Constraint Weighting by Evolution

You say X intending I and your interlocutor grasps your intention I as you intended on the basis of your saying X. That is successful communication. Successful communication of this kind reinforces the habits of coding I as X and of understanding X as meaning I. If the interlocutors realise that X was misunderstood as J different from I inhibits the strategy of expressing I by X and possibly also the strategy of interpreting X as J.

Unfortunately, it is problematic to think of the complex business of speaking and understanding language as pairings of full messages and full intentions. The habit of using X for I is made up from many different habits of the message X and the intention I and their relation. Any model of assigning messages to intentions can be used to develop a decomposition of the habit into subhabits. I will however use an optimality theoretic model, because its decomposition of the habits into a single set of weighted constraints is particularly simple and uniform for all messages and intentions.

Unfortunately, things are not as clear-cut as I suggested in my opening paragraph. What if J is only a little bit different from I? The chances that the interlocutors will realise their misunderstanding will then be small. And what if there is conflict: understanding one aspect of the message correctly is bought by giving up on another aspect while the chance of being completely and fully understood is very small? There is something like a degree of understanding. So I will assume a function $d(I, J)$ that gives the distance between intentions I and J and one can assume that the size of the distance is related to the chance that interlocutors will notice a misunderstanding. The distance should reflect the practical importance of the difference.

Language history is composed of events IXJ and we can assume it will reproduce its composing strategies by the ratio $1 - d(I, J)$. I am making the assumption that for an intention I there is a set of optimal forms X_i and that the speaker selects an arbitrary form X from that set. The hearer inversely finds the most likely intention J such that X is optimal for J, with "most likely" understood as the most probable intention in the circumstances.

The model of reproduction is inspired by the standard OT learning algorithm. The mean distance m_k of $d(I, J)$ for events IXJ is a dynamic parameter over a sample of events (say the last n). $1 + m_k - d(I, J)$ can then be used to change the weight of the constraints that promote X for I. Irrelevant constraints are reproduced by 1. The weights are dynamic parameters and can be given as $weight(k + 1, c) = weight(k, c) * (1 + (m_k - d(I, J))/n))$. This increases or decreases the weight of each constraint by a small amount, if n is sufficiently large. Small n gives more unstable constraint systems.

The model is sensitive to natural frequencies of the intentions. If a certain situation is frequent and leads to misunderstanding, it will have more effect than an infrequent situation. It is similarly sensitive to strength of misunderstanding.

I will use this model for formalising a re-

cent account of freezing effects (Jacobson (1958/1984), Lee (2001)) and in particular for motivating why certain weightings are necesary.

Word order freezing is the phenomenon that in many languages the word order subject-object becomes (almost) obligatory (a) when there is no case marking (b), head marking (c) or plausibility (d) making clear who is the subject and who is the object. (e) illustrates an exception to obligatoriness, it has an interpretation in which *welches Maedchen* is the object. There are marked interpretations of (a) as well that have this interpretation too, e.g. under parallelism. I take my example from German, but the phenomenon has been noted in Russian, Hindi, Korean, Japanese, German, Latin, Polish and Dutch. It may well be a universal phenomenon in which strongly configurational languages are just highly frozen.

(1) a. Johann liebt Maria.
Johann loves Maria (highly marked: Maria loves Johann)
b. Ihn liebt Maria.
Maria loves him.
c. Maria lieben sie.
They love Mary.
d. Heu isst das Pferd.
The horse eats grass.
e. Welches Maedchen liebt Johann?
Which girl loves John?/Which girl does John love?

The solution involves three kinds of constraints.

Markedness constraints

I am assuming that subjects naturally become before objects, topics before foci and that arguments of verbs meet prototypical selection restrictions. I lump these together under one constraint UNM.

Structural constraints

OPERATOR

Operators come at the left edge of the phrase.

CASE

If an NP can have case morphology (as a lexical property), it has case morphology iff it has the relevant θ-role.

For optional case systems this needs to be weakened. The proposals of Aissen (1999) give a way of expressing the typological possibilities. $*OBJ\&ANIM\&\emptyset$.

AGREE

If a constituent has agreement morphology, it has the morphology that reflects the properties of its arguments.

For optional agreement this needs to be weakened. An Aissen-style proposal is easy to develop.

Expression constraints

$max(\theta)$ θ-roles are expressed

$max(topic)$ topic is expressed

These expression constraints are part of a larger family of $max(X)$ constraints.

Elsewhere I argued that it is impossible to give a universal formulation of marking that is purely production based, due to the difficulty of defining marking without reference to language particular properties or without referring to other constraints. Language particular production formulations are however possible. The universal abstract definition I propose instead goes as follows:

$max(X)$ it is not the case that F is optimal for the X-variant I^X of I.

I^X is an input variant of I with respect to X. θ- variants inverse θ-roles, topic variants change the topic, animate variants change animacy and definiteness variants change the definites.

We adopt for German.

$STRUC > UNM > max(\theta) > max(topic) > BIAS$

All 5 examples meet the structural constraints.

"Ihn liebt Maria" is not optimal for $love(HE, maria)$ due to case morphol-

ogy.

"Maria lieben sie" is not optimal for $love(MARIA, they)$ due to agreement morphology.

$HeuisstdasPferd$ is optimal for $eat(hay, horse)$ but that meaning loses out to $eat(horse, hay)$ by BIAS in the interpretation.

"Welches Maedchen liebt Johann" does not have an alternative that meets the structural constraints. Therefore it violates $max(\theta)$ without becoming suboptimal.

The interesting case is "Johann liebt Maria". We should show that neither "love(maria,JOHANN)" or "love(MARIA,johann)" are possible inputs, i.e. inputs for which the form is optimal. The second case is easy: it would be a double violation of the markedness constraints, both the subject and the topic do not come first. The markedness constraints do not decide between "Johann liebt Maria" and "Maria liebt Johann" for $love(maria, JOHANN)$, but $max(\theta)$ does: "Johann liebt Maria" is optimal for $love(JOHANN, maria)$ so it does not pass $max(\theta)$. Notice that "Johann liebt Maria" also passes $max(\theta)$ for $love(johann, MARIA)$, because "Maria liebt Johann" is the only optimal expression for $love(MARIA, johann)$.

The set of examples forms a counterexample for generative approaches, for (pure) monodirectional OT and for abstract bidirectional OTs like Smolensky (1996)'s or Blutner (2000)'s or even for hybrid systems like Jäger (2003) or Zeevat (2001). The bidirectional interpretation that I give here do not rule out language specific constraints that force case, headmarking or word order to be enforced, so I do not predict online bidirectional processing (though it would be relatively efficient: the number of alternative inputs is small).

The claim of this paper is simple. Expression constraints $max(X)$ are direct reflexes of evolutionary pressure and are weighted by evolution. Non-observance leads to distances between the speaker's intention and the hearer's interpretation. Since I^{θ} is further away from I than $I^{t}opic$ the weight of $max(\theta)$ exceeds that of $max(topic)$. It would do that universally. The varying effects of $max(\theta)$ on word order would correspond to variation in the availability of other means of marking θ and to the structural constraints that impose those means.

If one makes the further assumption that it can be decided for which features X there are $max(X)$ constraints, one would obtain a detailed picture of the functional pressure behind language evolution. It is all the constructive force in language evolution and is counterbalanced by destructive processes that cause agglutination and phonetic erosion.

Universal ranking of OT constraints can be derived from evolution, as was shown in Jäger (2003). The main factor are the natural frequencies of certain combinations of features. This paper makes the case for the combination with a factor of meaning similarity to explain ranking behind expressivity constraints.

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