Diachronic Semantics

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Abstract

It is well established that meanings associated with linguistic expressions evolve in systematic ways across time. We have little precise understanding, though, of why and how this happens. We know even less about its implications for our models of grammar, communication, and cognition. This article reviews developments and results from grammaticalization, typology, and formal semantics/pragmatics that can be brought to bear on addressing the problem of semantic change. It deconstructs the notion of grammaticalization paths and offers a set of questions for systematic investigation, following which I contextualize the small body of literature at the intersection of formal semantics/pragmatics and language change. The approach I take is programmatic rather than survey oriented, given the emergent nature of the domain of investigation and the limited body of existing literature that pertains directly to the questions raised here.

1. INTRODUCTION[1]

Language, as a communication code, aligns linguistic forms with nonlinguistic concepts. Forms are concrete, whereas concepts are always abstract. Forms are subject to change, whereas concepts, for the most part, remain invariant. Diachronic semantics, at its core, is the study of the changing associations between concrete, changeable forms and abstract, unchanging concepts. These stable associations between forms and concepts are what we call linguistic meanings, given by conventions of interpretation. Thus, diachronic semantics is the study of observed patterns of change in conventions of interpretation.

One might expect that changes in conventions of interpretation are inevitable given that the transmission of the linguistic code across generations of speakers is always imperfect. However, it does not logically follow from imperfect transmission that changes from earlier to later stages of a language's grammar must occur along systematic trajectorial paths. Nonetheless, we find that changes in associations between forms and concepts do often exhibit such systematicity across languages. Research over the past four decades in the linguistic subdisciplines of grammaticalization and typology has revealed a number of robust cross-linguistic generalizations about patterns of change in such conventions of interpretation. This scholarship, focusing on the functional/grammatical lexicon of languages, investigates observable similarities in the ways that lexical expressions get recruited to create functional expressions and the ways in which functional expressions themselves undergo changes in meaning. Detailed descriptions of several such changes in the functional domain can be found in Dahl 1985; Traugott 1980, 1982; Bybee & Dahl 1989; Bybee 1994; and Heine 1993, 1997, 2003 (among others). These evolutionary patterns have been expressed primarily in the form of unidirectional diachronic trajectories—"grammaticalization paths" or "clines." One example of such a path is the cross-linguistically robustly observed change (Kru, Ewe, Romance, German, Indo-Aryan) in which resultative aspect markers diachronically shift to marking perfect aspect and later to marking perfective aspect or past tense (Bybee et al. 1994; Dahl 1985, 2000). Crucially, changes in the reverse direction, in which, for instance, past-tense marking is recruited to create perfect-aspect marking, are not attested.

The finding that paths of semantic evolution for grammatical forms are constrained and trajectorial poses a formidable problem for theories of both linguistic meaning and linguistic change. Why should it be that changes in the conventions of interpretation involving grammatical forms that are disconnected across space and time exhibit such similar evolutionary paths? This review addresses the question by synthesizing the findings and insights from two distinct research traditions within linguistics: grammaticalization/typology and formal semantics/pragmatics. Although both disciplines are centrally concerned with the meaning of functional/grammatical expressions in grammar, their approaches have historically been quite different.

Research in grammaticalization has adopted, for the most part, a functionalist, usage-based approach to grammar (e.g., Givón 1979; Bybee 2003, 2006; Traugott & Dasher 2002; Hopper & Traugott 2003). In this view, grammar is taken to be an emergent object shaped by the cognitive and communicative functions of language rather than a static object with abstract formal properties. Functional expressions are not taken to correspond to discrete invariant categories, because they are often gradually changing along a continuous trajectory from one category to another (Bybee 2010, p. 2). One consequence of this usage-based view of linguistic structure has been that the formal machinery used in synchronic semantic/pragmatic theories is assumed to be incompatible with developing an understanding of dynamic processes underlying variability and change in conventions of interpretation.

[1]This review builds on the synthesis of ideas and perspectives presented first in Deo (2014) and overlaps partially with the content of that article.

In contrast, formal approaches to linguistic meaning have typically taken an atemporal perspective on their explanandum. The focus has been on identifying the conceptual and communicational principles that characterize meaning subsystems. Providing empirically adequate and precise descriptions of the interpretation of functional expressions in particular languages and their cross-linguistic comparison is at the center of this enterprise.[2] This investigation of the mapping between the linguistic lexicon and the conceptual lexicon relies on nuanced native-speaker judgments that allow indirect access into the minds of the encoders and interpreters of a language. Because the focus has been on understanding the nature of the conceptual lexicon and constraints on the form–concept mapping, the dynamic processes that underlie variability and changes in conventions of interpretation that relate forms to concepts have been considered to be outside of the purview of the discipline.

The investigation of systematic paths of semantic change in linguistic systems brings up questions of the logical relation between related functional categories (progressive versus imperfective, locative versus possessive, etc.), the way in which such categories get introduced in languages, and the precise nature of the functional pressures involved in grammaticalization processes. The perceived divide between functional and formal approaches to meaning has led to these questions remaining in the margins of what is considered to be the explanandum for semantic theories. However, in recent years, theories of meaning have increasingly evolved in the direction of precisely modeling the interaction between semantic content, utterance context, and pragmatic pressures in the generation of meaning (e.g., Roberts 1996, Levinson 2000). There has been innovation in the application of mathematical modeling techniques to understanding the structure of knowledge in context and the interaction between speakers and hearers that results in exchange of knowledge (e.g., Blutner 2000, 2004; Parikh 2001; van Rooij 2004a,b). In such an intellectual context, the divide between functional and formal approaches to meaning becomes unnecessary because the goals for both approaches converge to that of understanding the diverse factors that structure language. The substantive question boils down to describing the precise content of the relevant cognitive and communicative factors and the dynamics of their interaction in context. This review outlines such an approach to the study of systematic changes in conventions of interpretation, building on the tools that have been developed within the synchronically oriented program of formal semantics and pragmatics.

In synthesizing the grammaticalization and semantic/pragmatic views, I hope to show that an agenda that reconciles subdisciplinary concerns is not only possible but essential for understanding the associations between forms and concepts (i.e., linguistic meanings) and the ways in which they undergo change. Furthermore, I argue that semantic change phenomena can offer a new perspective that influences both how synchronic states of a grammar are interpreted and what the constraints on synchronic semantic theorizing are taken to be. In general, any theory of a system at a synchronic state has implications for diachronic transitions into and out of that state, and semantic theory is no exception. A careful study of well-attested grammaticalization paths, which involve systematic shifts between functional meanings or from lexical to functional meanings, can help shape a theory that explicates these implications. The ultimate goal is to work toward an amphichronic program (Kiparsky 2006) for semantics in which linguistic explanations are not a priori either all diachronic or all synchronic but can be empirically determined to be one or the other on the basis of systematic investigation.

The organization of this article is as follows: Section 2 reviews relevant literature on grammaticalization paths. I argue that such paths are best understood as complex clusters of phenomena involving recruitment of lexical items for expressing functional meanings, the categoricalization of their functions relative to an existing grammatical system, and changes in such functions (e.g.,

[2]As von Fintel (1995, p. 177), in a programmatic paper on grammaticalization, remarks: "The semantics of determiners, modals, tenses, aspects etc. is after all the bread and butter of working semanticists."

semantic bleaching or generalization) over time. This interpretation motivates a bipronged approach to diachronic semantics that simultaneously studies the structural and dynamic aspects of semantic change. Section 3 reviews results from the application of formal modeling to particular problems of grammaticalization. Section 3.1 focuses on scholarship that investigates the structural component of diachronic semantic explanation, and Section 3.2 introduces ideas from bidirectional optimality-theoretic pragmatics, game-theoretic pragmatics, and iterated learning models as they are applied to questions of grammaticalization. Finally, Section 4 offers some concluding thoughts and discusses directions for further research.

2. THE GRAMMATICALIZATION PATH

2.1. The Phenomenon

The basic premise of research in grammaticalization is that language structure can be best understood in terms of how it has evolved because it is created as language is used (Hopper 1998; Bybee 2006, 2010).[3] As Bybee (2006) observes, a usage-based view of grammar holds that grammar is the cognitive organization of an individual's experience with language and is therefore shaped by different facets of such experience. In particular, change in grammatical structure is rooted in actual events of grammar usage and the frequency with which they occur. For instance, the production of innovative collocations and their licensing of pragmatic inferences in the context of speaker–hearer interactions are particular events. These may be replicated over time and gradually increase in frequency, leading to alterations in how the innovative collocations are represented in an individual's (and over time, a population's) grammar.

The finding that such events, the resources they use, and the effects of their replication on grammars are regular in certain ways has led to the claim that semantic change occurs along well-defined evolutionary paths (Bybee 1994, Traugott 1999, Traugott & Dasher 2002, among others). These paths, which are often described as reified patterns, encode information about the lexical material harnessed to create particular functional resources as well as the changes undergone by grammaticalized material within functional domains. Some examples of such cross-linguistically robust patterns are provided in observations 1*a–d*. For each of these trajectories, the observed change is unidirectional; in other words, there is little evidence of change in the opposite direction (e.g., from the imperfective to the progressive or the past to the perfect).

(1a) Progressive markers generalize to markers of imperfective aspect (Comrie 1976, Bybee 1994).

(1b) Resultative markers generalize to markers of perfect aspect and past tense (Dahl 1985, 2000; Bybee 1994).

(1c) Expressions encoding location evolve into expressions encoding alienable and inalienable possession (Clark 1978, Aristar 1996, Heine 1997, Stassen 2009).

(1d) Expressions restricted to expressing deontic modality diachronically acquire epistemic uses, but not vice versa (Shepherd 1982, Traugott 1989, Traugott & Dasher 2002).

Treating such paths as reified objects has had the effect of making unidirectionality a central point of debate; skeptics have argued against the existence of directed mechanisms of change (Ramat

[3]These ideas, in their modern form, can be traced back to Givón (1971, 1979) and can be neatly described with his slogans *Today's morphology is yesterday's syntax* (Givón 1971, p. 12) and *Today's syntax is yesterday's discourse* (Givón 1979, p. 209).

1992, Janda 2001, Joseph 2001, Newmeyer 2001) by providing examples of degrammaticalization, and proponents have argued that the low statistical frequency of apparent exceptions is evidence that such directed mechanisms do exist (Traugott 2001, Heine 2003, Brinton & Traugott 2005).

Regardless of whether possible counterexamples exist, it is striking that the semantic categories involved in such paths are cross-linguistically stable. This finding strongly suggests that functional expressions across languages express concepts drawn from some small set of well-defined possibilities. For semantic and pragmatic theories, the very existence of such regularities, whether exceptionless or not, is significant in that it potentially provides clues to the conceptual structures underlying the semantic categories of natural language and the mechanisms by which elements of conceptual structure are packaged into functional material.

2.2. Deconstructing Grammaticalization Paths

Deo (2014) provides a perspective on the investigation of semantic change that relies on the assumption that there is a common core of functional meanings that human languages may encode grammatically. The idea is that not all such possible functional meanings are realized in the inventory of overtly expressed functional meanings of a language at any given stage. However, over time, there will be changes within this inventory. Deo notes that logically there can be three types of changes to the functional inventory of a language: (*a*) recruitment, in which the inventory of overtly expressed functional meanings increases (e.g., when a language without a distinct marker of alienable possession develops one); (*b*) loss, in which there is a reduction in the inventory (e.g., when changes lead to the loss of a morphosyntactically expressed contrast between the perfect aspect and the past tense); and (*c*) redistribution, in which functional material acquires new uses relative to a semantic domain (generalization) or becomes obligatory, rather than optional, in certain contexts of use (categoricalization). Note that each of these changes, including loss, necessarily involves changes in conventions of interpretation.

This logical space of possible changes in the system of functional elements in languages allows us to deconstruct grammaticalization paths such as those in observations 1*a–d* into complex but structured clusters of discrete phenomena. The phenomena themselves can be reduced to recruitment, categoricalization, generalization, and loss of functional exponents. Once deconstructed thus, Deo (2014) poses a set of questions that can be addressed by a theory of semantic change.

(2a) What is the semantic content corresponding to the functional expressions that constitute the input to or the output of a grammaticalization path?

(2b) What is the logical relation between the meanings of these expressions such that a "path" may exist between them?

(2c) What are the necessary and sufficient conditions for the recruitment of lexical material to generate functional material?

(2d) What factors of usage and grammar are involved in categoricalization and generalization of innovated functional material in a given linguistic system?

(2e) Is reduction in inventory (i.e., loss) spontaneous, is it a concomitant of generalization, or can it be both?

These questions ground the study of semantic change within the broader enterprise of the investigation of linguistic change. In particular, they are closely related to the theoretical questions that Weinreich et al. (1968) consider in their empirically based investigation of language change

more generally. Questions 2*a* and *b* deal with the constraints problem for semantics. Question 2*c* addresses the actuation problem: What are the relevant cognitive contrasts and communicative goals that determine the emergence/recruitment of new semantic variants in a semantic subsystem? Why do alternative forms for expressing existing meanings arise in languages at all? Questions 2*d* and *e* illustrate the semantic version of the embedding and evaluation problems: How are innovated variants embedded within the larger linguistic matrix in which they occur, and how can the functional load they carry be evaluated relative to such a matrix? The propagation of innovated variants across a population cannot be attributed to mere imitation of newly emerged variants but must be systematically related to the pragmatic uses to which such forms are put and the contrasts that they enable speakers and hearers to linguistically access. The dynamics of the propagation process in a given semantic domain—or the transition problem—can be better addressed if we are able to precisely identify the usage conditions of innovated variants. Finally, we must consider the relation between the propagation of innovated variants and the priorly existing system (question 2*e*). Specifically, does the loss of a functional expression causally lead to the propagation of innovated variants, or is loss an effect of the competition between innovated and existing variants?

2.3. Structural and Dynamic Components of Semantic Change

Before we examine how formal semantic/pragmatic theories have been and can be harnessed in addressing questions 2*a–e*, it will be useful to distinguish between two aspects of a substantive explanation of grammaticalization paths. The first aspect has to do with the logical content of participating categories: What are the meanings that get conventionalized and altered over time (questions 2*a* and *b*)? The second has to do with the dynamics of change: How do new conventions of interpretation emerge over time (questions 2*d* and *e*)?

Although both aspects have been extensively explored in traditional grammaticalization approaches, they remain to be grounded in formally explicit and experimentally verifiable models. Furthermore, it is sometimes difficult to tease apart the description of a given change from the mechanism that is taken to effect that change. Consider, for instance, the assumption that a central mechanism in (semantic) grammaticalization is reanalysis, in which contextually arising pragmatic implicatures or invited inferences are "reanalyzed" as being part of the semantic content of expressions (Heine et al. 1991, Traugott & König 1991, Traugott & Dasher 2002). But, as Traugott (2011, citing Harris & Campbell 1995 and Andersen 2001) herself points out, such changes typically obtain during the acquisition process, in which ambiguous input is parsed by the language learner using a grammar that is distinct from the grammar that generated the input. The mechanism that leads to change in this case is the process of language acquisition, whereas reanalysis can, at best, be construed as a static description of the difference between conventions of interpretation at earlier and later stages of the language. A similar argument can be made for semantic generalization and bleaching, which also amount to descriptions of the relation between conventions of interpretation at prior and later stages, and do not provide insight into the dynamic aspects of meaning change.

Any adequate explanation for grammaticalization paths involving functional categories must distinguish between two components of the explanation: the static, structural one and the dynamic one.[4] In explicating the structural component of semantic change, what is needed is a precise

[4]We can understand this distinction using a parallel from phonology. An explanation of a synchronically observed pattern such as nasalization of vowels in prenasal context is based on the mechanics of articulation and its acoustic correlates on the one hand (the structural component) and the mechanism(s) by which these acoustic effects come to be interpreted differently by individuals and propagated through a speech community (the dynamic component) on the other.

characterization of the logical and conceptual relations (i.e., the similarities and differences) between the meanings of related functional categories, such that the transition from one meaning to another is rendered natural. The dynamic component, on the other hand, draws from theories of language use and language evolution to provide a plausible account for the recruitment of new functional exponents, their categoricalization, and subsequent generalization to a broader meaning under normal conditions of usage and transmission.

3. FORMAL TOOLS IN DIACHRONIC SEMANTICS

Research at the intersection of formal semantics/pragmatics and grammaticalization has begun to emerge only relatively recently, and the cross-temporal dimension has yet to become integrated into the field's domain (note that cross-linguistic semantic/pragmatics is itself a relatively new domain of inquiry). Moreover, there is no single work that covers all aspects of the program presented above. Existing work has focused either on the formalization of the structural or on the dynamic aspects of grammaticalization phenomena. In each case, the result allows for formally precise interpretations of themes that are central to grammaticalization, such as the conventionalization of invited pragmatic inferences in recruitment, the generalization of functional exponents, and the role of acquisition in categoricalization processes. The review that follows illustrates the range of ways in which formal tools have been employed to address (albeit not directly) some subset of questions 2*a–e*.

3.1. Investigating the Structural Component

In the following subsections, I discuss studies that have investigated aspects of the structural component. Section 3.1.1 focuses on recruitment, in which lexical expressions get harnessed to express functional meanings; Section 3.1.2 reviews a case study of generalization within functional categories; and Section 3.1.3 illustrates cyclical change, in which semantic contrasts drive lexical renewal of functional categories at a rapid pace.

3.1.1. Recruitment: from the lexical to the functional. Grice (1967) speculated that "it might not be impossible for what starts life, so to speak, as a conversational implicature, to become conventionalized." This idea has been implicit in much research in historical pragmatics, and most explicitly forwarded in Traugott's Invited Inferencing Theory of Semantic Change (Traugott 1999, Traugott & Dasher 2002). This theory details a path by which particular invited inferences in context become generalized (or stereotypic), and later semanticized. Formal semantic approaches started with investigating the implications of this theory for changes involving discourse adverbials and sentence-level operators with presuppositional content (e.g., Merin 1996 for English *but*, Eckardt 2001 for German *selbst*, Beck et al. 2009 for English *again*).

Eckardt (2006), the only monograph to date on grammaticalization and formal semantics, focuses on the structural component, namely the semantic content of the input lexical and output functional expressions in grammaticalization (questions 2*a* and *b*). This book lays out explicitly how the results of truth-conditional semantics can be applied to understanding meaning change in which lexical expressions get reanalyzed into functional expressions. In the compositional view taken in truth-conditional approaches, the meaning of complex expressions, including sentences, is determined by the meaning of the simpler parts of these expressions and their mode of composition. Structural reanalysis involves changes in the relation between a lexical item and the material it combines with. Reanalysis is driven by hearers (language learners) who attempt to assign meanings to linguistic expressions that can allow the whole meaning of the complex

expression to be derived compositionally. When a hearer is faced with a linguistic structure whose literal, compositional content reliably gives rise to certain pragmatic implications in a given context, he or she is likely to reinterpret parts of this structure in such a way as to make the pragmatic implication part of the literal content. Eckardt's (2006) innovation is to implement this intuitive idea within a formal compositionality-based framework. Eckardt analyzes several recruitment phenomena, including the grammaticalization of the *be going to* construction in English; the emergence of negative polarity items (NPIs) such as *pas* 'step,' *mie* 'crumb,' and *personne* 'person' in French; and the reanalysis of an intensifier *selbst* to a focus particle in German. These case studies explicitly show how pragmatic inferences at the propositional level get conventionalized and how such meanings then get redistributed over the lexical material—leading to the creation of new functional expressions such as NPIs, tense markers, and focus particles.

The essential elements of Eckardt's approach can be understood if we look at her analysis of the *be going to* construction in English, which realizes the prospective aspect. It has been noted that the prospective aspectual meaning of this construction results diachronically from the use and interpretation of *be going to* sentences to convey information about future action (Mossé 1938, Hopper & Traugott 2003). This change, at the syntactic level, amounts to the reanalysis of a lexical verb that combines with an infinitival complement to an overtly expressed aspectual operator that combines with a VP. Specifically, the progressive form of the lexical verb *go* is reinterpreted over time to express the future-oriented prospective aspect that combines with an event description. The two stages of the syntactic reanalysis are given in examples 3*b* and *c*.

(3a) I am going to visit my friend.

(3b) [PRES [PROG [*I go* [*to visit my friend* $_{VP}$]$_{VP}$]]]

(3c) [PRES [PROSP [*I visit my friend* $_{VP}$]]]

A sentence like example 3*a* literally conveys "the movement of an agent in order to undertake the activity of visiting a friend." The literal content of the sentence, however, allows hearers to also infer that the agent intends to undertake the described activity in the imminent future. At the initial stages of use, this type of inference is localized and arises only in those contents in which the shared information between the interlocutors can support it. However, over time, as the use of this construction increases in frequency, the localized pragmatic inference turns into a generalized invited inference (GIIN) that is reliably associated with the *be going to* construction (Traugott & Dasher 2002). Eckardt (2006) studies texts from the Early Modern English period to identify the contexts in which future-oriented inferences arise. This study reveals that the construction is exploited systematically to express the intentions of an individual in those contexts in which it is unlikely that the hearer will be able to recover such intentions directly from accessible contextual information. The empirical observation is that most early uses of *be going to* are found in dramatic prose, wherein the structure of a fictional narrative is being conveyed to an audience (the hearer) that has no access to how the narrative will unfold. Eckardt hypothesizes that for this particular case of recruitment, the crucial contexts for the conventional association of future-oriented meaning are those contexts in which the hearer is ignorant with respect to an agent's future intentions and the speaker wishes to convey these intentions.

Later generations of hearers who encounter the *be going to* construction and the inference of futurity that it is conventionally associated with are faced with the task of deriving the meaning of the whole sentence compositionally. Doing so requires that there be a systematic one-to-one relation between the lexical material occurring in the sentence and the content that it conveys. Note that the meaning of ongoing movement (associated with the progressive form of *go*) is no longer

part of the content conveyed by the *be going to* sentences. Therefore, hearers assign to this part, *be going to*, the meaning of an aspectual operator that applies to an event description and literally expresses the content that the event description will obtain in the near future. The reanalysis can thus be viewed as a compositionality-driven problem-solving process: What meaning α can be assigned to *be going to* such that it can be used to compositionally derive the future-oriented meaning of a sentence such as *John is going to visit a friend*? Once hearers assign the prospective aspect operator to the string *be going to*, future-orientedness becomes part of the literal content (rather than the inferentially derived content) of the sentence. More generally, any instance of a conventionalized inference associated with a particular construction presents an interpretive puzzle for the compositionality-driven hearer. The reanalysis of a construction occurs only when it is possible to associate pieces of meaning with pieces of lexical material such that the literal content of the sentence using such a construction matches the content that it conveys pragmatically.

3.1.2. Generalization: changes within the functional domain. Eckardt's study of semantic reanalysis focuses on recruitment—the process in which lexical material is harnessed to create new functional categories in the language. In grammaticalization paths, we also observe patterns of reanalysis in which functional expressions that instantiate a particular category at one stage are diachronically reanalyzed as instantiating a broader, more general functional category at a later stage. In such cases, each successive functional stage involves a systematic expansion in the domain of application of a given expression. Condoravdi & Deo (2014), also focusing on the structural component, investigate the grammaticalization path involving the resultative, the perfect, and the perfective operators (observation 1*b*) using diachronic data from Indo-Aryan languages from the earliest Vedic stage to Middle Indo-Aryan. They demonstrate that the range of readings available to the originally resultative form (which originates as a deverbal stative adjective) at each successive stage is a superset of the readings available at prior stages. This expansion is schematically expressed in **Table 1**, from Condoravdi & Deo (2014).

The contribution of this study is an explicit formulation of the logical semantics of the resultative, perfect, and perfective operators among the inventory of aspectual categories found in natural languages. These are treated uniformly as functions that combine with event descriptions (sets of events) and return temporal predicates (sets of times). These operators are taken to be characterized by a relation of asymmetric entailment: The meaning (set of times) describable by using a resultative form is a subset of the meaning describable by using a perfect form, which in turn is a subset of the meaning corresponding to the use of a perfective form. If these semantics are taken to be universal, then the cross-linguistically robustly attested resultative > perfect > perfective shift can be interpreted as a change from semantically specific to semantically general meanings.

Table 1 Available readings for the *-ta* form at distinct stages

	Resultative	Perfect	Perfective
Readings	**Stage I**	**Stage II**	**Stage III**
Resultative perfect	√	√	√
Existential perfect	∅	√	√
Universal perfect	∅	√	√
Eventive/past	∅	∅	√

Table modified from Condoravdi & Deo (2014).

Deo (2009) achieves a similar result for the progressive and the imperfective aspects—the path described in observation 1*a*. The proposal there is that both progressive and imperfective aspects are universal quantifiers over temporal intervals, but that they differ in the type of intervals that they quantify over. The particular semantics proposed there also involves a relation of asymmetric entailment, which lays the foundation for Deo's dynamic analysis (Deo, forthcoming) of the progressive-to-imperfective grammaticalization path (discussed in Section 3.2.2).

These proposals for analyzing generalizing changes within both the perfect/perfective aspects and the progressive/imperfective aspects offer precise formal interpretations of the notions of semantic generalization and bleaching, which have been centrally invoked as mechanisms of change in the grammaticalization literature. The grammaticalization path connecting related categories is, in these cases at least, demonstrated to be underpinned by the logical relation of asymmetric entailment. In contrast to treating bleaching and generalization as mechanisms of change, this body of work focuses on the structural relationships between grammaticalized meanings, which serve as an enabling factor in the process of change.

Finally, the question of the semantic content and logical relation between functional categories across diachronic stages (questions 2*a* and *b*) is also investigated by Yanovich (2013), who undertakes a close study of changes in the modal system of English. The contribution is a new formal analysis of the semantics of the modal verb *motan* (cognate to modern *must*) as a variable-force modal in Old English and a modal that is ambiguous between possibility and necessity readings in Early Middle English. The semantic trajectory from variable-force modal semantics to modal ambiguity is a new diachronic trajectory that has been identified for the first time in Yanovich's dissertation.

3.1.3. Cyclical changes in functional domains. A class of semantic changes in natural language involves expressions that encode a scalar semantics. Dahl (2001) observes semantic changes in expressions that lexicalize a high value on an evaluative scale. He observes that such expressions tend to be used much more frequently than is justified by context, and that this usage is motivated by pragmatic and social, rather than purely descriptive, considerations. For example, expressions such as *excellent* and *fantastic* convey the speaker's highly positive evaluation of an object or a situation. A teacher, seeking to provide positive feedback to her students, may overuse the term *excellent* to describe her students' work. If this happens often enough, the term may lose its informative strength over time. Generalized over instances and populations of speakers, the loss of strength of such expressions is an unintended result that obtains over time from the local linguistic choices of agents that have socially oriented rather than purely information-transfer goals. The loss of strength of the original expression triggers the innovation of new material for expressing the strong meaning. Dahl notes that this erosion of original meaning and recruitment of new material gives rise to a rapid rate of lexical replacement in apparently cyclic fashion in these domains.[5] The semantic phenomena discussed by Dahl include evaluative adjectives, politeness systems, and emphatic constructions (e.g. emphatic negation), all of which share the underlying dynamic behavior in which an increase in frequency has pragmatic/social motivation and semantic effects. According to Dahl, there are three ways in which "rhetorical devaluation" (his term) in the

[5]Haspelmath (1999) overextends this mechanism to all grammaticalizing changes, describing grammaticalization as an "invisible-hand phenomenon" (Keller 1989, 1994). His claim is that all innovation and generalization emerge from extravagance—the speaker's tendency to use unusually explicit formulations to attract attention. Although the dynamics described by Keller, Haspelmath, and Dahl (2001) is clearly at work in some domains of language change, it is not clear that all of semantic change can be described using the heuristic of the "invisible-hand phenomenon." Moreover, how such a dynamic process plays itself out in any particular empirical domain crucially rests on the precise explication of underlying meanings and how they might be enriched through "unusually explicit formulations."

meaning of expressions may take place: (*a*) A lexical item that expresses a strong value of some parameter may tend to be used even when a weaker value is called for, (*b*) a construction whose function is to draw attention to an element whose content is counter to expectation is used indiscriminately also for elements that are not counter to expectation, and (*c*) an expression may tend to be used even when the information it carries is irrelevant (does not belong to the intended message) or predictable (presupposed or inferable).

Kiparsky & Condoravdi's (2006) analysis of Jespersen's cycle (Jespersen 1917) in Greek builds on these intuitive ideas. Jespersen's cycle describes a process in which forms marking emphatic negation diachronically come to be used to mark plain negation. Jespersen (1917) discovered this cross-linguistically robust historical process through its instantiation in the diachrony of Germanic and Romance languages. Kiparsky & Condoravdi (2006) trace the history of negation markers in Greek over three millennia. At each stage of the language, Greek dialects morphosyntactically distinguish between emphatic negation and plain negation, although there is variation in the precise markers employed at different stages and in different dialects. Markers of emphatic negation are built using a focused indefinite [which is either a minimizer (e.g., *a bit*, *a drop*) or a generalizer (e.g., *a thing*, *a soul*)] in composition with plain negation. The diachronic phenomenon for Greek (and elsewhere) is that such qualitative and quantitative strengtheners regularly get reanalyzed into markers of plain negation and are replaced in their emphatic function by newer strengtheners in cyclic fashion.

Kiparsky & Condoravdi (2006) focus on explicating the structural aspect of this cycle, providing a more precise interpretation of emphatic and plain negation as distinct functional categories. The universal validity of this distinction is evidenced by the fact that Jespersen's cycle has been attested in both Indo-European and non-Indo-European families such as Bantu (Devos & van der Auwera 2013) and Austronesian (Vossen & van der Auwera 2014). In this analysis, emphatic negation expresses the "strong value" of the negation parameter, whereas plain negation expresses the "weak value." Emphatic negation differs from plain negation with respect to its felicity conditions. Specifically, emphatic negation may be employed in a subset of contexts in which plain negation may be used: It may be used (*a*) to mark contradiction of (a possibly implicit) assertion (sentence 4*a*); (*b*) to deny a presumption or an expectation (sentence 4*b*); or (*c*) to lift restrictions on indefinites in the scope of negation and widen the domain to the entire domain of discourse (sentence 4*c*).

(4a) A: *John did the dishes and laundry, right?* B: *He didn't do a thing!*

(4b) A: *How much did the therapy cost you?* B: *It didn't cost me a thing.*

(4c) A: *Did you hear that bird call?* B: *I didn't hear a thing.*

In its core contexts of use, emphatic negation serves to eliminate a contradictory proposition that is either explicitly or implicitly present in the discourse context, either as a direct belief or as a hearer bias. Being informationally stronger, emphatic negation serves to restrict the common ground of discourse more than plain negation—the source of its overuse. Condoravdi (2009), in unpublished work, offers a precise interpretation of the notion of informative strength in emphatic and plain negation assuming Stalnaker's view of discourse as a communal inquiry into the state of the world (Stalnaker 1974, 1978) and its structuring as a sequence of questions and answers (Groenendijk & Stokhof 1984; Ginzburg 1995a,b; Roberts 1996). She proposes that emphatic negation presupposes finer-grained partitions of the common ground. An emphatic negative assertion therefore serves to eliminate more possibilities than plain negation.

The dynamic element of the explanation is left unformalized by Kiparsky & Condoravdi (2006). However, they sketch out a diachronic trajectory along the lines of Dahl's (2001) idea: As

speakers extend the use of emphatic negation to make stronger claims in contexts that do not necessarily license the use of the emphatic form, hearers may fail to associate emphatic negation with its contextual felicity conditions. Thus, overuse of the emphatic form leads to its de-emphasization or change to plain negation, and the emphatic function is renewed by new morphosyntactic material, resulting in cyclic change.

3.2. Investigating the Dynamic Component

We now turn to work that investigates the dynamic component of grammaticalization (questions 2*c–e*). In most work in this domain, the semantic content of functional categories is assumed to be given by independent analyses (or kept at an intuitive level), and the focus is on explicitly modeling dynamic processes such as recruitment, categoricalization, and generalization at the level of the population.

Work in optimality-theoretic pragmatics and game-theoretic pragmatics studies mechanisms of natural language interpretation and their grounding in the basic principles of cognitive psychology by using formal mathematical techniques to model these mechanisms. The relevant mechanisms fall under the rubric of Gricean reasoning and are of particular interest in understanding lexicalization and grammaticalization patterns in language. Another relevant strand of research is the iterated learning framework (Kirby 1999, 2001; Smith et al. 2003). The iterated learning model developed within this framework has been applied to the problem of deriving particular grammaticalization paths.

3.2.1. Bidirectional optimality-theoretic pragmatics. Zipf (1949) identified two basic opposing forces that are in action in language and responsible for language change: Speaker's economy (or the force of unification), which drives the tendency to simpler messages, and Auditor's economy (the force of diversification), which is an antiambiguity principle leading toward an isomorphic (one-to-one) mapping between forms and messages.[6] Neo-Gricean approaches seek to derive Grice's (1967) maxims from these two opposing forces, construed in terms of two countervailing optimizing principles: the hearer-oriented Q-principle [*Say as much as you can!* (modulo R)] and the speaker-oriented R-principle [*Say no more than you must!* (modulo Q)]. The idea is first presented in this form by Horn (1984), who uses it to account for both synchronic patterns of inference and diachronic processes of language organization.

Bidirectional optimality theory (Blutner 2000, 2004) models the optimization of the linguistic output against a system of ranked constraints that evaluates form–meaning pairs. A form–meaning pair $\langle f, m\rangle$ is considered interpretively optimal iff there is no pair $\langle f, m'\rangle$, such that it satisfies the ranked constraints better. A form–meaning pair $\langle f, m\rangle$ is considered expressively optimal iff there is no pair $\langle f', m\rangle$, such that it satisfies the ranked constraints better. This formulation (on a recursive implementation) has been used, among other things, to derive what Horn (1984, 1989, 2005) has labeled the division of pragmatic labor: the tendency in languages that "unmarked forms tend to be used for unmarked situations and marked forms for marked situations" (Horn 1984, p. 26).

In a diachronic context, this optimization pattern can be seen to underlie the initial and conventionalized interpretation of novel collocations built using a language's morphosyntactic resources. In particular, given competing expressions with identical meanings, but differential morphosyntactic complexity, the meaning gets categorically differentiated into distinct

[6]The idea that language change emerges from the interaction between two factors in communication, the speaker's need to convey a message and the principle of least effort, is also found in Martinet (1962) and goes back to Paul (1888).

submeanings such that the rarer, more unusual submeaning gets conventionally associated with the morphosyntactically complex form while the simpler form is retained for the more frequently occurring meaning. This "fossilization" process (Blutner 2000) is rooted in language acquisition biases that themselves derive from sensitivity to statistical asymmetries in the input (Mattausch 2004). Although the relevance of bidirectional optimality theory to language change has been noted, there is only one actual application of these ideas to real problems of diachronic semantics (Mattausch 2004).

Mattausch (2004) offers a formal account of the problem of the grammaticalization of anaphora and deriving universal trends in binding phenomena. The computational model describes changes in the distribution and interpretation of complex *self*-marked (reflexive) and simple bare pronouns in Old English, building on observations about the corpus data from Keenan (2002a,b). The corpus observation from Old English is that 18% of conjoint object pronouns are *self*-marked (i.e., *him-self*, *her-self*) while the remainder appear bare. In contrast, in Modern English, all conjoint object pronouns must be *self*-marked. This is an instance of the diachronic emergence of division of pragmatic labor in that the more complex form is reserved for the more marked, less frequent meaning (conjoint reference) while the simple form is used to convey the less marked meaning (disjoint reference).

Mattausch (2004) derives this change in grammar by using a bidirectional learning algorithm (BiGLA), bidirectional optimality theory grammar, and a hypothetical corpus of Old English that mimics the frequencies observed in Old English. The learning algorithm draws an observation $\langle f, m \rangle$ from the corpus at random and, based on the meaning, determines the optimal form on the basis of the grammar. If the optimal form in production is distinct from the observed form, constraints preferring the optimal form are decreased in strength, whereas those preferring the observed form are increased in strength. In comprehension, the input is taken to be the form in the $\langle f, m \rangle$ pair and determining the optimal meaning on the basis of the grammar and comparing it to the observed meaning. Thus, learning proceeds bidirectionally and is both speaker and hearer oriented. The first-generation learner learns a constraint ranking based on these observations and produces a new corpus that reflects the changed constraint ranking. The frequencies in the new corpus may differ slightly from the old corpus. After this process is iterated over several generations, the grammar conventionalizes or "fossilizes" the initial observed tendency for *self*-marked pronouns to have conjoint reference and bare pronouns to have disjoint reference—thus deriving division of pragmatic labor as a process of gradual language evolution.

3.2.2. Game-theoretic pragmatics. Game-theoretic pragmatics adapts the resources of game theory to the investigation of linguistic communication and pragmatic reasoning—in particular, the dynamic interaction between expressiveness (hearer-oriented) and economy (speaker-oriented) constraints. The goal is to model the circumstances under which conventional ways of signaling meaning arise: in other words, how meaningfulness develops as interlocutors communicate with each other. Game-theoretic models of communication as a coordination game between the sender and the receiver of a signal can be traced to the work of Lewis (1969), who modeled linguistic convention in terms of repeated plays of signaling games with possibly arbitrary signals. For an introduction to the idea of signaling games, see Parikh (2001), Benz et al. (2006), and Franke (2009), among others.

Such signals come to acquire particular meanings because of the ways in which they are used by rational agents. Later work (e.g., van Rooij 2004a,b; Jäger 2007), framed within evolutionary game theory (Maynard Smith & Price 1973), investigates why particular strategies of conventionalization or morphosyntactic marking are reflected robustly in natural language systems. The evolutionary approach, which is concerned with diachronic processes of language learning and

adaptive organization, gives a noncentral role to rationalistic (online pragmatic) reasoning in how linguistic systems might come to exhibit certain tendencies.

The basic linguistic application models the interaction between the speaker and the hearer as a game in which the speaker aims to convey some private knowledge to the hearer through his or her utterance. The game model specifies possible choices of linguistic signals (speaker strategies) for the speaker and possible interpretations of these signals (hearer strategies) for the hearer. Solution concepts for a language game can be understood as formal rules that predict how the game will be played out on the basis of speaker and hearer preferences (signal economy, successful communication). The use of any given strategy leads to some payoff for its users, which in an evolutionary setting is associated with fitness—the ability of that strategy to propagate and increase its share in a population. The idea is to determine, for a population in which individuals exhibit different forms of behavior, which forms of behavior are able to persist and which forms of behavior tend to be driven out.

Although there is a natural diachronic dimension to the evolutionary game-theoretic framework, there has until now been little application to actually observed diachronic patterns such as the grammaticalization paths discussed in the previous sections. In recent unpublished work, Deo (forthcoming) shows that patterns of recruitment, categoricalization, and generalization in grammaticalization are underpinned by a familiar pragmatic phenomenon, also introduced in Horn (1984): privative oppositions between specific and general meanings (Horn 1984, pp. 33–38). The pattern involves, for some lexical domain, the existence of more informative, marked forms, side by side with unmarked, semantically general forms. Such privative dyads (Horn & Abbott 2012) give rise to a division of pragmatic labor in which the use of the general form is conventionally restricted to the complement of the domain of the specific form. This amounts to the conventionalization of a scalar implicature in the grammatical system of a language.

The phenomenon addressed by Deo (2014) is the path in observation 1*a*. The relation between the progressive operator and the imperfective operator is construed as a privative dyad in which the specific form (the progressive) asymmetrically entails the general form (the imperfective). The diachronic path is observed to be cyclic. Progressive markers get recruited in linguistic systems to morphosyntactically distinguish between phenomenal and structural meanings (Goldsmith & Woisetschläger 1982). These innovated markers, which explicitly mark phenomenal meanings, diachronically generalize to become imperfective markers, which are ambiguous between phenomenal and structural meanings. This generalization often leads, in a familiar cyclic Jespersonian pattern, to a second recruitment of progressive markers to reinstate the semantic contrast. Building on the explicit semantic analysis from Deo (2009), which provides the structural component to the explanation of this path, Deo's (2014) game-theoretic model explicates the dynamic component as a cyclic alternation between alternative strategies of communicating phenomenal and structural meanings within an "imperfective game." The recruitment of progressive markers and their categoricalization is identified with the rise in the population of an explicit marking speaker–hearer strategy that relies on formal differences to determine intended messages. The generalization of progressive to imperfective is identified with the rise of a contextually disambiguating speaker–hearer strategy that relies on contextual cues rather than formal distinctions for determining the intended message from an ambiguous form. The dynamic behavior of cycling among alternative strategies obtains from the relative payoffs of each strategy, mutation probabilities among competing strategies, and assumptions about the composition of the population in terms of cognitive preferences.

The application of evolutionary game theory developed here can be naturally extended to any functional domain that can be analyzed as being underpinned by a privative semantic contrast.

These domains include Jespersen's cycle (Jespersen 1917) as well as the grammaticalization paths in observations 1*b* and *c*.

3.2.3. Iterated learning models in grammaticalization. Yet another explicit treatment of the dynamics of a grammaticalization path is framed within an iterated learning model developed by Smith et al. (2003). Schaden (2012) models the perfect-to-past path in observation 1*b* as an instance of Dahl's (2001) inflation-based semantic weakening. The proposal rests on a basic contrast between the present perfect and the past tense that is often assumed but not precisely explicated in the literature on aspectual semantics: Perfect marking signals that a past situation being described is of "current relevance," whereas past-tense marking is neutral with respect to such a relation with the present time (Portner 2003).[7] Schaden assumes that current relevance is a gradable notion (measurable on the real interval from zero to one) and that it must be relativized with respect to a discourse participant. Speakers and hearers assign some subinterval of this interval to the past and the present perfect each. This means that they use the present perfect if they consider the eventuality being described as having current relevance above some threshold *n*. If the current relevance value of the eventuality does not meet this threshold, they use the past tense instead. The threshold parameter *n* is the crucial ingredient because the diachronic change is captured as an effect of changes in this parameter. The formal model also assumes that hearers can calculate the degree of current relevance of a sentence on the basis of information contained in the sentence and the utterance context of that sentence.

The dynamics is driven by the tendency of speakers to use the present perfect as a rhetorical strategy, inviting the hearer to infer the situation at the reference time that makes the past eventuality relevant to the current issue in the discourse. Thus, rather than using the present perfect only in contexts in which it is contextually clear that the past eventuality is relevant at least to the threshold level *n*, speakers also use it in contexts in which it is relevant to levels below *n*. According to Schaden (2012), this happens because speakers systematically tend to overestimate the current relevance of their contribution in discourse.[8] That is, they use the present perfect with the belief that the past eventuality being described is relevant to a degree above *n* in contexts in which it is not. Hearers, attuned to the context of utterance, do not fully compensate for this inflationary behavior, and infer from the speaker's use of the perfect that the threshold *n* that licenses the use of the present perfect in a particular context is lower than it actually is.

Schaden (2012) simulates this dynamics in an iterated learning model, which tracks how the input of overestimating speakers causes language learners/hearers to infer a grammar with a lower threshold *n* than the one characterizing the original speaker grammar. The data produced by this grammar at a lower threshold (with similar overestimation of current relevance) are the input to the next generation of learners, who infer an even lower threshold. Schaden shows that *n* (even

[7]For instance, a sentence such as *John has eaten camel meat* conveys that this past eventuality has some bearing on some current issue, perhaps our evaluation of John's culinary adventurousness, or his skills as a survivor, or something else. The corresponding simple past sentence, *John ate camel meat*, need not be associated with such a requirement.

[8]Schaden (2012) brings in an interesting parallel from evolutionary psychology as a possible explanation for why speakers might systematically overestimate the current relevance of their contributions. It has been well observed that agents operate with cognitive biases that favor positive self-images and eliminate or background negative aspects. Such biases lead to errors in self-ranking tasks, for instance, when agents have to compare their own merits within a larger group. Trivers (2011) reports that 94% of academics involved in a study judged themselves as belonging to the upper half of their profession. In evolutionary terms, Trivers's (and by analogy, Schaden's) explanation is that self-deception is a species-general behavior that allows individuals to deceive others by allowing the speakers to believe that that the signal they convey corresponds to reality. Speakers overestimating the current relevance of their utterance is simply a species-specific particular example of this more general evolutionarily useful behavior.

when initial conditions set *n* to 0.999) is eventually driven to zero over 40–65 generations—leading to the extinction of the simple past and generalization of the perfect.

4. FURTHER DIRECTIONS

Diachronic semantics is still in its infancy as a discipline, but the directions taken by the research so far suggest that a substantive theory of how meaning, use, and change are tied together is gradually crystallizing into a robust program within semantics/pragmatics. The recent development of techniques/applications that are suited to modeling context, gradualness, and frequency effects—all essential elements of a usage-based theory of change—has been responsible for this turn. On the evolutionary perspective taken within grammaticalization, grammar is primarily a historical product whose synchronic structure is best explained by reference to the historical forces shaping it. The diachronic flux in this interplay between conceptual meanings and linguistic expressions, often assumed to be unformalizable in earlier work (Croft 2001, Heine 2003, Bybee 2010), is gradually becoming more and more tractable with the formal foundation of semantics/pragmatics.

As research on the underpinnings of grammaticalization and semantic change expands, it needs to be rooted in models of cognition. Meanings get produced and perceived in certain ways and not in others; that is why recruitment, categoricalization, and generalization obtain in certain ways and not in others. Inevitably, the mechanisms of change that we observe must be supported and shaped by independently motivated properties of the infrastructure of cognition and, in particular, the conceptual system that human languages draw on.[9] Investigating this infrastructure and how it connects to the patterns of change we observe is a critical subprogram that must necessarily ground semantic analyses that allow us to connect the structure of the meanings to mechanisms of change (the structural component) and explicit models of recruitment of new semantic variants, competition between semantic variants, and their functional embedding within the broader system of communication. Very preliminary exploratory work in this direction is reported by Jäger & Rosenbach (2008), who argue that asymmetric priming (rooted in the cognitive asymmetry between different meanings) can account for certain patterns of diachronic unidirectionality observed in grammaticalizing changes.

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[9]Compare again with the better-studied domain of linguistic sound change, which reveals similar structured diachronic patterns and processes in the evolution of sound systems. As with the present approach, such change is understood as being psychologically and biologically grounded, in this case in the architecture of the human speech production and perception systems (Ohala 1989, 1993; Blevins 2004, 2006). An emerging research program investigates the cognitive factors that underlie the emergence and spread of variants within sound systems that lead to the actuation and implementation of sound change (Yu 2010).

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Errata

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