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TRACE-ing Intelligence Reasoning

📊 The Problem

- In the U.S. Intelligence Community (IC), analytic reports "lack clarity and defensibility," specifically when addressing assumptions, gaps, and alternative explanations in research

- While analysts are trained in structured techniques (tools to improve methods of reasoning) it is unclear if analysts are also trained in nuances of writing

- One former FBI intelligence analyst does not recall being instructed in writing during formal intelligence training

📊 What's TRACE?

Trackable Reasoning and Analysis for Collaboration and Evaluation

- The TRACE Project, led by Dr. Stromer-Galley, created a web-based software to help analysts develop their evidence-based reasoning and intelligence reports, funded by IARPA, an arm Office for the Director of National Intelligence

- TRACE created fake cases and prompts Amazon Mechanical Turk workers answered using the TRACE software. Each report was coded with a reasoning score using the TRACE codebook, based on ICD203

📊 Method

- Literature review (IC standards, philosophy, logic, etc.)

- Read **20** reports to form hypotheses on linguistics and other drivers of good/bad reasoning in reports

- Created Excel of **96** reports (word count, sum reasoning scores, case names)

- Used Python to run text analysis on parts of speech (POS)

- Interviewed former FBI intelligence analyst

Key

Adj_all v. Adj_prop: Adj_prop is the proportion of adjectives to each report's word count. This applies to each of the other POS, which are combinations of each sub-category of POS described below

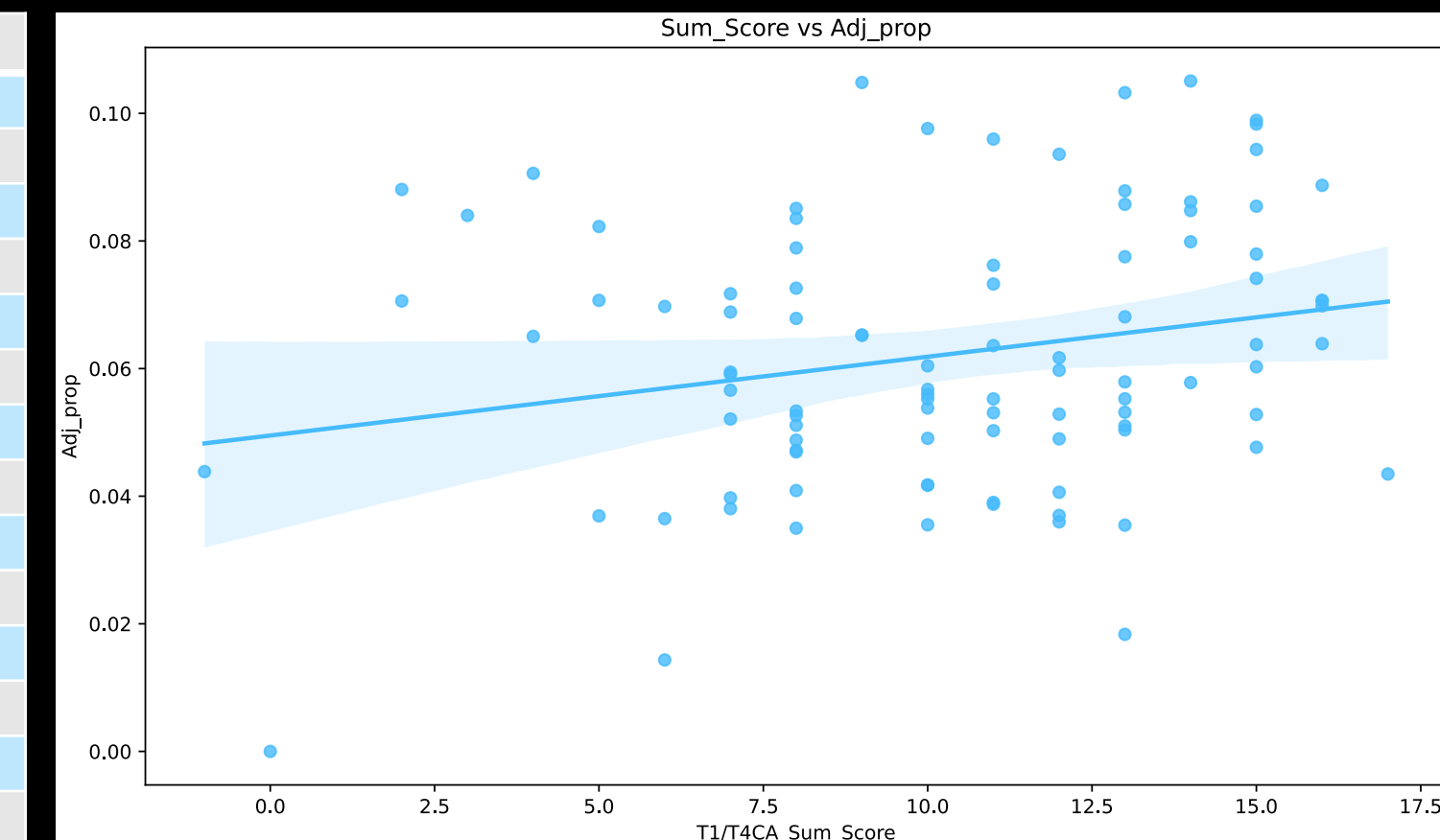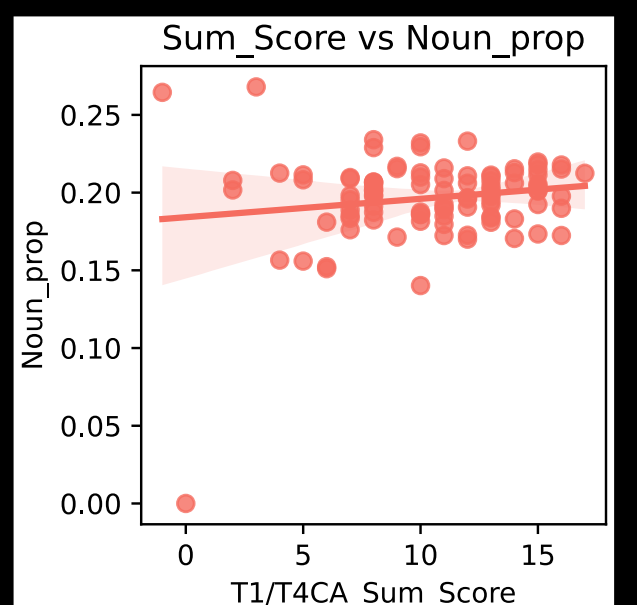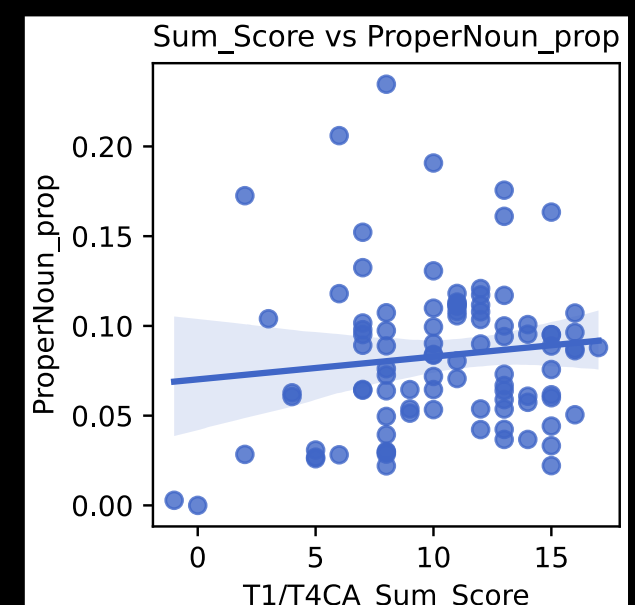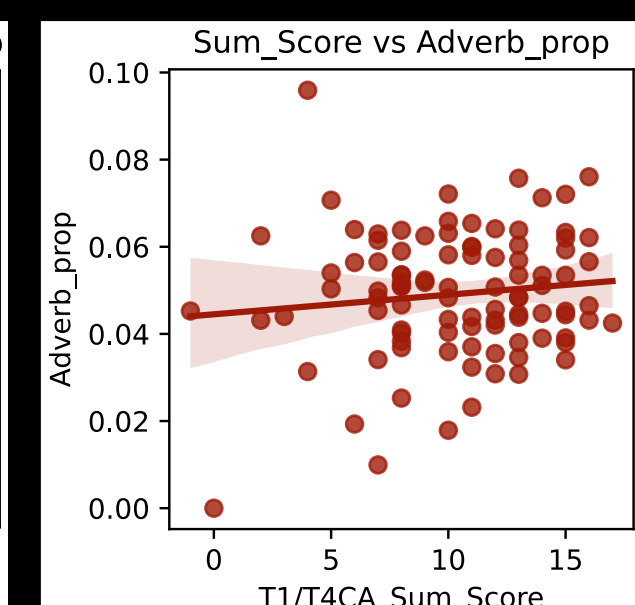| Variable	Includes
Adjective	adjectives, advective superlative/comparative
Adverb	adverb, adverb comparative/superlative, Wh-adverb
ProperNoun	proper noun singular/plural
Noun	noun singular/plural
Pronoun	personal/possessive pronoun, Wh-pronoun/possessive Wh-pronoun
T1/T4 Sum Score	reasoning score for each report, which were code using TRACE codebook
Case Name/#	TRACE cases coded as a number
Word Count	amount of words per report
WordCount%	% of words per report to overall word count

TRACE Heat Map of Correlations
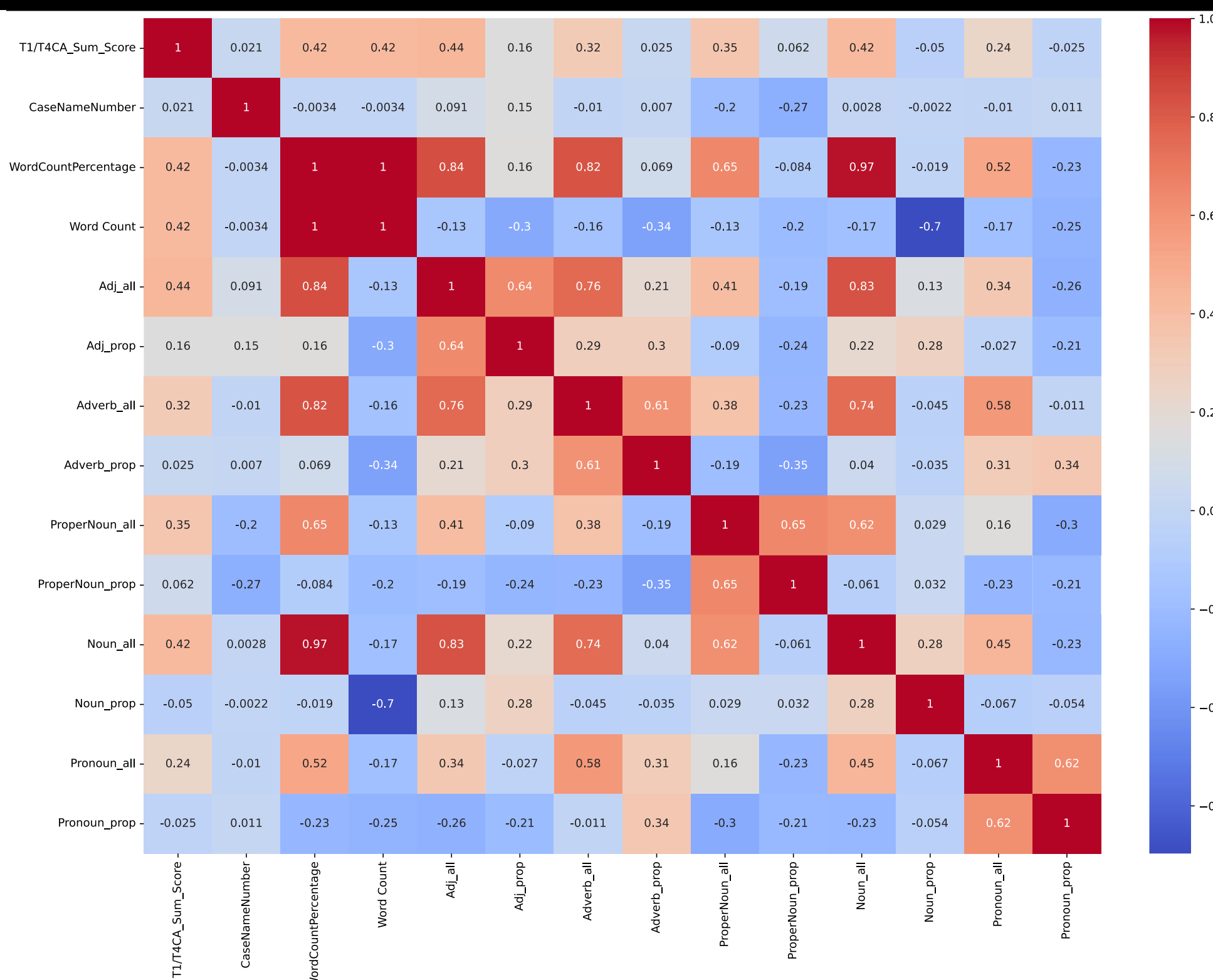
Part of Speech Variables That Are Significant

	Sum_Score	Word Count	CaseName
Sum_Score	0.0	0.01	0.582
Word Count	0.108	0.0	0.196
CaseName	0.582	0.196	0.0
Adj_all	0.000002	0.189	0.278
Adj_prop	0.025	0.002	0.07
Adverb_all	0.0003	0.116	0.875
Adverb_prop	0.250	0.0006	0.612
ProperNoun_all	0.0001	0.21	0.094
ProperNoun_prop	0.269	0.046	0.019
Noun_all	0.000003	0.086	0.760
Noun_prop	0.123	0.0	0.377
Pronoun_all	0.005	0.086	0.873
Pronoun_prop	0.676	0.013	0.681

Sum_Score vs Adj_prop

OLS Results for POS

	P>|t|
Constant	0.00
Adj_all	**0.016**
Case Name	0.573
ProperNoun_all	**0.032**
Adverb_all	0.345
Pronoun_all	**0.086**
Noun_all	0.742

Sum_Score vs Pronoun_prop

Sum_Score vs Adverb_prop

Sum_Score vs ProperNoun_prop

Sum_Score vs Noun_prop
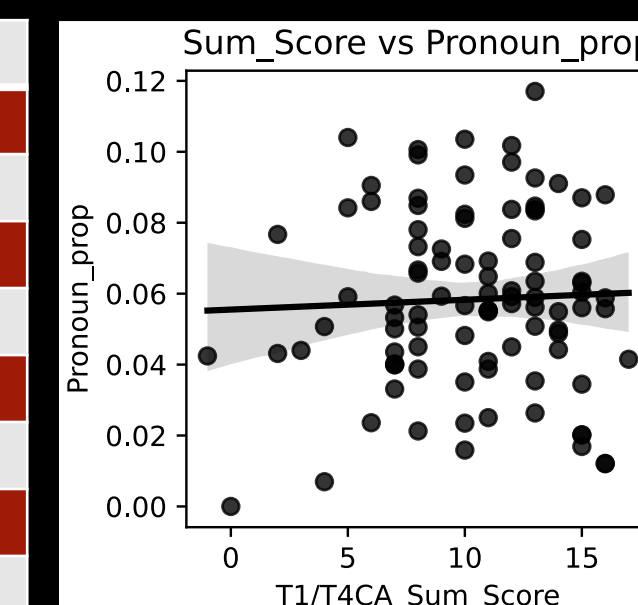
"TRACE Heat Map of Correlations"

Because the POS variables and the POS_prop variables show different correlation values to the sum reasoning scores, I created a p-value matrix.

"POS Variables That Are Significant"

This p-value matrix (and scatter plots) show **adj_prop** is positively correlated with a higher reasoning score. No other POS was strongly correlated.

"OLS Results for POS"

In this OLS regression, when I controlled for all POS and the report case, **adjectives**, but also **proper nouns** and **pronouns**, are statistically significant. A limitation is the regression does not control for word count

Conclusions and More Questions…

- Possible explanation: Adjectives and proper nouns add more concreteness to writing and thus reflects higher reasoning
- This research raises even more questions about the writing and linguistic training of intelligence analysts (contradicts interview)

Sources:
- Stromer-Galley, J., Rossini, P. G. C., Kenski, K., Folkestad, J., McKernan, B., Martey, R. M., Clegg, B., Osterlund, C., & Schooler, L. *User-centered Design and Experimentation To Develop Effective Software for Evidence-Based Reasoning In The Intelligence Community.*
- *Data from TRACE Project at Syracuse University* (2018)
- Interview with Jorhena Thomas, a former FBI intelligence analyst and a lecturer in the Georgetown Applied Intelligence program
- ICD203, Analytic Standards of the Intelligence Community, from the Director of National Intelligence

About the Researcher
Jasmine De Leon is a senior at Seton Hall University majoring in International Relations and Catholic Studies with minors in Journalism and Asian Studies. At Seton Hall, she is the Executive Producer of The Global Current Podcast and the first Student Representative for the Institute for Communication and Religion. She is a former Girl Security National Security Fellow, Emma Bowen Fellow, West Point MCLC Leader, and the 2023 World Youth Day Student Envoy to Lisbon.