What makes a word memorable?

Kyle Mahowald (MIT), Phillip Isola (MIT), Evelina Fedorenko (MGH), Aude Oliva (MIT), Edward Gibson (MIT)

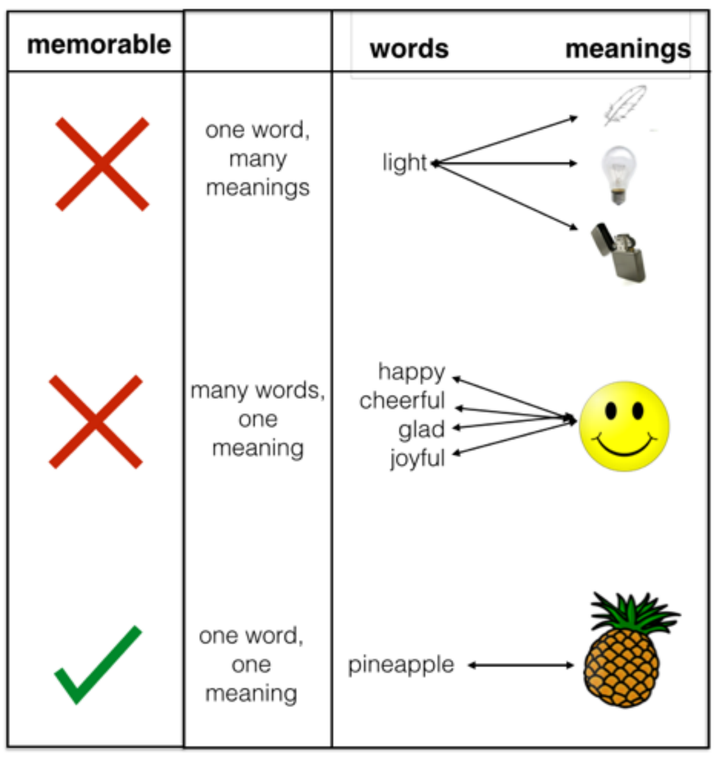
brain+cognitive sciences

Motivation

- Much past work on recognition memory has focused on word frequency effects: lower frequency words are better remembered.
- This past work models P(word) but ignores the mapping between words and memories, i.e. P(word, memory).
- We propose two new information-theoretic measures that quantify this mapping.
- These new measures predict recognition memory much better than does word frequency alone.

Model

- When someone encounters a word *w*, she stores not the word itself but a meaning selected by that word. At recognition time, the participant has access to the stored meaning *m* and the new stimulus w' and must decide whether the word that generated *m* is the same as the new word w'.
- Under this model, the mapping of word to meaning will have an effect on recognition memory, specifically:
  - **It is harder to remember words that have many synonyms.**
  - **It is harder to remember words that have many meanings.**
  - **The easiest words to remember will be those that have a 1-to-1 mapping between word and meaning, as shown below for *pineapple*.**



Experiment 1

Materials

2,222 words were frequency-weighted sampled from Subtlex (Brysbaert & New, 2009) and chosen to be morphologically distinct from one another.

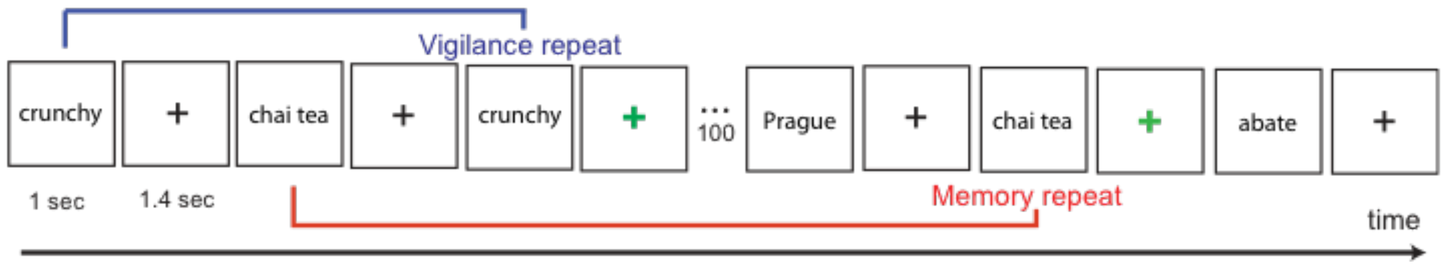
Experiment 2

Materials

To replicate the results from Exp 1, and to test the effect of semantic categories, we ran the same experiment described in Exp 1 using a new set of words selected to have a range of semantic categories.

Procedure

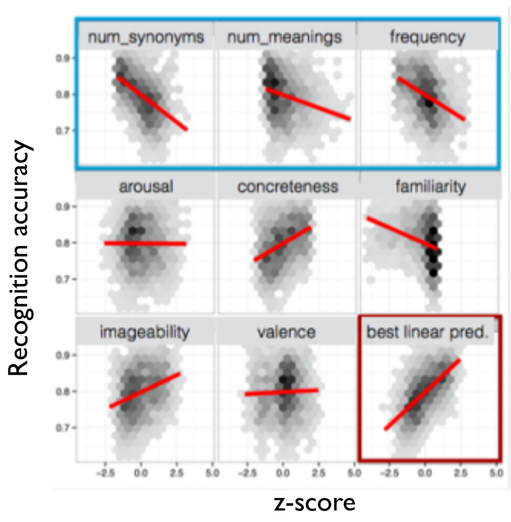
Each word was shown for 1 second followed by a 1.4 second fixation. Participants were asked to press the spacebar when a word occurred that they had already seen. Vigilance repeats (used to make sure that participants were paying attention) occurred every 10 trials. Critical repeats occurred 91-109 trials after the first presentation.



Results

Most memorable words (highest accuracy): pineapple, Madonna, tampons, Eisenhower, yahoo, vagina, coccyx, potbelly, GPS, whorehouse, PSST, pi

Least memorable words (lowest accuracy): lacks, offer, among, transpired, handing, remained, fortunes, fought, remind, constantly, reluctance, concepts



- Our information-theoretic norms were highly predictive of word memorability.
- Spearman correlation (ρ) between the memorability score and model prediction was .51 [95% CI .47, .55] out of a theoretical maximum of .58 (the split-half correlation across participants).
- We also tested several other norms that are known to affect recognition memory: valence (positive or negative), imageability (how easily the word produces a mental image), familiarity, concreteness, and arousal.
- Linearly combining all norms gives ρ = .57, indicating that we are explaining almost all of the explainable variance.

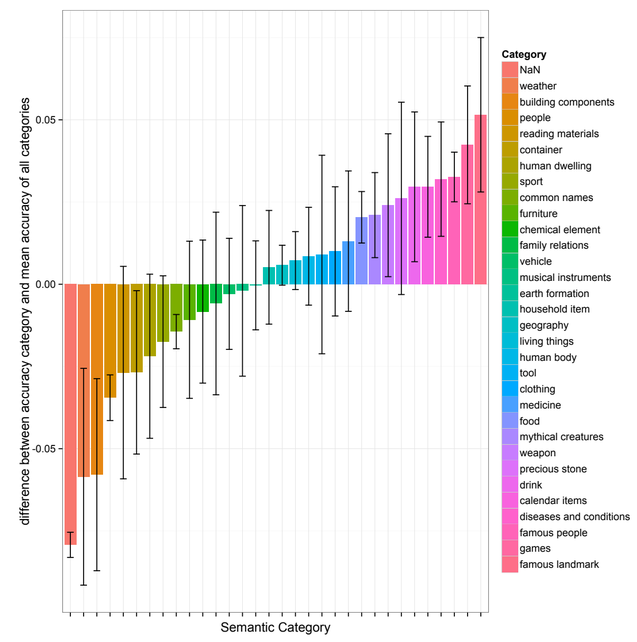
Table 1: Spearman correlations for each measure on whole data set

Predictor	Accuracy	Hit rate	False alarm rate
num. synonyms	**-.54**	**-.45**	**.26**
num. meanings	**-.27**	**-.16**	**.27**
Wordnet meanings	**-.37**	**-.31**	**.21**
Wordnet synonyms	**-.39**	**-.32**	**.22**
Subtlex frequency	**-.43**	**-.32**	**.28**
valence	.05	.06	-.02
imageability	.37	.37	-.05
familiarity	-.34	-.22	.28
concreteness	.44	.39	-.14
arousal	-.01	.04	.10

Results

Most memorable words (highest accuracy): Blondie, Long Island Iced Tea, panties, AIDS, R.E.M., The Dixie Chicks, Jennifer Anniston, David Hasselhoff, toilet bowl brush, mahi-mahi, Mike Tyson, Eminem

Least memorable words (lowest accuracy): cost, search, hurry, crowd, run, exchange, concern, shake, remain, disagree, leave



- As in Expt 1, information-theoretic norms were highly effective, achieving ρ = .61 [95% CI .60, .66] out of a theoretical maximum of .65. Combining with other norms reaches ρ = .63.
- Nouns were remembered more easily (mean accuracy .83) than adjectives and verbs (mean accuracy .75 for both).
- Famous landmarks and people were remembered especially well.

Table 2: Spearman correlations for each measure on whole data set

Predictor	Accuracy	Hit rate	False alarm rate
num. synonyms	**-.64**	**-.56**	**.32**
num. meanings	**-.45**	**35**	**.31**
Log frequency	**-.21**	**-.14**	**.21**
valence	.12	.11	-.02
imageability	.44	.44	-.11
familiarity	-.30	-.20	.28
concreteness	.57	.53	-.22
arousal	-.05	.00	.11

Conclusion

- Our set of predictors can largely capture the variance in memorability among words in our samples.
- In addition to known effects, a word's synonym count and its meaning count are both highly predictive of a word's intrinsic memorability.
- ***An avalanche of grotesque, weirdo words has an advantage as a manner of expression***. If asked to say whether the words "weirdo," "grotesque," or "avalanche" appeared in the first sentence, you are far more likely to be right than if asked about "advantage," "manner", or "expression." (They all did.) The more memorable words have fewer synonyms and fewer meanings.

contact: kylemaho@mit.edu