Faulty Analysis: Analyzing Different Faultline Measurement Algorithms for Long-Duration Space Exploration

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Introduction

Faultlines, as constructs, split teams into two or more **subgroups** consisting of similar members and may produce **isolates**: members who are separated into their own individual subgroup.

Different categories of faultlines may be conceptualized: **demographic based faultlines**, or the underlying **values based faultlines** that result from conflicting values in teams.

Research comparing different faultline measurements within the context of small teams (four members) and the specific team composition attributes relevant for long-duration space exploration (LDSE) is needed.

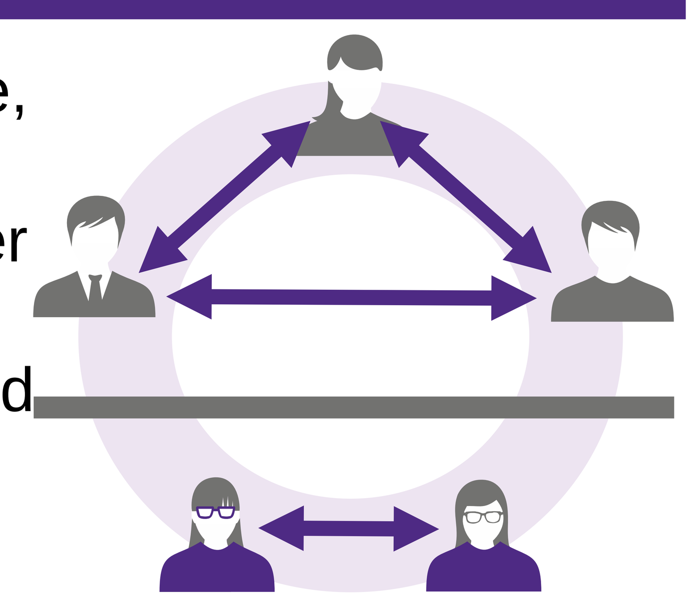
Demographic attributes, due to covariance between different attributes, are fit to an empirical distribution drawn from the attributes of all past and scheduled ISS missions. Values attribute distributions are fitted based on data collected from the HERA analog environment.

Faultline Type	Attribute	Sampling Distribution
Demographic	Nationality	Empirical from ISS Data
	Military Background	Empirical from ISS Data
	Gender	Empirical from ISS Data
Values Based	Self-Direction	$N(2.906,0.638)$
	Stimulation	$N(4.792,0.815)$
	Benevolence	$N(5.094,0.464)$

Note the demographic attributes use categorical variables and value attributes (Smith, 2016) use numeric variables.

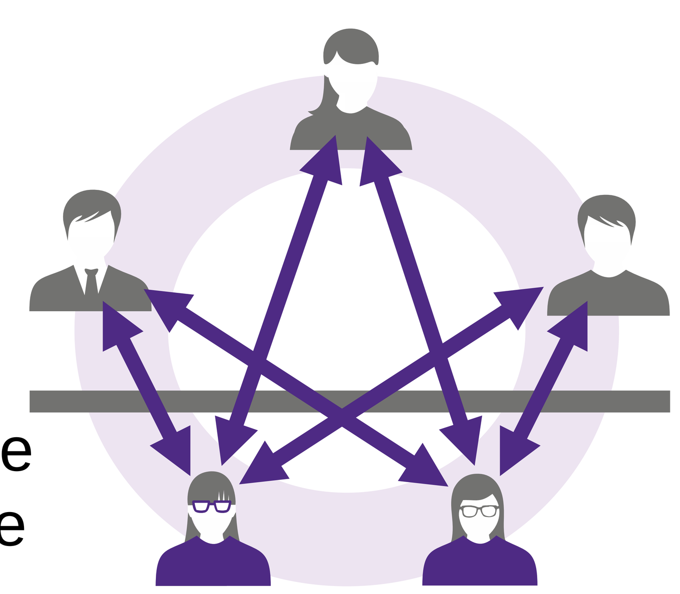
Method

To compare how similar two given faultline configurations are, rather than categorizing faultline configurations as either identical or non-identical, we compare for each dyad whether both configurations have **spanning ties** or **internal ties**. Thus, one pairing of faultline configurations may be compared to another faultline configuration.



Internal Ties

This approach allows us to compare similarities in the organization of team members into groups in addition to overall faultline strength. Understanding these groupings is important for faultline research examining their effects at an individual level or using a network perspective.



Spanning Ties

We compare the similarity of the faultline configurations determined by each measurement technique. To demonstrate the effects that attribute weighting may have upon results, we compare the outcomes of three different weightings for each.

Results

We create **10,000 simulated teams** in order to compare the similarity of clusters produced by different faultline measures. Three different weightings are used in order to test how robust findings are across different attribute weights. All variables were standardized by dividing by their standard deviation before weighting was applied.

DEMOGRAPHIC: **Equal:** Nationality (0.33), Military (0.33), Gender (0.33)
Low Variance: Nationality (0.60), Military (0.20), Gender (0.20)
High Variance: Nationality (0.80), Military (0.15), Gender (0.05)

VALUES: **Equal:** Self-Direction (0.33), Stimulation (0.33), Benevolence (0.33)
Low Variance: Self-Direction (0.33), Stimulation (0.33), Benevolence (0.33)
High Variance: Self-Direction (0.33), Stimulation (0.33), Benevolence (0.33)

Demographic Faultline Associations (Cramer's V)

	ASW (Equal Weight)	ASW (Low Variance)	ASW (High Variance)
Fau (Equal Weight)	0.847^{***}	0.555^{***}	0.527^{***}
Fau (Low Variance)	0.541^{***}	0.96^{**}	0.974^{***}
Fau (High Variance)	0.542^{***}	0.938^{***}	0.935^{***}

Values Faultline Associations (Crammer's V)

	ASW (Equal Weight)	ASW (Low Variance)	ASW (High Variance)
Fau (Equal Weight)	0.038^{***}	0.235^{***}	0.288^{***}
Fau (Low Variance)	0.053^{****}	0.672^{***}	0.728^{***}
Fau (High Variance)	0.052^{****}	0.788^{***}	0.824^{***}

Significance Levels: ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$

Discussion

This research advances discussion of the role faultlines play in long-duration space analogs in two regards:

It establishes how frequently we can expect these different measures of faultlines strength to produce the same results given the list and distributions of variables theorized to matter in LDSE analogs.

It demonstrates the influence that faultline weighting can have upon results, suggesting a need for future research identifying which faultline weights produce results with the most predictive ability in LDSE analogs.

We observe that there tend to be stronger effect sizes between measurements for the nominal demographic faultlines in comparison to the numeric values-basd faultlines.

This work also build upon previous efforts to compare faultline measurement constructs (Meyer et al, 2014). We conclude that faultline grouping is also influenced by measurement differences in a small team environment on attribute distributions similar to those expected to be encountered during LDSE.

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