Social Meaning, Sociolinguistic Variation and Game-Theoretic Pragmatics: Semantic change and evolutionary game theory

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Main goal
To explore how notions relevant to evolution and evolutionary game theory can shed light on socio-pragmatic phenomena and language change.

Plan:
- Return to the example of Politeness (van Rooij 2003): Evolutionary handicaps
- Explore a model of grammaticalization over time (Deo 2015): Communicative success and learnability concerns in Evolutionary Game Theory
- Wrap up
From Horn’s transcription of Nora Ephron’s 1989 *When Harry Met Sally*

**Jess**: If she’s so great why aren’t YOU taking her out?

**Harry**: How many times do I have to tell you, we’re just friends.

**Jess**: So you’re saying she’s not attractive.

**Harry**: No, I told you she IS attractive.

**Jess**: But you also said she has a good personality.

**Harry**: She HAS a good personality.

**Jess**: [stops walking, turns around, throws up hands, as if to say *Aha!*]

**Harry**: What?

**Jess**: When someone’s not attractive they’re ALWAYS described as having a good personality.

**Harry**: Look, if you were to ask me what does she look like and I said she has a good personality, that means she’s not attractive. But just because I happen to mention that she has a good personality, she could be either. She could be attractive with a good personality or not attractive with a good personality.
Politeness flouts Grice’s Maxims

(1) A: Here is a picture of my baby nephew.
   B: Oh, he is so cute!
**Quality**: B actually thinks A’s nephew looks like a small alien.

(2) A: How was the concert?
   B: The grass of the lawn was well maintained, our friends brought a good bottle of wine, and we were far enough from the stage for the volume to be at a good level.
**Quantity**: A gave B the tickets and B doesn’t want to say that the music was terrible.

(3) A: Could you possibly lend me your car for just a short time this weekend?
**Manner**: A could have said *Lend me your car this weekend.*
Van Rooij’s Analogy

General evolutionary tendency
Bright peacock feathers
Sacrifices camouflage
Signals likely survival

Grice’s Maxims (efficiency)
Complex/long polite speech
Sacrifices social status
Signals likely repayment/gratitude
In the previous two classes, we’ve considered models in which S and L have similar goals (to accurately index and to decode various personae, for example).

In cases of polite speech in which the polite form is more complex than another form, van Rooij argues that S and L’s goals are not aligned, but that this can be resolved via the addition of costs:

Van Rooij (2003:12)

“Polite utterances come with social costs that can establish a harmony of preferences between sender and receiver that did not exist before, but these costs can be afforded only by certain types of individuals.”
A **Handicap** is something that would normally be to the disadvantage of some entity such that if one has or performs this handicap and is not seen to suffer for it, that entity is evaluated as having some compensatory property (good genome, gratitude, etc.).

- Less survival-ready peacocks and less grateful/able to repay a favo(u)r requesters would not choose to convey that fact, which would lead to a lack of communication of such types to others (everyone would send the same message).

- Because receivers want to know these types, the non-aligned goals mean that a signalling game is not possible.

- Having a handicap, then, makes signalling possible again because only those with the selected-for qualities will generally have the resources to pay the cost of the handicap.
For van Rooij:

- \( T \) is the set of types \( t_H, t_L \). \( t_H \) is grateful, \( t_L \) is not.
- \( M \) is the set of messages \( m, m' \). \( m \) is complex, \( m' \) is short.
- \( E \) is the set of actions \( e, e' \). \( e \) is lending, \( e' \) is not lending.
- A speaker strategy \( S \) is a function from \( T \) to \( M \).
- A listener strategy \( R \) is a function from \( M \) to \( E \).
- Utility functions for speaker and listener are functions from \( T \times M \times E \) to the rational numbers.
Utility

\[ U(t, S(t), R(S(t))) = \begin{cases} 
 l(S(t))^{-1}, & \text{if } R(S(t)) = t \\
 0, & \text{otherwise} 
\end{cases} \]

- \( l \) is a function on the length of the message
- \( U(\text{Separating equilibria}) > U(\text{Pooling equilibria}) \)
- \( U(\text{Shorter separating equilibria}) > U(\text{ Longer separating equilibria}) \)

In order to incorporate a handicap...

We need to add the message to the utility functions of the speaker and the listener in addition to type and action (whereas a costless signalling game would only require these latter two).
Costs

- Cost of $m$ is based on type: $C(t_H, m)$, $C(t_L, m)$
- $C(t_L, m) > 1 > C(t_H, m)$
- Guarantees that $m$ is too expensive for $t_L$
- Following Zahavi, van Rooij assigns $C(t_H, m) = 1/2$, $C(t_L, m) = 3/2$
- He also assumes that $P(t_H) = 1/4$ (they are more rare in the population)
Note that this models the fact that the listener will not lend her/his car to a speaker that uses the short imperative because \((\frac{1}{4} \times 1) + (\frac{3}{4} \times 1) = 1\), while \((\frac{1}{4} \times 2) + (\frac{3}{4} \times 0) = \frac{1}{2}\)
**Strategies for players and Payoffs for Action profiles**

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We have seen an example of a case of non-aligned goals (and no separating equilibria) where goals were aligned and equilibria separated by adding .

We have worked through a model of manner-violating polite forms in terms of the evolutionary notion of handicaps.

The difference in cost depending on type is crucial to the model’s success.

We might hypothesize that relative power relationships could be added to this model, as might other social aspects of politeness phenomena that have been well-studied.
Example 3: Grammaticalization

(4) Jane is sorting the mail. (Progressive)
(5) Jane sorts the mail. (Imperfective)

As noted by Deo 2015, inter alia, progressives often become imperfectives over time, and then new progressive markers arise. How do we model this cyclic change?

- Players: Serena (S) and Lenny (L).
- Set of types that Serena has (i.e. the real-life situations she is trying to convey):
  - Something happening right now (answering Why is Porkchop wagging his tail?)
  - Something structural about the world (answering Why does a dog wag his tail?)
Example 3: Grammaticalization

- Set of **messages** that Serena can send to convey her type/meaning:
  - *He is lying in wait of the mailman.* (PROG)
  - *He lies in wait of the mailman.* (IMPF)

- The **costs** associated with various messages. Having multiple forms in a similar semantic domain is costly, so having a choice of message rather than one increases the cost in the system.

- **Interpretations** of these messages (actions by receiver that guess at the type): same set as the types (happening now or happens generally)
Example 3: Grammaticalization

Preferences and Payoffs:

- Serena’s preferences: avoid costly messages, try to have her type understood by Lenny
- Lenny’s preferences: try to coordinate with Serena
- Payoff/Utility Structure: For a game of change over time, the setup will differ depending on which stage in the cycle we are in. The number of messages will also change, which affects payoffs.
- In this case, we are at a stage where IMPF and PROG both exist but where IMPF can be used to respond to both questions, while PROG can only respond to ‘now’ questions. Thus, we are moving toward a system where IMPF can only be used for ‘general’ questions.
Example 3: Grammaticalization

Payoff/Utility example:

- If the real type (state of affairs) is conveying that something is happening right now:
  - S says *He is lying in wait of the mailman.* and L understands ‘now’ : (3,3)
  - S says *He is lying in wait of the mailman* and L understands ‘general’ : (0,-2)
  - S says *He lies in wait of the mailman.* and L understands ‘now’ : (2,3)
  - S says *He lies in wait of the mailman.* and L understands ‘general’ : (0,0)
Why Evolutionary Game Theory?

- When modelling communication, the solution concept that we use should make reference to reasoning process of the agents involved (?).
Evolutionary Game Theory

- Evolutionary Game Theory (EGT) models the propagation of some strategies over others across a population (Maynard Smith and Price, 1973).

Modelling the imperfective cycle
Requires developing a game for each synchronic stage individually and developing an overarching game that explains the transitions between these stages.

The former is like the Bayesian games we’ve already seen, and the latter requires a new addition: evolutionary dynamics.
The Progressive to Imperfective Path

- There are four stages in the cyclic diachronic process of innovating a progressive form and having it eventually generalize to the imperfective (Deo 2015’s (24)):

\[
\begin{align*}
X_{impf} & \quad \text{zero-PROG} \\
(Y_{prog}) \ X_{impf} & \quad \text{emergent-PROG} \\
Y_{prog}, X_{impf} & \quad \text{categorical-PROG} \\
Y_{impf} & \quad \text{generalized-PROG}
\end{align*}
\]

- That means that there are three transitional states:
  - Emergence of a grammatical progressive (1 to 2)
  - Categoricalization of an optional progressive to an obligatory one (2 to 3)
  - Generalization of an obligatory progressive to more situations (3 to 4)
Synchronic Games

Speaker’s Utility Function:

\[ U_S(t, S, L) = \delta_t(S, L) - k \times n(s) \]

- The first part represents cooperation: it’s 1 if L retrieves S’s type and 0 otherwise.
- \( n(s) \) represents the cost of having 2 similar expressions: it’s 1 for 2 forms and 0 for 1 form.
- \( k \) represents the value of how much S prefers communicative success over signal cost (low value for effective communication over signal cost).

Hearer’s Utility Function:

\[ U_L(t, S, L) = \delta_t(S, L) \]
So far we’ve seen asymmetric games in that the speaker and hearer play different strategies. But for the purposes of semantic change, it is important to consider each individual as both a hearer and a speaker.

The way to turn this asymmetric strategy into a symmetric one is to calculate the utility for that person as a speaker and the utility for the same person as a listener and then combine them.

The way in which Deo (2015) does this is to add both utility values together and divide by two.
The evolutionary dynamics seek to model changes in the frequencies of different strategies in a population over time. S plays a particular strategy and is sequentially paired with other players in the population. The payoff obtained from each encounter is summed to yield the fitness of a strategy, and an average is taken that is weighted by the proportion of each type of participant that S plays against. This calculation of fitness is the rate at which players of that strategy are likely to replicate in the population, which can change the population composition over time.
In addition to the fitness calculation, we also need a measure of the learnability of individual strategies from the structure of the learner’s input.

In Deo’s model, mutations from one strategy to another happen because of input being misinterpreted during the acquisition process.

Replicator-mutator dynamics are well-suited to processes where two competing strategies are at play (cf. Nowak et al. 2001)

The replication rate of a strategy is the rate at which it might be adopted by players of other strategies.

The mutation rate of a strategy is the set of barriers to the learnability of that strategy.
Conclusions

Game theory is a broad, flexible tool for analyzing events of strategic interaction.

- Signaling games allow us to incorporate the interactive aspect of communication into our formal pragmatic theories.

- Bayesian signaling games:
  1. Allow us to study pragmatic meaning and social meaning within a general theory of human cognition.
  2. Allow for the construction of mathematical models that make quantitative predictions for language use and interpretation.

- Evolutionary games:
  1. Allow us to model the changing behaviour of large populations over time.
  2. Provide a new perspective on grammaticalization.
We can set proposals concerning social meaning, indexical fields and speaker/listener beliefs within formal Bayesian game-theoretic models.

The models allow us to make qualitative and quantitative predictions for sociolinguistic variation and interpretation.

Obama at the barbecue is a toy.

Listener prior beliefs and intended personae can be evaluated:

1. Through questionnaires, in an experimental context.
2. Through ethnographic analysis, in a sociolinguistic interview context.

Our models can be extended with structure and dynamicity...
Looking back...

Class 2
Phenomena with analyses in both sociolinguistics and semantics/pragmatics: discourse particles, politeness, and honorifics.

▶ Formal tools: Signalling games.

Classes 3 and 4
A formal semantics/pragmatics for sociophonetic variation. Style shifting and social stratification.

▶ Formal tools: Iterated Best Response models.

Class 5
Socio-semantic change.

▶ Formal tools: Evolutionary game theory.


Campbell-Kibler, K. (2007). Accent, (ING), and the social logic of listener perceptions. American speech, 82, 32-64.


