Methods for Toddler's Comprehension of Negation

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Main Question: At what age do toddlers understand negation in the context of rejecting desires?

Design

The study presents toddlers with video recordings and measures their looking time to the screen in a violation of expectation paradigm (Baillargeon, Spelke, Wasserman 1985). In each trial, there are two puppets and two objects on the screen. One puppet asks the other if they want one of the objects. The second puppets answers with "yes" or "no". Then the first puppet goes ahead to give them the object they wanted, or the object they did not want.

The study has four within-subject trial types. These four trial-types are created based on two factors:

1. Whehther the answer to the question is positive or negative
2. Whether the reaction to the answer is consistent or inconsistent with the expressed desire

The table below summarizes the study's 2×2 design. Positive trial types consititue the control condition and negative trial types constitute the test condition.

Condition	Trial-Type	Objects	Question	Answer	Reaction
Control	Positive-Consistent	X, Y	Do you want the X?	Yes	gives X
Control	Positive-Inconsistent	X, Y	Do you want the X?	Yes	gives Y
Test	Negative-Consistent	X, Y	Do you want the X?	No	gives Y
Test	Negative-Inconsistent	X, Y	Do you want the X?	No	gives X

Stimuli

Puppets and Objects

[we should include the picture of the puppets and the objects used in the experiment]

2 puppets

Objects: apple vs. banana ball vs. car dog vs. kitty ducky vs. bear

Linguistic Stimuli

Here we want to argue that in the window of 24-30 months toddlers know all these lexical items that's why we do our pilot in this age range.

List of lexical items used: no, yes, want, you, ... [list of our items like car, banana, ...]

According to CDI data (accessed through wordbank.stanford.edu), around 27 months of age almost all children produce "yes" and "no".

Studies to cite on earlier comprehension of these common nouns: Bergelson and Swingley (2012, 2015)

Video Recording and Editing

Trials

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Block 1: Positive Consistent

Objects	Question	Answer	Reaction
Apple, Banana	Do you want the apple?	Yes	gives apple
Ball, Car	Do you want the ball?	Yes	gives ball
Cat, Dog	Do you want the kitty?	Yes	gives cat
Duck, Bear	Do you want the ducky?	Yes	gives duck

Block 2: Positive Inconsistent

Objects	Question	Answer	Reaction
Apple, Banana	Do you want the apple?	Yes	gives banana
Ball, Car	Do you want the ball?	Yes	gives car
Cat, Dog	Do you want the kitty?	Yes	gives dog
Duck, Bear	Do you want the ducky?	Yes	gives bear

Block 3: Negative Consistent

Objects	Question	Answer	Reaction
Apple, Banana	Do you want the apple?	No	gives banana
Ball, Car	Do you want the ball?	No	gives car
Cat, Dog	Do you want the kitty?	No	gives dog
Duck, Bear	Do you want the ducky?	No	gives bear

Block 4: Negative Inconsistent

Objects	Question	Answer	Reaction
Apple, Banana	Do you want the apple?	No	gives apple
Ball, Car	Do you want the ball?	No	gives ball
Cat, Dog	Do you want the kitty?	No	gives cat
Duck, Bear	Do you want the ducky?	No	gives duck

- would Block 3 be surprising to babies?
- label-object matching: if the object given is the label mentioned then no surprise, but if it's a different one = surprise (prediction: surprise at Block 2 and 3)

Participants

Csibra et al (2016) report that the average effect size in infant looking time studies is about 0.6. Based on this they recommend at least 12 participants and for smaller than usual effect sizes at least 26 participants. Therefore, for our pilot study we aim to recruit between 12-26 participants in the age range of 24-30 months.

Measurment & Reliability

We use the duration of infant's looking at the screen after a trial video has ended as our dependent measure. All trials end with the last frame frozen on the screen. We move to the next trial if infants stop looking at the screen for more than 2 seconds. Timing, trial ordering, and presentation was managed using the open source software https://github.com/jfkominsky/PyHab/releases

Reliability Coding

Procedure

Results and Analyses

We predict that toddlers who understand our task will look longer at inconsistent trials than consistent ones. In the control condition, success inscludes correct comprehension of the positive word "yes". In the test condition, success involves correct comprehension of the negative word "no".

To test toddler's performance we use a Bayesian linear regression with the following as predictors: answer (yes/no) and reaction (consistent/inconsistent). Following Barr et al, we use the maximal by subject and item random effects. Item here is interpreted as the object handed to the second puppet by the first.

Following the adivce of Csibra et al (2016) we log-transform the infant looking time for our statistical analyses.