# Environmental Effects on Parental Teaching and Infant Word Learning

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## Background

Infants learn language in context-rich environments with multiple possible referents, but **how do children know what a novel word refers to?**

A computational model of word learning predicted that multiple cues, including **gestures**, **guided referent identification** (Monaghan, 2017).

**Parental gesture use and its quality is related to language development** (Rowe, Özçalışkan and Goldin-Meadow, 2008; Cartmill et al., 2013).

Infant word learning occurs in an interactive context, where speaker and listener adapt to each others' knowledge state (O'Neill, 1996; Bahtiyar & Kuntay, 2009). However, **how parents adapt cues to the environment is not yet known.**

**Do parents alter gestures based on referential uncertainty? Do infants of parents who gesture more learn better?**

## Method

**Participants:** Parent-infant dyads, infants 18—24 months-old
Training, $n$ = 47 ($M$ = 20.9 mo, $SD$ = 1.7 mo, m:f = 27:20)
Testing, $n$ = 27 ($M$ = 20.8 mo, $SD$ = 1.6 mo, m:f = 13:14)

**Training procedure:** 3 novel words as labels (noop, darg, terb)
3 novel objects as targets, 6 as foils (randomly assigned)

Parents were asked to teach infant novel label-referent pairings, viewed at 70cm, for 30 seconds. Each participant underwent three conditions (Fig.1):

One-referent: 1 target ("noop")

Two referents: 1 target ("terb") + 1 foil

Foil 1

Six referents: 1 target ("darg") + 5 foils

Foil 2 Foil 3 Foil 4 Foil 5

Foil 6

**Testing procedure:** Infants tested on novel labels they learnt (six trials; Fig.2):

"Where is the [target]? Can you see the [target]? Point to the [target]."

1. "terb":

2. "noop":

3. "darg":

## Results

Training was video-coded (Rowe, Özçalışkan & Goldin-Meadow, 2008). IRR: 20% were coded by a second coder; $\kappa$=.86 for speech with gesture (N=160) and $\kappa$=0.78 for gesture (N=284).

**Speech + gesture**: per utterance as **complementary** (singling out target) and **supplementary** (related information about the target, e.g. colour).

**Gesture**: per utterance as **deictic** (singling out objects, e.g. pointing) and **representational** (object characteristics, e.g. hands indicating 'round').

**Linear mixed effects models** were used to predict gesture and speech use (random effects: participant & infant age; fixed effects: condition & vocabulary, UK-CDI expressive & gesture subscales).

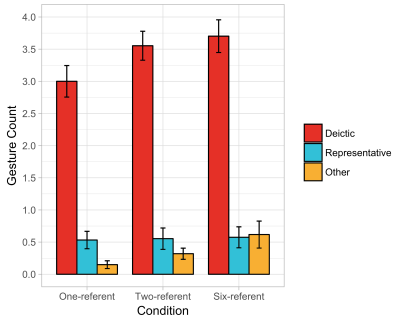


Fig.3 – Gesture type generated by parents per condition (mean & std. error)

**Deictic gestures:** effect of condition ($p$ = .015), with a significant increase in gestures from **one to two referents ($p$ = .030)**, and **one to six ($p$ = .006)**, but not two to six ($p$ = .553; Fig.3).

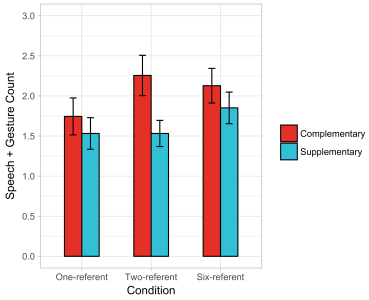


Fig.4 – Speech + gesture type generated by parents per condition (mean & std. error)

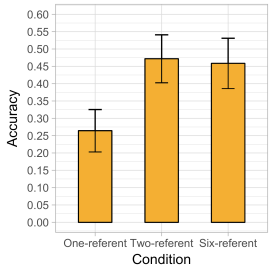


Fig.5 – Infant word learning accuracy per condition (mean & std. error)

**Complementary speech + gesture:** effect of condition and symbolic gesture vocabulary ($p$ = .041), with a significant increase from **one to two referents ($p$ = .012),** but not one to six ($p$ = .096) or two to six ($p$ = .376; Fig.4).

**Infant accuracy during testing trials:** effect of condition ($p$ = .048), with significant increase in accuracy from **one to two referents ($p$ = .028)** and from **one to six ($p$ = .044)**, but not two to six ($p$ = .893; Fig.5).

## Discussion & Next Steps

Parents **altered gesture use** according to the **presence, but not the degree of referential uncertainty**.

**Infants learnt best with a small amount of referential uncertainty**, in-keeping with Monaghan's (2017) computational model.

There was **no translation of parental gesture use during training to infant accuracy in testing** – possible reasons are sample-related (Hirsk-Pasek et al., 2015).

**Future analysis and studies:**
- Parental prosody analysis for prosodic cues during training and its relation with infant performance on word learning
- Does an enforced parent gesture condition improve word learning?

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