The scope of infants' early object word extensions

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Author Note

The authors made the following contributions. Zhang Xinyu, Hong Wenjie, Du Guiqin, Wangyan, Xu Jiarong: Zhang: Write the code for Experiment 3, organize and summarize the paper and report group assignments, Hong: Write the code for Experiment 2, Du: Write the code for Experiment 1 and written materials, Wang:Write Write the code for Experiment 1 and written materials, Xu: Write the code for Experiment 1 and written materials.

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Abstract

Recent research indicates that 6- to 9-month-olds understand a number of object words, but the nature of this understanding is unclear. This work examined whether infants restrict these terms to individual objects (like proper names) or extend them across multiple objects from a category (like common nouns). Experiment 1 reports evidence that 6-month-olds comprehend the name for their mother (e.g., "Mommy") as restricted to the individual person. Experiment 2 offers support for the claim that 6- and 9-month-olds understand both a label that is restricted to an individual person (e.g., "Mommy") and a label that extends to multiple members of an object category (i.e., "hand" or "ball"). Experiment 3 provides evidence that 12- to 15-month-olds comprehend both a word that is restricted to an individual (e.g., "Fido") and a word that extends to multiple category members (e.g., "dog") for the same object (i.e., a pet dog). The findings indicate that infants understand both individual- and categorical-scope words early in development, suggesting that neither lexical type represents a privileged starting point in word learning. We propose that cross-situational learning abilities, along with intuitive biases to conceptualize objects from particular semantic classes as either individuals or members of categories, play a role in infants' learning of words of the two lexical types.

Keywords: Word learning Infancy Individuals Categories Proper names Common nouns

Word count: X

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1 Experiment 1

Experiment 1 explored whether infants were able to understand any words with a personal scope, focusing on whether 6-month-old infants restricted their mother's correct name (e.g. 'mum') to the individual caregiver or extended it from the caregiver to another familiar person of a different gender or the same sex.

1.1 Objective of Experiment 1

6-month-old infants were assessed whether they would limit their address to their mother (e.g. 'mum') to her alone or whether they would extend it to another familiar person, i.e. their father, their grandmother or their maternal aunt/consanguineous female friend.

1.2 Data

The experiment was divided into three groups (fathers & grandmothers & aunts), each with a separate experimental and control group. 120 infants, with each subject assigned to any of the 6 groups.

1.3 Method

One-way experimental design (infants heard the name of their mother or another familiar person (father, grandmother or aunt)). First, four 10-s long silent familiarization trials were presented to the infant. In each trial, the infant saw a video of a person on one side of the screen (left or right) two familiarization trials showing one adult (mother) and two showing another adult (father, grandmother, or aunt/friend). These trials were randomly arranged to familiarize the infant with the position of each person in the

experiment. Next, infants performed four 10-s baseline trials in which a video of the same mother and another familiar adult as in the experimental trials was displayed on the screen and a "look" sound was played during the baseline trials, which was designed to obtain the infant's visual preference. This was followed by eight 10-s experimental trials in which the same video of the mother and familiar adult were presented, and the word "mom" or the name of another familiar adult was played once at the beginning, 4s, and 7s of each trial.

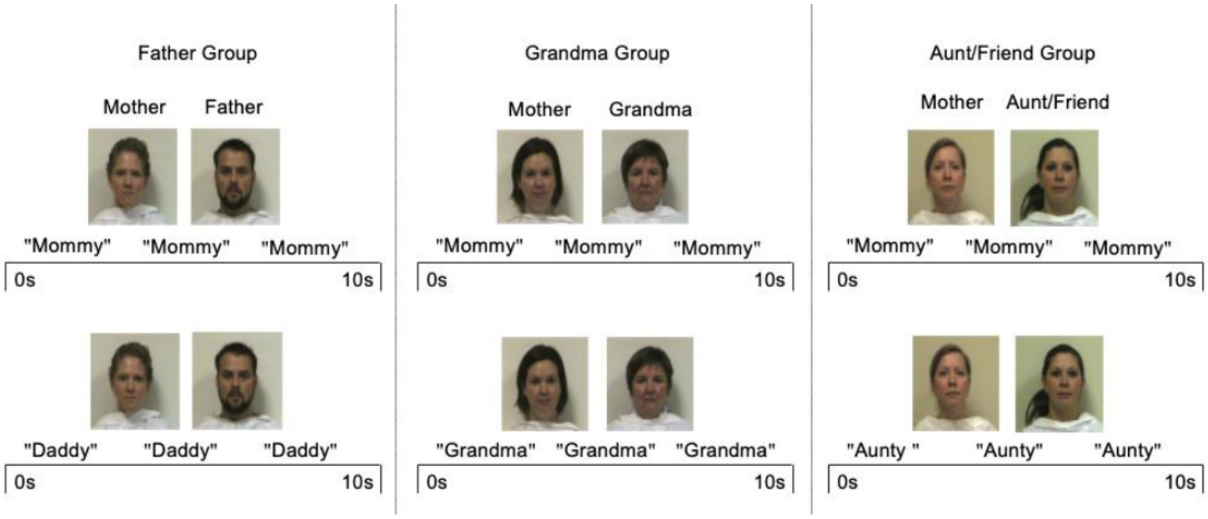


Fig. 1. Example of test trial structure for Experiment 1.

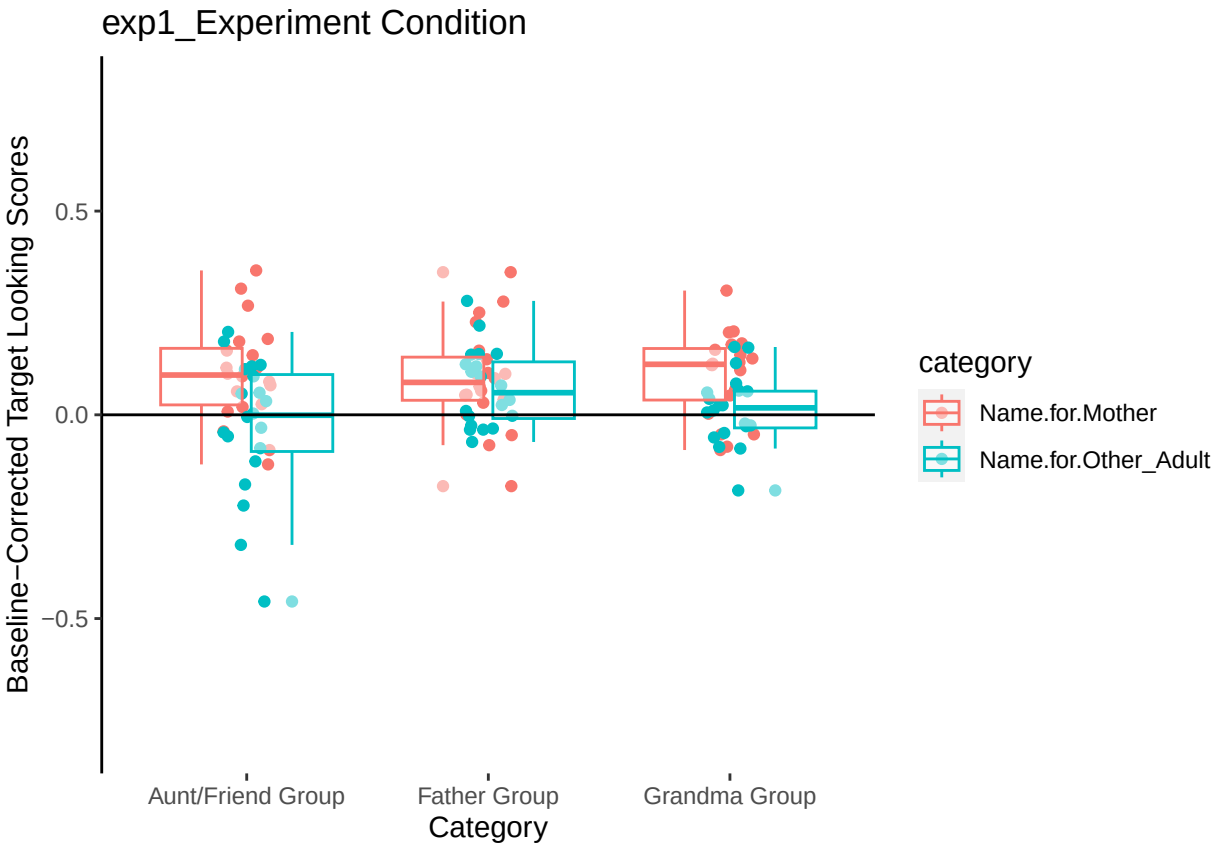
1.4 Study replication ideas and results.

Mother and father groups in experiment 1.

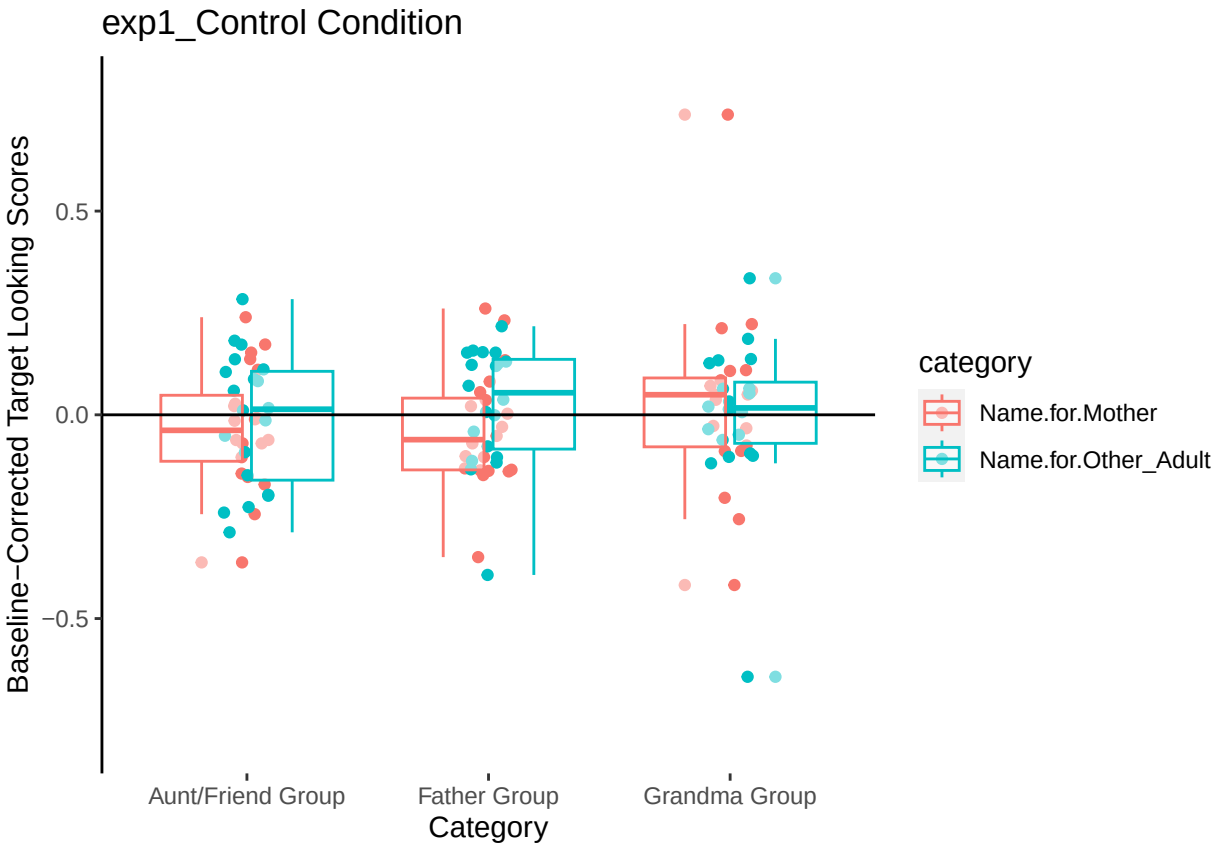
Mother and grandmother groups in Experiment 1.

Mother and aunt groups in Experiment 1.

```
## Warning: Using 'size' aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use 'linewidth' instead.
## This warning is displayed once every 8 hours.
## Call 'lifecycle::last_lifecycle_warnings()' to see where this warning was
## generated.
```


exp1_Experiment Condition
Baseline−Corrected Target Looking Scores
0.5
0.0
−0.5
Aunt/Friend Group
Father Group
Grandma Group
Category
category
Name.for.Mother
Name.for.Other_Adult

71



1.5 Discussion of the results and conclusions

Experiment 1 provides the clearest evidence to date that young infants interpret references to their mothers (e.g., "mom") as labels with a personal scope, i.e., 6-month-old infants do not appear to extend references to their mothers from their mothers to someone of a different gender in the family (their father) or another familiar person of the same race and gender who is older than their mother (maternal grandmother) or to their someone of similar age to their mother (a maternal aunt or family friend). Second, we also found that 6-month-olds' tendency to understand their father's name (e.g., "dad") as a separate term, and, 6-month-olds' tendency to understand their grandmother's label (e.g., "grandmother") as a separate term, were associated with their number of previous weekly exposures to their grandmother. Finally, we found no evidence that infants interpreted their label for mother, father, grandmother, or aunt/friend as a personal range term for strangers.

2 Experiment 2

Experiment 2 examined whether infants understood both individual- and category-scope words by assessing the extensions of their mother's proper name (e.g. 'mother') and the common nouns 'hand' or 'ball' at the ages of 6 and 9 months.

2.1 Aim of Experiment 2

Experiment 2 assessed infants' understanding of the extension of their mother's unique name (e.g. 'mother') and the common nouns 'hand' or 'ball' by assessing infants' understanding of both individual scope and a word with categorical scope at 6 and 9 months of age. test whether the infants understood both individual scope and a word with categorical scope.

2.2 Data

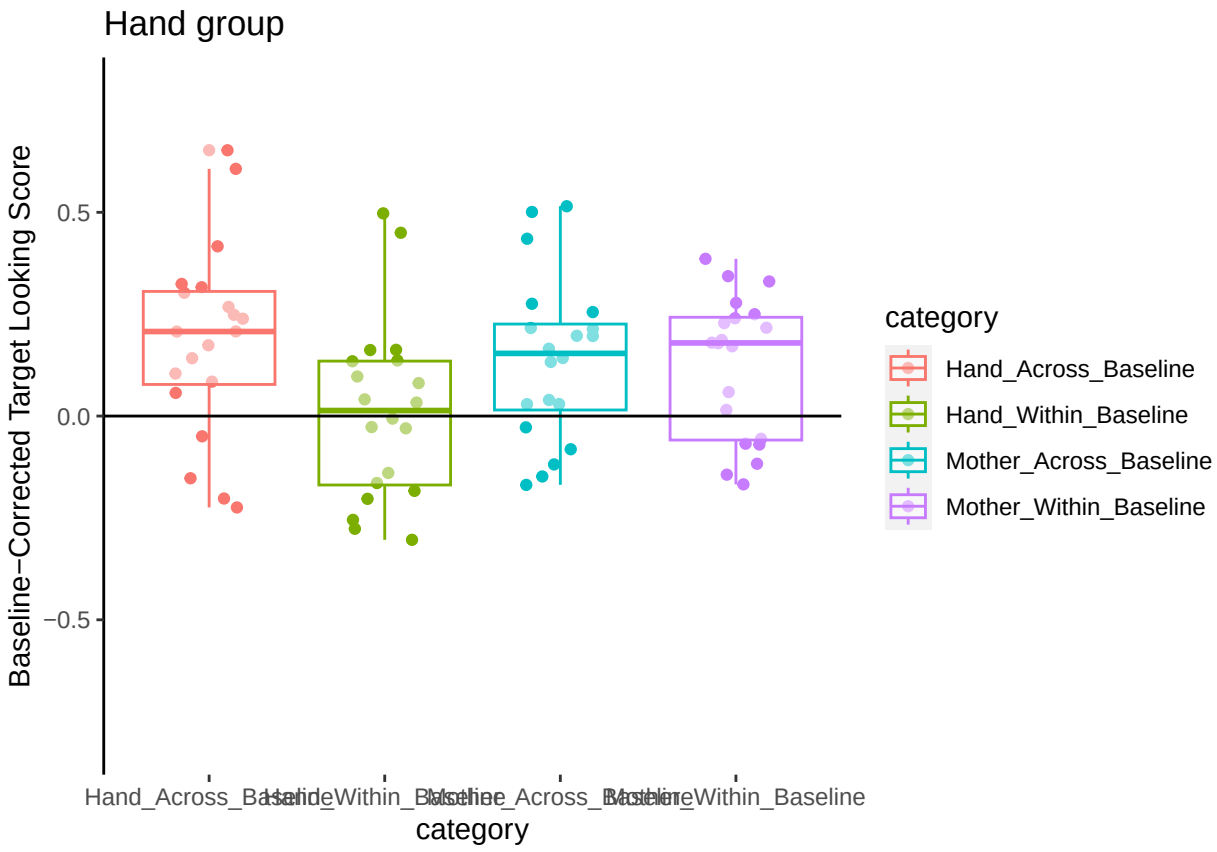
The experiment was divided into two groups (Hand Group & Ball Group), with each subject comprising four randomly ordered trials and two baseline trials, resulting in six columns of data per group.

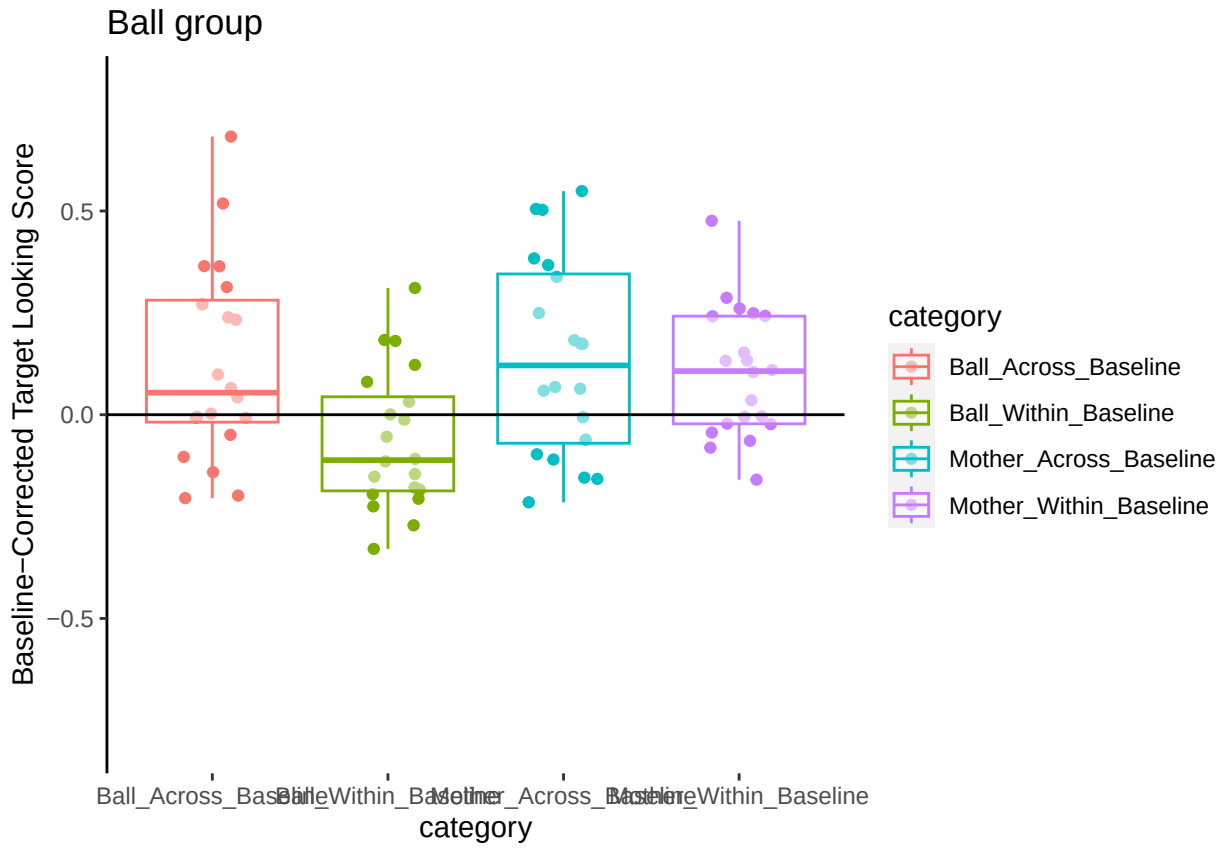
2.3 Methods:

2 (hand group, ball group) x 2 (cross-category trial, within-category trial) mixed design Participants: hand group: 20 infants aged 6 months; ball group: 20 infants aged 9 months . The methodology for Experiment 2 was similar to that of Experiment 1: It involved two baseline and test trials: Each baseline trial was repeated three times: the infants looked at two photographs on the screen side by side when they heard the words "look" or "see". Cross-category trials: where the target's photograph (the baby's mother; or the baby's own hand or ball) is next to an unfamiliar photograph of a different category. Within-category trials: where the target is next to a photograph of an unfamiliar member

of the same category. Data calculation method: If the babies interpreted any one person's name as a term in a separate category, they looked at that person more in the test trial when they heard that person's name than they did in the baseline trial. To quantify the change between baseline and test experiments, we calculated each infant's baseline pair-adjusted score, one for mother's name and the other for father, grandmother, or aunt/friend's name. We computed these scores by subtracting the mean proportion of total looking to the named person (the target) during baseline trials (i.e., [Look to target] / [Look to target + Look to distractor]) from the mean proportion of total looking to the target during test trials (i.e., [Look to target] / [Look to target + Look to distractor]). A positive score indicated an increase in looking to the target on test trials compared to baseline trials.

2.4 Study replication ideas and results:





2.5 discussion of the results and conclusions

When presented with an unfamiliar woman of the same race, the infant also appeared to limit the mother's name to her, which is consistent with the personal scope interpretation of the label. 6-month-olds appeared to understand the common noun 'hand' as encompassing both their own hand and an unfamiliar hand), which is consistent with the category interpretation of the term. 9-month-olds seem to understand the common noun 'ball' as meaning across the ball (both their own ball and an unfamiliar ball), which implies that the category interpretation of the word is understood. That is,The tendency of infants to restrict their mother's name to the mother in both groups reflects their interpretation of names as having a body-wide term, while the tendency of infants to extend the words 'hand' (or 'ball') over two hands or two balls reflects their interpretation of Common nouns are interpreted in terms of scope terms. This indicates that 6- and 9-month-old infants can understand both a word restricted to a single object (e.g., their mother's name) and a word that is a member of a cross-object category (e.g., the common nouns 'hand' or 'ball'). 6 months represents the youngest age at which infants The results of this study suggest that infants' initial understanding of object words includes both personal- and category-wide terms, and although we do not provide evidence that this is equivalent to adult understanding of personal- and category-wide terms, it suggests the possibility that infants' early vocabulary includes both personal- and category-wide terms.

3 Experiment 3

Experiment 3 went further than this and explored whether infants could understand both individual range words and category range words for the same object.

3.1 Introduction

- Aim of the study: Experiment 3 explored whether infants understood two categories of different object words for the same object, in light of studies that reported that infants may know both proper and common nouns at the age of 12 - 15 months.
- Data: The experiment was divided into two types of objects, similar (dog-dog) and cross-category (dog-cat), and each category of objects was divided into proper and common nouns, so that there were four sets of data in total, and the scores were tallied as the value obtained by subtracting the proportion of time spent looking at the target object from the proportion of time spent looking at the target at baseline.

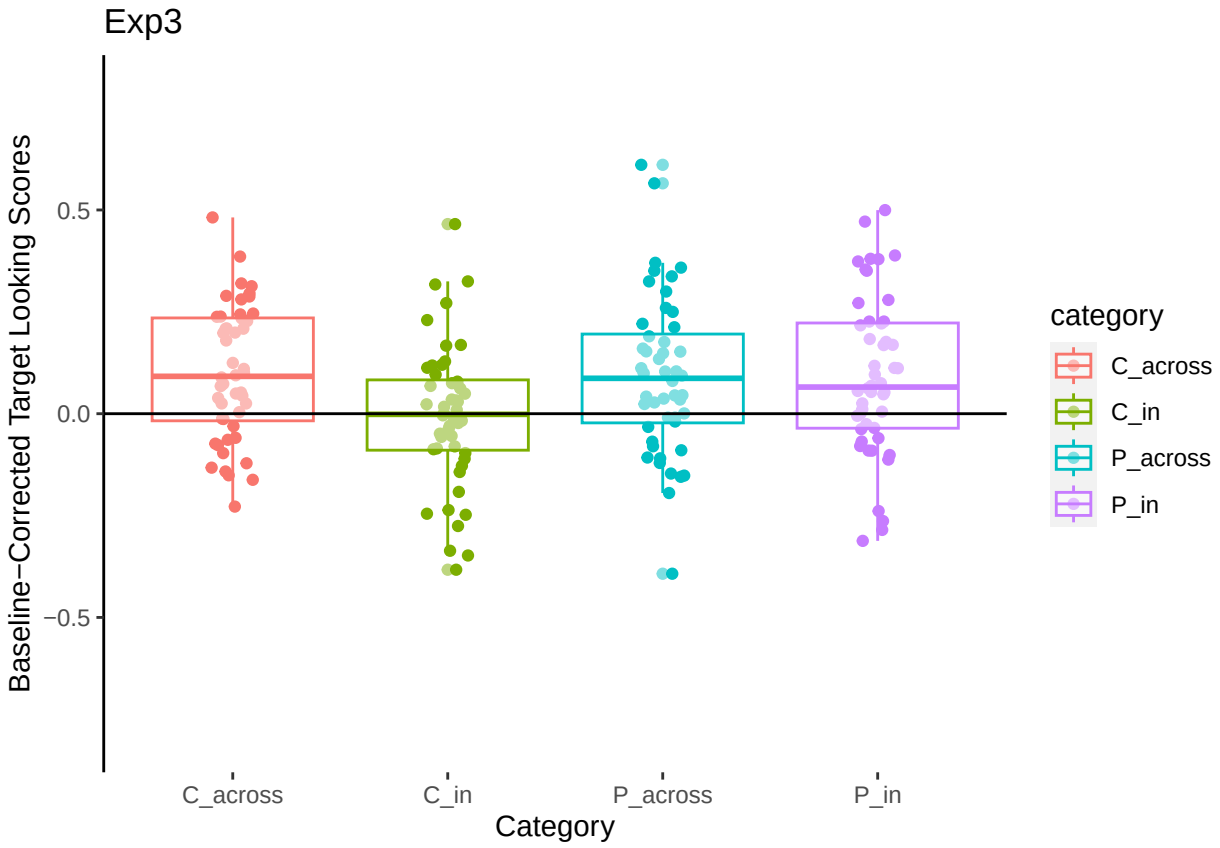
3.2 Method

Within-subject design for categories (similar, different) × (proper nouns, common nouns) * Subjects: 48 infants aged 12 - 15 months * Experimental material: video using photos of the infants' family dog, other dogs or cats * Experimental procedure: The experiment was divided into three blocks, a silent block (7s), a proper noun block, and a common noun block. the first 7s of the experiment, a silent video clip, was designed to familiarise the infants with the location of the animals in the pictures; the second block was a proper noun or a common noun, and each block had four trials, two in the same category and two different category tests. The duration of each trial was 13 s, consisting of 3 s of silent and 10 s of audio clips, with the gaze duration of the 3 s silent clip being used as baseline data.

3.3 Research idea replication and results:

```
## # A tibble: 2 x 3
##   Group   mean_age sd_age
##   <chr>      <dbl>  <dbl>
```

```
## 1 Older       14.3  0.407
## 2 Younger     12.9  0.363
```



3.4 Discussion of the results and conclusion

Experiment 3 provides evidence that infants understand two labels with differing extensions for the same object (their family pet) – both a word that is restricted to an individual object (a proper name in the adult language) and a word that extends across members of a category (a common noun in the adult language).

4 General discussion

In these experiments, we observed a consistent pattern of results, albeit with different methods, enabling them to be sensitive to the task demands of infant competence. The

findings of this paper suggest that it is possible that there are two types of vocabulary in the vocabulary of six-month-old infants, due to the fact that vocabulary learning takes place during the first six months of life and that infants first acquire a personal vocabulary or category of vocabulary before acquiring another type of vocabulary. This possibility becomes reasonable if there is evidence that infants understand either type of vocabulary by six months of age. However, if vocabulary learning does not begin until six months of age, then the evidence for both individual and category words in infants' lexicons at this age suggests that they learn both types of labels from the very beginning of their vocabulary development - inconsistent with the narrow-to-broad and broad-to-narrow accounts, but consistent with the narrow-to-broad account, according to which neither type of vocabulary has an advantage in acquisition. If neither of these two vocabulary types is privileged in the acquisition process, how do infants learn individual and categorical ranges of object vocabulary? One possibility is that this learning occurs simply through the infant's ability to track and analyse the co-occurrence of labels and objects in different contexts. For example, infants may hear caregivers restrict a word such as 'mum' (or 'dad') to one person in a variety of situations and not extend it to others; conversely, they may hear caregivers extend a word such as 'hand' (or 'ball') to multiple hands (or balls). Another possibility (not mutually exclusive with the first) is that infants' early learning of individual- and categorical-scope words is not driven solely by their cross-situational tracking and analysis of word-object pairings. Rather, it may be aided by certain intuitive biases that conceptualize objects in certain semantic categories as individuals (e.g., people, dolls, anthropomorphic animals) and objects in other categories as members of categories that are interchangeable with any other category (e.g., body parts, food, artifacts). To be sure, the observed semantic distinction between early individual-scope and categorical-scope words may be the product of learning rather than a reflection of the operation of intuitive biases guiding the learning. But recent work from the study of early cognitive development offers a reason to suspect that intuitive biases drive the learning.

This research suggests that infants are endowed with certain systems of core cognition, including an intuitive psychology centred on the notion of an agent and an intuitive physics centred on the notion of an object . If these core cognition systems dispose infants to conceptualize agents (e.g., people) as individuals but to construe non-agents (e.g., body parts, foods, artifacts) as interchangeable category members, then they may furnish the basis for the proposed intuitive biases that lead to the observed semantic class distinctions in infants' individual-scope and category-scope words. Further experimentation focused on young infants' interpretations of novel words for novel objects from different semantic domains (e.g., people, artifacts) would be helpful to clarify whether such intuitive biases play a role in how infants determine the scope of their first object words.

5 Conclusion

This work advances our understanding of language development by offering the first experimental evidence that young infants have knowledge of object words of two different types – those with individual scope and those with categorical scope. Contrary to many prior accounts, the findings suggest that neither type represents a privileged starting point in lexical development. Infants' initial lexicons may instead be semantically more complex than previously believed. Understanding the genesis of this early lexical-semantic complexity and determining its impact on subsequent word learning represent important challenges facing efforts to elucidate how children acquire their native language.