Mutual Exclusivity in the Intermodal Preferential Looking Paradigm

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Abstract
Infants are argued to use a ‘mutual exclusivity’ bias to attach novel object labels to name-unknown objects, rather than name-known objects (Markman, 1989). In an intermodal preferential looking experiment with 22.5-month-old infants, stimulus repetition was critical for observing mutual exclusivity. On the first occasion that a novel label was presented with a name-known and name-unknown object, looking behaviour was unsystematic. Upon re-exposure to the same stimuli, the infants looked preferentially at the name-unknown object prior to the re-presentation of the novel label. These findings suggest a powerful memory mechanism for novel labels, enabling mutual exclusivity to emerge across multiple exposures to potential referents.

1 Introduction
During the second year of life, it is claimed that infants use a word-learning strategy called mutual exclusivity (e.g. Halberda, 2003; Markman, 1989), where an infant will not accept second names for name-known objects. An infant may see, e.g., a shoe and a key, but only know the word ‘shoe’. If the infant hears ‘key’, they may decide it refers to the key by ruling out the shoe as a potential referent. There is disagreement over the nature of the underlying mechanism and the onset of the strategy (e.g. Markman, Wasow, & Hansen, 2003; Merriman, Marazita, & Jarvis, 1995).

Many investigations of mutual exclusivity have used object selection procedures (e.g. Merriman & Bowman, 1989). Halberda (2003) measured looking time, argued to be a more sensitive measure of comprehension. However, there are flaws with Halberda’s study, such as potential reinforcement and item effects, and a lack of appropriate controls. Our aim is to establish whether infants will display mutual exclusivity as a looking behaviour in a well-controlled experiment. A further aim is to explore the role of processing factors. Increased stimulus exposure across trials may facilitate the use of mutual exclusivity.

2 Method

2.1 Participants

Thirty 22.5-month-olds (mean age 675 days; range 665 - 691 days; 17 male, 13 female) contributed data. A further 11 infants participated but were excluded due to
experimenter error (2), fussiness or failure to complete study (8), or parental interference (1).

2.2 Stimuli

Twelve name-known images (e.g., ball, car), twelve name-unknown images (e.g., can opener, anchor), twelve familiar labels (corresponding to name-known images), and four novel labels (blick, gop, meb, wug).

2.3 Design and Procedure

Twenty-four 6s trials each presented a name-known object and a name-unknown object within an intermodal preferential looking task (see Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987). There were three trial types: Familiar, where the name-known object was labelled; Novel, where a novel label was presented; Control, presenting a neutral phrase (“Look at that”). The onset of the label was at 2633ms, and trials were split into 3s pre- and post-naming phases.

The experiment was divided into two halves of 12 trials, each presenting different sets of labels and images. Each half was divided into two blocks of six trials. During the first block in each half, two trials of each type were presented in a randomised sequence (see Figure 1). The second block presented the same sequence of trials as the first (counterbalancing side of presentation). Thus, each trial had an original and repeat presentation. The labelled object for a given pair of images was counterbalanced across infants. Parents completed the Oxford Communicative Development Inventory (Oxford CDI; Hamilton, Plunkett, & Schafer, 2000) to check infants’ comprehension of the familiar images. Infants’ looking direction was coded every 40ms using offline coding software.

Figure 1. Example of a trial block

<table>
<thead>
<tr>
<th>Trial type</th>
<th>Image pair</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>🏑</td>
<td>“Look at that”</td>
</tr>
<tr>
<td>Novel</td>
<td>🍀</td>
<td>“Look at the meb”</td>
</tr>
<tr>
<td>Control</td>
<td>🎨</td>
<td>“Look at that”</td>
</tr>
<tr>
<td>Familiar</td>
<td>🏐</td>
<td>“Look at the ball”</td>
</tr>
<tr>
<td>Novel</td>
<td>🔫</td>
<td>“Look at the wug”</td>
</tr>
<tr>
<td>Familiar</td>
<td>🛠</td>
<td>“Look at the key”</td>
</tr>
</tbody>
</table>

3 Results

The dependent variable was the percentage proportion of looking to the name-known image (total looking time to name-known image divided by total looking time to both images).
3.1 Preliminary analysis

Initial analyses comparing pre- and post-naming phases found an interaction between trial type, trial repetition and naming. For the repeat trials there were significant effects of trial type for the pre-naming phase and the post-naming phase. Thus, a more fine-grained analysis of changes over time was conducted.

3.2 Main analysis

Trials were divided into four 1.5s phases; trial phase was entered into an ANOVA with trial type, trial repetition, experiment half, and sex. There were no effects of experiment half or sex, so the ANOVA was collapsed across these factors. There were main effects of trial repetition, $F(1, 29) = 4.2, p < .05$, and trial type, $F(2, 58) = 8.0, p < .005$. There were interactions between condition and trial phase, $F(6, 174) = 3.0, p < .01$, and trial type, trial phase, and trial repetition, $F(6, 174) = 3.4, p < .005$ (see Figure 2).

For original trials, there were no significant differences to chance in novel label and control condition. For the familiar label condition there was a name-known image preference for the pre-naming $1.5 - 3s$ phase ($p < .05$), and the post-naming $3 – 4.5s$ ($p < .001$) and $4.5 – 6s$ ($p = .001$) trial phases. For repeat trials, there were no significant differences to chance for any condition for the $0 – 1.5s$ phase; for the $1.5 – 3s$ phase, there was a name-known image preference in the familiar label ($p < .005$) and control ($p < .025$) conditions, but a name-unknown image preference in the novel label condition ($p = .005$). These preferences were maintained during the $3 – 4.5s$ post-naming phase in the familiar ($p < .01$) and novel label ($p < .05$) conditions.

Figure 2. Preference for the name-known image over time as a function of trial type

4 Discussion

Infants are on-task in the familiar label condition for both original and repeat trials. Yet, in the novel label condition, infants do not display a significant preference for the name-unknown object until a trial is repeated. Although this preference occurs prior to naming on the repeat trials, this effect must be driven by hearing the novel label on the original trial, as infants respond differently on the repeat trials in both the familiar label and control conditions. This emergent mutual exclusivity response may be due to infants remembering that the novel label was previously presented with the same pair of images.
5 Conclusion

These findings suggest a powerful memory mechanism for novel labels, enabling mutual exclusivity to emerge across multiple exposures to potential referents.

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References