

A communicative framework for early word learning

XXXXX and XXXXX

S1 Corpus Details

S2 Model Details

For readability, the main text includes only the key effects for each statistical model rather than a full specification. We include those here. Each model included at least a random intercept for each subject and item. Models were estimated using version XXXX of the lme4 package (Bates, Mächler, Bolker, & Walker, 2015).

S2.1 Learning

To first confirm that we successfully manipulated participants' learning, we asked whether items with more exposure during training were better learned at pretest. To do this we fit a logistic mixed-effects model to analyze learning at baseline (i.e. prior to gameplay). We see the predicted significant effect of exposure rate on learning. The full results of this model are presented in Table S1.

Additionally, we can test our critical between-subjects manipulations to ensure that learning of the lexicon does not differ significantly at pretest. Neither utility condition or partner's exposure significantly predicts performance at pretest (full results in Table S1). This provides an important sanity check that participants in each condition learned the lexicon similarly.

Table S1: Participant learning at baseline, specified as `testCorrect ~ exposureRate + condition + (exposureRate | subj) + (1 | realLabel)`.

term	estimate	std.error	z-value	p-value
intercept	-0.97	0.23	-4.21	< .001
exposure rate	1.08	0.08	13.67	< .001
utility condition	-0.22	0.19	-1.15	.249
partner's exposure	0.11	0.12	0.93	.352

S2.2 Communicative Strategy

Our key analyses concerned participants choice of communicative strategy. In each trial, participants were able to choose one of 3 communicative strategies: gesture, speech, or teaching. We expected flexible trade-off between the use of each strategy given their relative utilities, participant's knowledge of the lexicon, and the listener's knowledge of the lexicon. To test our predictions about each communicative behavior (gesture, speech, and teaching), we conducted separate logistic mixed effects models for each behavior, reported below. It should be noted that these three behaviors are mutually exhaustive.

S2.2.1 Gesture

Looking first at gesture, we ran a mixed effects logistic regression to predict whether speakers chose to gesture during a given trial as a function of the target object’s exposure rate during training, object instance in the game (first, second, or third), utility manipulation, and partner manipulation. Random effects terms for subject and object were included in the model.

Table S2: Propensity to use gesture as a strategy, specified as $\text{gesture} \sim \text{exposureRate} * \text{partnersExposure} + \text{appearanceNum} * \text{partnersExposure} + \text{utilityCondition} + (1 \mid \text{subj}) + (1 \mid \text{realLabel})$.

term	estimate	std.error	statistic	p.value
intercept	2.07	0.35	5.96	< .001
exposure rate	-0.50	0.04	-12.88	< .001
partner’s exposure	-0.81	0.22	-3.61	< .001
instance	0.03	0.06	0.56	.576
high relative cost condition	1.20	0.32	3.79	< .001
partner’s exposure * exposure rate	-0.21	0.03	-6.69	< .001
partner’s exposure * instance	0.07	0.04	1.53	.127

S2.2.2 Speech

S2.2.3 Teaching

Table S3: Propensity to use labeling as a strategy, specified as $\text{label} \sim \text{exposureRate} * \text{partnersExposure} + \text{appearanceNum} * \text{partnersExposure} + \text{utilityCondition} + (1 \mid \text{subj}) + (1 \mid \text{realLabel})$.

term	estimate	std.error	z-value	p-value
intercept	-3.19	0.30	-10.66	< .001
exposure rate	0.35	0.04	9.76	< .001
partner’s exposure	1.95	0.19	10.02	< .001
instance	0.72	0.06	12.93	< .001
high relative cost condition	-0.87	0.25	-3.42	.001
partner’s exposure * exposure rate	0.27	0.03	9.05	< .001
partner’s exposure * instance	-0.48	0.04	-11.07	< .001

Table S4: Propensity to use teaching as a strategy, specified as $\text{teach} \sim \text{exposureRate} * \text{partnersExposure} + \text{appearanceNum} * \text{partnersExposure} + \text{utilityCondition} + (1 \mid \text{subj}) + (1 \mid \text{realLabel})$.

term	estimate	std.error	z-value	p-value
intercept	0.07	0.29	0.25	.799
exposure rate	0.14	0.04	3.21	.001
partner's exposure	-2.23	0.27	-8.38	< .001
instance	-1.09	0.07	-14.69	< .001
high relative cost condition	-0.96	0.29	-3.29	.001
partner's exposure * exposure rate	-0.14	0.05	-2.70	.007
partner's exposure * instance	0.48	0.08	5.86	< .001

References