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DISCUSSION

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Bias, innateness and domain specificity

SIMON KIRBY

Language Evolution and Computation Research Unit, School of Philosophy, Psychology and Language Sciences, University of Edinburgh
simon@ling.ed.ac.uk

For over 35 years, beliefs about the learnability of natural language have acted as roadblocks in the way of further development in linguistics. Rigorous and useful formal work has led to the unwarranted adoption of extreme positions which in turn have tended to stifle collaboration and polarize debate. In his article, MacWhinney suggests a way around such roadblocks – or rather many ways around. He demonstrates that we should look for multiple mechanisms to help understand how it is that children learn language from the evidence to which they are exposed.

The article starts with a review of how one such roadblock was constructed: how Gold's learnability results have been used to justify tightly constrained, language-specific models of acquisition. MacWhinney sets out a number of problems with this approach, but it is worth reflecting again on what Gold's result is actually about: the correct identification of a language, in the limit, on exposure to positive instances of strings in that language.

If children are solving this task, then we can conclude that they must have some prior knowledge guiding their selection of grammars. Notice that there is immediately a problem here. We have not shown that children are correctly identifying languages in the limit from texts. In fact, it is self-evident that this is quite far from what children do. They are not always correct (otherwise language would never change, nor could there be any linguistic variation or idiolects). Identification may be an ill-defined goal given that the strings children hear are generated by multiple languages, each of which is likely to be non-stationary. Neither are children actually exposed to merely strings. Rather, these strings come embedded in a rich social environment within which they have relevance and grounding. A better characterization of the learning task would be that children are seeking optimal communication.

Some of these differences between Gold's idealization and the real situation could actually be used to argue that the real acquisition task is even harder, whilst others may mitigate some problems. Whatever the case may

be, it is of utmost importance that we bear these differences in mind before setting out claims of LOGICAL impossibility.

However, idealizations are essential for scientific progress, and the Chomskyan idealization of the single speaker in a homogenous speech community has been an enormously fruitful one for linguistic theory. So, what if we were to accept the relevance of Gold's challenge? Is the only solution one where language learning is governed by language-specific acquisition machinery?

The argument that the solution to the learnability problem MUST be language-specific has simply not been made. What I think we can say without question is that the child does not come to the task of language acquisition empty headed. We do not need any difficult argumentation to make this case, however. Since language acquisition involves generalization, Hume's problem of induction applies (Hume, 1772). In other words, we have to have some kind of *a priori* bias towards some types of generalization over others.

It might be helpful to think of this in statistical terms. If we treat learning as the selection, given data, of the most likely language to have generated that data, then we can use BAYES LAW to recast this problem as one involving prior bias. Put simply, the most probable language L is the one that maximizes the product of the LIKELIHOOD of the observed data D and the PRIOR PROBABILITY of that language:

$$\arg\max_L \Pr(L|D) = \arg\max_L \Pr(D|L)\Pr(L)$$

If we believed all languages to have equal probability, then there would never be a reason to go beyond the data.[1]

The mechanisms reviewed in MacWhinney's paper may have natural statistical interpretations. For example, a generalization which is assigned a high prior probability should eventually be rejected by a learner once the likelihood of the observed data has fallen too far. The competition between analogy and episodic memory is a biological implementation of Bayesian statistics.[2]

[1] In fact, the space of languages over which the learner is selecting may force the learner to go beyond the data with a perfectly flat prior-probability distribution. However, it is fair to say that knowledge of the limits of a hypothesis space is another form of prior bias.

[2] To see how this works, consider Rosencrantz and Guildenstern at the start of Tom Stoppard's play, '*Rosencrantz and Guildenstern are Dead*'. Guildenstern tosses a coin over and over again but it always lands heads up – a result that he finds increasingly troubling. In Guildenstern's shoes we would initially believe that both heads and tails will turn up, but over time our belief changes. In other words, our initial over-generalization, conditioned by our prior belief that this is a normal coin, is overturned in response to indirect negative evidence to the contrary. In the end, it is simply more likely in light of the evidence that this is not a normal coin. As an example, assume that Guildenstern believes the prior probability that the coin is normal is 0·99, and he

So, we can think of solutions to learnability problems in terms of children's prior biases. These biases will ultimately be determined by their biology. In other words, an explication of child language acquisition must be couched in terms of innateness. What MacWhinney shows so convincingly is that there is more than one way to frame a nativist argument.

A linguist attempting to characterize innate bias by uncovering significant generalizations in grammaticality patterns within and across languages, is almost by necessity going to couch that bias in domain-specific terms. In other words, the syntactician's account of prior bias will inevitably be a theory of Universal GRAMMAR. The conclusions drawn by a psychologist looking at other forms of learning are bound to be quite different. Christiansen & Devlin (1997), for example, shows how subjects' ability to learn sequential tasks can be used to predict linguistic structure. In this case, a theory of innateness that is not language-specific seems appropriate.

What remains is an intriguing puzzle: can we determine whether a particular component of our innate language-acquisition bias is domain specific or domain general? What would a solution to this puzzle look like?

The growing field of evolutionary linguistics is likely to provide some answers. Many have argued that the specific nature of language acquisition is strong evidence for a language faculty that has evolved through natural selection FOR THE SPECIFIC TASK OF LANGUAGE LEARNING, in other words, that the language faculty is an adaptation (Pinker & Bloom, 1990). An alternative viewpoint appeals to the EXAPTATION for language of mechanisms adapted to other functions, suggesting a way for domain-general biases to be brought to bear on language acquisition.

It is worth considering MacWhinney's mechanisms in the light of evolution. For example, MUTUAL EXCLUSIVITY can plausibly be seen as a mechanism whose ultimate origins lie in adaptations specific to communication. It can be cast in terms of the child's prior assumption that the system she is exposed to is optimized for efficient communication. Work in evolutionary modelling has repeatedly demonstrated that similar heuristics are critical for the emergence of a viable language (e.g. Smith, 2002). What is less clear is the exact nature of the selection pressures that could give rise to these heuristics. It is by exploring this EVOLUTIONARY question that we will determine whether innate bias is domain specific or general.

Much fundamental work remains to be done on the relationship between natural selection and learning bias, but MacWhinney's contribution is to show the value of a pluralist approach. If we are to move forward, we need to abandon monolithic solutions to supposed logical problems and bring as

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believes that all coins are 'fair' – that is, an abnormal coin is simply one with heads or tails stamped on both sides. It turns out that he should start suspecting something is wrong after 8 heads are tossed in a row, because $0{\cdot}99 \times 0{\cdot}5^8 < 0{\cdot}01 \times 0{\cdot}5$.

many sources of evidence as possible to bear on uncovering exactly how it is that our species learns language.

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