



Through Thick and Thin: Predicting Team Performance Using History of Interaction Patterns via Deep Learning Models

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Text Analysis in Spaceflight Contexts



Image Credit: NASA



Text Analysis in Spaceflight Contexts



- Human Exploration Research Analog
- 4 astronaut-like crew members per crew
- 45 day simulated space mission



Image Credit: NASA

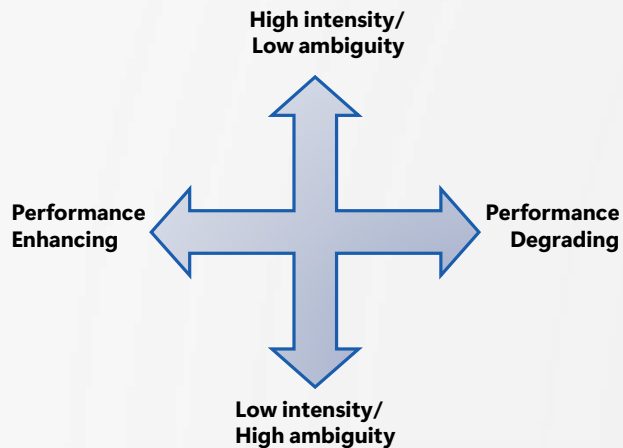


Defining Micro-Behaviors



- Identified theoretical space
- Developed coding scheme for ground truth

The Two-Dimensional Spectrum of Interpersonal Organizational Behavior (Cortina et al., 2017)



The VIDI Framework for Incivilities (Smith & Griffiths, 2022)

Dimension	Definition
Violation	A slight that threatens fairness, identity or respect
Intensity	How strong or offensive the slight is perceived to be
Duration	Whether the experience is frequent and occurs over a long period of time
Intent	Whether the slight is deliberate, unintentional or ambiguous

Our operationalization of violation:

Behaviors that **uplift** or **discourage** another individual, or have no valenced impact (**neither**)

Narrative Example 1 : Valence of Interactions



Speaker	Target	Turn	Coded Valence
B	C	It's the biggest lake on the planet.	Discourage
C	B	No it's not. Camilla is the biggest on the planet. Camilla has the largest lake.	Discourage
A	C	Well...	Neither
B	All	Okay, but even if it's not the biggest lake on the planet how small does the lake have to be that you're going to not hit the edges?	Discourage
C	All	I am not the pilot at the time. I don't know.	Discourage
D	All	My friend [name] studies paleo lakes on Mars. I've seen many, many photographs of these lakes. You could see the old delta deposits against the old shoreline. Pretty cool stuff.	Uplift

 *B and C contentious interaction*
 *A attempts statement*
 *B and C contentious interaction*
 *D diffuses tension*



Narrative Example 2 : Importance of Context



Crew Member	Turn
C	Only thing I have to add to that is there's two rings, two tethering rings, one is damaged, the other one is more dangerous. But this is only really useful for equipment that uses this, collects information for navigation by detecting hazardous debris, cosmic dust, clouds and radiation.

← Neutral statement



Narrative Example 2 : Importance of Context



Sender	Target	Turn
A	B	Yeah, yeah okay, what did you have?
B	A	The only thing I have it to add is, it's only a year-old computer. It was just repaired. Sorry it was repaired a year ago. One of the two tether rings were damaged making EVAs difficult.
A	B	Gotcha.
C	All	Only thing I have to add to that is there's two rings, two tethering rings, one is damaged , the other one is more dangerous. But this is only really useful for equipment that uses this, collects information for navigation by detecting hazardous debris, cosmic dust, clouds and radiation.
B	All	Somebody do propulsion.

← *B shares information*

← *Discouraging statement:
C repeats B directly after
speaking*

← *B changes subject*

Contextualizing information: B and C have exchanged several discouraging interactions in the preceding turns.

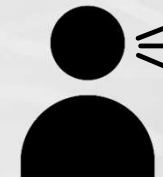


Detecting Micro-Behaviors

- Compare text-based vs. acoustic identifiers
- Consider role of sender *and* target
- Detect using random forest models

Classifier	Examples
Lexicon-Based	Linguistic Inquiry Word Count (LIWC) STRESSNet Sentiment (positive, negative, neutral, compound)
Acoustic	Voicing probability Fundamental frequency
Lexicon-based and Acoustic	Turn-similarity (e.g., sender-target cosine similarity across frequency, across sentiment)
Combinations	STRESSNet + LIWC LIWC + Acoustic Sentiment + Turn Similarity

Considering features of sender only



Considering features of sender and target



Predicting Performance



- Part 1: Train models to detect MBs
 - Random forests models using different classifiers
 - E.g., STRESSnet, LIWC + acoustic features, Sentiment + Turn Similarity
- Part 2: Develop models to predict performance, using output of detection models
 - Deep learning framework
 - Graph Neural Network – model complex dynamics to predict performance
 - Create edge weights based on history (e.g., average directed interaction between dyad)
- Detect early warning indicators of degrading performance

