Obtaining Reliable Human Ratings of Valence, Arousal, and Dominance for 20,000 English Words

Saif M. Mohammad

National Research Council Canada

✉ Saif.Mohammad@nrc-cnrc.gc.ca @SaifMMohammad

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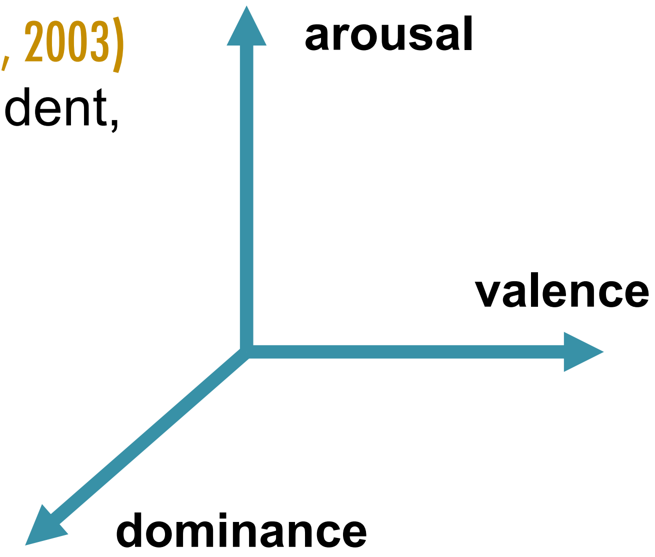
Core Dimensions of Meaning

Influential factor analysis studies (Osgood et al., 1957; Russell, 1980, 2003) have shown that the three most important, largely independent, dimensions of word meaning:

- valence (V): positive/pleasure – negative/displeasure
- arousal (A): active/stimulated – sluggish/bored
- dominance (D): powerful/strong – powerless/weak



Thus, when comparing the meanings of two words, we can compare their V, A, D scores. For example:

- *banquet* indicates more positiveness than *funeral*
- *nervous* indicates more arousal than *lazy*
- *queen* indicates more dominance than *delicate*

This work:

Obtaining Reliable Human Ratings of Valence, Arousal, and Dominance for 20,000 English Words

fine-grained

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Obtaining Reliable Human Ratings of Valence, Arousal, and Dominance

for 20,000 English Words

Motivation

Human annotations of words for VAD

- For use by automatic systems:
  - predicting VAD of words
  - predicting sentiment and emotions of sentences, tweets, etc.
  - detecting stance, personality traits, well-being, cyber-bullying, etc.

- To draw inferences about people:
  - to understand how we (or different groups of people) use language to express meaning and emotions
    - analyze text written/spoken by different groups of people
    - analyze VAD judgments of different groups of people

Related Work: Existing VAD Lexicons

Affective Norms of English Words (ANEW) (Bradley and Lang, 1999)

- ~1,000 words
- 9-point rating scale

Warriner et al. Norms (Warriner et al. 2013)

- 14,000 words
- 9-point rating scale

Small number of VAD lexicons in non-English languages as well

- E.g.:
  - Moors et al. (2013) for Dutch
  - Vo et al. (2009) for German
  - Redondo et al. (2007) for Spanish
- rating scale

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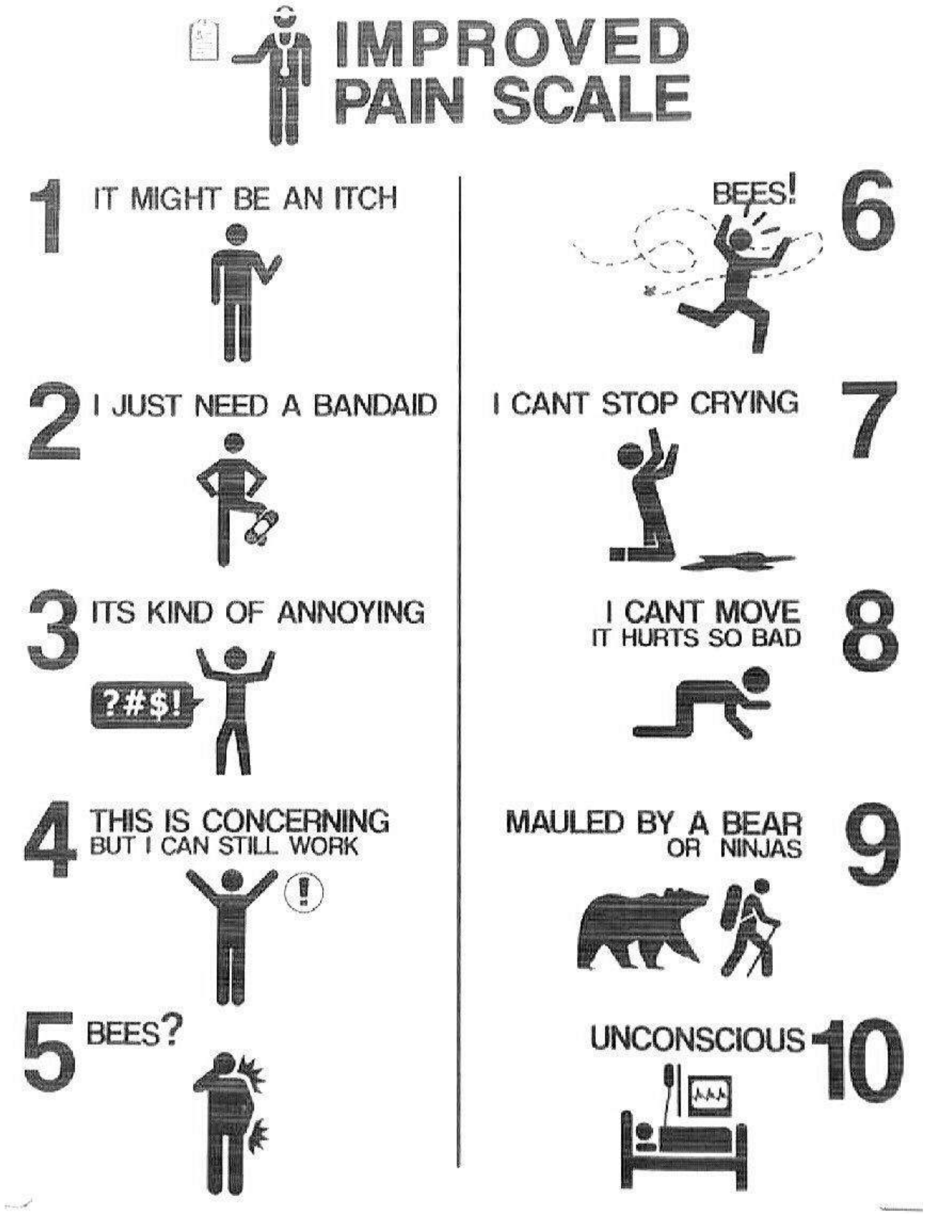
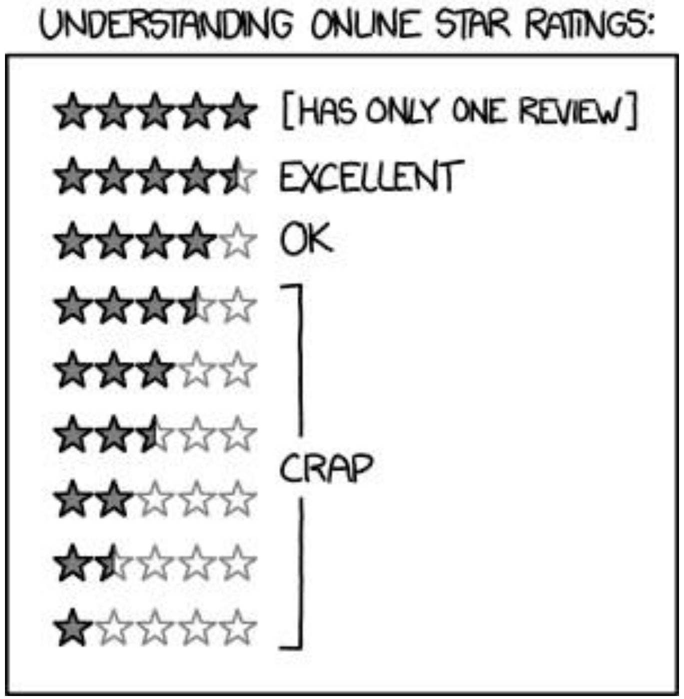
Rating scales:



source: imgur

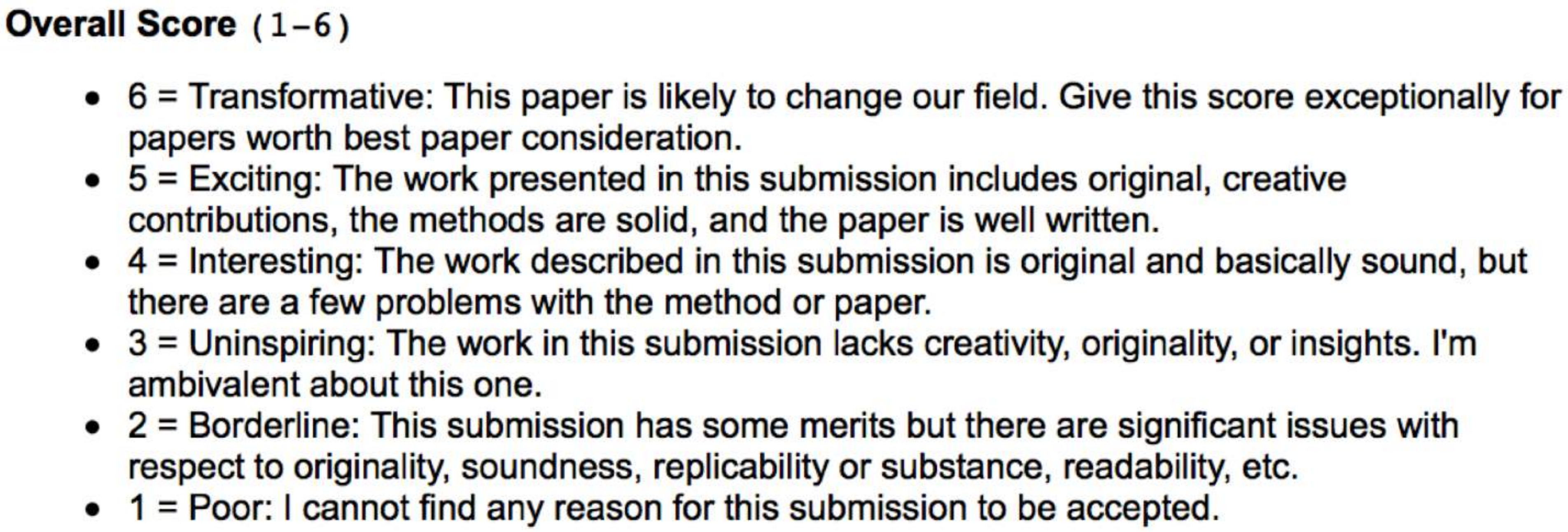
Rating scales:


UNDERSTANDING ONLINE STAR RATINGS:
★★★★★ [HAS ONLY ONE REVIEW]
EXCELLENT
OK
CRAP

source: xkcd

Rating scales:

ACL-2018 Reviewing Scale

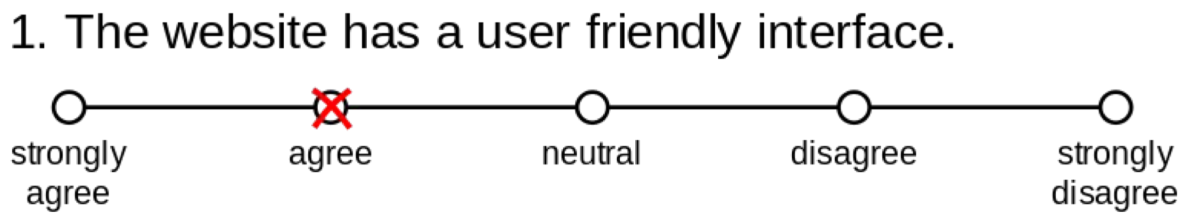


Overall Score (1-6)

- 6 = Transformative: This paper is likely to change our field. Give this score exceptionally for papers worth best paper consideration.
- 5 = Exciting: The work presented in this submission includes original, creative contributions, the methods are solid, and the paper is well written.
- 4 = Interesting: The work described in this submission is original and basically sound, but there are a few problems with the method or paper.
- 3 = Uninspiring: The work in this submission lacks creativity, originality, or insights. I'm ambivalent about this one.
- 2 = Borderline: This submission has some merits but there are significant issues with respect to originality, soundness, replicability or substance, readability, etc.
- 1 = Poor: I cannot find any reason for this submission to be accepted.

Rating scales:

Likert Item (Likert 1932)

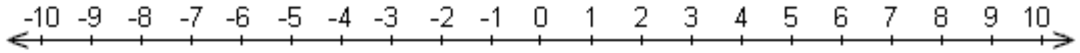


1. The website has a user friendly interface.

○ strongly agree — [✓ agree] — ○ neutral — ○ disagree — ○ strongly disagree

source: Wikimedia Commons

Note: A Likert scale is the sum of responses on several Likert items.



Problems with rating scales:

- fixed granularity
- difficult to maintain consistency across annotators
- difficult for an annotator to be self consistent
- scale region bias

Comparative Annotations

Paired Comparisons (Thurstone, 1927; David, 1963)**:**

If X is the property of interest (positive, useful, etc.), give two terms and ask which is more X

- less cognitive load
- helps with consistency issues
- requires a large number of annotations
  - order N^2, where N is number of terms to be annotated

Best–Worst Scaling (BWS) (Louviere & Woodworth, 1990)

- The annotator is presented with four words (say, A, B, C, and D) and asked:
  - which word is associated with the most/highest X (property of interest, say valence)
  - which word is associated with the least/lowest X

- By answering just these two questions, five out of the six inequalities are known
  - For e.g.:
    - If A: highest valence
    - and D: lowest valence, then we know:

A > B, A > C, A > D, B > D, C > D

Best–Worst Scaling (Louviere & Woodworth, 1990)

- Each of these BWS questions can be presented to multiple annotators.
- We can obtain real-valued scores for all the terms using a simple counting method (Orme, 2009)

  score(w) = (#best(w) - #worst(w)) / #annotations(w)

  the scores range from:
  -1 (least X)
  to 1 (most X)

  X = property of interest, say valence

  - the scores can then be used to rank all the terms

Best–Worst Scaling (Louviere & Woodworth, 1990)

- preserves the comparative nature
- keeps the number of annotations down to about 2N
- leads to more reliable, less biased, more discriminating annotations (Kiritchenko and Mohammad, 2017, Cohen, 2003)

Creating the Valence, Arousal, and Dominance Lexicon

Term Selection

We wanted to include:

- commonly used English terms
- terms common in tweets
- terms that denotate or connotate emotions

Selected:

- All terms in the NRC Emotion Lexicon (Mohammad and Turney, 2013): ~14,000
  - labels indicate association with eight basic emotions
    anger, anticipation, disgust, fear, joy, sadness, surprise, and trust (Plutchik, 1980)
  - includes terms that occur frequently in the Google n-gram corpus
- All terms in ANEW (Bradley and Lang, 1999): ~1000
- All terms in the Warriner et al. lexicon (2013): ~14,000
- Words from the Roget's Thesaurus categories corresponding to the eight basic Plutchik emotions: ~520
- High-frequency content terms, including emoticons, from the Hashtag Emotion Corpus (a tweets corpus) (Mohammad, 2012): ~1000

Total: 20,007 terms

Best-Worst Questionnaires

Q1. Which of the four words below is associated with the
MOST happiness / pleasure / positiveness / satisfaction / contentedness / hopefulness
OR LEAST unhappiness / annoyance / negativeness / dissatisfaction / melancholy / despair?

(Four words listed as options)

Q2. Which of the four words below is associated with the
LEAST happiness / pleasure / positiveness / satisfaction / contentedness / hopefulness
OR MOST unhappiness / annoyance / negativeness / dissatisfaction / melancholy / despair?

(Four words listed as options)

Similar questions for arousal and dominance

This study was approved by the NRC Research Ethics Board (NRC-REB) under protocol number 2017-98.
REB review seeks to ensure that research projects involving humans as participants meet Canadian standards of ethics.

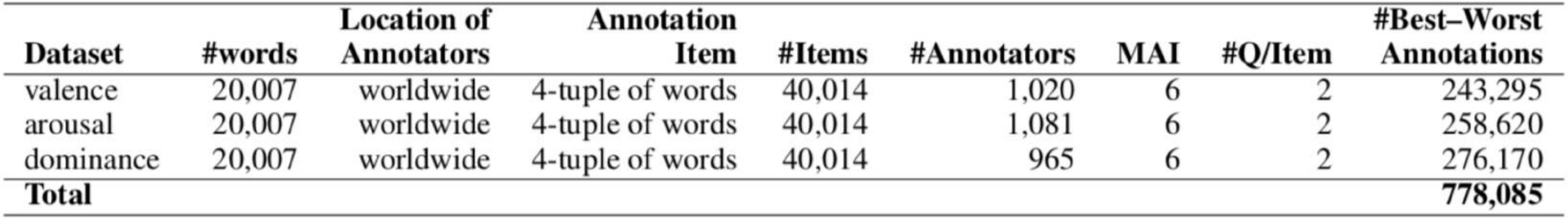
Crowdsourcing and Quality Control

About 2% of the data was annotated internally beforehand (by the author)

- These gold questions are interspersed with other questions
- If one gets a gold question wrong, they are immediately notified of it
  - feedback to improve task understanding
- If one's accuracy on the gold questions falls below 80%,
  - they are refused further annotation
  - all of their annotations are discarded

Mechanism to avoid malicious or random annotations

Valence, Arousal, and Dominance Annotations (with BWS)



Dataset	#words	Location of Annotators	Annotation Item	#Items	#Annotators	MAI	#Q/Item	#Best–Worst Annotations
valence	20,007	worldwide	4-tuple of words	40,014	1,020	6	2	243,295
arousal	20,007	worldwide	4-tuple of words	40,014	1,081	6	2	258,620
dominance	20,007	worldwide	4-tuple of words	40,014	965	6	2	276,170
Total								**778,085**

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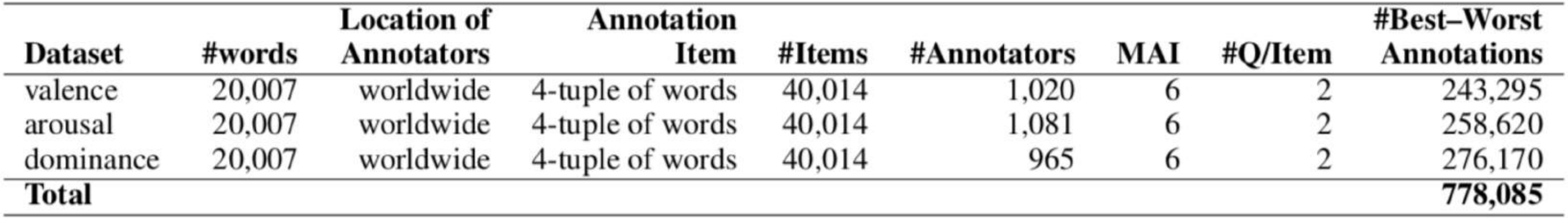

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2N 4-tuples

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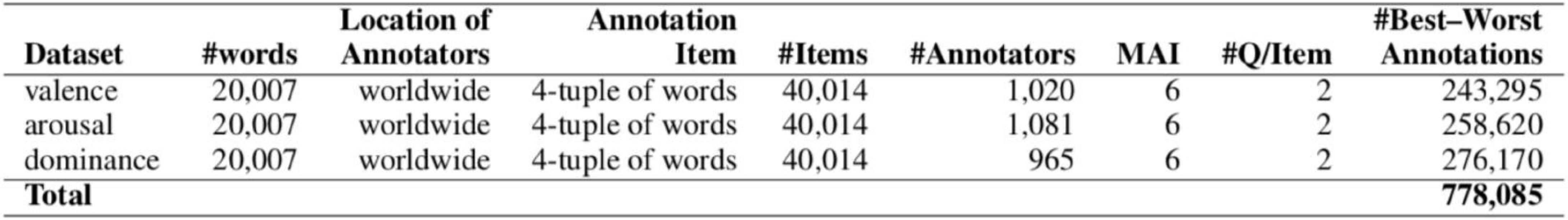

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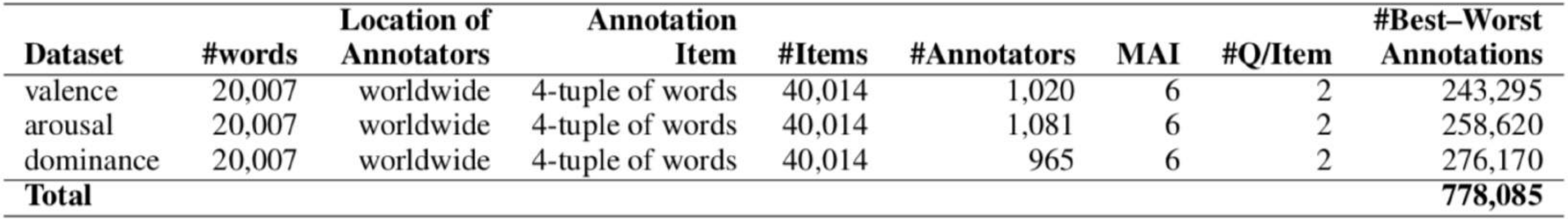
~1000 annotators for each task

Valence, Arousal, and Dominance Annotations (with BWS)



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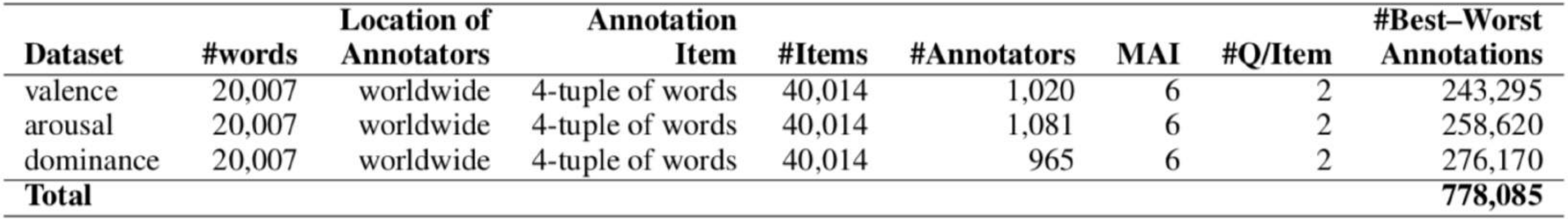
minimum and median annotations per 4-tuple

Valence, Arousal, and Dominance Annotations (with BWS)



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Total								**778,085**

number of pairs of best—worst annotations

Best–Worst Scaling (Louviere & Woodworth, 1990)

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- We can obtain real-valued scores for all the terms using a simple counting method (Orme, 2009)

  score(w) = (#best(w) - #worst(w)) / #annotations(w)

  the scores range from:
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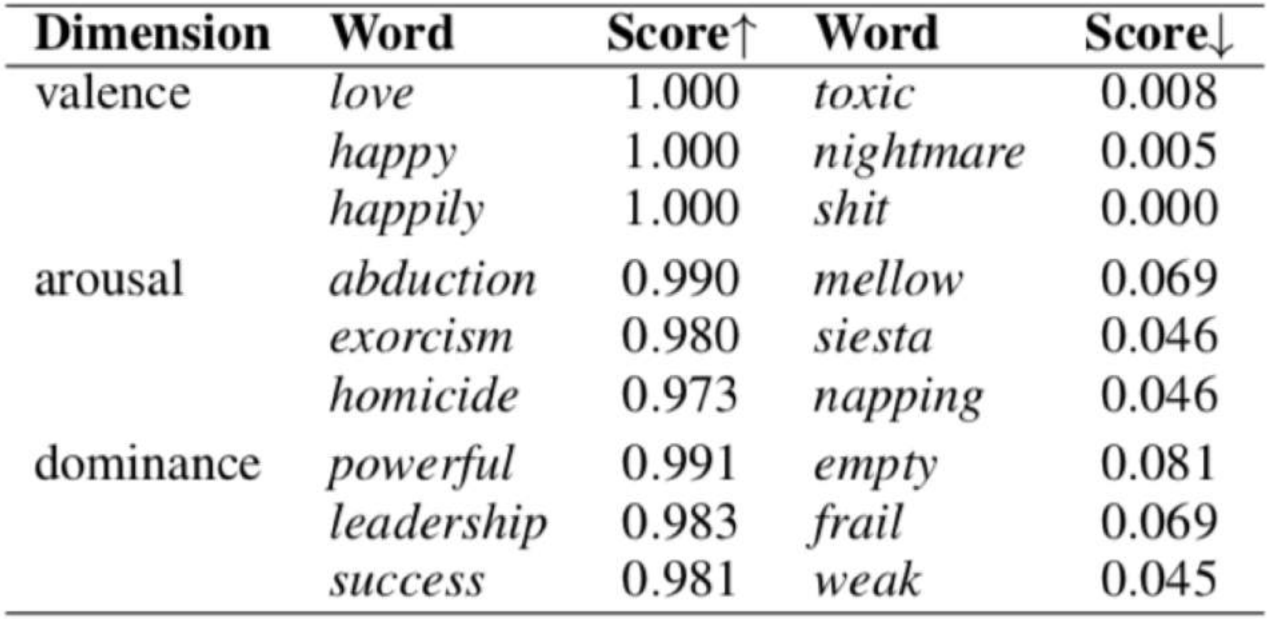
  X = property of interest, say valence

  - the scores can then be used to rank all the terms

Example Entries in the VAD Lexicon

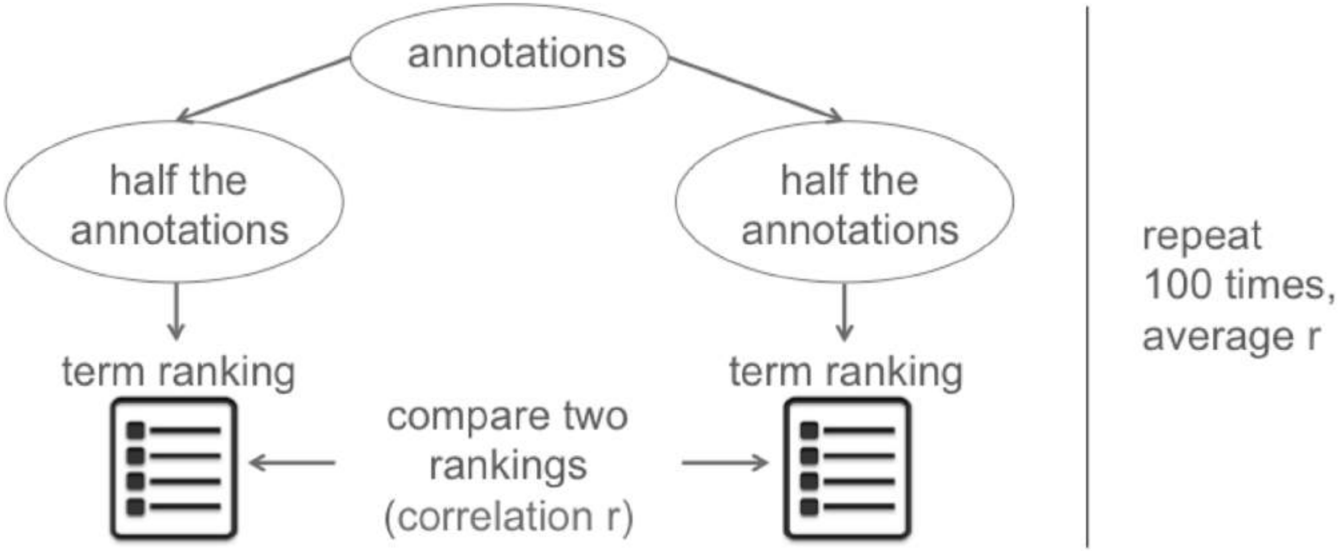


Dimension	Word	Score↑	Word	Score↓
valence	*love*	1.000	*toxic*	0.008
	happy	1.000	*nightmare*	0.005
	happily	1.000	*shit*	0.000
arousal	*abduction*	0.990	*mellow*	0.069
	exorcism	0.980	*siesta*	0.046
	homicide	0.973	*napping*	0.046
dominance	*powerful*	0.991	*empty*	0.081
	leadership	0.983	*frail*	0.069
	success	0.981	*weak*	0.045

Scores are in the range 0 (lowest V/A/D) to 1 (highest V/A/D)

Reliability (Reproducibility) of Annotations

Average split-half reliability (SHR): a commonly used approach to determine consistency (Kuder and Richardson, 1937; Cronbach, 1946)



Pearson correlation: -1(most inversely correlated) to 1(most correlated)

Split-Half Reliability Scores for VAD Annotations

Annotations	# Terms	# Annotations	V	A	D
Warriner et al. (2013)	13,915	20 per term	0.91	0.79	0.77

Markedly lower SHR for A and D.
The dominance ratings seem especially problematic since the Warriner V-D correlation is 0.71.

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Ours (Warriner terms)	13,915	6 per tuple	0.95	0.91	0.91
Ours (all terms)	20,007	6 per tuple	0.95	0.90	0.90

These SHR scores show for the first time that highly reliable fine-grained ratings can be obtained for valence, arousal, and dominance. Also, our V-D correlation is 0.48.

NRC VAD Lexicon and the Warriner et al. Lexicon:

How Different are the Scores?

Pearson correlations r

Annotations	V	A	D
Ours-Warriner (for overlapping terms)	0.81	0.62	0.33

The especially low correlations for dominance and arousal indicate that our lexicon has substantially different scores and rankings of terms.

Done:

Create the large and reliable VAD lexicon

On to:

Analyze VAD judgments of different groups of people

Shared Understanding of VAD:

Within and Across Demographic Groups

- Human cognition and behaviour are impacted by evolutionary and socio-cultural factors
- These factors impact different groups of people differently
- Consider gender
    - Men, women, and other genders are substantially more alike than different
    - However, they have encountered different socio-cultural influences
    - Often these disparities have been a means to exert unequal status and asymmetric power relations
    - Gender studies examine
        - both the overt and subtle impacts of these socio-cultural influences
        - ways to mitigate the inequity
        - how different genders perceive and use language

Demographic Survey

Annotators could optionally respond to a separate survey asking for their demographic information:

- age
- gender
- country
- personality traits
  - we asked how they viewed themselves across the big five personality traits (Barrick and Mount, 1991)

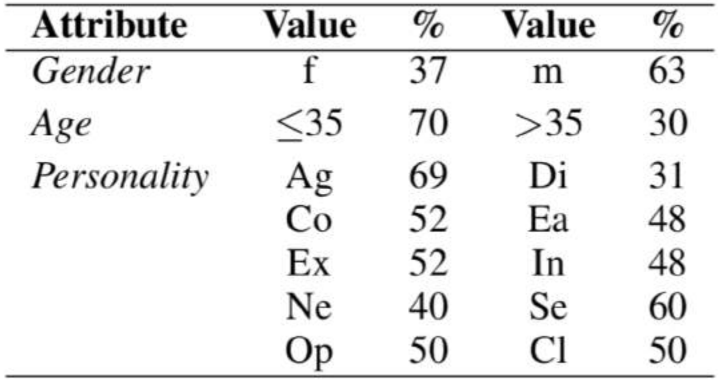
991 people (55% of the VAD annotators) chose to provide their demographic information

Experiment

- For each demographic attribute, we partitioned the annotators into two groups:
  - male (m) and female (f)
  - those 18 to 35 (≤35) and those over 35 (>35)

Experiment

- For each demographic attribute, we partitioned the annotators into two groups:
  - male (m) and female (f)
  - those 18 to 35 (young) and those over 35 (grownups)
  - agreeable (Ag) and Disagreeable (Di)
  - extrovert (Ex) and introvert (In)
  - and so on



Attribute	**Value**	**%**	**Value**	**%**
Gender	f	37	m	63
Age	$\leq$35	70	>35	30
Personality	Ag	69	Di	31
	Co	52	Ea	48
	Ex	52	In	48
	Ne	40	Se	60
	Op	50	Cl	50

- Calculated
  - the extent to which people within the same group agreed with each other on the VAD annotations
  - whether the differences in average agreements in each group are significant
    - chi-square test for independence and significance level of 0.05

Differences in Average Agreements: Gender

Sub-group with Significantly Higher Agreement

	Valence	Arousal	Dominance
F–F vs. M–M			

F = female
M = male

Differences in Average Agreements: Gender

Sub-group with Significantly Higher Agreement

	Valence	Arousal	Dominance
F–F vs. M–M	M–M	F–F	M–M

F = female
M = male

Women have a higher shared understanding of the degree of arousal of words.
Men have a higher shared understanding of the dominance and valence of words.

Differences in Average Agreements: Age

	Sub-group with Significantly Higher Agreement		
	Valence	Arousal	Dominance
Y–Y vs. G–G			

Y = young
G = grownups

Differences in Average Agreements: Age

Sub-group with Significantly Higher Agreement

	Valence	Arousal	Dominance
Y–Y vs. G–G	G–G	G–G	Y–Y

Y = young
G = grownups

The young have a higher shared understanding of the dominance of words.
The grownups have a higher shared understanding of valence and arousal of words.

Differences in Average Agreements: Big 5 Traits

Sub-group with Significantly Higher Agreement

	Valence	Arousal	Dominance
Ag—Ag vs. Di—Di	Ag—Ag	Ag—Ag	Di—Di
Co—Co vs. Ea—Ea	-	Co—Co	Co—Co
Ex—Ex vs. In—In	Ex—Ex	Ex—Ex	Ex—Ex
Ne—Ne vs Se—Se	Se—Se	-	Se—Se
Op—Op vs Cl—Cl	Op—Op	Op—Op	Op—Op

Ag = Agreeableness (friendly and compassionate)
Di = Disagreeableness (careful in whom to trust, argumentative)

Co = Conscientiousness (efficient and organized)
Ea = Easygoing (easy-going and carefree)

Ex = Extrovert (outgoing, energetic, seek the company of others)
In = Introvert (solitary, reserved, meeting many people causes anxiety)

Ne = Neurotic (often feel anger, anxiety, depression, and vulnerability)
Se = Secure (rarely feel anger, anxiety, depression, and vulnerability)

Op = Open to experiences (inventive and curious; seek out new experiences)
Cl = Closed to experiences (consistent and cautious; anxious about new experiences)

Done:

Create the large and reliable VAD lexicon
Analyze VAD judgments of different groups of people

On to:

Applications and Summary

Selected Applications and Future Work

- Source of features for systems in sentiment, emotion, and other affect-related tasks
  - useful to create emotion-aware word embeddings and emotion-aware sentence representations
- Source of gold (reference) scores, to evaluate automatic methods of determining V, A, and D
- Study the interplay between the basic emotion model and the VAD model of emotions (Mohammad, 2018: LREC paper)
  - Companion lexicon: NRC Emotion Intensity Lexicon
    provides real-valued affect intensity scores for ~6000 words with four basic emotions (anger, fear, sadness, joy)
- Study the role of high VAD words in high emotion intensity sentences, tweets, snippets from literature

Summary

- Created the NRC Valence, Arousal, and Dominance Lexicon:
  - has entries for about 20,000 English words
  - has fine-grained real-valued scores for V, A, and D (core dimensions of meaning)
  - showed that the annotations are reliable (high split-half reliability scores)
- Showed that certain demographic attributes impact how we view the world around us.

The VAD lexicon is useful in a wide range of applications and research projects.

The NRC Valence, Arousal, and Dominance Lexicon

provides ratings of valence, arousal, and dominance for ~20,000 English words

http://saifmohammad.com/WebPages/nrc-vad.html

The NRC Word–Emotion Association Lexicon aka NRC Emotion Lexicon

provides associations for ~14,000 words with eight emotions (anger, fear, joy, sadness, anticipation, disgust, surprise, trust)

http://saifmohammad.com/WebPages/NRC-Emotion- Lexicon.htm

The NRC Emotion Intensity Lexicon aka Affect Intensity Lexicon

provides intensity scores for ~6000 words with four emotions (anger, fear, joy, sadness)

http://saifmohammad.com/WebPages/AffectIntensity.htm

The NRC Word–Colour Association Lexicon

provides associations for ~14,000 words with 11 common colours

http://saifmohammad.com/WebPages/lexicons.html

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Search by Maxim Kulikov from the Noun Project

https://thenounproject.com

Resources Available at: www.saifmohammad.com

- NRC Valence, Arousal, and Dominance Lexicon
- NRC Emotion Lexicon and Emotion Intensity Lexicon
- Interactive visualizations

Saif M. Mohammad

✉ Saif.Mohammad@nrc-cnrc.gc.ca

@SaifMMohammad

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