# Cross-situational Word Learning in Toddlers with Varying Language Proficiency

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## Introduction

- Infants and toddlers learn words in perceptually demanding environments where they must make some assumptions about which words go with which objects.
  - For example, when mom says, "doggie", the toddler must figure out if she is referring to the furry animal that barks or the round object that bounces.
- Infants and toddlers resolve this referential ambiguity by tracking the co-occurrences of words and their referents across many different learning opportunities and generate hypotheses about which words map to which objects in their environment (Yu & Smith, 2007).
  - This is referred to as cross-situational word learning and has been demonstrated in infants as young as 12-months (Smith & Yu, 2008).
- Late talkers (LTs) are toddlers with small expressive vocabularies in absence of overt neurodevelopmental disorders and sensory impairments (Collison et al., 2016).
- There has been very little research on how LTs learn words and if they employ cross-situational learning opportunities to add to their lexicon.

## Objective

- To evaluate cross-situational word learning in typically developing and late talking toddlers.

## Methods

*Participants*

- Toddlers ($N$=23), 18-36 months, were divided into two groups based on expressive language skills from the MacArthur-Bates Developmental Communicative Inventories (MB-CDIs, Fenson et al., 2007)
  - **Typically developing (TD):** Expressive vocabularies ≥ 19th percentile.
  - **Late talker (LT):** Expressive vocabularies ≤ 15th percentile.
- See Table 1.

## Methods (cont.)

**Table 1. *Participant Characterization***

| | Group | |
|---|---|---|
| **Characteristics** | **TD ($n$=16)** | **LT ($n$=7)** |
| Mean age in Months (*SD*)* | 27 (4) | 24 (5) |
| % Male | 50 | 57 |
| Mean # of words produced on MB-CDIs (*SD*) | 436 (212) | 80 (79) |
| Mean Percentile on MB-CDIs (*SD*) | 55 (30) | 10 (5) |
| Maternal Education (% with ≥ college) | 100 | 71 |

*Note. NS difference in age between TD and LT groups ($t$ =-1.5(22), $p$ =.13).

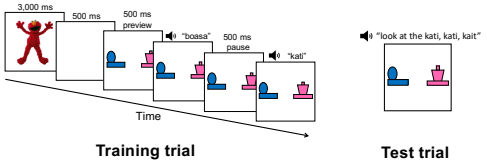
*Materials*

- Six novel spoken word-object pairs.

*Experiment*

- Cross-situational word learning paradigm (Smith & Yu, 2008; see Fig. 1) using preferential looking.
- Participant's eye gaze was recorded during the training and test phases.
  - **Training trials.** Two novel spoken words and two novel objects were presented in each trial. Word-object mappings were ambiguous within trials.
  - **Test trials.** Two novel objects from training were presented along with a verbal direction to look at one of the objects (target).

**Figure 1. *Experiment structure***




*Data acquisition*

- Data were collected using Lookit, an online data collection platform (Scott & Schultz, 2017).

*Coding*

- Participant's gaze was coded, frame-by-frame for every trial, using ELAN software (Version 6.3; 2022).
- Looks were categorized based on direction of gaze, left or right.
- Ambiguous looks or looks away from the screen (e.g., looking at parent) were not coded.

## Methods (cont.)

*Reliability*

- A random ~20% ($n$=5) of the sample was re-coded by a second coder to establish inter-rater reliability.
- Agreement on direction of gaze (left or right) for frames was >80%.

*Data analysis*

- Duration (in seconds) of looking to the left or the right side of the screen (i.e., looking at the objects) was calculated for all training and test trials.
- Linear mixed effects models were used to compare differences in time spent looking at objects during training and test trials for each group.
- Participant was included as the random variable (slopes) for all models.
- Analyses were conducted in R (Version 1.1.463; R Core Team, 2020).

## Results

- TD and LT groups spent similar amounts of time looking at the objects during training trials ($b$ = 0.27, $SE$ = 0.26, $t$ = 1.05, $p$ = .30; see Fig. 2).
- The TD group looked significantly longer at the target object compared to the distractor object during test trials ($b$ = 0.29, $SE$ = 0.08, $t$ = 3.60, $p$ = <.001; see Fig. 3).
- The LT group spent more time looking at the distractor object during test trials, although this was not significant ($b$ = -0.07, $SE$ = 0.014, $t$ = -0.49, $p$ = .62).

**Figure 2. *Time spent looking at objects during training***

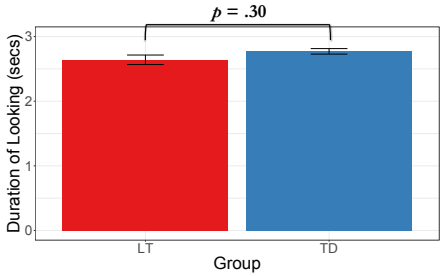
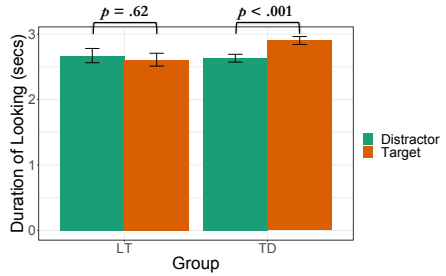



**Figure 3. *Time spent looking at targets vs. distractors during test***




## Discussion

- Both groups spent a similar amount of time attending to the objects during training, suggesting visual attention was comparable between groups while learning.
- Typically developing toddlers learned the novel word-object mappings, as evidenced by more time spent looking at the labelled object (correct object) than the object that was not labelled (incorrect object).
- Late talking toddlers did not show the same pattern of learning; rather, they looked negligibly longer at the incorrect objects compared to the correct, labelled objects during testing.
- Findings suggest that toddlers with language delay may be less sensitive to cross-situational learning opportunities and LTs may be less efficient at leveraging this input to acquire new vocabulary words.

## Next Steps

- Data collection will continue in order to validate the effects found in this pilot study.
- Contributions of other variables on learning, such as cognition, were not evaluated but individual differences measures will be included in future iterations of this work.

**References**

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