

Associating
Difficulty in Near-Synonymy Choice
with Types of Nuance
using Core Vocabulary

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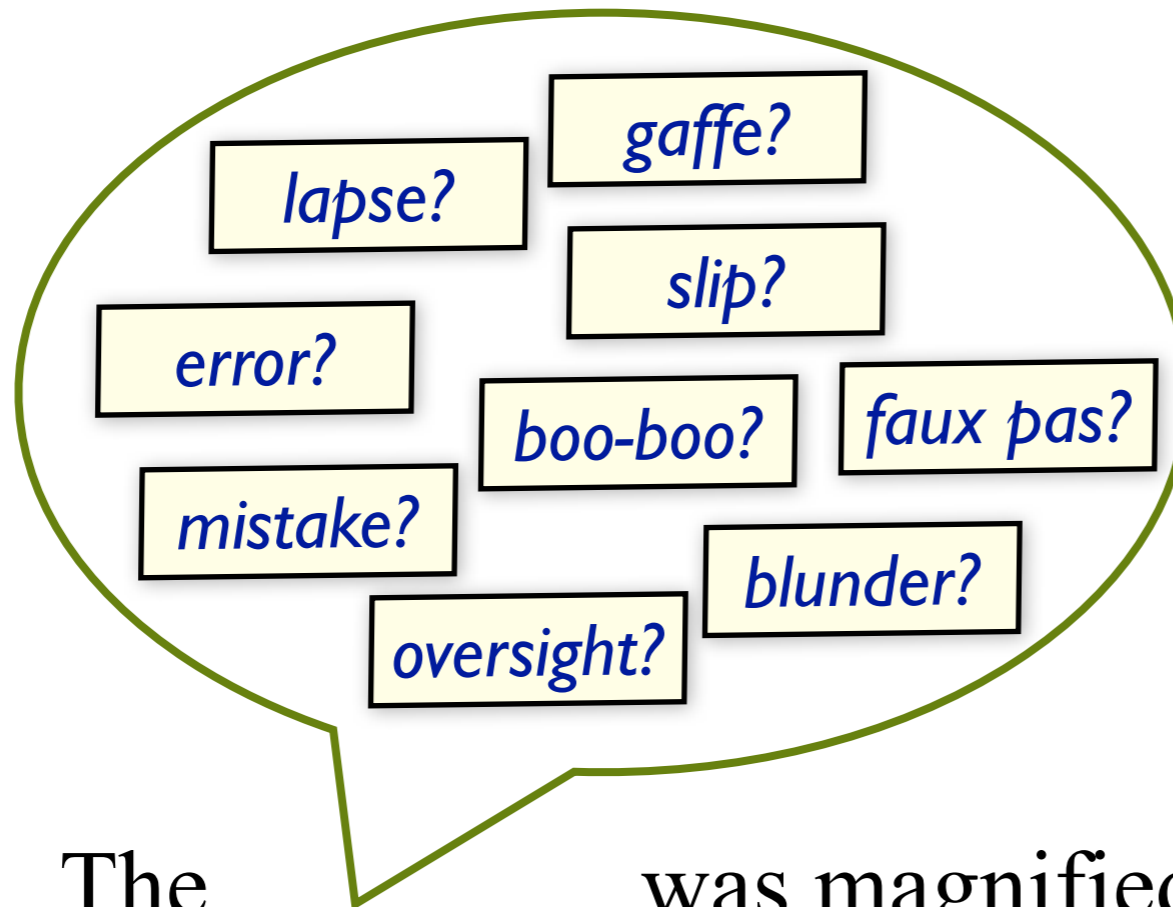
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Choosing between near-synonyms



The _____ was magnified when the Army failed to charge the standard percentage rate for packing and handling.

Evaluating near-synonym choice

- How to evaluate a lexical choice process for near-synonyms?
- Edmonds 1997: The fill-in-the-blanks task:
 - Does the system's choice match that of the original human author?

Edmonds, Philip. 1997. Choosing the word most typical in context using a lexical co-occurrence network. *Proceedings of the 35th Annual Meeting of the Association for Computational Linguistics and the 8th Conference of the European Chapter of the Association for Computational Linguistics*, 507–509, Madrid.

Fill in the blanks



However, such a move also would have dug us deeply into the economic growth engine. The move would be a big _____

error?

mistake?

oversight?

error?

mistake?

oversight?

The _____ was magnified when the Army failed to charge the standard percentage rate for packing and handling.

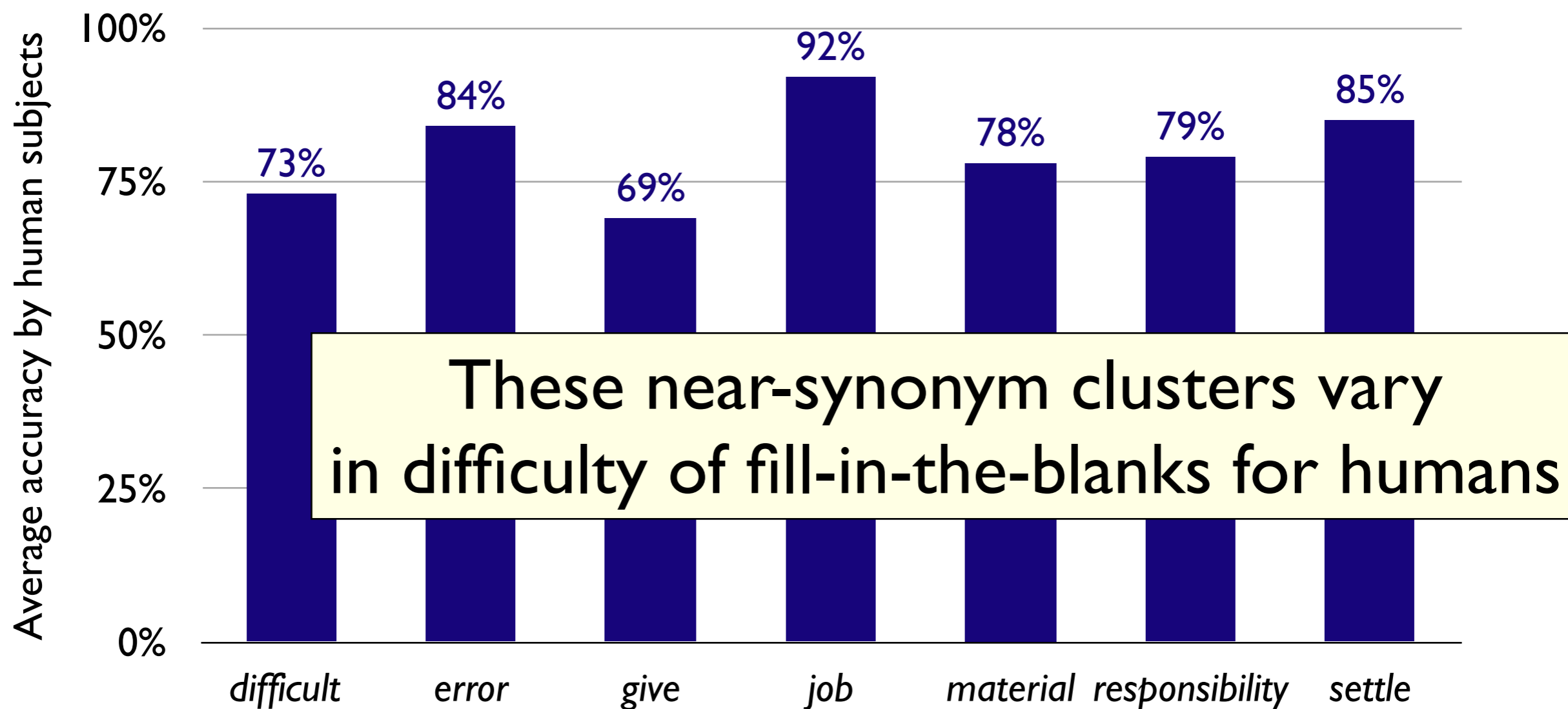
Fill in the blanks

- Edmonds: Seven near-synonym clusters, set of *Wall Street Journal* sentences for each.
 - *difficult, hard, tough* (6665 sentences)
 - *error, mistake oversight* (1030 sentences)
 - *job, task, duty* (5402 sentences)
 - *responsibility, burden, obligation, commitment* (3138 sentences)
 - *material, stuff, substance* (1828 sentences)
 - *give, provide, offer* (10204 sentences)
 - *settle, resolve* (1568 sentences)
- Subsequently used by a number of researchers.

Interpreting performance

- Ideally, system always matches writer's original choice.
- But humans cannot perform that well.
- Difficulty depends on
 - Relative absence of syntactic or collocational constraints
 - Number of alternatives
 - Closeness of meaning among alternatives

Human performance on FITB test



Inkpen, Diana. 2007. A statistical model for near-synonym choice. *ACM Transactions on Speech and Language Processing*, 4, 1–17.

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Near-synonymy

- Any pair of near-synonyms differs on one or more dimension.

Near-synonymy

Near-synonyms **Dimension of variation**

drunk, inebriated

Formality

slender, skinny

Attitude

*error, mistake, blunder,
slip*

Abstractness and strength;
blameworthiness

seep, drip

Continuous / intermittent

enemy, foe

Emphasis on fighting or hatred

⋮

⋮

DiMarco, Chrysanne; Hirst, Graeme; and Stede, Manfred. 1993. The semantic and stylistic differentiation of synonyms and near-synonyms. *AAAI Spring Symposium on Building Lexicons for Machine Translation*, 114–121

Near-synonymy — Denotational

- Set of dimensions of differentiation is open-ended (infinite); includes arbitrary aspects of denotation.
 - Blameworthiness
 - Enmity
- But many denotational dimensions recur:
 - Magnitude or strength
 - Continuous / intermittent
 - Intentional / accidental
 - ...

Near-synonymy — Connotational

- Connotational / pragmatic dimensions relate to style and evaluation.
 - Formality
 - Floridity
 - Euphemism
 - Abstractness
 - Force
 - Slant
 - ...

Stede, Manfred. 1993. Lexical choice criteria in language generation. *Proceedings of the 6th Conference of the European Chapter of the Association for Computational Linguistics*, 454–459.

Hovy, Eduard. 1988. *Generating Natural Language Under Pragmatic Constraints*. Hillsdale, NJ: Lawrence Erlbaum Associates.

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Core vocabulary

- Intuitively: The most basic or central words of a language.
- Carter 1998: Ten lexical properties that indicate or correlate with 'coreness'.

Carter, Ronald. 1998. *Vocabulary: Applied Linguistics Perspectives* (second edition). Routledge.

Properties of core vocabulary

- Acts as defining vocabulary for other words.

Not core

Core

— e.g., *dine* can be defined in terms of *eat*, but not *eat* in terms of *dine*.

- Can substitute for other words as more-general terms.

— e.g., *eat* can substitute for *dine* (but *ingest* cannot).

Examples from Carter (1998) except *ingest*.

Properties of core vocabulary

- Clear antonymy

— *fat* – *thin*; *laugh* – *cry* ← Core

— *emaciated* – ??; *guffaw* – ?? ← Not core

Examples from Carter (1998).

Properties of core vocabulary

- Many collocations (“collocability”).

| | <i>bright ...</i> | <i>radiant ...</i> | <i>gaudy ...</i> |
|-------------|-------------------|--------------------|------------------|
| Core | <i>light</i> | <i>light</i> | * <i>light</i> |
| | <i>idea</i> | * <i>idea</i> | * <i>idea</i> |
| | <i>colours</i> | <i>colours</i> | <i>colours</i> |
| | <i>red</i> | <i>red</i> | * <i>red</i> |
| | <i>future</i> | * <i>future</i> | * <i>future</i> |
| | <i>child</i> | <i>child</i> | * <i>child</i> |
| | <i>sun</i> | ? <i>sun</i> | * <i>sun</i> |
| | ⋮ | ⋮ | ⋮ |

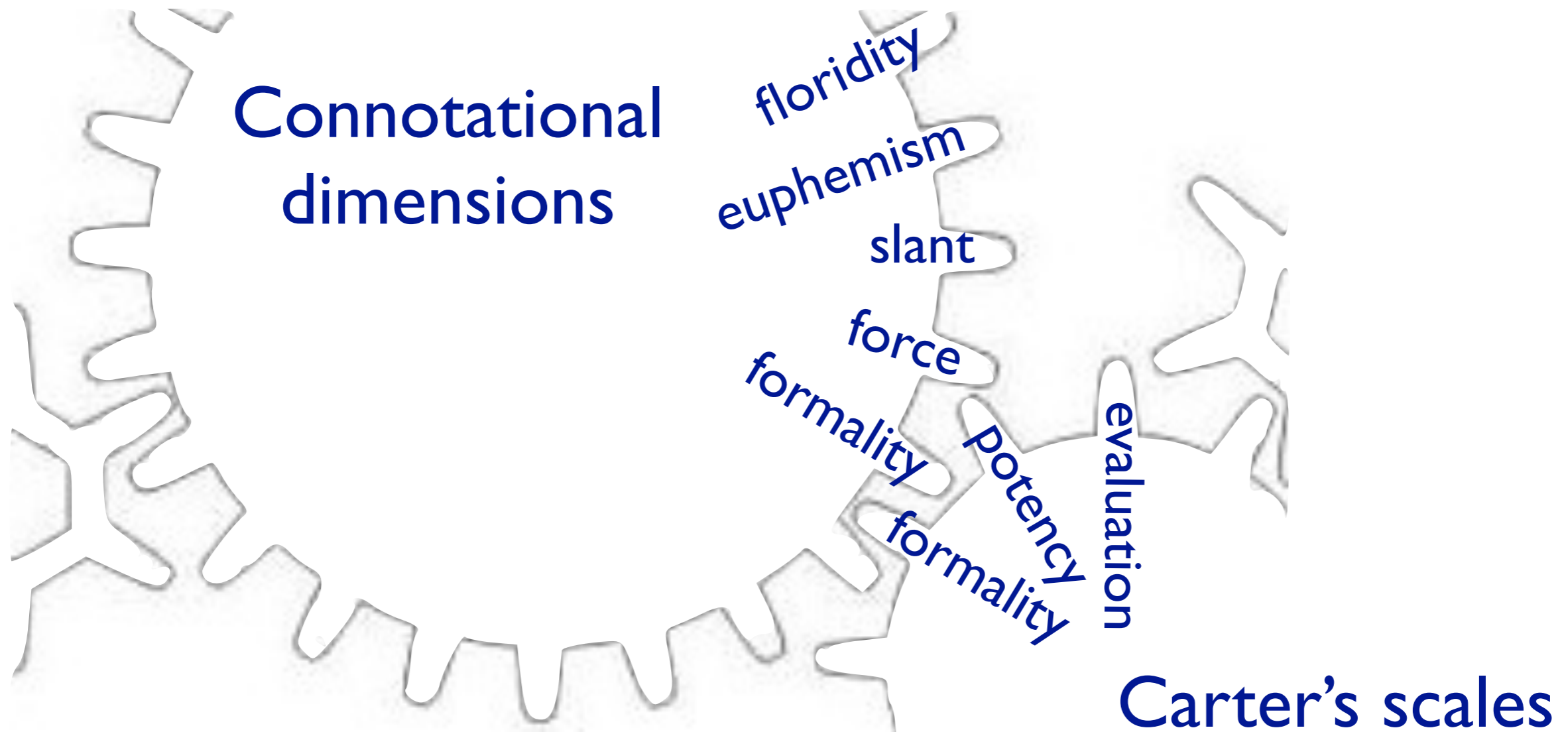
Examples from Carter (1998).

Properties of core vocabulary

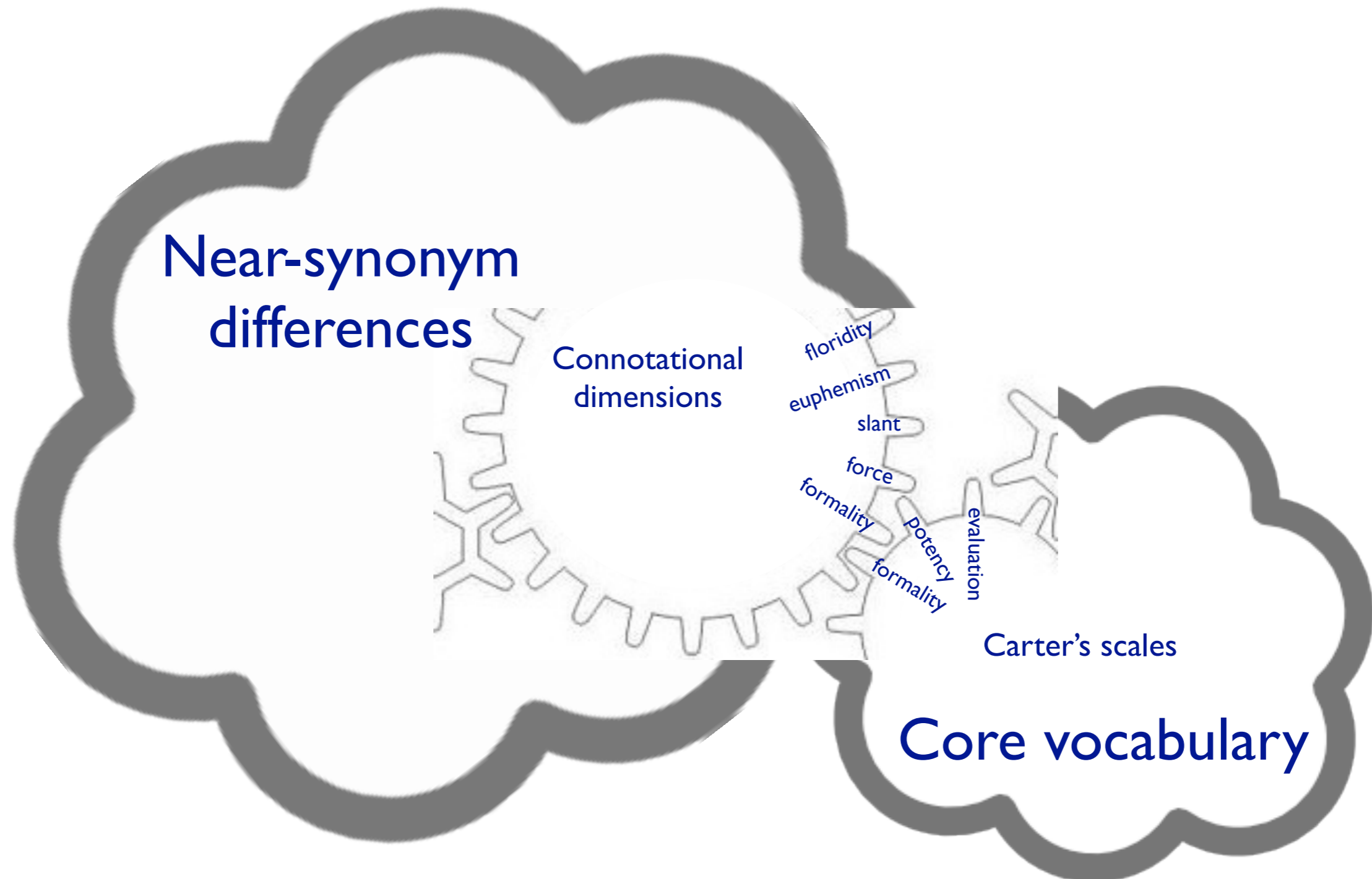
- Neutrality on Osgood scales:
 - Evaluation: positive ↔ negative ← ≡ Slant
 - Potency: strong ↔ weak ← ≡ Force
- Neutrality of tenor:
 - Formality: formal ↔ informal

Osgood, Charles E.; Suci, George; and Tannenbaum, Percy. 1957. *The Measurement of Meaning*. University of Illinois Press.

Core vocabulary and connotation



Core vocabulary and near-synonyms



Quantifying coreness

- As defining vocabulary
 - $defvoc(w)$ = frequency of w in the defining vocabulary
- Counted word frequencies in all definitions in the *Macquarie Dictionary*.

Quantifying collocability

- Collocability defined as entropy H .

$$\begin{aligned} \text{colent}(w) &= H(\text{distribution of } w\text{'s collocates}) \\ &= \sum_{w_i \in \mathcal{V}} p(w_i) \log \frac{1}{p(w_i)} \end{aligned}$$

- Greater entropy means
 - greater collocability (more collocates);
 - more-even distribution among collocates.

Quantifying collocability

- Collocation distribution calculated from bigram collocates of w in the British National Corpus.

Quantifying collocability

Simplified example of collocability as entropy:

bright ...

light – .20

smile – .20

color – .20

future – .20

child – .20

$$H_1 = \sum_{i=1}^5 0.2 \times \log \frac{1}{0.2}$$
$$= \log 5 \approx \mathbf{0.6990}$$

radiant ...

light – .33

smile – .33

color – .33

future – .00

child – .00

$$H_2 = \sum_{i=1}^3 0.33 \times \log \frac{1}{0.33}$$
$$= \log 3 \approx \mathbf{0.4771}$$

gaudy ...

light – .10

smile – .10

color – .80

future – .00

child – .00

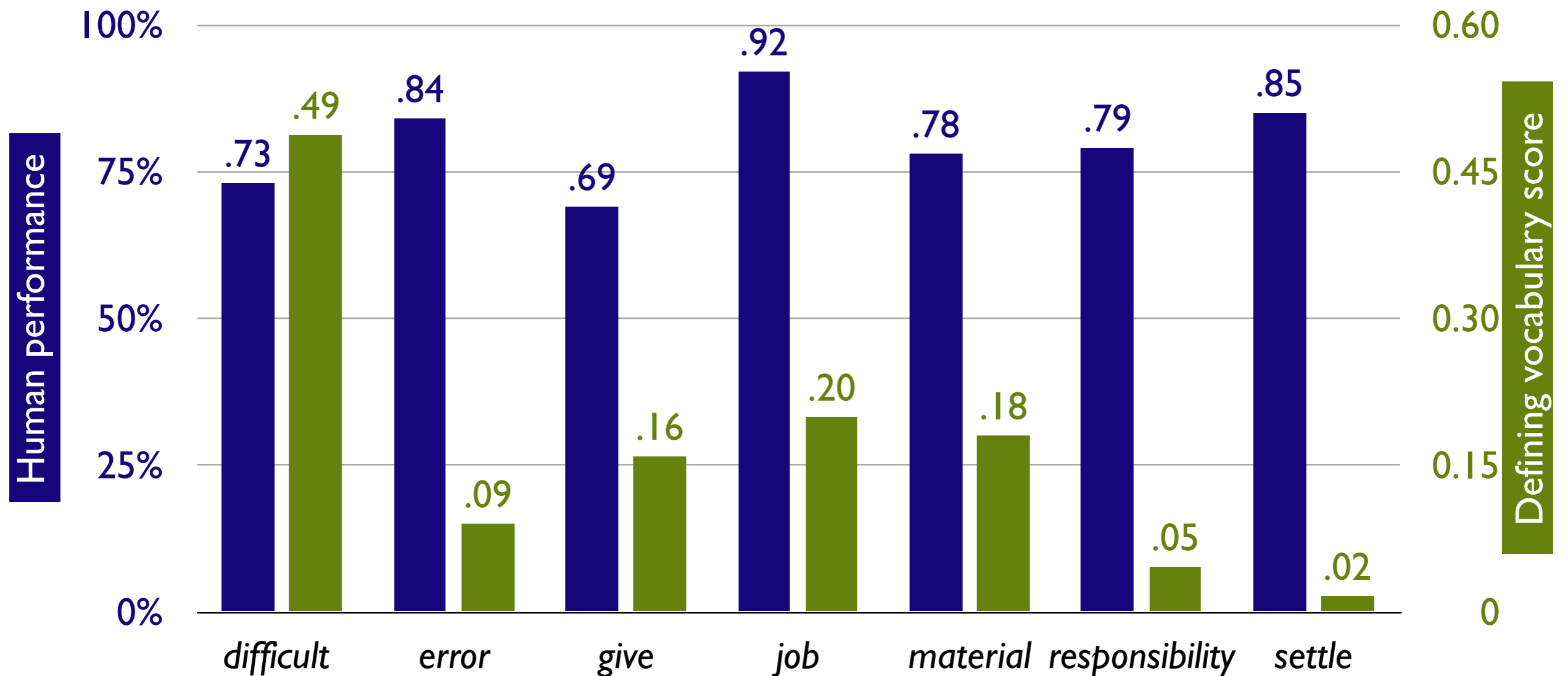
$$H_3 = 2 \times 0.1 \times \log \frac{1}{0.1}$$
$$+ 0.8 \times \log \frac{1}{0.8}$$
$$\approx 0.2 + 0.0775 = \mathbf{0.2775}$$

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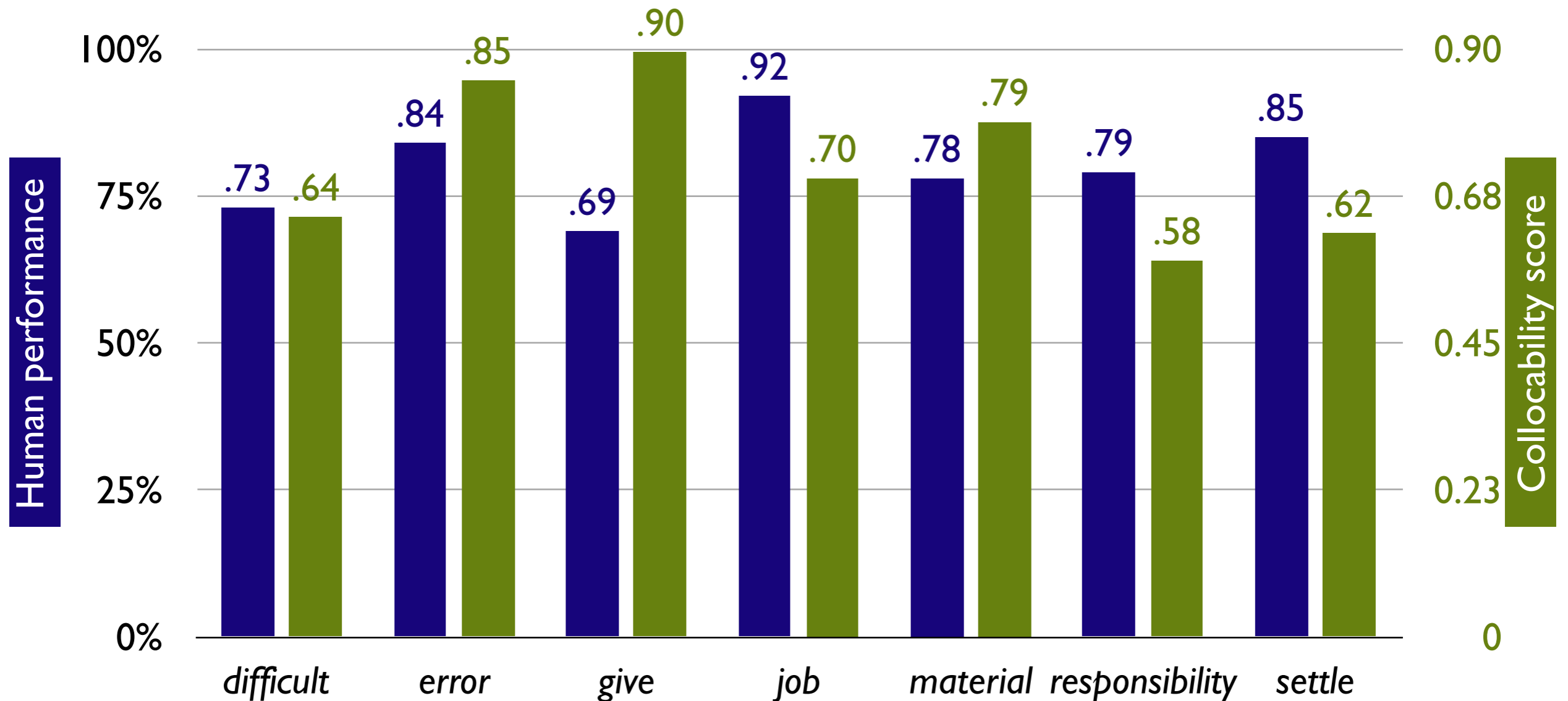
Results

Correlation between average human accuracy and max defining vocabulary score, $\rho = -.68$.



Results

Correlation between average human accuracy and max collocability score, $\rho = -.54$



Results

- Near-synonym clusters differ in coreness (by two key measures of coreness).
- Coreness and difficulty in choice are correlated.

Moreover, ...

- Core-vocabulary words are neutral in style.
- Near-synonyms with stylistic variations are easier to differentiate.
- Coreness and difficulty in choice are positively related.

Conclusions

- Near-synonym clusters are more difficult to differentiate if they contain words that are more-core.
- Core vocabulary is a promising concept in characterizing near-synonym differences.

Concurrent work

- Characterizing difficulty of near-synonym lexical choice.
 - Relating difficulty to latent semantic space dimensionality (Wang and Hirst 2010).
 - Characterization of *subtlety of near-synonym differentiating nuances* (\propto difficulty) as those residing in the higher dimensions of the latent semantic space.

Wang, Tong and Hirst, Graeme. 2010. Near-synonym lexical choice in latent semantic space. *Proceedings of the 23rd International Conference on Computational Linguistics (COLING-2010)*, Beijing.

Future work

- Characterizing difficulty of near-synonym lexical choice.
 - Obtaining human judgement on difficulty / subtlety among near-synonym sets.
 - Building larger data sets for both automated system and human judgement.

Future work

- Characterizing core vocabulary:
 - Summary: Statistical measures of word frequency in titles, abstracts, and opening and closing sentences of paragraphs.
 - Antonymy: Use Mohammad and Hirst's antonym lists.

Future work

- Characterizing core vocabulary:
 - Meaning extensibility:
a bright spark; bright and early; brighten up
 - Syntactic variation:
give the book to them / give them the book
*donate the book to them / *donate them the book*