Linguistic structure emerges from cognitive mechanisms

Molly L. Lewis

Department of Psychology, Stanford University

Conceptual Analysis of Dissertation Area

6 October 2014

Advisor: Michael C. Frank

Additional Readers: Ellen Markman and Noah Goodman

Abstract

People interact with people and, because of shared interest, try to coordinate their behavior. This behavior is governed by the competition of pragmatic pressures. These pressures lead to equilibria. These equilibria become conventionalized over time (Lewis). This convention becomes an additional pressure in the moment of interaction. Language as a paradigm case of these dynamics.

Human society can be viewed as a field which both influences the individual members of the group and is influenced by them.

<div align="right">

– G.K. Zipf, *1949*

</div>

Introduction

"Room for cream?" asked the barista. "Mm, yes – just a bit" replied the customer. Mundane linguistic interactions such as this are the building blocks of daily experience. They are individuals making sounds to each other in an effort to coordinate their behavior in the physical world (Clark, 2006). These interactions are messy, variable, and highly unconstrained. Indeed it is this variability that gives language its vast expressive power (Hockett, 1960). Yet, despite this appearance of irregularity, rich patterns in linguistic usage are revealed when we aggregate across instances of language use both within and across languages. At the level of syntax, for example, there is a strong bias in English to put subjects before verbs and, across languages, this pattern is attested more often than would be expected by chance alone (Dryer, 2005). These types of probabilistic regularities exist at every level of linguistic structure — from phonology, to semantics, syntax, and discourse — and researchers from a variety of disciplines have taken as their project the goal of characterizing these regularities.

In this paper, I argue that we can gain insight into the character of linguistic structure by considering the dynamics of language use. I will suggest the best way to do this is by framing language use as an instance of a broader phenomenon: social interaction (Clark, 1996). In particular, I will adopt the formal framework of social interaction proposed by Thomas Schelling, in which social interactions are viewed as acts of solving coordination problems. To illustrate, consider the barista example above. In this example, the agents are the barista and the customer, and they must coordinate how to fill the coffee mug. There are two outcomes — full and almost

full — and the barista's desired outcome is determined by the preference of the customer. In this case, the barista and the customer rely on language to coordinate their behavior, but this coordination could have been achieved in other ways (e.g. the customer could have shook her head, pointed to the place inside the mug that she wanted the coffee filled to, etc.). Coordination of their behavior is achieved by arriving at the mutually preferred outcome (the customer's mug is almost full).

A key tenet to the broader argument is that the act of using language is itself an act of solving a coordination problem (Clark, 1996). When a person speaks, there are many possible ways the utterance could be interpreted, and arriving at the intended interpretation is an act of coordination. For example, in the case of the customer's interaction with the barista, there are many possible interpretations of the phrase, "Room for cream?." The barista could mean "Would you like to add cream to your coffee? If so, I will facilitate that by not filling your mug full with coffee." Or, "We have so much extra inventory of cream! Do you have room in your bag to take some?" Or, "Do you like the band 'Room for cream'?". Or, if the speaker is speaking another language, a totally unrelated meaning. The point is that the speaker's intended meaning is underspecified from the language alone and the interlocutors must work collaboratively to arrive at a shared understanding. Following Lewis (1969), I will suggest that we can gain insight into the dynamics of linguistic coordination problems such as this by using Schelling's formal framework. This perspective on language use will ultimately provide a helpful framework for understanding the relationship between language use and language structure.

In Part I, I will outline the linguistic coordination problem as a paradigmatic case of the social coordination problem. I will suggest that coordination problems are solved through the dynamics of two opposing two forces — the goals of the one's self and the goal of the other. Following Lewis, I suggest that these opposing forces are resolved by finding an equilibrium

point. I will then argue that the equilibria that are reached in language use are reflected in the structure of language, and survey a variety of phenomena in linguistic structure that show this pattern.

In Part II, I will consider the mechanism that might cause linguistic structure to reflect the equilibria reached in linguistic use. Lewis argued that once individuals succeed in solving a coordination problem, there is a tendency to stick with that solution (even though other, equally good solutions exist). This solution is called a convention. I will argue that the key to understanding the link between regularities in linguistic usage and linguistic structure is the process of children's acquisition of these conventions. I will consider how the dynamics of language acquisition might lead to language change. Finally, I will consider the complementary role of conventions and cognitive forces in solving language coordination problems, and the empirical challenge associated with disentangling the two.

Part I: Linguistic structure reflects pragmatic equilibria

Where does linguistic structure come from? Christiansen and Chater (2008, 2010) argue that multiple cognitive constraints influence language evolution. They suggest four constraints: the representational format of thought, properties of the percepto-motor system, learning and processing constraints, and so-called 'pragmatic' constraints. Pragmatic constraints are the result of reasoning about another speaker's intention in context. Their argument is that these cognitive constraints influence language at the moment of use, but over time, these biases become instantiated in the structure of language. Although each of these constraints likely plays an important role in the evolution of language, the present paper focuses on the independent contribution of pragmatic constraints. The claim is that in-the-moment pragmatic constraints become fossilized in the structure of language. To develop this claim, we begin by modeling language use as a type of social coordination.

5

Social interaction as a coordination problem

The idea that language is an instance of a much broader class of behavioral phenomenon — social coordination — has been noted by many theorist of language (Zipf, 1936; Lewis, 1969; Grice, 1975; Clark, 1996). Each viewed language use as a case of multiple agents making interdependent rational choices.[1] Nonetheless, language use is a paradigmatic case of a coordination problem: it provides a tool that is universal in a community, easy to use, and capable of expressing complex ideas.

Lewis (1969) formalized the notion of language as a coordination problem by building off work by Schelling. Lewis defines a coordination problem as follows: "Two or more agents must each choose one of several alternative actions. Often all the agents have the same set of alternative actions, but that is not necessary. The outcomes the agents want to produce or prevent are determined jointly by the actions of all the agents" (1969, pg. XX). The result is an equilibrium point no better....

Zipf provided a parsimonious framework for thinking about the psychological forces that lead to the resolution of an equilibrium point in a coordination game. Zipf argued that dynamical systems were the result a single force.

This broad framing describes many social interactions. Take the above example of the barista and the customer. We can model this interaction using a payoff matrix.

other examples?

———

[1] In outlining his seminal theory of pragmatics, Grice writes: "As one of my avowed aims is to see talking as a special case or variety of purposive, indeed rational, behaviour, it may be worth noting that the specific expectations of presumptions connected with at least some of the foregoing maxims have their analogues in the sphere of transactions that are not talk exchanges" (Grice, 1975, pg. 47).

Language use as a coordination problem

The application of this analysis to linguistic coordination problems is relatively straight forward. Consider the the utterance of a novel word.

As in the case of Zipf,

Lay out Horn theory

Bayesian stuff, wilkes and gibes

Pragmatic equilibria reflected in the structure of language

Consider four cases in which equililbtriam points predicted by Horn's theory of pragmatics are reflected in the structure of language: lexicon, semantics, semantics and words.

Lexicon.

Semantics.

Words.

Syntax.

Part II: The role of ontogenesis in the emergence of linguistic structure from pragmatic equilibria

References

Christiansen, M. H., & Chater, N. (2008). Language as shaped by the brain. *Behavioral and Brain Sciences*, *31*, 489–509.

Clark, H. H. (1996). *Using language* (Vol. 1996). Cambridge University Press Cambridge.

Clark, H. H. (2006). Social actions, social commitments. *The roots of human sociality: Culture, cognition, and interaction*, 126–150.

Dryer, M. S. (2005). Order of subject, object, and verb. *The world atlas of language structures*, 330–333.

Grice, H. (1975). Logic and conversation. *1975*, 41–58.

Hockett, C. (1960). The origin of speech. *Scientific American*, *203*, 88-96.

Lewis, D. (1969). *Convention: a philosophical study.* Harvard University Press, Cambridge, Mass.

Zipf, G. (1936). *The psychobiology of language*. Routledge, London.