kinds). We can refer to these as HISTORICAL COMPARATIVE CONCEPTS and TYPOLOGICAL COMPARATIVE CONCEPTS respectively.

And historical linguistics and typology are not completely independent fields of study. Language sampling for typology takes into account language history by constructing a genealogically and geographically diverse sample, to mimimize the likelihood of historical relatedness of the linguistic phenomena being compared, due to descent or contact. Diachronic typological universals are universals of language change that are manifested directly in language lineages, where we have evidence for them. Diachronic typology dates back to the emergence of modern linguistic typology (Greenberg 1964, 1969, 1979). Many typologists believe that many if not all synchronic typological universals of language are best explained by universals of language change, i.e. diachronic typology. In comparison, a typologist employs both kinds (typological comparative concepts) and populations (language history and phylogeny, i.e. historical comparative concepts).

Conversely, language description involves describing, that is, categorizing, linguemes—tokens of language use—in terms of substantive properties of language form and function, that is, kinds. A description of the phonology of a language, among other things, roots the phoneme descriptions in terms of phonetic properties. A description of the morphosyntax of a language

roots the word and construction descriptions in terms of semantic and discourse properties, which are kinds, as well as certain basic formal properties such as zero vs. overt coding, linear order and so on which are also kinds. We can describe kinds in language description as TYPE PROPERTIES.[2]

There are also properties that pertain to grammatical categories and constructions as populations. We can describe population-based properties grammatical categories and constructions as HISTORICAL PROPERTIES. For example, the fact that *afraid* is predicated in the English Copula construction (*He was afraid of the consequences*) is a historical property of *afraid*. The spatiotemporally bounded nature of this property can be seen from the fact that predication of *fear* is expressed in the basic English Predication construction (*He feared the consequences*). More generally, distributional properties are historical properties.

Properties of constructional function can also be historical properties. For example, the fact that the English Copula construction is used for property predication (*She is tall*), object predication (*She is a professor*), and location predication (*She is in her office*), that is, the polysemy of the English Copula construction, is a historical property of that construction. This is evident in that this pattern of polysemy is not found in all languages. In contrast, the fact that the English Copula construction includes overt coding of the predication function (in the copula) is a type property of the construction. Overt (vs. zero) coding of a function is a property applicable to a construction independent of its spatiotemporal, that is, historical, nature.

There is another important way in which language description involves the analysis of linguistic properties of kinds and populations, even in the perspective of a population-based analysis of linguistic categories. In the population-based model, categories of linguemes are grouped together by shared lineages. These lineages are produced in the process of replication. Replication involves inheritance: replication is mostly faithful, and replicates possess most of the structure of the parent replicator (see §4.1). This structure can be described as properties of the lingueme's form and function. Yes, they can and do change over the course of replication, and any property of structure can change, so the population as a whole cannot be given an essentialist definition. But what is interesting of course is the very changes in type properties that occur in replication. These "unfaithful" changes that happen in replication are indeed the same changes that typologists are looking for in diachronic universals (Croft 2010, 2016). And these type properties play a major role in causing language changes to be the way they are.

5.3. The importance of distinguishing kinds and populations in linguistics

The real issue is: what language phenomena are best analyzed as populations, and what phenomena are best analyzed in terms of kinds? And: what properties of a linguistic category or construction are historical properties, and what properties are type properties? From this basic ontological perspective, it appears to me that the most controversial issue is whether grmamatical categories in specific languages should be analyzed as kinds or populations. The proposal here (and in Croft 2000 and subsequent publications, such as Croft 2021, 2023) is to treat language-

[2] Type properties are close to what Haspelmath (2018:86-8) calls 'etic comparative concepts'. Haspelmath argues that these are not relevant to description of specific languages. But this is not true: any language description will and should describe the phonetic realization of phonemes and the range of functions of morphosyntactic forms. Haspelmath seems to be assuming a monosemy analysis of linguistic forms, with a single type property covering all and only the meanings of a word or construction, or all the phonetic values of a phoneme. But this is overwhelmingly not the case for phonemes or constructions.

specific grammatical categories as populations. The population analysis of linguistic categories is a plausible extension of the usage-based, exemplar-based model of language. It is also a natural extension of the Radical Construction Grammar analysis of language-specific categories as derivative of the constructions that define them.

The more standard approach to specific language categories is to define them as kinds, more specifically, as instances or subtypes of the more general kinds that are taken to be comparative concepts. For words, their syntactic category is usually treated as an essentialist property of the word (see §4.3). This approach leads to problems for both the definition of specific language categories and of comparative concepts, that is, categories that can be applied across languages. These topics have been discussed more extensively elsewhere, so the summary here will be brief.

The problem for defining specific language categories as kinds—an essentialist definition—is that methodologically, it is generally agreed that the syntactic analysis proceeds by what American structuralist linguists called distributional analysis. Distributional analysis is the occurrence of linguistic elements, e.g. morphemes, words, or larger syntactic units, in a role (also called slot) of a construction, for example in the Subject role of the English Passive Construction. Anything that occurs in that role is a member of the Passive Subject category, and anything that doesn't, isn't.[3] Yet this is patently language-specific: the English Passive Construction is a construction of English, and the phrases that occur in its Subject role are English phrases. Occurrence in the English Passive Construction is not an inherent property that could be used to define a 'passive subject' comparative concept across all languages.

The usual strategy to deal with this anomaly is to consider the distributional facts in particular languages as "diagnostics" for identifying the essentialist cross-linguistic category of passive subject, of which the English Passive Subject is an instance. But the diagnostics have to be different in different languages. This leads to disagreements on analysis: one linguist's diagnostic is another linguist's irrelevant grammatical distribution. If one believes the essentialist category exists in the language, then one finds a diagnostic that will indicate it; if one doesn't, then one doesn't find such a diagnostic. This is what I call methodological opportunism (Croft 2001), and Haspelmath (2018:101-2) calls diagnostic-fishing.

The flip side of this problem is positing universal linguistic categories as comparative concepts. Linguistic categories are distributionally defined, hence language specific. Moreover, they are populations, not kinds. Nevertheless, there are ways to compare categories across languages, and even to do distributional analysis across languages, without engaging in methodological opportunism. Basically, one uses cross-linguistically valid properties, i.e. comparative concepts in Haspelmath's and my sense, to align both the construction determining the distribution and the units that fill the relevant role in the construction for the distribution.

For example, in Croft (1991, 2001) I fix the constructions determining the distribution for major parts of speech to be the propositional act constructions for reference, predication and modification constructions of a language. The propositional act function is a type property of the construction, defined in information-packaging terms. Most languages have multiple, different strategies for expressing reference, predication and modification. I distinguish these strategies in terms of language-independent morphosyntactic properties, such as structural coding (the

[3] I am of course abstracting away from some important issues here, such as how the construction as a whole is interpreted depending on what occurs in the Subject role, differences in frequency of occurrence of different syntactic elements in the Subject role, and other usage-based phenomena that would necessarily affect the description of the English Passive Subject category. But my point is that even abstracting away from these issues still leaves serious problems in an essentialist analysis of a grammatical category such as "passive subject".

number of morphemes expressing the function) and behavioral potential (the number of cross-cutting functional distinctions that are formally expressed in the construction). These are type properties of constructional form. These two type properties generally converge to indicate the typological markedness of the construction's strategy, a universal ultimately explained by token frequency (see Croft 2003). Then I identify the words in the language that fill the relevant role in each language-specific reference, predication and modification construction, and compare them to the corresponding words in the other languages via their meanings or more precisely, their translation equivalents—also a type property.

Of course, when this is done, the actual distributional mapping varies across the languages, and across the different propositional act constructions in a single language. It turns out that there is an empirically observed typologically universal relationship between the semantics of the words (i.e. translation equivalents) and the morphosyntactic typological markedness properties of the reference, predication and modification constructions that they occur in. Specifically, there is a typological prototype of object reference, another prototype of action predication, and a third prototype of property modification, which are typologically unmarked as defined by structural coding and behavioral potential. I treat these prototypes as comparative concepts, and name them 'noun', 'verb' and "adjective' respectively.

There are three observations to be made about these typological comparative concepts. First, although a cross-linguistic distributional analysis was performed, the result was not a universal word class. The comparative concepts of noun, verb and adjective in *Radical Construction Grammar* and *Morphosyntax* are functional prototypes.

Second, these part of speech prototypes are not arbitrary observer-created categories. They are comparative concepts that emerged from the empirical data. The term 'prototype' is shorthand for typological universals of structural coding and behavioral potential. They reflect 'natural' properties in the data. Of course, like all empirical data, they are observed data.

Third, the 'comparative concept'—the functional prototype—is equally relevant to single language description. Object reference is the best place to start to describe a language's Noun word class, and action predication the best place to start to describe a language's Verb word class. And those starting points, coupled with the typological universals, are important for describing distributional variation in single language description. Languages have a very high degree of distributional variation for words and other units that fill the roles of larger constructions. But the same patterns of variation emerge in single-language analysis as in cross-linguistic typological analysis. It's just that cross-linguistic comparison with a diverse language sample is likely to reveal universal patterns of variation faster than a single language description.

Van der Auwera and Sahoo argue that comparative concepts and language-specific categories are 'the same sorts of entities', because 'they are both sets of properties' (van der Auwera and Sahoo 2015:139). This is not sufficient: everything is a set of properties, and properties can defined as anything. What matters is what kind of things they are—in this case, kinds or populations—and what kinds of properties they have—type properties or historical properties, or in the case of language comparison, typological comparative concepts or historical comparative concepts.

5.4. Additional issues in the ontology of theoretical concepts in linguistics and elsewhere

A good deal of the discussion in Dahl (2016), Haspelmath (2018) and Spike (2020) is about the vagueness of theoretical concepts such as 'mountain', or differences over theoretical concepts

such as biological species. Haspelmath calls 'mountain' a comparative concept rather than a natural kind because the distinction between a mountain and a hill is rather arbitrary (Haspelmath 2018:90). But Spike argues that 'mountain' is a useful theoretical concept in geology; for instance, orogeny, the process by which mountains are formed, is a phenomenon that has been studied extensively (Spike 2020:482). 'Mountain' may require more precise definition, or perhaps can only be defined in terms of certain geological processes. But it is clearly a kind, not a population: it is not a spatiotemporally bounded category.

The population theory of species is still contested in evolutionary biology (Mayr 1982:276, 279; Hull 1988:213, fn. 2). Hull's 1988 book uses this debate as a case study for Hull's General Analysis of Selection as a theory of conceptual change in science. Both Dahl (2016) and Spike (2020) appeal to the theoretical concept of a homeostatic property cluster to define biological species, following Boyd (1999). A homeostatic property cluster is a set of properties that most but not all members of the category have, and those properties are relatively stable. An appeal to a homeostatic property cluster allows for some members to lack properties, such that the category as whole cannot be defined by a set of properties; and those properties tend to persist over time.

It is hard to see how the homeostatic property cluster concept would be a useful one for defining species. It is a pseudo-essentialist concept: a set of properties that are not spatiotemporally bounded defines membership in the category, but not every member has to have every property, as long as they have most of the properties for a long enough period of time. But what counts as 'most of the properties', and what counts as a 'long enough period of time' is not defined. Defining a species, or a linguistic category, as a homeostatic property cluster does not predict the evolutionary properties of species or linguistic categories. However, if one adopts the population theory of biological species and linguistic categories, the population theory predicts that species will look like homeostatic property clusters, at least over a short period of time (or a not too lengthy sequence of replications). Replication is mostly faithful, so members of the population will share most of their type properties, at least over a relatively short period of time. But over longer periods, populations will evolve to the point that type properties of the original replicators may be completely lost and replaced with other type properties.

Both Dahl and Spike propose comparative concepts of linguistic categories as homeostatic property clusters. But the question is whether they are more useful as such than more precisely defined comparative concepts and language specific categories (and biological species) as populations. The methods and results that Dahl uses for tense-aspect categories (e.g. in Dahl 1985; see also Dahl and Wälchli 2016) are compatible with comparative concepts defined in cross-linguistically valid ways (i.e. as kinds) and a population theory of grammatical categories. Dahl and Wälchli argue that whereas most typological analyses proceed onomasiologically, starting from function or meaning and comparing languages as to how they express forms, they proceed semasiologically, proceeding from forms and comparing the range of functions or meanings they express (Dahl and Wälchli 2016:328-29). However, in order to compare forms across languages, Dahl and Wälchli must initially look at the set of functions expressed by the forms in order to categorize those forms in term of clusters or relevant functions (e.g. as 'perfect' or 'iamitive' in their 2016 article). So there is an initial onomasiological stage in their analysis, before grouping functions in terms of a shared form in a specific language.

Dahl (2016) and Gil (2016) suggest that different dialects, varieties and even languages may have the "same" category, e.g. the Perfect in different English dialects or the Relative Case in Eskimo-Aleut languages (Dahl 2016:430). Gil extends this idea to code-mixing and borrowing.

What these categories have in common is a shared lineage (language contact can lead to category lineages "jumping" from language to the next via bilingual speakers). These are historical comparative concepts, not typological comparative concepts. One can still ask how these grammatical categories are defined in the different dialects or languages. If they are defined by the same construction in all of the languages, that is, cognate constructions, then the grammatical category defined by that construction can be considered a legitimate historical comparative concept.

Finally, with respect to Haspelmath's concern with supposedly observer-free, naturally recognizable categories vs. categories created by observers: all categories are part of scientific theories. Scientific theories are debated by communities of scientists, such as typologists or descriptive linguists. As a result, the definitions of theoretical concepts vary across scientists. As a theory evolves, the definitions of theoretical concepts often change; the older definitions in retrospect seem vague, ambiguous, or just plain wrong. In other words, theoretical concepts in a scientific theory also form a population; they do not have essentialist definitions (this is the basic thesis of Hull 1988; see also Hull 2006; Croft 2024). However, we can ask for a particular scientist, or a particular publication of that scientist, whether her definition of a theoretical concept depends on spatiotemporal boundedness or not, and then conclude whether her theoretical concept represents a population or a kind.

6. Replicators, artifacts and language revitalization

In language endangerment research, and particularly among community members, the biological metaphor of languages as "living" or "extinct" has been criticized. Extinction implies that the language is gone forever. A language is instead considered to be 'sleeping' when there are no living speakers of the language. But a 'sleeping' language can be 'awakened' if there exists documentation that can be used by community members to start speaking the language again. The theory of language described in this chapter is obviously very close in structure to the theory of biological evolution, specifically population thinking in that theory. How does this theory accommodate language awakening?

In §4, replicators are described as instances of linguistic behavior, specifically the production and reception of utterances by interlocutors in acts of communication. The same applies to many other types of cultural evolution, such as pottery making, riding a horse, or music performance. Demonstrating the cultural act and its imitation are examples of cultural replication; these can of course also be mediated through verbal instruction.

But behaviors are not the only cultural replicators (Croft 2013). Artifacts are also cultural replicators. They are individuals with structure that can be replicated with varying degrees of faithfulness. They form lineages that diverge, and can for example provide archaeologists with evidence of cultural evolution. Replication involving artifacts need not include direct interaction between the person who created the artifact and the person who is replicating the artifact. 20th century Pueblo potters replicated pottery designs from pre-contact artifacts dug up by archaeologists. Musicians today replicate musical compositions in performance from the past—up to a thousand years ago for European music.

Finally, written language is an artifact that can serve as a replicator. In this and other publications, I have replicated technical terms and the theoretical concepts they express from linguists I have not met. I can even replicate concepts, albeit in translation, from Greek philosophers from over two millennia ago. More recently, audio and video recordings are also

artifacts of languages, including languages without writing, that can be replicated without the speakers who were recorded being around.

If a language stops being spoken, the lineages of behavioral replicators end; but if there are artifactual replicators, they will survive as long as the artifacts survive. This is unlike behavioral replicators, which vanish as soon as they are produced, except for the traces in the memories of those who heard or produced them. Of course, the meaning and context of use of replicators must be inferred, and much of that is difficult if not impossible to extract from artifactual replicators after their initial (re)production, though such replicators may be supplemented with, for example, translations that shed light on their meaning.

The artifactual replicators (writing, audio, video) that survive can serve as the parent of future behavioral replicators which can be replicated in social and functional contexts resembling those of the behavioral replicators that came to an end with the deaths of the previous fluent speakers. Due to the lack of context of artifactual replicators, once they are replicated anew in interpersonal communication, they will be altered in function, as Modern Hebrew is compared to its Ancient Hebrew ancestor. But all languages change, so this phenomenon is not surprising.

7. Conclusion

Linguistics is a scientific discipline whose object of study—language, its structure, function and social context of use—is not kinds but populations: speech communities and the speakers that belong to them, and utterances and the grammatical categories and constructions (i.e., linguemes) that constitute them. A population is a set of individuals that are connected to each other through intertwining lineages of replications, and distinguished from other populations by the (near) absence of replication relations with individuals in the other populations. Both populations as wholes and the individuals that make them up are spatiotemporally bounded, that is, historical entities. The replication process is a social-interactional one; hence grammatical categories are in effect social histories of the use of the linguistic form in a speech community. This is lineage-based linguistics. Although populations and individuals are historical entities, they possess type properties, at least for a period of time, and those type properties enter into causal relations with the evolutionary processes of replication and selection of individuals in the populations. Lineage-based linguistics thus requires identifying what is a historical entity (individual or population) and what is a kind, and how their interplay allows us to describe languages and explain language diversity and change.

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