To Be or Not to Be: Examining the Role of Language in a Concept of Negation

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Method

- 67 Smith College undergraduates participated in this study for course credit.
- Participants sat in front of a Tobii eyetracker and the experimenter briefly explained the function of the machine. Participants were then told that they would see pairs of photos on the screen in front of them, and that their job was to watch the pictures and pay attention to what they saw on the screen in front of them.
- Half of the participants participated in a negation task, and half participated in a control task. In each task, 26 pairs of pictures were created. Four pairs were used as examples and were each shown twice at the beginning of the experiment, once with the target on the left and once with the target on the right. In each trial, the photograph pair was presented for 3 seconds before the animation began. The animation consisted of a cartoon foot emerging and moving down to squash the target photo to 20% of its original height. The foot then moved back up and the photograph returned to its original height as the foot receded.
- Half of the participants in each task also participated in a verbal shadowing task. Participants in the verbal shadowing condition listened to an audio book through a pair of headphones, and were asked to repeat what they heard out loud as they listened. Participants were told to be as accurate as possible, but to continue speaking if they made any mistakes, as the most important thing was that they spoke as continuously possible.

Results

- The 22 trials following the 4 example trials were included in the analysis.
- Total Fixation Duration on the target or the nontarget photo was analyzed for the three seconds prior to the animation in each trial.

Hypotheses

- We hypothesized that adults would only be able to form an implicit concept of negation by using language.
- If the language faculty was tied up by an interfering task such as verbal shadowing, adults would fail to see the resemblance across negative exemplars.
- To examine implicit concept formation, we used an eyetracking paradigm in which adults viewed pairs of photos (a scene & its negative version) in which the negative version animated after three seconds.
- We hypothesized that after viewing several examples, adults would implicitly anticipate the animation of the picture of a negated event, but that adults who viewed the pictures while participating in a verbal interference task would not be able to anticipate the animation of the target negative picture.
- As a contrasting task, it was hypothesized that adults who viewed pairs of pictures consisting of one natural kind and one artifact would be capable of anticipating the animation of the natural kind picture in both non-interference as well as verbal interference conditions.

Background

- This study examined the role that language, specifically syntax, plays in forming and reasoning about a concept of negation.
- Philosopher and Cognitive Scientist Jerry Fodor emphasizes the unique role that language plays in conveying information about the world with the example “Think about trying to draw a picture of ‘there’s not a giraffe standing beside me’”
- The idea that language structures thought comes from the work of Wolfram Hinzen, a philosopher of language whose work suggests that there is a conceptual framework that underlies human thought, and that language is necessary to organize these concepts into complex, propositional thoughts.
- According to this theory, while a non-linguistic being could learn simple concepts such as “dog” or “child”, language is required to structure these concepts into complex concepts such as negation.

Natural Kind v. Artifact

- Natural kind v. Artifact pairs were selected so that each picture would be perceptually similar in color and shape to its pair. This was done so that the task could not be solved based on perceptual cues alone, making it a good control for comparison to the complex negation task. Two examples of natural kind v. artifact pairs are presented on the left.

Negation Examples

- Negation pairs were selected so that in each pair one picture portrayed a scene that would be described without using negation (i.e. affirmative), and the other picture portrayed a negated version of the same scene (i.e. negation). Four different types of negation were portrayed – not expected, nonexistence, not working, and refusal. These different types of negation were portrayed in order to assure that the instances of negation would be perceptually different. Three examples of the negation pairs are presented on the right.

Discussion & Future Directions

- This experiment offers support for our hypothesis that language is required to form a concept of negation.
- In the negation task, adults looked significantly more towards the photograph portraying a negated proposition in the no-shadowing condition, but did not look significantly more to either photograph in the shadowing condition. There was an effect of interference in the negation condition, but no effect of interference in the natural kind condition.
- Although this experiment only examined adults’ performance, future studies could examine children’s performance on a similar task. Due to the implicit nature of the task, children as young as 12 months could be tested in the future. This would allow us to examine the role that language plays in the initial formation of language-based concepts, such as negation.
- Further studies could also examine the role of language in understanding other logical connectives, such as “and” and “or”, and quantifiers such as “some” or “all”.

Results figures and tables include:
- An ANOVA of the UL3 scores (target-nontarget/target +nontarget) for each participant was conducted to determine if there was a significant effect of verbal interference in either the negation or the natural kind group:
  - Negation: F(1) = 4.884, p<.05
  - Natural Kind: F(1) = .231, n.s. (p=.636)

- T-tests were conducted to determine if participants looked significantly more to the target picture in any of the four groups:
  - Negation no-shadowing: t(10)=3.396, p<.05
  - Negation shadowing: t(10)=0.135, n.s. (p=.895)
  - Natural Kind no-shadowing: t(10)=1.974, n.s. (p=.074)
  - Natural Kind shadowing: t(10)=2.064, n.s. (p=.064)