Andreas van Cranenburgh 0440949
Language & Optimality
December 30, 2009

The comprehension-production dilemma

Abstract

Smolensky (1996) presents a way of dealing with the comprehension-production dilemma that avoids positing two grammars or ad-hoc performance constraints. In contrast, this paper tentatively suggests that the dilemma is actually an artefact of the competence-performance distinction, and shows several ways in which it can be explained in non-generative theories of language acquisition.

Introduction

Smolensky's (1996) famous article proposes an explanation of the gap between comprehension and production in a simple Optimality Theory (OT) framework. In this article I shall review his proposal and question both whether the proposal is adequate and whether the problem is really that much of a problem after all.

Smolensky's proposal

Smolensky calls the gap between comprehension and production a dilemma because of an unwritten assumption that a single grammar, unconstrained in its production, would have to function symmetrically (ie., comprehension and production being equally good). Since this is empirically not the case a dilemma presents itself in that either the linguist has to assume two grammars, or assume external constraints on production such as pronunciation difficulties or limited working memory.

This is a dilemma because both these options are undesirable. The latter option, of external constraints, is undesirable because it fails to explain empirical observations relating the marked structures avoided in production by the child, as well as by the people around them (comprehension) and cross-linguistically (other languages according to the Jakobson typology). Another problem is that there has never been adequate empirical evidence for such processing constraints.

The former, of assuming two grammars is also undesirable. It is not parsimonious and leaves more questions than it solves, for example

about why production agrees so much with comprehension if they are separate grammars.

The unwritten assumption leading to the dilemma derives from the generative tradition. A competence/performance distinction is assumed, and only the idealised capacity of competence is deemed worthy of study. Optimality Theory is, like other generative theories, a theory of competence. Even in Smolensky (1996), dealing with something as obviously and deeply performance related as a comprehension-production gap, it is stressed that the proposal purely concerns competence, not performance. If it weren't for this important, assumed theoretical distinction of competence and performance, there probably wouldn't be any dilemma in the first place, but instead a reality theories should accommodate. The dilemma seems to consist of: given that we assume an idealised competence, why aren't language users performing like idealised language users?

In Optimality Theory there is a way out of the dilemma. With a simple, technical modification it is possible to present a single grammar with perfect comprehension but severely hindered production. This is achieved by separating the constraints in two categories, markedness and faithfulness. Of the two sides in a structural description, markedness constraints operate only on one, whereas the faithfulness constraints operate on both. This difference has the consequence that markedness constraints only affect production, when different realizations compete; in comprehension, on the other hand, different underlying forms compete, all with the same overt form (as it was perceived). By letting all faithfulness constraints be outranked (dominated) by markedness constraints, one can have an unfaithful production, due to the markedness constraints, with faithful comprehension, which is unaffected by the markedness constraints.

OT and Language acquisition

> OT is unique in that it regards the process of language acquisition as central to its tenets. – Gierut (2006)

While I agree that language acquisition should be a central tenet of any theory of language, I disagree that OT is an appropriate framework. The argument for this is that OT makes much too strong assumptions about representations to explain much of the difficult feat of language acquisition. The only difference between a child just starting its acquisition and an adult speaker is their ranking of a universal set of constraints. It is assumed that both operate on unique and abstract representations capable of accurately describing the structure of their linguistic input.

This goes against both very natural intuitions about cognitive development and empirical evidence. The intuition is that acquiring better and more accurate representations is one of the most important parts of cognitive development, and thus also of language acquisition. Representations need to allow hierarchies of concepts, such as tables and chairs, and it is implausible to assume they are innate.

There is also empirical evidence that the phonological representations presented in Smolensky (1996) are inadequate. Beckman (2003) explores pronunciation errors made by children with a Phonological Disorder, and argues that they stem from their underdeveloped representations. Of Smolensky's proposal she writes:

> [...] couching this proposed explanation in a model of phonology such as (8) vitiates its explanatory power because of other assumptions that are packaged with it. In particular, in the model in (8), each word is associated with a single unique input representation, and that representation is a very abstract minimalist one.
>
> [...] However, a large body of experimental literature on phonological comprehension shows this standard assumption to be untenable. This literature, which is reviewed in Johnson (1997) and Pierrehumbert (2002), supports instead an "exemplar model" of the mental lexicon, as outlined in Pierrehumbert (2003).

Such an exemplar model contains a whole range of stored instances for each unit to be recognized. As development proceeds, more and richer exemplars are acquired, and more generalizations can be made between them. This elegantly accounts for the piecemeal development of rich representations from simple beginnings, without assuming the representations to be abstract and minimal to begin with, and without assuming complex rule-based mechanisms.

What is arguably the most important step in language acquisition is the ability to recognize symbolic reference (Deacon 1997). It is the most compelling difference between humans and other animals that we develop the capability to operate on triadic Peircean signs (ie., three levels of representations: concrete, iconic and symbolic). Nothing of the sort is explained by Optimality Theory. Beckman notes that her exemplar-based account, of phonological errors by children, might be related to this phenomenon:

> "Thus, the emergence of language-specific perceptual categories for stop place of articulation may constitute the first step of the transition into symbolic behavior in the phonological grammar. It may be no accident that this happens

> at around the age that the infant begins to acquire a comprehension vocabulary."

Another problem of Optimality Theory, which it shares with other generative theories, is the insistence on innate universals. Although in OT the assumptions are relatively modest, being confined to a set of constraints and an initial ranking, it is still a claim that must be backed up with empirical evidence, which has not been forthcoming. In a recent monograph (Evans 2009) a wealth of evidence against language universals is reviewed. Even the famed Jakobson typology, from which the most treasured OT examples derive, can no longer be maintained:

> As more such rarities [contrastive labial-alveolar consonants, sounding like 'b' and 'd' at the same time] accrue, experts on sound systems are abandoning the Jakobsonian idea of a fixed set of parameters from which languages draw their phonological inventories, in favour of a model where languages can recruit their own sound systems from fine phonetic details that vary in almost unlimited ways – Evans (2009)

Such evidence not only suggests that binary constraints may not be adequate, perhaps it is the whole idea of domain-specific constraints which has got to go. It is simply not plausible that a constraint such as "a reflexive element is preferrable to a pronoun in its binding domain" has evolved to be part of the human mind at birth, rather than being the result of lots of exposure to pronouns and reflexives in appropriate contexts.

Optimality Theory, along with most other theories of language, acknowledges that experience plays an important part in language learning. But if experience plays such an important role in learning, why would there need to be a second, separate mechanism for grammar? The poverty of stimulus argument has by now lost its appeal, it has become recognized that viewing language as a set of sentences is too narrow.

Language acquisition as a statistical learning problem

Let us look at the problem of language acquisition as a statistical learning problem. We can define comprehension as a suitable reduction of experience (in different modalities) at the time of an utterance. Certain words occur in specific contexts and generalizations to their

specific word-meanings can be formed from this; but note that succesful comprehension can already occur before words have been fully generalized into their appropriate word-meanings, for example using additional cues from the context and redundancy in language. This description does not hold for displaced language usage, but there is ample reason to assume that language acquisition proceeds from the concrete to the abstract in gradual succession.

Production would require a generative model of the data, to anticipate whether the result of an utterance would be as desired. It is well known that generative models require much more data and are more difficult to compute than merely discriminative models, just as it is clear from psychology that recognition is much easier than recall. Production, with its reliance on a generative model of the data, is more affected by the data sparsity than comprehension. Another aspect of production which makes it more difficult is that it requires some measure of agency, to decide what to say. Instead of being given an utterance, as in comprehension, both a message and its realization as an utterance need to be produced — something which is flatly ignored in Smolensky (1996), which conceives of production as simply the reverse of comprehension. Already we have an indication that the comprehension-production dilemma could be a side-effect of the learning problem.

Furthermore, there is a big asymmetry in the two sides of the data to be learned. On the one hand is the linguistic code, which is highly compressed and concise (a single phoneme can make a world of difference by turning a positive in a negative sentence). On the other hand is the rest of multi-modal experience, perceptions and intentions, which is a sparse and largely unstructured mass of data (a blooming, buzzing confusion, quoth William James). While recognizing ten different realizations of the word "dog" as being of the same word should be difficult enough, it is obvious that between ten breeds of canines there is much less similarity and consequently recognizing them should be more difficult. So it should be easier to recognize the word "dog" being said than to know when a certain animal can be called a dog. There is good evidence that the mind operates on such a dual code (Paivio 1971), rather than on a single, amodal, symbolic representation as is customarily assumed in generative theories.

Another asymmetry in language and its meaning is that they are a many-to-many mapping, if they are to be conceived as a mapping at all. Any given utterance can be highly ambiguous, and any situation can warrant a multitude of reactions, which can in turn be realized in a variety of utterances.

The usual argument against such empiricist accounts of language

is that it would immediately trip over examples such as (Chomsky 1975):

1. John's friends appeared to their wives to hate one another
2. John's friends appealed to their wives to hate one another

The argument being that an empiricist account, based on analogy and generalization, would fail to recognize the big semantic difference from the one-letter surface difference. However, this obviously makes a straw man of the empiricist. Firstly, there is no reason to assume that similarities on surface forms translate proportionally to semantic similarities. Secondly and more generally, there exist much more powerful mathematical models than just analogy and generalization (Kriston 2008). Such models have the big advantage of being completely domain-general, which offers the potential of completely eliminating all the speculative talk of abstract mental entities.

Empirical evidence from language acquisition

The intuitions about the asymmetry of discriminative and generative models are confirmed by Naigles (2002). Her research discusses the paradoxical findings that pre-verbal infants generalize readily during comprehension while speaking toddlers demonstrate weak or non-existent generalization in production. Thus, while comprehension is already on an abstract level, production is still non-abstract and item-based. The favored resolution to this paradox is to assume that the abstractions are not yet integrated in meanings. While learning forms and meanings is easy, linking them appropriately is hard.

Shatz (1978) presents experimental evidence indicating that children's adequate responses to parent utterances are often fortuitous, relying on a heuristic bias towards action responses. As long as the majority of parent utterances allow following such a simple response strategy, it will appear as if the child has a much more advanced capability of comprehension than it actually has.

In a series of experiments Shatz contrasts children's responses in both neutral contexts and those in contexts of sequences of either directive or informing contexts. In the former experiment children show a bias for action responses. The latter experiment shows that the more advanced children are more likely to recognize the contexts which call for an informing response, and thus are more sensitive to the grammatical features of sentences.

The item-based nature of children's linguistic development presents another problem for OT (and other generative theories). When a constraint is re-ranked, presumably a general, across-the-board improve-

ment in language use would be predicted by OT (or a parameter-setting generative theory, for that matter). In contrast, what happens in practice is that children acquire a select set of frequently occurring constructions, which they use productively and generalize selectively in a piecemeal fashion (Tomasello 2000). When children are taught nonce-verbs, they only produce them in the way they have been taught, even though they already inflect other verbs correctly. Such findings clearly suggest that language development pivots around concrete experience rather than abstract syntactic categories or general constraints.

Conclusion

The 'dilemma' can actually be explained from different angles, without positing two different grammars or ad-hoc performance limitations such as vocal chord limitations or referring to cognitive capacity. If we view grammar not as a mechanism but as a memory-based repository that requires proper organization and sufficient critical mass, it becomes much less surprising to see the asymmetries that exist. Optimality theory is unlikely to explain or model language acquisition in a useful sense, due to its strong assumptions, restricting itself to linguistic competence with constraint ordering as the sole *modus operandi*. At best it can model specific parts of mechanisms in adult language and the order of acquisition of particular phenomena. It seems to be a useful framework to summarize knowledge in linguistics parsimoniously, but linguistics should not work in isolation, and language should not be viewed as an autonomous system in a vacuum. A realistic theory of language acquisition cannot skip straight to abstractions, but should account for them and do justice to the broad psychological context of language.

Bibliography

Beckman, Mary E (2003). *Input Representations (Inside the Mind and Out)*, WCCFL 22 Proceedings, ed. G. Garding and M. Tsujimura, pp. 70-94. Somerville, MA: Cascadilla Press.

Chomsky, Noam (1975). *Reflections on Language*. Pantheon Books, New York.

Deacon, Terrence W. (1997). *The Symbolic Species*. W. W. Norton, New York.

Evans, Nicholas & Levinson, Stephen (2009). *The myth of language universals: Language diversity and its importance for cognitive*

science, Behavioral and Brain Sciences, vol. 32, pp. 429-448. Cambridge Univ. Press.

Friston, Karl. (2008). *Hierarchical Models in the Brain*, PLoS Comput Biol 4(11).

Gierut, Judith A (2006). *Experimental Validation of OT Solutions to the ComprehensionProduction Dilemma*, Clinical Linguistics & Phonetics, SeptOct 2006; 20(78): 485491

Naigles, Letitia R. (2002). *Form is easy, meaning is hard: resolving a paradox in early child language.* Cognition 86, pp. 157199

Paivio, A. (1971). *Imagery and verbal processes.* New York NY: Holt, Rinehart & Winston.

Shatz, Marilyn. (1978). *On the development of Communicative Understandings: An Early Strategy for Interpreting and Responding to Messages.* Cognitive Psychology 10, pp. 271-301 (1978)

Smolensky, Paul (1996). *On the comprehension-production dilemma in child language*, in Linguistic Inquiry, Vol. 27, No. 4 (Autumn, 1996), pp. 720-731

Tomasello, Michael. (2000). *The item-based nature of children's early syntactic development.* Trends in cognitive sciences, 4(4):156163.