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What is more democratic, a stone or a feather? Predicting nonsensical choices using high-dimensional vector representations obtained from a semantic space model
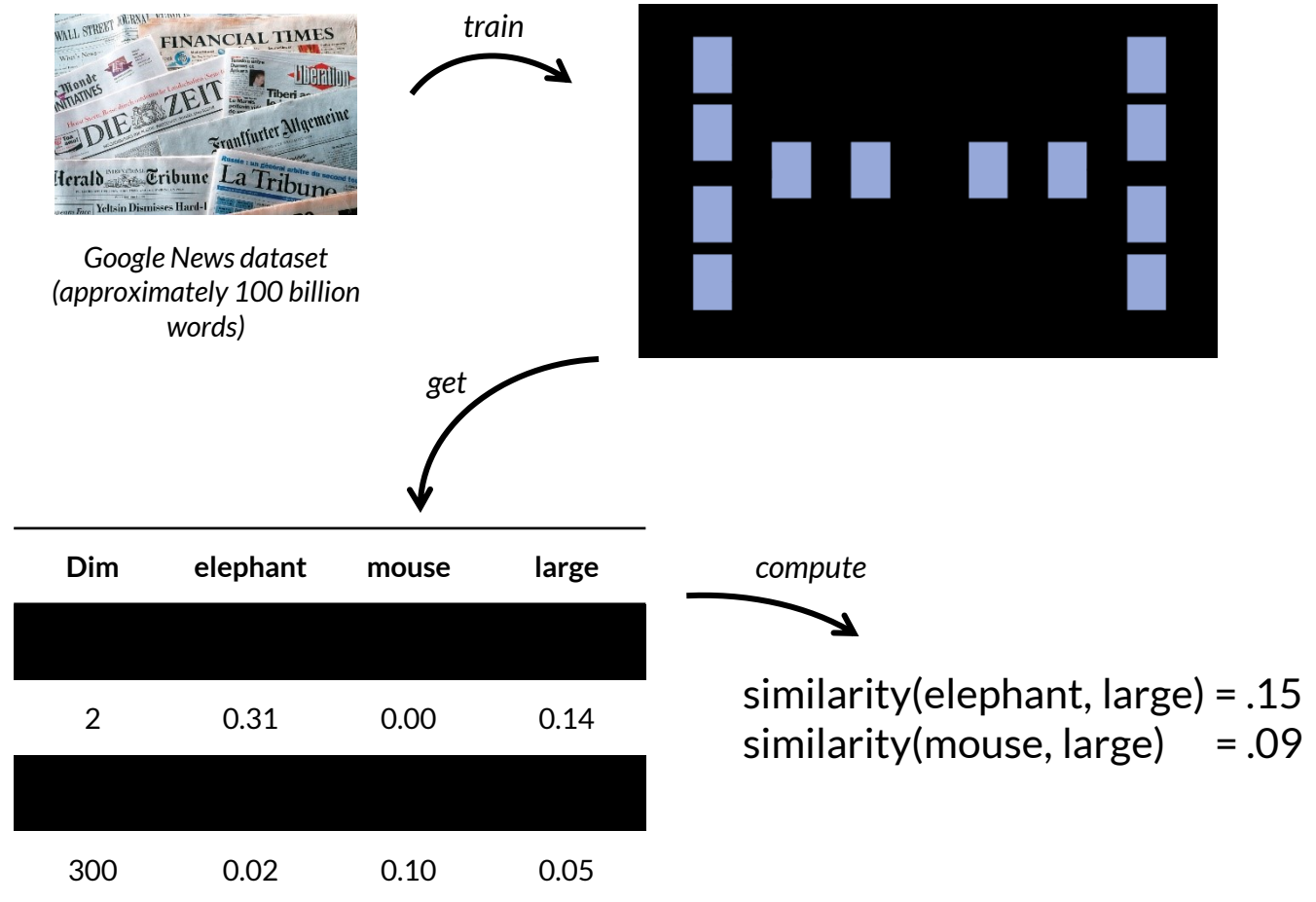
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Word2Vec

- is a vector-based semantic space model, where words are represented as high dimensional vectors (Mikolov et al., 2013)

- has been used to predict participants behavior in a variety of tasks:

  - Associative judgment (Bhatia, 2017)
  - Psycholinguistics (Mandera et al., 2017)
  - Similarity judgments (Pereira et al., 2016)
  - numerical estimation (Zou & Bhatia, 2021)

Research Question:

Can Word2Vec predict even non-sensical choices?

train

Google News dataset (approximately 100 billion words)

get

Dim	elephant	mouse	large
2	0.31	0.00	0.14
300	0.02	0.10	0.05

compute

similarity(elephant, large) = .15
similarity(mouse, large)   = .09

Method

Sample:
- N = 31 participants, M_{age} = 32.2 (SD = 10.6), 74.2% female
- Participants were recruited via Prolific

Materials:
- 10 comparison dimensions ["democratic", "expensive", "healthy", "undemocratic", "sick", "optimistic", "rainy", "hot", "inexpensive", "cold"]

- 6 word pairs per dimension
  - 4 word pairs, whose words could not be meaningfully rated on the dimension *[meaning = 0]*
  - 2 word pairs, whose words could be meaningfully rated on the dimension *[meaning = 1]*

- 2 attention check word pairs (clear correct choices)

➔ 62 trials in total

What is more democratic?

tree   drum

press S   press L

What is healthier?

salad   sport

press S   press L

Measuring:

- Correspondence between the predictions of the vector-based semantic space model and the choice responses of the participants

Posterior Distributions of Model Coefficients

H₁: The overall match rate between model predictions and participants responses θ is higher than chance level (i.e., $\theta > .5$).
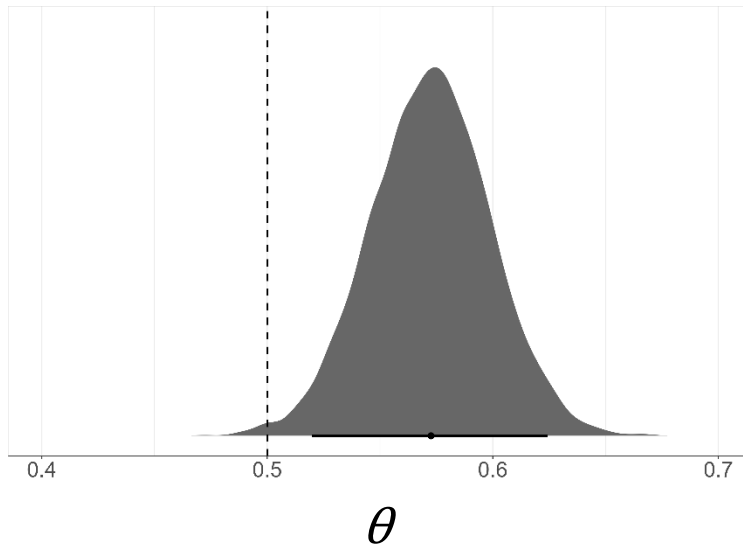
H₂: The match rate for the non-meaningful word pairs alone is still higher than chance level (i.e., $\theta_{meaning = 0} > .5$).
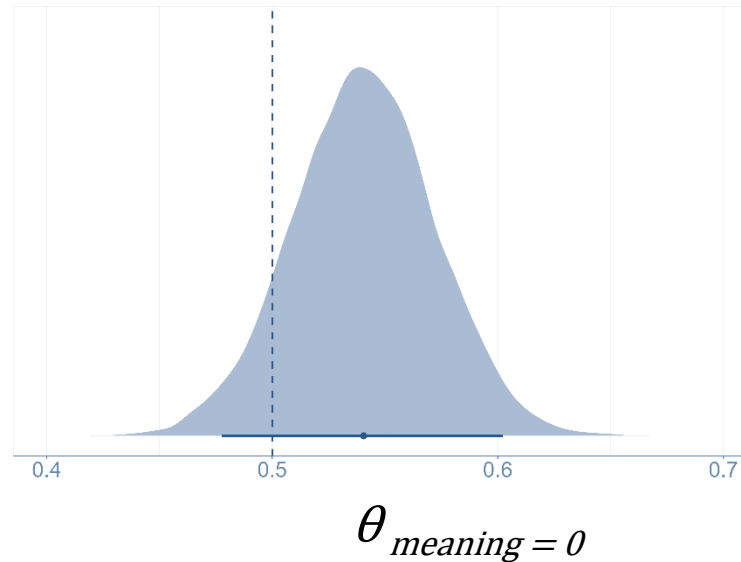
H₃: The model match rate is higher for meaningful than not meaningful word pairs ($b_{meaning = 1} > 0$).

θ

$\theta_{meaning = 0}$

$b_{meaning = 1}$
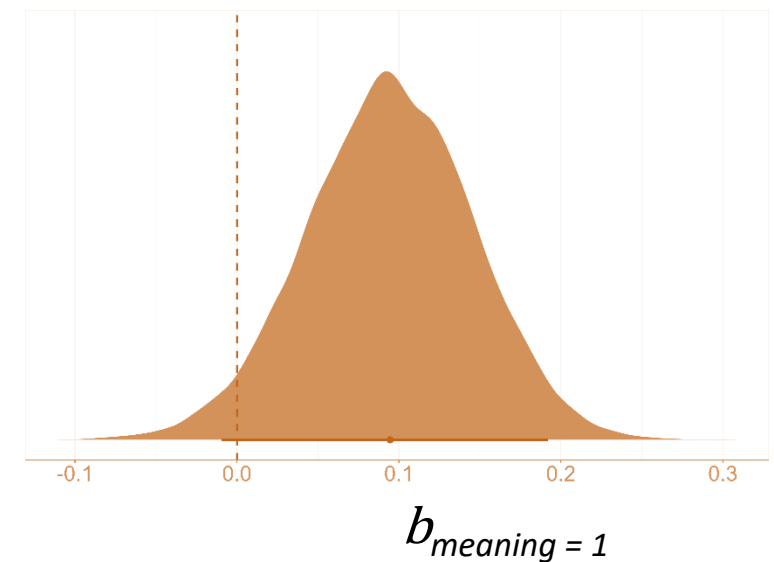
Data were analyzed using Bayesian hierarchical logistic regression models with random effects for participants and items

Summary & Discussion

- Overall, the Word2Vec model can predict non-sensical judgments only slightly above chance level

- Effect seems to be driven mostly by meaningful comparisons

- Large variance between item pairs

- The around chance level prediction-response match rate of many items (*i.e.*, θ_{pair} around .5) indicates low correspondence between participants choice for these items

Effects by