Learning word meaning by inferring speakers' intended referents:

An incremental approach to socially-guided statistical learning

Michael C. Frank

Department of Psychology, Stanford University

Molly L. Lewis

Department of Psychology, Stanford University

Noah D. Goodman

Department of Psychology, Stanford University

Please address correspondence to Michael C. Frank, Department of Psychology, Stanford University, 450 Serra Mall (Jordan Hall), Stanford, CA, 94305, tel: (650) 724-4003, email: `mcfrank@stanford.edu`.

Abstract

How do children learn word meanings?

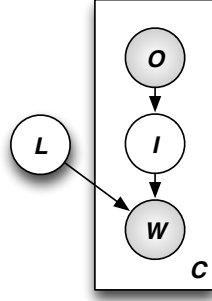*Figure 1*. Caption.

Introduction

Model

Model Specification

$$P(L,I|W,O) \propto P(W,O|L,I)P(L,I)). \tag{1}$$

But the objects O are observed in the context. In addition, for simplicity, we assume that there is a uniform prior over possible intentions (though we return to this issue in the Discussion). By the generative model in Figure 1, the remaining expression can be factored as follows:

$$P(L,I|W,O) \propto P(W|I,L)P(I|O)P(L). \tag{2}$$

In this model, the lexicon L consists of two separate parts. The referential lexicon L_R is a set of integrated Dirichlet-Multinomial distributions, one for each object in the world. This distribution represents the posterior probability of a particular word, relative to that object.
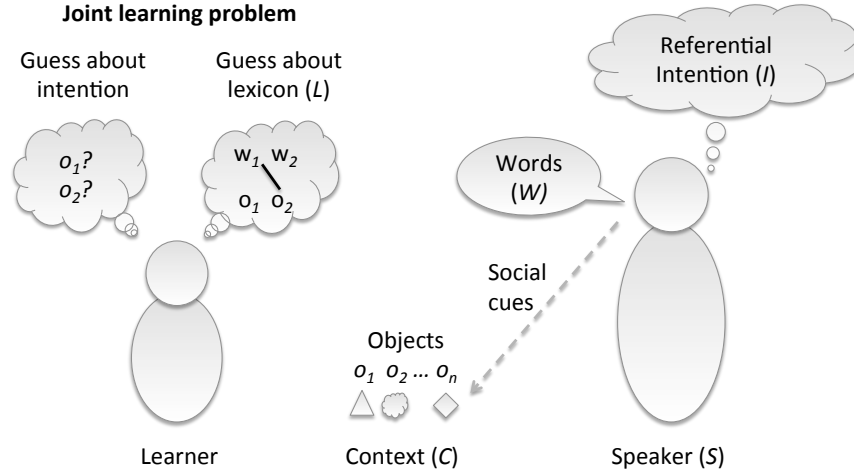
$$P(L) = \prod o \in W P(L_o) + P(L_{NR}). \tag{3}$$

3

Joint learning problem

Guess about intention

Guess about lexicon (L)

o_1?
o_2?

w_1, w_2
o_1 o_2

Referential Intention (I)

Words (W)

Social cues

Objects
o_1 o_2 ... o_n

Learner

Context (C)

Speaker (S)

Figure 2. Caption.

$$P(W|I,L) = \gamma \quad\quad\quad (4)$$

Inference

   Batch inference using a gibbs sampler.

   Incremental inference using a particle filter.

Simulations

Cross-situational word learning with adults

   Yu & Smith (2007).

Experiments with children

   Disambiguation.

   Dewar & Xu (2007).

4

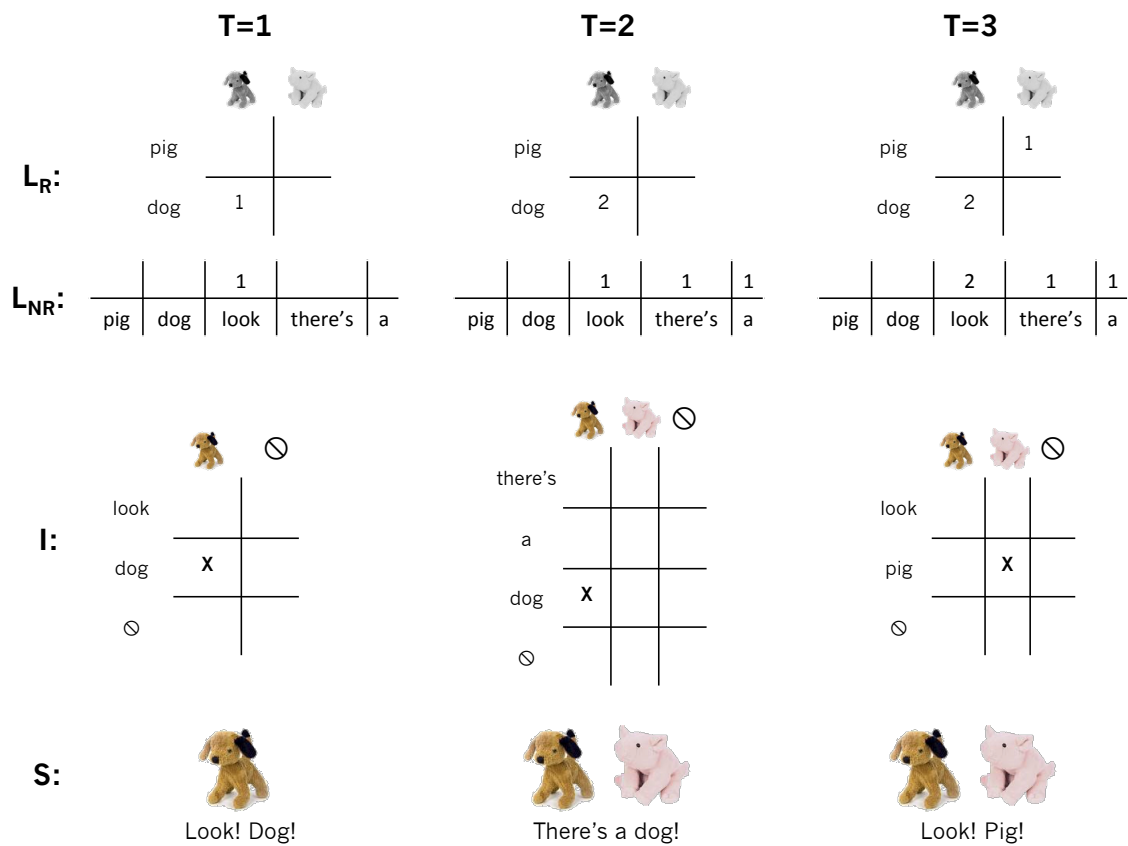*Figure 3*. Caption.

Corpus simulations

Rollins subset (Frank, Goodman, & Tenenbaum, 2009)

Fernald & Morikawa (Johnson, Demuth, & Frank, 2012)

Discussion