

Ousiometrics: The Essence of Meaning

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Principles of Complex Systems, Vols. 1, 2, & 3D
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- The PoCSverse
- Ousiometrics 1 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

This is not easy:

“Abed’s Uncontrollable Christmas”

- 🔗 Abed searches for the meaning of Christmas (in stop animation)
- 🔗 Abed Nadir: [opens present] “It’s the first season of Lost on DVD.”
- 🔗 Pierce Hawthorne: “That’s the meaning of Christmas?”
- 🔗 Abed Nadir: “It’s a metaphor. It represents lack of payoff.”

“Introduction to Teaching”

Abed Nadir: “I thought the meaning of people was somewhere in here. Then I looked inside Nicolas Cage and I found a secret—people are random and pointless.”

- The PoCSverse
- Ousiometrics 4 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

Semantic differentials from Osgood et al.: [13]

1. pleasant-unpleasant	18. large-small	36. colorful-colorless
2. repeated-varied	19. clean-dirty	37. hot-cold
3. smooth-rough	20. resting-busy	38. rich-thin
4. active-passive	21. dull-sharp	39. obvious-subtle
5. beautiful-ugly	22. deep-shallow	40. wide-narrow
6. definite-uncertain	23. gliding-scrapping	41. deliberate-careless
7. low-high	24. familiar-strange	42. happy-sad
8. powerful-weak	25. soft-hard	43. gentle-violent
9. steady-fluttering	26. heavy-light	44. mild-intense
10. soft-loud	27. wet-dry	45. rounded-angular
11. full-empty	28. safe-dangerous	46. slow-fast
12. good-bad	29. concentrated-diffuse	47. rugged-delicate
13. rumbling-whining	30. pushing-pulling	48. simple-complex
14. solid-hollow	31. labored-easy	49. green-red
15. clear-hazy	32. dark-bright	50. masculine-feminine
16. calming-exciting	33. even-uneven	
17. pleasing-annoying	34. loose-tight	
	35. relaxed-tense	

Outline

- Measuring essential meaning
 - History
 - Definitions
 - Emotions
- Problems
- Remeasuring meaning
- Ousiograms
 - Extremousionyms
 - Dimension names
- Safety bias
- Applications
 - The Ousiometer
 - Correspondences
 - Nutshell
- Extras
- References

- The PoCSverse
- Ousiometrics 2 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

The meaning of pings:



“A factorial study of complex auditory stimuli (passive sonar sounds)”
L. M. Solomon,
Unpublished Doctoral Dissertation, University of Illinois, , 1954. [22]

From the introduction:

“This study represents the convergence of three disparate areas of investigation in an attempt to analyze one of the many problems encountered in the study of human factors in undersea warfare.

The domains referred to are these:

- 🔗 naval sonar,
- 🔗 the nature of “meaning,”
- 🔗 and multidimensional scaling techniques.

The problem may be stated as follows: In the detection and recognition of underwater sounds by the use of sonar equipment, what are the discriminative cues employed by the sonar operator?

More generally, what factors does the operator utilize in decoding the significance of sonar signals?'

- The PoCSverse
- Ousiometrics 6 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

Definitions:

- 🔗 Ousiometrics: The quantitative study of the **essential meaningful components** of an entity, however perceived.
- 🔗 Used in philosophical and theological settings, the word ‘ousia’ comes from Ancient Greek οὐσία.
- 🔗 To be distinguished from semantics, semiotics, ...
- 🔗 οὐσία is the etymological root of the word ‘essence’.
- 🔗 Ousiometry, ousiometer, ousiograms, ...
- 🔗 Telegonics: The distant sensing of knowledge (~ distant reading [12])

- The PoCSverse
- Ousiometrics 10 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

The meaning of meaning:



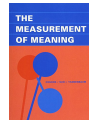
“Ousiometrics and Telegonics: The essence of meaning conforms to a two-dimensional powerful-weak and dangerous-safe framework with diverse corpora presenting a safety bias”
Dodds et al.,
, 2021. [5]

What does meaning even mean?

- 🔗 From the smack-tweeting Merriam-Webster:¹
“The thing that is conveyed especially by language”
- 🔗 What are the essential characteristics of meaning?
- 🔗 Does essential meaning meaningfully span some kind of space?

- The PoCSverse
- Ousiometrics 3 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

From pings to things:



“The Measurement of Meaning”
by Osgood, Suci, and Tannenbaum (1957). [13]

THE MEASUREMENT OF MEANING	
TABLE I	THE MEANING OF THE OBJECTS LISTED
OBJECT	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Apple	1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
Banana	1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
...	...

- 🔗 Osgood et al. used **semantic differentials** and factor analysis to identify a basis of three variables for meaning-space:
 - 🔗 **Evaluation**: {bad ↔ good}
 - 🔗 **Potency**: {weak ↔ strong}
 - 🔗 **Activity**: {passive ↔ active}
- 🔗 100s of students, 10s of things, 50 semantic differentials
- 🔗 “EPA framework”

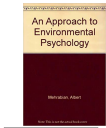
- The PoCSverse
- Ousiometrics 7 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

Essential dimensions captured by emotion:

- 🔗 Late 1800s: Three dimensional representation of emotion postulated by Wendt. [23, 17]
- 🔗 1970s: Mehrabian and Russell explicitly port EPA framework: [7, 8]
 - 🔗 Evaluation ~ Pleasure/Valence (~ Happiness)
 - 🔗 Potency ~ Dominance
 - 🔗 Activity ~ Arousal
- 🔗 VAD has become standard nomenclature even though emotion is less general than meaning.
- 🔗 Explicit presumption of independence of VAD dimensions, has hardened as fact.
- 🔗 Intention that VAD ≡ EPA has become lost in literature. [2]

- The PoCSverse
- Ousiometrics 12 of 71
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremousionyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nutshell
- Extras
- References

¹Life goal: Never get owned by a dictionary on social media



“An Approach to Environmental Psychology.”
by Mehrabian and Russell (1974). [7]



“The basic emotional impact of environments”
Mehrabian and Russell,
Perceptual and motor skills, **38**, 283–301, 1974. [8]

“Semantic differential studies, in particular, have shown that human judgments of diverse samples of stimuli can be characterized in terms of three dimensions: evaluation, activity, and potency. We have termed the corresponding emotional responses pleasure, arousal, and dominance.”

“Thus, each dimension is, in principle, functionally independent of the other two; none of the three dimensions could be subsumed by the others.”

The PoCSVerse
Ousiometrics
13 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

ANEW study: Valence ~ Happiness:

- Valence scale presented to participants as a ‘happy-unhappy scale.’
- Participants were further told:
 - “At one extreme of this scale, you are happy, pleased, satisfied, contented, hopeful. ...
 - The other end of the scale is when you feel completely unhappy, annoyed, unsatisfied, melancholic, despaired, or bored.”
- The Hedonometer was always about essential meaning.

We now know that ANEW is a no-no:

- Problem: Expert-chosen list of ~ 1,000 words.
- Fine words but poorly cover real texts [16].
- Wrongly suggests Arousal and Dominance are minimal relative to Valence.

The PoCSVerse
Ousiometrics
16 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

NRC VAD study: 20,007 words:

Standard correlations suggests a bit of Barney Rubble:

$$R(V, A) \approx -0.268$$

$$R(A, D) \approx 0.302$$

$$R(D, V) \approx 0.488$$

The PoCSVerse
Ousiometrics
19 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

Major problems with measuring essential meaning:

- Scale:** Originally 10s and 100s of words → now 10,000s + online rating.
- The focus on types alone and not tokens:** Missing the forest for the book of tree species.
- The use of Likert scales for semantic differentials:** Solid but can be improved upon.
- Limitations of factor analysis for a large number of categorical dimensions:** Ousiograms will help sort things out.
- The misalignment between expert-chosen, end-point descriptors and dimensions of essential meaning:** How to guide raters to score VAD dimensions?
Solution is to always perform factor analysis (SVD).

The PoCSVerse
Ousiometrics
14 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

Remeasuring meaning:



“Obtaining Reliable human ratings of valence, arousal, and dominance for 20,000 English words”
Saif M. Mohammad,
Proceedings of The Annual Conference of the Association for Computational Linguistics (ACL), **38**, , 2018. [10]

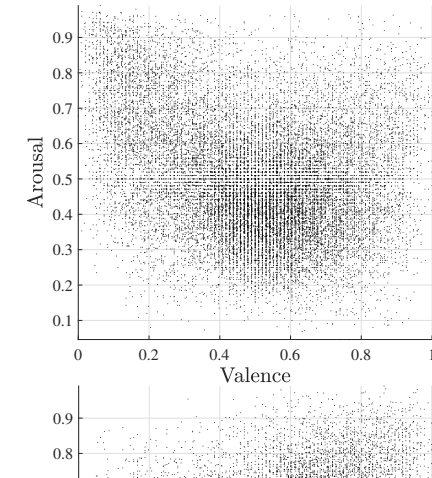
Moving beyond Likert scales:

- Best-worst scaling
- Ask raters to examine n things once, and choose the best and worst according to some criterion.
- For $n = 4$, there are 6 pair comparisons of Things.
- Choosing best and worst gives 5 orderings: $\tau_1 > \tau_2, \tau_3 > \tau_4$.
- Things end up with scores in $[0, 1]$.

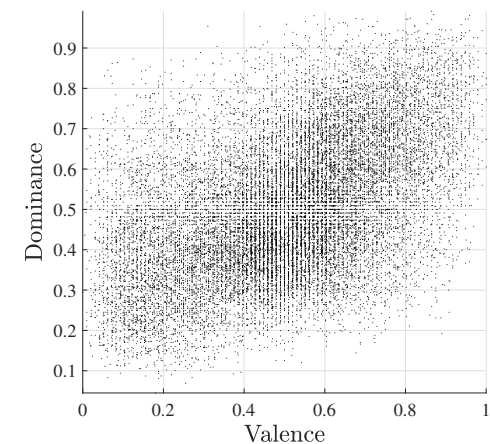
The PoCSVerse
Ousiometrics
17 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

The Delicious English Muffin of Meaning:¹

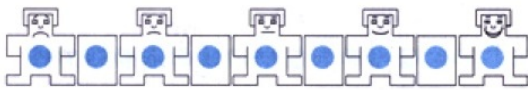


$$R(D, V) \approx 0.488$$



1999 ANEW study—three 1–9 scales: [4]

valence:



arousal:



dominance:



The PoCSVerse
Ousiometrics
15 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

NRC VAD Lexicon [10]

VAD endpoints: Paradigm words and phrases presented to raters: [11]	
highest valence	happiness, pleasure, positiveness, satisfaction, contentedness, hopefulness
lowest valence	unhappiness, annoyance, negativness, dissatisfaction, melancholy, despair
highest arousal	arousal, activeness, stimulation, frenzy, jitteriness, alertness
lowest arousal	unarousal, passiveness, relaxation, calmness, sluggishness, dullness, sleepiness
highest dominance	dominant, in control of the situation, powerful, influential, important, autonomous
lowest dominance	submissive, controlled by outside factors, weak, influenced, cared-for, guided

Major problem 5: Imposing dimensions through clouds of endpoint descriptors.

The PoCSVerse
Ousiometrics
20 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

The PoCSVerse
Ousiometrics
21 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosyntax
- Dimension names
- Safety bias
- Applications
- The Ousimeter
- Correspondences
- Nutshell
- Extras
- References

Release the Hounds by which we mean Singular Value Decomposition:

Variance explained:

VAD: 44.4%, 28.0%, and 27.6%.

Apply SVD.

Singular values: $\sigma_1 \approx 34.1$, $\sigma_2 \approx 27.2$, and $\sigma_3 \approx 13.8$,

For what will be Goodness-Energy-Structure (GES): 55.6%, 35.3%, and 9.1%

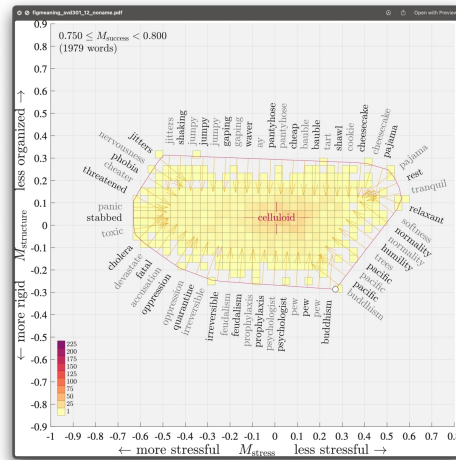
Rotate in G-E plane by $\pi/4$ for what will be Power-Danger-Structure (PDS) 45.5%, 45.5%, 9.1%

Interpretability enhancements: Ousiograms.

The PoCSVerse Ousiometrics 22 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosynonyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nushell
- Extras
- References

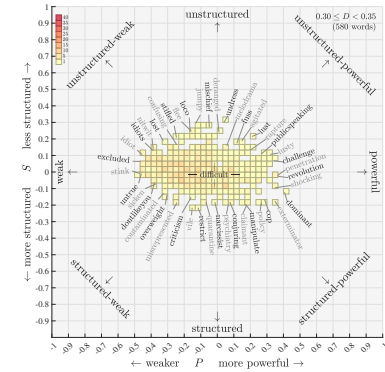
Building ousiograms (2021/01/31):



The PoCSVerse Ousiometrics 22 of 71

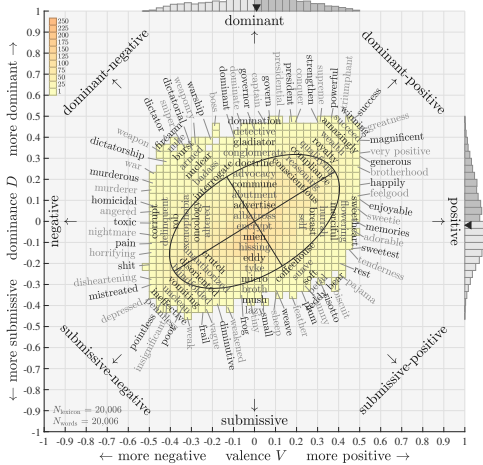
- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosynonyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nushell
- Extras
- References

Ousiometric slices—MRIs of Meaning



Slices of Structure Flipbook
 Slices of Danger Flipbook
 Slices of Power Flipbook

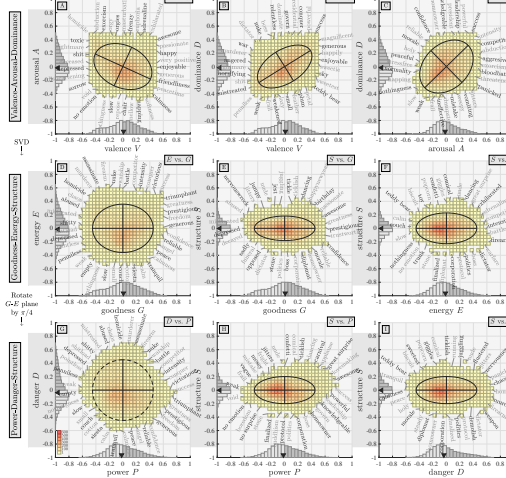
~ valence-dominance ousiogram for the NRC VAD lexicon ~



The PoCSVerse Ousiometrics 23 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosynonyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nushell
- Extras
- References

Ousiograms for the NRC VAD lexicon in the VAD, GES, and PDS frameworks:



The PoCSVerse Ousiometrics 26 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosynonyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nushell
- Extras
- References

Extremonyms: Synosynonyms and Antosynonyms:

Powerful-Safe (Good) to Weak-Dangerous (Bad) axis:

Synonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
Anchor: wisdom	0.430	-0.198	0.371	0.579	-0.031	-0.158	0.388	-0.432	-0.158
education	0.396	-0.225	0.340	0.539	-0.065	-0.167	0.336	-0.427	-0.167
healthy	0.438	-0.181	0.318	0.558	-0.047	-0.108	0.362	-0.428	-0.108
trustworthy	0.469	-0.185	0.324	0.589	-0.052	-0.100	0.379	-0.453	-0.100
reliable	0.412	-0.259	0.375	0.575	-0.076	-0.202	0.353	-0.460	-0.202

Antosynonyms

Antosynonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
bullshit	-0.458	0.176	-0.317	-0.575	0.046	0.095	-0.373	0.439	0.095
shitty	-0.480	0.179	-0.337	-0.604	0.042	0.100	-0.397	0.456	0.100
nauseate	-0.438	0.160	-0.324	-0.558	0.026	0.101	-0.376	0.413	0.101
weeping	-0.418	0.188	-0.332	-0.549	0.042	0.131	-0.359	0.418	0.131
shame	-0.440	0.170	-0.345	-0.572	0.023	0.120	-0.388	0.421	0.120
diarrhea	-0.408	0.184	-0.357	-0.552	0.023	0.151	-0.374	0.407	0.151

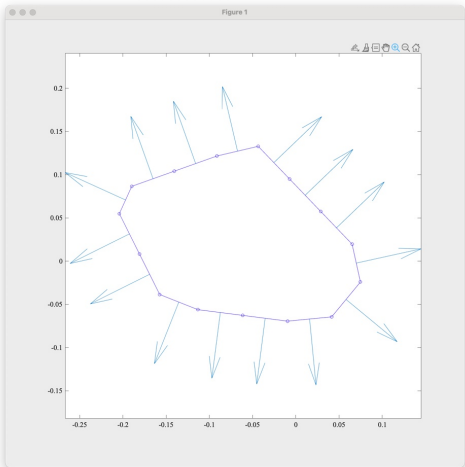
Powerful to Weak axis:

Synonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
Anchor: success	0.459	0.380	0.481	0.571	0.501	0.095	0.758	-0.050	0.095
almighty	0.438	0.374	0.458	0.543	0.487	0.098	0.728	-0.040	0.098
triumphant	0.449	0.337	0.472	0.565	0.462	0.073	0.726	-0.072	0.073
champion	0.390	0.380	0.445	0.494	0.492	0.087	0.698	-0.001	0.087
victorious	0.384	0.386	0.446	0.489	0.499	0.087	0.698	0.007	0.087

Antosynonyms

Antosynonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
sorrow	-0.448	-0.265	-0.336	-0.509	-0.329	-0.127	-0.593	0.127	-0.127
tasteless	-0.354	-0.304	-0.352	-0.430	-0.385	-0.092	-0.576	0.032	-0.092
idle	-0.321	-0.333	-0.388	-0.414	-0.434	-0.068	-0.600	-0.014	-0.068
empty	-0.312	-0.317	-0.419	-0.424	-0.439	-0.033	-0.610	-0.011	-0.033
void	-0.365	-0.337	-0.370	-0.443	-0.420	-0.103	-0.611	0.016	-0.103

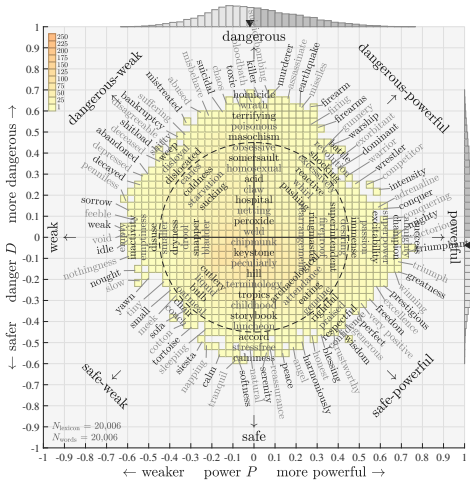
Building ousiograms (2021/01/31):



The PoCSVerse Ousiometrics 24 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosynonyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nushell
- Extras
- References

~ power-danger ousiogram for the NRC VAD lexicon ~



The PoCSVerse Ousiometrics 27 of 71

- Measuring essential meaning
- History
- Definitions
- Emotions
- Problems
- Remeasuring meaning
- Ousiograms
- Extremosynonyms
- Dimension names
- Safety bias
- Applications
- The Ousiometer
- Correspondences
- Nushell
- Extras
- References

Extremonyms: Synosynonyms and Antosynonyms:

Dangerous-Powerful (High Energy) to Safe-Weak (Low Energy) axis:

Synonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
Anchor: volcanic	-0.156	0.410	0.281	-0.061	0.515	-0.045	0.322	0.407	-0.045
shelling	-0.163	0.417	0.273	-0.072	0.518	-0.049	0.316	0.417	-0.039
artillery	-0.150	0.412	0.294	-0.050	0.523	-0.050	0.335	0.405	-0.050
wild	-0.188	0.422	0.250	-0.105	0.514	-0.032	0.289	0.438	-0.032
rifles	-0.163	0.364	0.265	-0.068	0.470	-0.062	0.284	0.380	-0.062

Antosynonyms

Antosynonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
couch	0.094	-0.418	-0.302	-0.002	-0.524	0.025	-0.372	-0.369	0.025
mellow	0.133	-0.431	-0.235	0.066	-0.504	-0.009	-0.310	-0.403	-0.009
pillow	0.163	-0.372	-0.305	0.049	-0.498	0.085	-0.317	-0.387	0.085
tortoise	0.173	-0.422	-0.250	0.092	-0.511	0.025	-0.297	-0.427	0.025
quilt	0.143	-0.377	-0.274	0.048	-0.482	0.052	-0.307	-0.375	0.052
cotton	0.139	-0.429	-0.260	0.059	-0.517	0.012	-0.324	-0.405	0.012

Dangerous to Safe axis:

Synonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
Anchor: homicide	-0.490	0.473	0.018	-0.485	0.478	0.011	-0.005	0.681	0.011
killer	-0.459	0.471	0.043	-0.446	0.485	0.008	0.028	0.658	0.008
psychopath	-0.460	0.443	0.036	-0.446	0.458	-0.003	0.009	0.640	-0.003
bloodshed	-0.452	0.442	0.025	-0.444	0.450	0.008	0.004	0.633	0.008
violate	-0.439	0.470	0.019	-0.440	0.468	0.033	0.020	0.642	0.033

Antosynonyms

Antosynonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
natural	0.354	-0.382	-0.019	0.354	-0.382	-0.026	-0.020	-0.520	-0.026
tranquil	0.417	-0.406	-0.145	0.351	-0.480	0.078	-0.091	-0.588	0.078
softness	0.375	-0.414	-0.098	0.338	-0.455	0.021	-0.082	-0.561	0.021
serenity	0.400	-0.378	0.057	0.429	-0.345	-0.054	0.060	-0.547	-0.054
comfortable	0.427	-0.337	-0.027	0.406	-0.361	0.039	0.032	-0.542	0.039
calmness	0.434	-0.395	-0.106	0.383	-0.453	0.065	-0.049	-0.591	0.065

Etymological, taxonomic, and nomenclatural madneses:

- Physics: Power was once sometimes called Activity
- Danger and Dominance trace back to Dominus (~ lord/ruler/person of power)
- Framing words for EPA, VAD, etc., matter greatly.

Other descriptors that don't hold up:

- Success-Stress-Structure.
- Energy/Flourishing/Thriving-Threat
- Power-Order/Chaos-Gravity/Seriousness

After much staring at the ceiling:

- Goodness-Energy-Structure (GES) (still fails)
- Power-Danger-Structure (PDS) (succeeds)

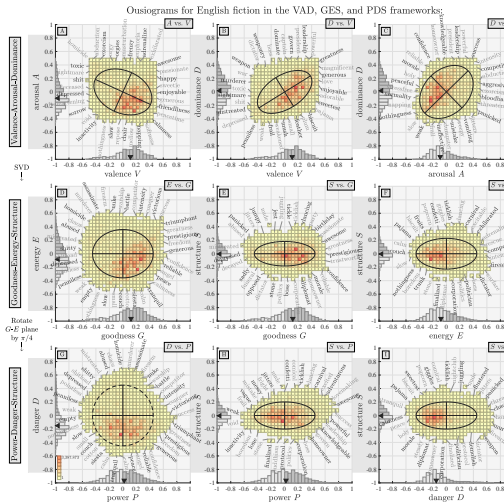
Connections between meaning dimensions:

$$\begin{bmatrix} \text{Goodness} \\ \text{Energy} \\ \text{Structure} \end{bmatrix} \approx \begin{bmatrix} +0.86 & -0.15 & +0.48 \\ -0.16 & +0.83 & +0.54 \\ +0.48 & +0.55 & -0.69 \end{bmatrix} \begin{bmatrix} \text{Valence} \\ \text{Arousal} \\ \text{Dominance} \end{bmatrix}$$

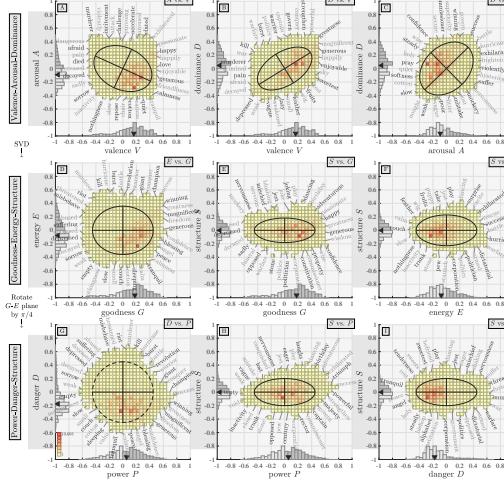
$$\begin{bmatrix} \text{Power} \\ \text{Danger} \\ \text{Structure} \end{bmatrix} \approx \begin{bmatrix} 0.53 & 0.45 & 0.72 \\ -0.70 & 0.71 & 0.07 \\ 0.48 & 0.55 & -0.69 \end{bmatrix} \begin{bmatrix} \text{Valence} \\ \text{Arousal} \\ \text{Dominance} \end{bmatrix}$$

$$\begin{bmatrix} \text{Power} \\ \text{Danger} \end{bmatrix} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} \text{Goodness} \\ \text{Energy} \end{bmatrix} \quad (1)$$

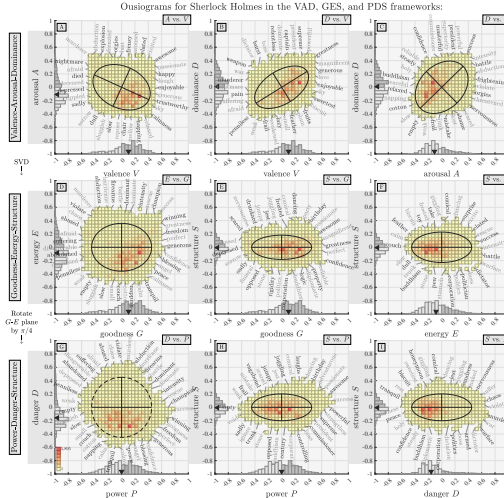
The PoCSVerse
Ousiometrics
35 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References



Ousioigrams for Jane Austen's novels in the VAD, GES, and PDS frameworks:



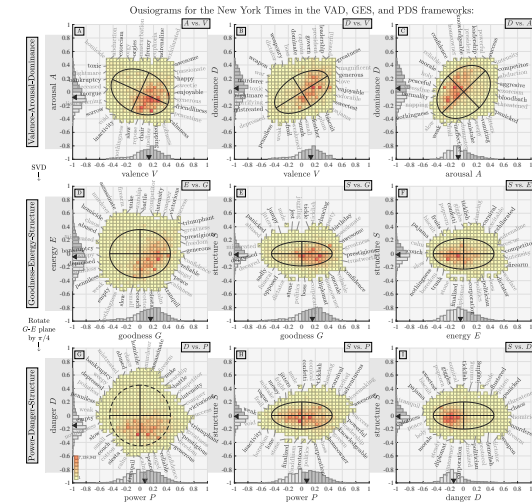
The PoCSVerse
Ousiometrics
35 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References



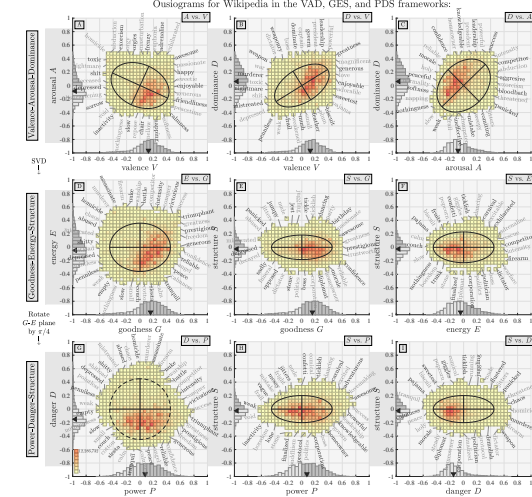
From types to tokens: [15, 2]

- Analysis so far is for a lexicon of types: Each word counts once.
- Must consider how words are used in real texts by frequency: Tokens.
- Rebuild ousioigrams with usage frequency incorporated.
- A set of distinct corpora:
 - English fiction from Google Books (120 years). [9, 14]
 - Jane Austen's novels.
 - Sherlock Holmes stories.
 - New York Times (20 years). [19]
 - Wikipedia (2019/03). [20]
 - RadioTalk: Transcriptions of talk radio. [3]
 - Twitter through Storywrangler. [1]

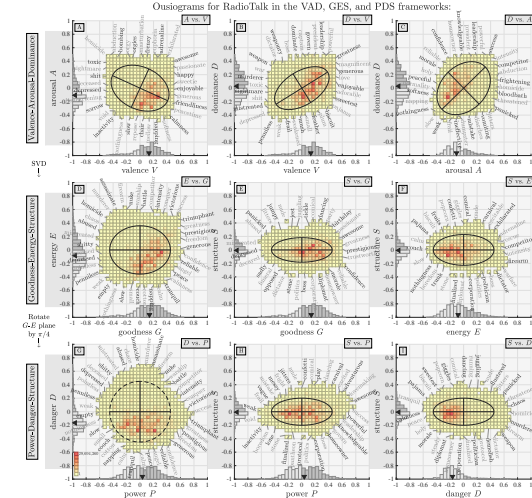
The PoCSVerse
Ousiometrics
36 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References



The PoCSVerse
Ousiometrics
37 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References



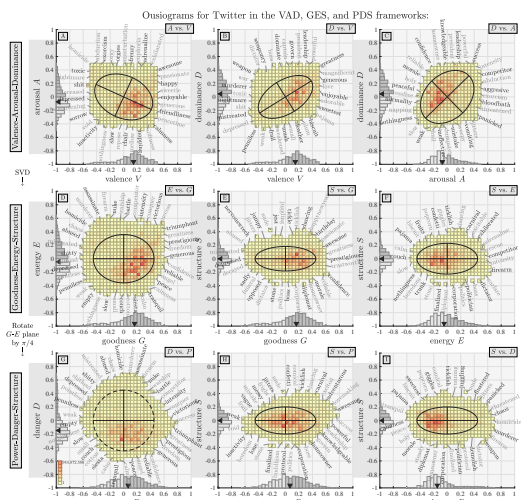
The PoCSVerse
Ousiometrics
38 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References



The PoCSVerse
Ousiometrics
39 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References

The PoCSVerse
Ousiometrics
40 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References

The PoCSVerse
Ousiometrics
41 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousioigrams
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nihilism
Extras
References



The PoCSVerse Ousiometrics 42 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

The Ousiometer

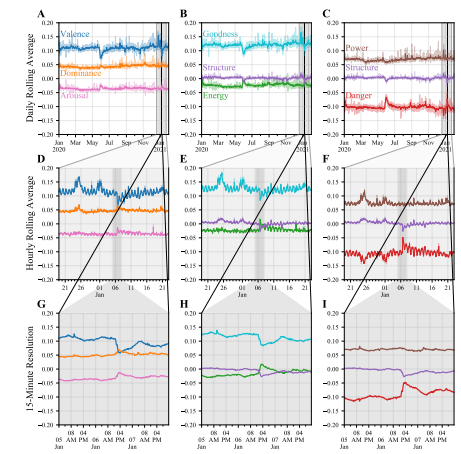
Correspondences

Nushell

Extras

References

Prototype ouisiometer—Twitter:



The PoCSVerse Ousiometrics 46 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

The Ousiometer

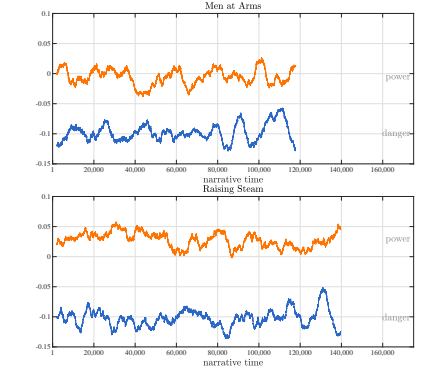
Correspondences

Nushell

Extras

References

Prototype ouisiometer—Terry Pratchett's Discworld:



The PoCSVerse Ousiometrics 49 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

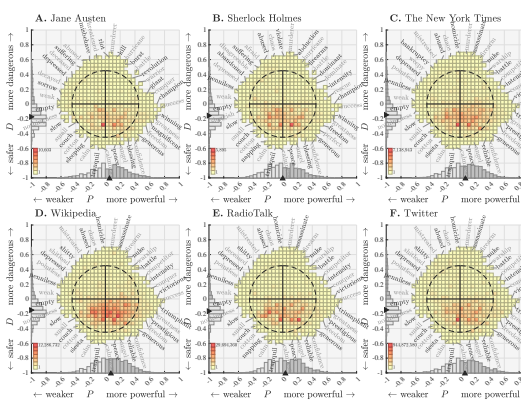
The Ousiometer

Correspondences

Nushell

Extras

References



The PoCSVerse Ousiometrics 43 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

The Ousiometer

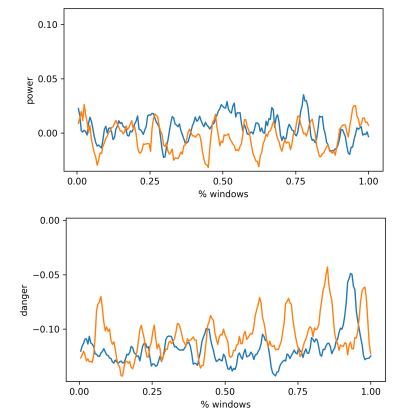
Correspondences

Nushell

Extras

References

Prototype ouisiometer—Harry Potter:



Blue: Harry Potter and the Half-Blood Prince
Orange: Harry Potter and the Deathly Hallows

The PoCSVerse Ousiometrics 47 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

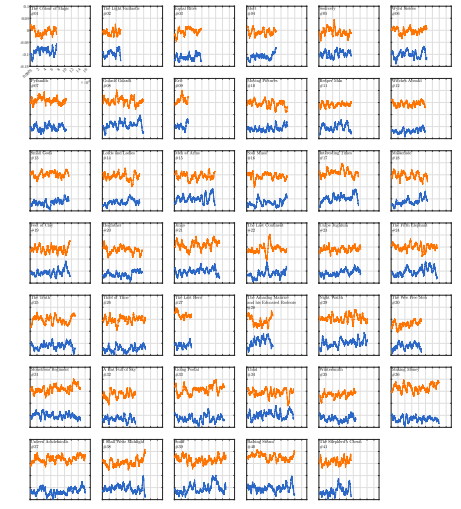
The Ousiometer

Correspondences

Nushell

Extras

References



The PoCSVerse Ousiometrics 50 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

The Ousiometer

Correspondences

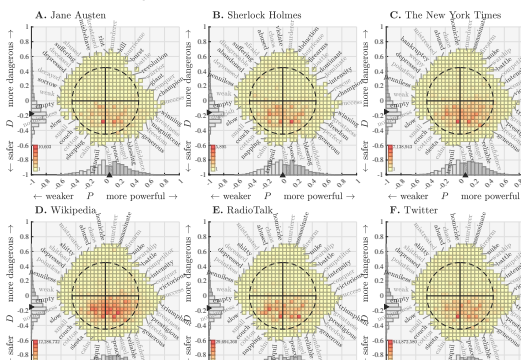
Nushell

Extras

References

A special thing has happened:

- The PDS framework emerged only from analyzing a lexicon (types).
- Applying PDS framework to disparate corpora (tokens) reveals a linguistic 'safety bias'.



The PoCSVerse Ousiometrics 44 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

The Ousiometer

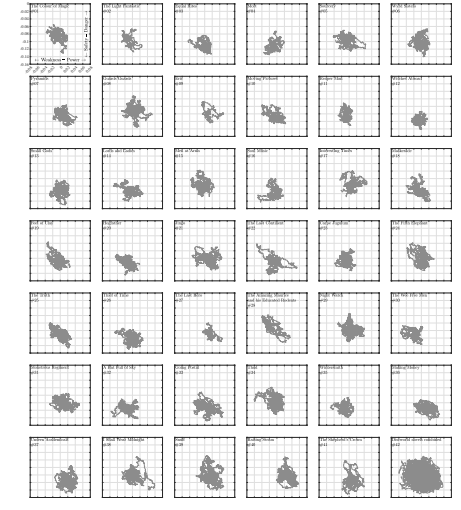
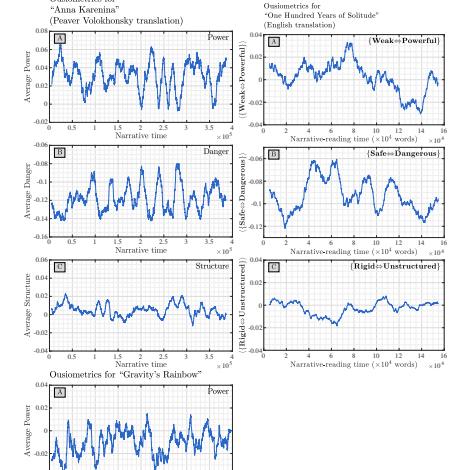
Correspondences

Nushell

Extras

References

Power and Danger time series for books:



The PoCSVerse Ousiometrics 51 of 71

Measuring essential meaning

History

Definitions

Emotions

Problems

Remeasuring meaning

Ousiograms

Extremosyntax

Dimension names

Safety bias

Applications

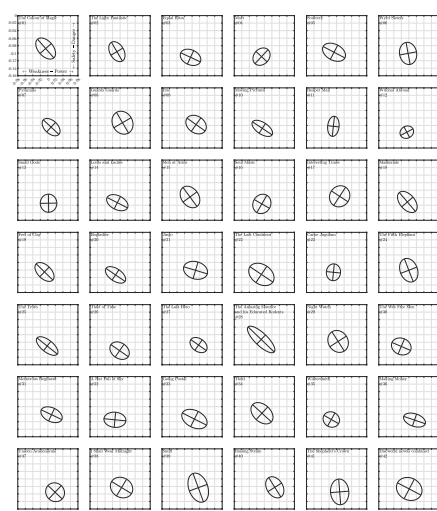
The Ousiometer

Correspondences

Nushell

Extras

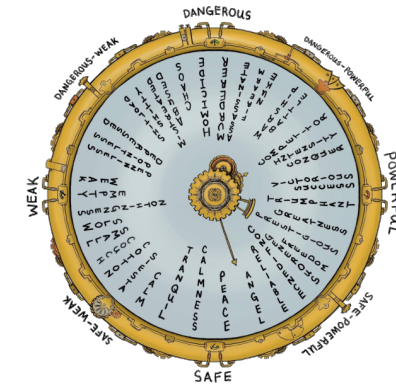
References



The PoCSVerse
Ousiometrics
52 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nunhall
Extras
References

lawful-good ~ structured-powerful-safe	neutral-good ~ neutral-powerful-safe	chaotic-good ~ unstructured-powerful-safe
lawful-neutral ~ structured-neutral	(true) neutral	chaotic-neutral ~ unstructured-neutral
lawful-evil ~ structured-dangerous	neutral-evil ~ neutral-dangerous	chaotic-evil ~ unstructured-dangerous

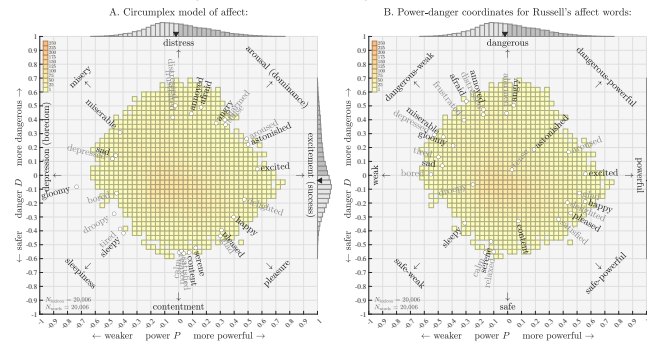
The Compass of Meaning:



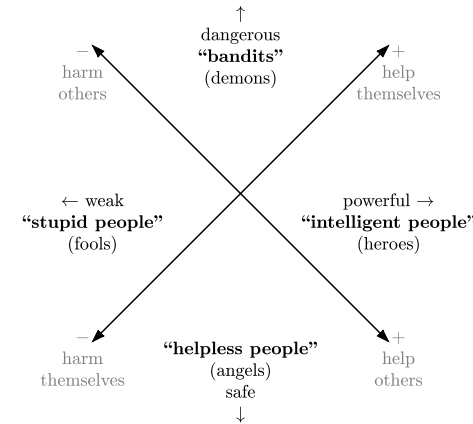
Online appendices: Paper(s), flipbooks, code, ...
<https://storylab.w3.uvm.edu/ousiometrics>

The PoCSVerse
Ousiometrics
60 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nunhall
Extras
References

Rough agreement with Russell's circumplex model,^[18] which itself doesn't disagree with a 2-D orthogonal framework.



Aligns with rotated version of Cipolla's Basic Laws of Human Stupidity:



The PoCSVerse
Ousiometrics
57 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nunhall
Extras
References

Synonyms	Valence	Arousal	Dominance	Goodness	Energy	Structure	Power	Danger	Structure
happy	0.50	0.24	0.27	0.53	0.26	0.18	0.57	-0.16	0.17
delighted	0.44	0.16	0.18	0.44	0.17	0.17	0.44	-0.18	0.17
excited	0.41	0.43	0.21	0.39	0.40	0.29	0.56	0.04	0.29
astonished	0.01	0.28	0.07	0.08	0.27	0.10	0.18	0.19	0.10
aroused	0.21	0.45	0.17	0.19	0.43	0.23	0.43	0.19	0.23
tense	-0.10	-0.06	0.15	-0.01	0.05	-0.19	0.03	0.04	-0.19
alarmed	-0.31	0.32	-0.01	-0.32	0.31	0.03	-0.03	0.45	0.03
angry	-0.38	0.33	0.10	-0.33	0.39	-0.07	0.02	0.51	-0.07
afraid	-0.49	0.28	-0.26	-0.59	0.17	0.09	-0.32	0.52	0.09
annoyed	-0.40	0.28	-0.16	-0.46	0.21	0.07	-0.19	0.47	0.07
distressed	-0.36	0.27	-0.18	-0.43	0.19	0.10	-0.19	0.43	0.10
frustrated	-0.42	0.15	-0.25	-0.50	0.06	0.05	-0.33	0.38	0.05
miseric	-0.44	-0.04	-0.31	-0.52	-0.13	-0.02	-0.47	0.26	-0.02
sad	-0.28	-0.17	-0.35	-0.38	-0.28	0.02	-0.47	0.05	0.02
gloomy	-0.39	-0.09	-0.21	-0.43	-0.13	-0.09	-0.40	0.20	-0.09
depressed	-0.48	-0.05	-0.36	-0.58	-0.17	-0.01	-0.54	0.27	-0.01
bored	-0.35	-0.33	-0.30	-0.40	-0.38	-0.14	-0.55	-0.02	-0.14
droopy	-0.06	-0.15	-0.20	-0.13	-0.22	0.03	-0.25	-0.08	0.03
tired	-0.38	-0.18	-0.31	-0.45	-0.26	-0.07	-0.50	0.11	-0.07
sleepy	0.10	-0.37	-0.25	0.03	-0.46	0.02	-0.29	-0.36	0.02
calm	0.37	-0.40	-0.22	0.28	-0.51	0.11	-0.14	-0.56	0.11
relaxed	0.36	-0.41	-0.12	0.32	-0.46	0.03	-0.08	-0.56	0.03
at ease	0.46	0.01	0.18	0.48	0.04	0.10	0.38	-0.30	0.10
at ease	0.30	-0.11	-0.01	0.27	-0.15	0.09	0.10	-0.29	0.09
content	0.26	-0.20	0.06	0.29	-0.18	-0.03	0.09	-0.33	-0.03
serene	0.30	-0.37	-0.13	0.25	-0.42	0.03	-0.10	-0.48	0.03
glad	0.44	0.26	0.24	0.45	0.27	0.19	0.52	-0.10	0.19
pleased	0.44	0.05	0.29	0.51	0.13	0.03	0.47	-0.25	0.03

Dungeons & Dragons—Two alignment axes for character:



{lawful ↔ chaotic}
(vertical) and
{good ↔ evil}
(horizontal).

The PoCSVerse
Ousiometrics
55 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nunhall
Extras
References

Findings, observations, possibilities:

- Power-danger-structure framework emerges in distinct settings, fitting types and tokens.
- Safety bias of communication refines Pollyanna Principle of positivity
- Happiness/Goodness = Power + Safety
- Ousiometer can be improved and refined.
- Possible: Emotions map onto powerful-safe and danger axes.
- Power-danger framework for survival.
- Possible: Telegnomics for stories—Measuring character arcs, plots.
- Complement to information theory which is meaning-free.^[21]

See concluding remarks in the foundational paper.^[5]

The PoCSVerse
Ousiometrics
59 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nunhall
Extras
References



"Semantic differential profiles for 1,000 most frequent English words."

David R. Heise,
Psychological Monographs: General and Applied,
79, 1, 1965.^[6]

Dimension	Scale
Evaluation	Good-Bad
Activity	Pleasant-Unpleasant
Potency	Lively-Still
Stability	Strong-Weak
	Tough-Tender
	Rational-Emotional
	Tamed-Untamed

The PoCSVerse
Ousiometrics
62 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosynonyms
Dimension names
Safety bias
Applications
The Ousiometer
Correspondences
Nunhall
Extras
References

¹From this Reddit thread, where, naturally, the choices are enthusiastically debated.

Remeasuring meaning:

Confusion and Conflation:



“Pleasure, arousal, dominance: Mehrabian and Russell revisited”
Bakker et al.,
Current Psychology, 33, 405–421, 2014. [2]

- Test whether EPA and VAD match.
- Explore historical problems of defining end point descriptors for meaning dimensions.

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The PoCSverse
Ousiometrics
65 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosyntax
Dimension names
Safety bias
Applications
The Ousimeter
Correspondences
Nushell
Extras
References

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The PoCSverse
Ousiometrics
69 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosyntax
Dimension names
Safety bias
Applications
The Ousimeter
Correspondences
Nushell
Extras
References

The PoCSverse
Ousiometrics
67 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosyntax
Dimension names
Safety bias
Applications
The Ousimeter
Correspondences
Nushell
Extras
References

The PoCSverse
Ousiometrics
68 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosyntax
Dimension names
Safety bias
Applications
The Ousimeter
Correspondences
Nushell
Extras
References

The PoCSverse
Ousiometrics
69 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosyntax
Dimension names
Safety bias
Applications
The Ousimeter
Correspondences
Nushell
Extras
References

The PoCSverse
Ousiometrics
70 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosyntax
Dimension names
Safety bias
Applications
The Ousimeter
Correspondences
Nushell
Extras
References

The PoCSverse
Ousiometrics
71 of 71
Measuring essential meaning
History
Definitions
Emotions
Problems
Remeasuring meaning
Ousiograms
Extremosyntax
Dimension names
Safety bias
Applications
The Ousimeter
Correspondences
Nushell
Extras
References