Communicative pressure can lead to input that supports language learning

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Abstract

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Introduction

One of the most striking aspects of children's language learning is just who quickly they master the complex system of their natural langauge (Bloom, 2000). In just a few short years, children go from complete ignorance to conversational fluency that is the envy of second-language learners attempting the same feat later in life (Newport, 1990). What accounts for this remarkable transition?

One possiblility is that children's caregivers deserve most of the credit; that the language parents produce to their children is optimized for teaching. Although there is some evidence that aspects of child-directed support learning, other aspects–even in the same subproblem, e.g. phoneme discrimination–appear to make learning more difficulty (Eaves Jr, Feldman, Griffiths, & Shafto, 2016; McMurray, Kovack-Lesh, Goodwin, & McEchron, 2013). In general, parents rarely explicltly correct their children, and children are resistant to the rare explicit language correction they do get (Newport, Gleitman, & Gleitman, 1977). Thus while parents may occasionally offer a supervisory signal, the bulk of the evidence suggests that parental supervision is unlikely to explain rapid early language acqusition.

Alternatively, even the youngest infants may already come to language acquisition with a precocious ability to learn the latent structure of language from the statistical properties of the language in their ambient environment (Saffran & 2003, 2003; L. B. Smith & Yu, 2008). While a number of experiments clearly demonstrate the early availability of such mechanisms, there is reason to be suspicious about just how precocious they are early in development. For example, infants' ability to track the co-occurrence information connecting words to their referents appears to be highly constrained by both their developing memory and attention systems [Vlach & Johnson (2013);smith2013]. Further, computational models of these processes show that the rate of acquisition is highly sensitive to variation in environmental statistics (Blythe, Smith, & Smith, 2010; Vogt, 2012). Thus precocious unsupervised statistical learning also appears to fall short of an explanation for rapid early language learning.

In this paper we explore the consequences of a a third possibility: The language that children hear is neither designed for pedagogy, nor is it random: it is designed for communication (Brown, 1977). We take as the caregiver's goal the desire to communicate with the child, not about language itself, but instead about the world in front of them. To succeed, the caregiver must produce the kinds of commincative signals that the child can understand, and thus might tune the complexity of their speech not for the sake of learning itself, but as a byproduct of in-the-moment pressure to communicate successfully (Yurovsky, 2017).

We take as our model system a simple iterated reference game in which two players earn points for communicating successfully with each-other about the objects in front of them. First in a computational model, and then in a set of experiments with adults on Mechanical Turk, we show that pedagogically-supportive input can arise from purely selfish motives to maximize the cost of communicating successfully while minimizing the cost of communcation. We take these results as a proof of concept that both the features of child-directed speech that support learning as well as those that inhibit it may arise from a single unifying goal: The desire to communicative efficiently.

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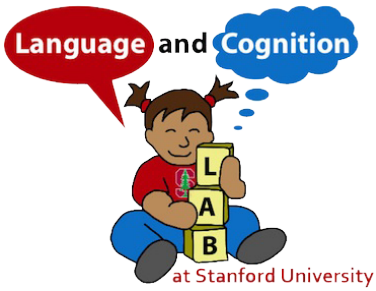

Figure 2: One column image.

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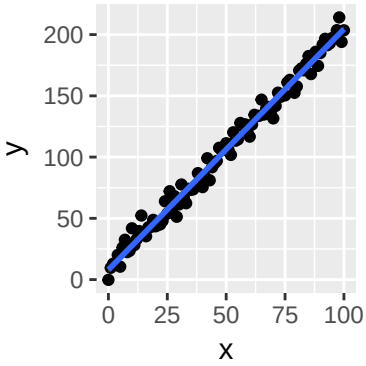

Figure 3: R plot

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You can use the xtable function in the xtable package.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.08	0.09	0.9	0.38
x	2.15	0.10	20.9	0.00

Table 1: This table prints across one column.

[1] Sample of the first footnote.
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Figure 1: This image spans both columns. And the caption text is limited to 0.8 of the width of the document.

Acknowledgements

Place acknowledgments (including funding information) in a section at the end of the paper.

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