A Novel Approach to Investigating Deception during Group Interaction

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Agenda

1. What Are the Topoi of Relational Communication?
2. How Do They Relate to Deception?
3. Methods for Studying Relational Messages
    a. Participant Perceptions
    b. Automated Multimodal Behavioral Analysis
4. Connecting Relational Messages to Deception
5. Future Directions

The Topoi of Relational Communication

Relational Communication - Definitions

- How two or more people use verbal and nonverbal messages to define the nature of their relationship
- Distinction between report (content) and command (relational) facets
- Relative importance of verbal vs. nonverbal

Relational Communication - Relational Topoi

Burgoon and Hale identified 12 nonorthogonal topoi:

- Intimacy (horizontal dimension of relationships)
  - **Affection-Hostility (Liking)**
  - Inclusion-Exclusion
  - Involvement-Uninvolvement
  - Receptivity-Non-receptivity
  - Depth-Superficiality
- **Dominance (vertical dimension of relationships)**
- **Composure-Nervousness**
- **Emotional Arousal Trust-Distrust**
- Task-Social orientation
- Similarity-dissimilarity

Purpose of the Relational Topoi within the SCAN Project

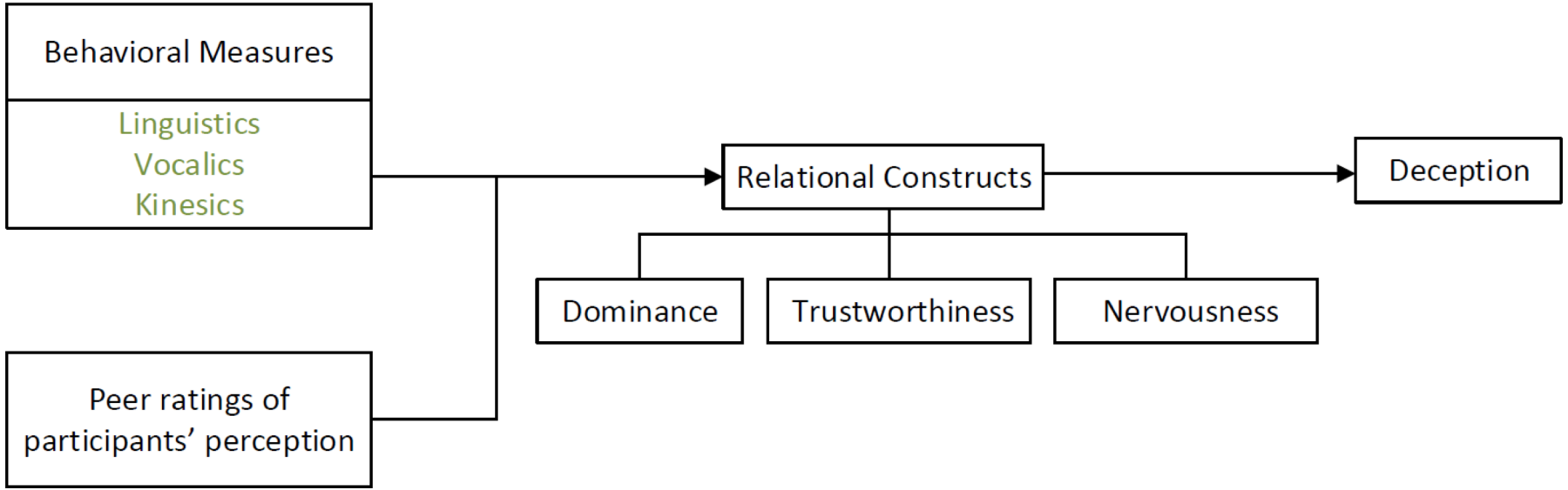
1. ***Gauge how group members regard one another***

   Are relational messages of dominance, arousal and trust evident in how group members behave?

1. ***Gauge whether relational messages predict who is deceptive***

   - Can these perceptions be proxies for perceived deception?
   - Should behavioral indicators be measured directly or fused into their constituent relational message themes to predict veracity?

Overview of Analysis on Relational Communication and Deception



Results from Previous Research

Results from previous deception experiment indicate:

When multiple predictors were used:

- Arousal and involvement predicted deception
- Deceivers were more aroused and less involved than truth tellers

When single predictors were used:

- Nervousness/tension was negatively associated with truthfulness
- Deceivers were more tense

Relational Communication Hypotheses

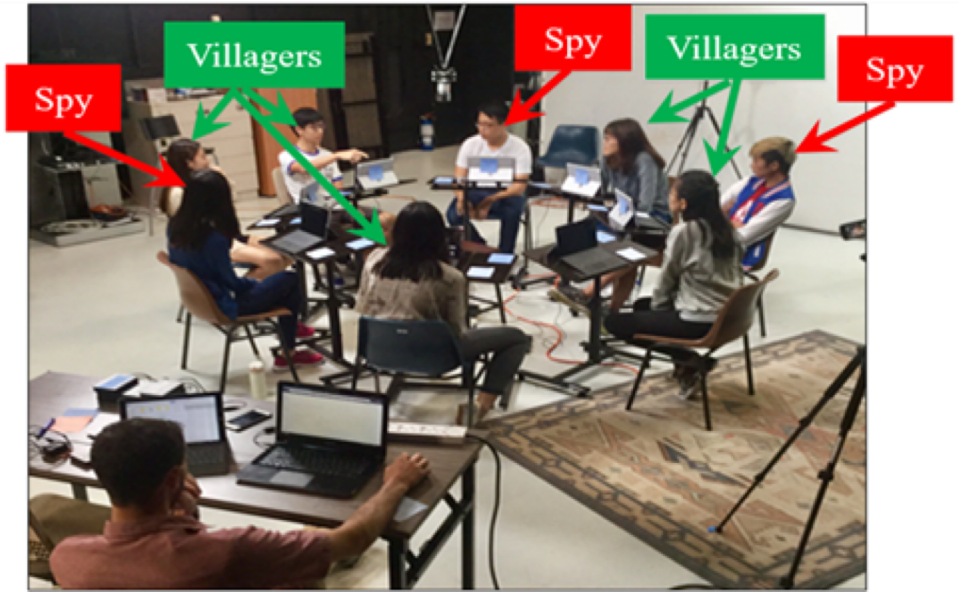
1. ***"Hiding in the weeds"***
    a. Deceivers might initially be passive (less dominant) to conceal their identity
    b. Might increasingly engage in "persuasive dominance"
2. ***Leakage***
    a. Deceivers betray more nervousness than truth tellers
3. ***Trust***
    a. Deceivers trusted less than truth-tellers
    b. Judgments change over time

Experimental Procedures - Game Overview

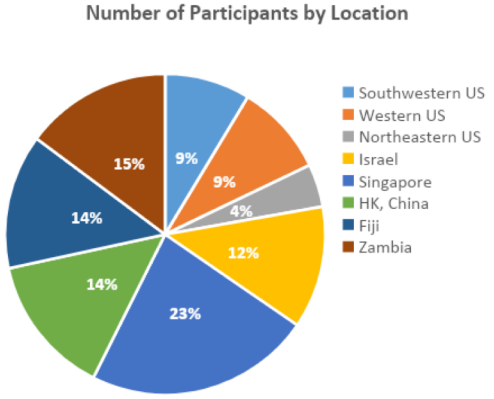
- Modified version of Resistance
- 6 - 8 players per group
- Participants assigned role of villager (truth-teller) or spy (deceiver)
- Only spies knew who the other spies were
- Game consisted of series of missions to protect hypothetical town
  - Villagers earned points for successful missions
  - Spies earned points by failing missions
- Game rounds had three phases: leader election, team formation, and mission vote
- 695 participants from 8 sites in 6 countries (US, Fiji, Israel, Zambia, Singapore, and Hong Kong, China)
- 95 games were played

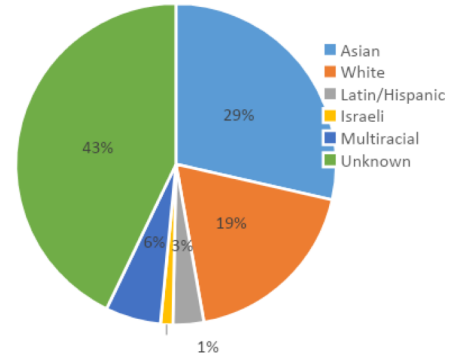
Relational Communication Measurement

- Perceptions measured with self-report surveys
  - Pre-game measures
  - In-game perceptions
  - Post-game survey
- Multiple sensors
  - Audio-visual signals from tablet at each desk
  - 360 degree overhead camera
  - Profile view with webcam



Descriptives of Homogeneous Games





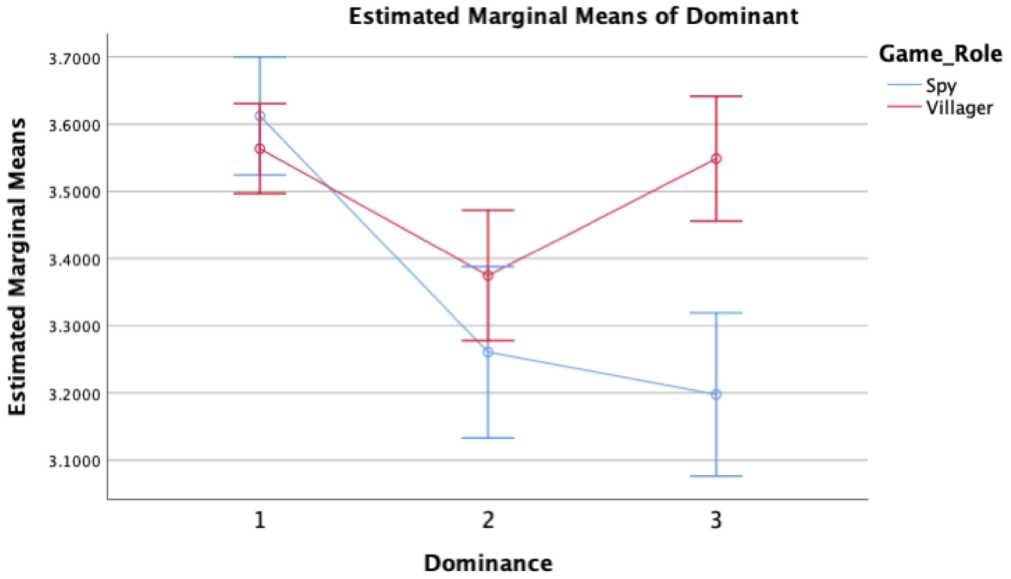
Variable Name	Attribute Value
Number of games	22
Number of participants	162
Number (percentage) of males	68 (42%)
Number (percentage) of games won by villagers	13 (59%)
Number (percentage) of spies	63 (39%)
Mean (standard deviation) age	22.13 (3.71)
Number (percentage) of players with game experience	86 (54%)
Number (percentage) of native English speakers	78 (48%)

Relational Communication - Perceptions

- Ratings collected after beginning ice breaker
  - served as a baseline
- Scales ranged from 1 (not at all) to 5 (very)
- Collected after every two rounds to obtain dynamics of interaction
- Only villagers' ratings were considered
  - Spies' ratings would be contaminated by their knowledge of one another's role

Results: Perceived Dominance

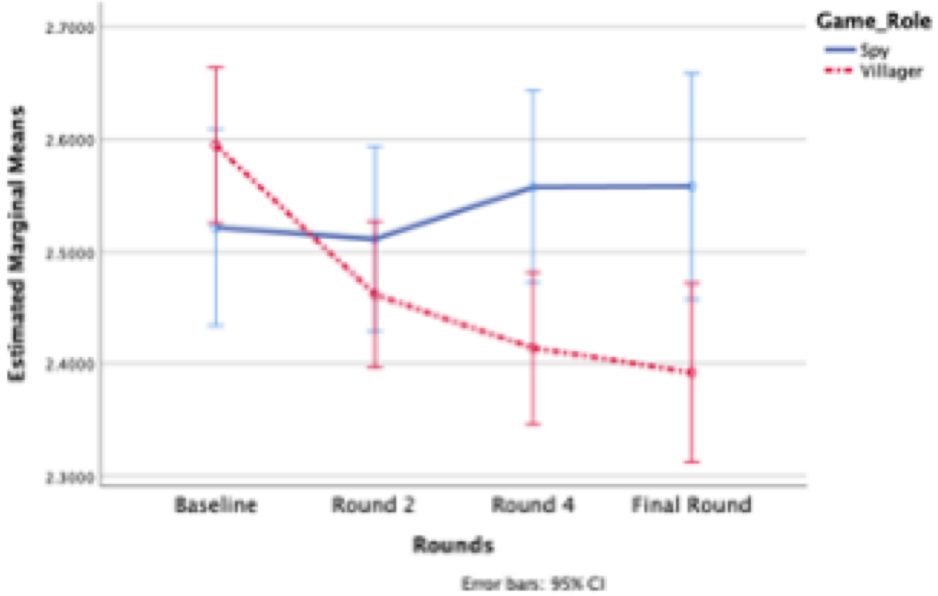
- Spies (deceivers) less dominant than villagers (truth tellers)
- Discussed in more detail in Dunbar webinar



Mean Dominance Ratings by Role and Round

Results: Perceived Nervousness

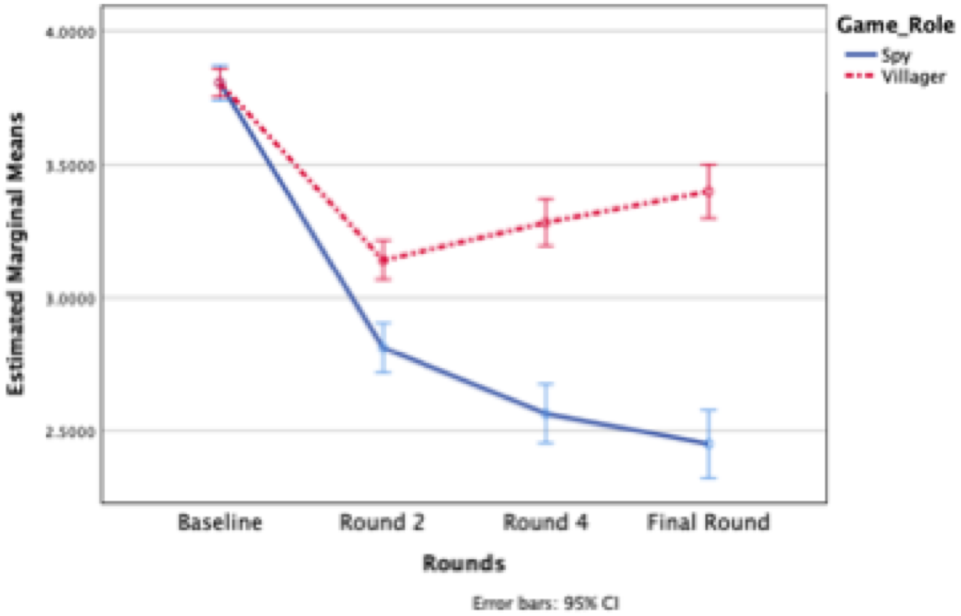
- Main effect and interaction between nervousness and game role
  - Spies maintained the same degree of nervousness they displayed at the outset of the game
  - Villagers became increasingly relaxed



Mean Nervousness Ratings by Role and Round

Results: Perceived Trustworthiness

- Main effects for game role, trust ratings across time, and interaction between game role and trust
- Spies were trusted less than villagers
  - Ratings declined over the course of the game
  - Ratings of villagers remained higher and showed an upswing over time
  - Trust and nervousness could be an indirect (proxy) measure for deception



Mean Trust Ratings by Game Role and Rounds

Relational Messages as Predictors of Deception

Multiple Discriminant Analysis Results Predicting Deception

- Three relational message dimensions independently distinguished between spies (deception) and villagers (truth)
- Villagers trusted other villagers more, were seen as more dominant and were less nervous

	Wilks' Lambda	F	df1	df2	Sig.
Trust	.848	123.197	1	687	.000
Dominance	.964	25.505	1	687	.000
Arousal	.993	5.173	1	687	.023

Tests of Equality of Group Means between Spies and Villagers

- Cross-validated classification accuracy rate:

  Detecting Villagers 79%
  Detecting Spies 55%

Inclusion of Temporal Dynamics in Logistic Regression

- 9 steps in final best model in logistic regression
- Variables Entered in 9th Step
- Baseline dominance
- Round 4 trust
- Round 6 trust
- Round 6 dominance

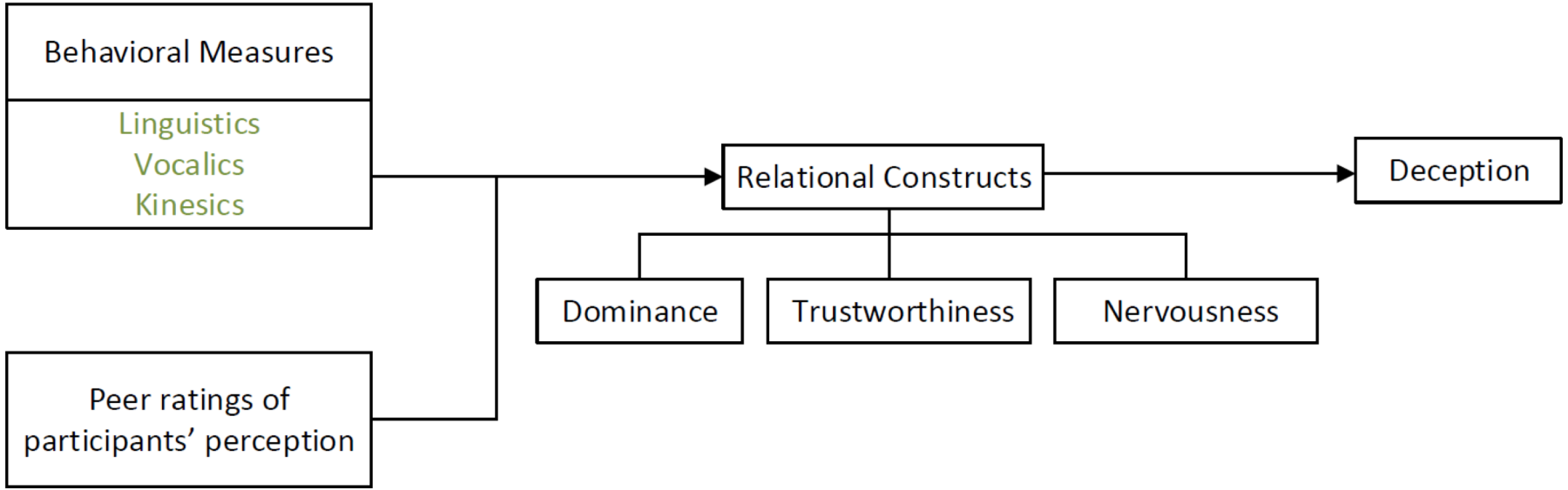
- Improved detection accuracy
- Cross-validated classification:
  Detecting Villagers 83%
  Detecting Spies 65%

Discussion

- ***The importance of more granular, temporal measurement.***
    - impressions at different stages of the group process add information to the ability to predict veracity
- ***Relational communication becomes the leading edge in assessing the truthfulness or deceptiveness of others.***

Behavioral Predictors of Relational Communication and Deception

Overview of Behavioral Analysis on Relational Communication and Deception



Linguistic Measure Extraction Process

	Steps	Tools	Purposes
1	Convert audio recordings of each player to text transcriptions	IBM's Watson Speech-to-Text service	Produced multiple transcriptions for each game.
2	Merge multiple transcripts into a single transcript	Recognizer Output Voting Error Reduction (ROVER)	Produced a transcript and word-level timestamps for each game and reduced the word error rate of transcription
3	Coded the speakers in the transcription	Research assistants	Produced a final transcript including the speakers
4	Extract linguistic features	SPLICE and VADER	Obtained linguistic features (see the next slide for examples)

Extracted Linguistic Measures

Measure Name	Definition
# of Words	Total words spoken by a participant for a given time window
# of Turns-at-Talk	Number of times a participant spoke for a given time window
Dominance Ratio	Dominant turns-at-talk are those which contain phrases like “you must” or “I can”, and the ratio is computed with the number of dominant turns-at-talk divided by the total number of turns-at-talk for a player in a time interval
Disfluency Ratio	Ratio of repeat phrases (e.g. “I think that... that is a good idea.”) and filled pauses (e.g. “um”, “uh”, etc.) to the total number of words. Filled pauses are transcribed as “%HESITATION” by IBM Watson Speech-to-Text
Polarity score	Absolute value of the compound sentiment score computed by the VADER sentiment algorithm in NLTK (Hutto & Gilbert, 2014)
Hedging Ratio	Ratio of number of hedging and uncertainty terms to total number of words

Voice Measure Extraction Process

	Steps	Tools	Purposes
1	Identify time segments of Turns-at-Talk	Manually conducted using RA's	Provided audio segments of speech to analyze
2	Extract audio features from speech segments	OpenSmile	Provided voice measures of interest for each Turn-at-Talk
3	Aggregate features based on game rounds T1) Introduction T2) Rounds 1 and 2 T3) All remaining rounds	R	Standardizes game length for games with different number of rounds

Automatically Extracted Voice Measures

Measure Name	Definition
F_0 (pitch) Mean	The lowest frequency of a periodic waveform
F_0 (pitch) Std	
Loudness-Mean	Subjective perception of sound pressure
Loudness-Std	
HNR-Mean	The harmonic-to-noise ratio (HNR) is the proportion of harmonic sound to noise in the voice measured in decibels
HNR-Std	
Jitter-Mean	Jitter is a measure of period-to-period fluctuations in fundamental frequency
Jitter-Std	
Shimmer-Mean	Shimmer measures the variability of the amplitude value
Shimmer-Std	
Turn-at-talk Duration	Duration in seconds of a turn-at-talk

Dominance Analysis

Vocalic Indicators of Dominance

Characteristics of Dominance	Cues of Dominance	Description of Cues
Monopolizing/leadership	Fundamental frequency Vocal energy	Lower/deeper pitch More pitch variability Larger amplitude
Influential and self-confident	Speech fluency	Few hesitations Short response latencies
Authoritative and avoiding uncertainty	Uncertainty	Few hesitations Short response latencies Rapid speaking rate
Animated and open, transparent with emotions	Vocal diversity	More pitch variability More change in jitter/shimmer/hoarseness

Linguistic Indicators of Dominance

Characteristics of Dominance	Cues of Dominance	Description of Cues
Monopolizing	Speech quantity	Talking often and talking for a longer duration
Influential and self-confident	Subjunctive phrases	A more definitive speech style and less use of subjunctive language
Authoritative and avoiding uncertainty	Uncertainty	Less hedging and fewer hesitations
Animated and open, transparent with emotions	Emotion	Greater exhibition of positive or negative emotions

Linguistic Analysis Results on Dominance

- Players with a **higher dominance ratio** are rated as being more dominant
- Players with a **larger number of words** are rated as being more dominant
- Only two of the expected linguistic cues (number of words and dominance ratio) were significantly related to perceived dominance
- Dominance declined in T3
- This perhaps demonstrates that **it is not what you say, but how you say it**. Perceived dominance appears to be a function of overt characteristics of the voice opposed to semantic content

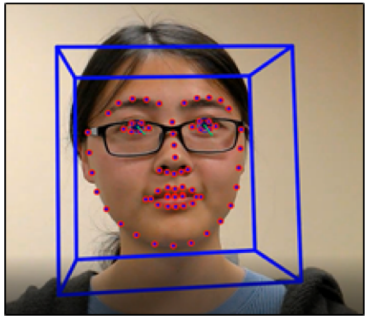
Dependent variable: Dominance Score			
	Variable Names	Baseline Model	Full Model
Control Variables	Gender (Male = 1)	0.322*** (0.085)	0.132* (0.077)
	Game Experience	0.130 (0.101)	0.082 (0.090)
	Native English Speaker	0.132 (0.113)	0.014 (0.105)
	Game Status	-0.008 (0.037)	-0.008 (0.033)
Linguistic Variables	Dominance Ratio		0.733* (0.395)
	Number of Words		0.291*** (0.105)
	Number of Sentences		0.160 (0.111)
	|Polarity|		-0.243 (0.412)
	Hedge Ratio		-0.269 (1.093)
	Disfluency Ratio		-0.815 (0.916)
Main Effects	T3 (After Round 2)	0.240*(0.125)	-0.204*(0.123)
	T2 (Round 1 and 2)	-0.019 (0.131)	-0.167 (0.118)
	Game Role (Spy = 1)	0.221 (0.138)	0.173 (0.120)
Interactions	T3 * Game Role	-0.789***(0.197)	-0.687*** (0.171)
	T2 * Game Role	-0.307 (0.198)	-0.235 (0.173)
	Observations	409	409
	Note:		*p<0.1; **p<0.05; ***p<0.01

Dominance Analysis Summary

In adversarial group settings, cues of perceived dominance include:

- More talking
- Lower pitch and greater pitch variance
- Greater loudness variance
- Less hoarseness and less variance in voice hoarseness
- Higher dominance ratio
- Higher number of Words

Extraction of Facial Kinesic Indicators from Video Data (In Progress)



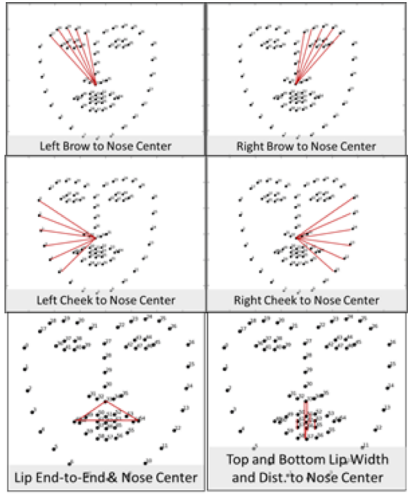
Eye Gaze Vector
Head Pose
Face Landmarks 2D & 3D

AU #	FACS name
1	Inner brow raiser
2	Outer brow raiser
4	Brow lowerer
5	Upper lid raiser
6	Cheek raiser
7	Lid tightener
9	Nose wrinkler
10	Upper lip raiser
12	Lip corner puller
14	Dimpler
15	Lip corner depressor
17	Chin raiser
20	Lip stretcher
23	Lip tightener
25	Lips part
26	Jaw drop
28	Lip suck
45	Blink

18 Facial
Acton Units (AUs)

Emotion	Action Units
Happiness	6+12
Sadness	1+4+15
Surprise	1+2+5+26
Fear	1+2+4+5+7+20+26
Anger	4+5+7+23
Disgust	9+15+16

6 Basic Emotions

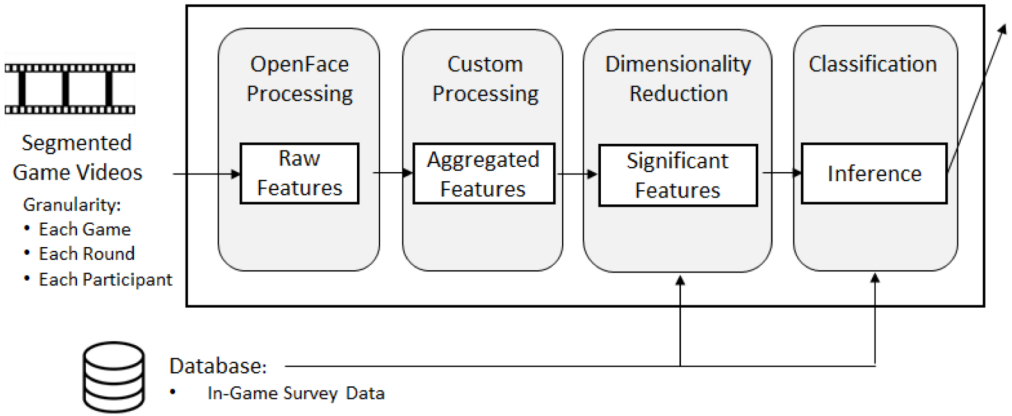


10 Facial Rigidity
Values

Values Directly Output from OpenFace

Calculated Values from OpenFace Data

Analysis of Facial Indicators for Perceived Dominance (In Progress)



Perceived Dominance

Top 5 Visual Indicators

Less time showing AU05		Upper Lid Raiser
Less intense & Less deviation in showing AU04		Brow Lowerer
More time & More visible showing AU23		Lip Tightener
More time & More visible showing AU25		Lips part
More deviation in top lip width	A custom rigidity score, May be related to AU23 & AU25 or talking	

2-Way Classification Performance (High Dominance & Not-High Dominance)

True Condition \ Predicted Condition	0	1
0	155	26
1	24	150

# 0	# 1	
181	174	Not High = 0 / High = 1

For Positive Condition

Accuracy	Recall	Precision	F1
85.915	85.227	86.206	85.714

Note: Current kinesic analysis is currently using only domestic data collected at UA, UCSB, & UMD.



Trustworthiness Analysis

Voice Indicators of Trustworthiness

Cues of Trustworthiness	Description of Cues	Explanations
Pitch	Lower average pitch / lower maximum pitch	Increases perceived competence and trustworthiness
Vocal Variations	Higher vocal variations (e.g., higher standard deviations of loudness, pitch, HNR, jitter, shimmer, etc.)	Increases nonverbal immediacy and perceptions of closeness and intimacy

Trust-Vocalic Analysis Results

		Trustworthiness Score		
		Baseline Model	Simplified Model	Full Model
Control Variables	Gender	-0.024(0.081)	**-0.323(0.128)** **	-0.215(0.140)
	Game Experience	0.151(0.091) *	**0.171(0.093)** *	**0.172(0.092)** *
	Native English Speaker	-0.011(0.096)	0.047(0.099)	0.052(0.098)
	Game Status	0.041(0.027)	0.036(0.028)	**0.049(0.028)** *
Vocalic Features	TaT duration		0.013(0.008)	**0.016(0.008)** **
	F_0-mean		-0.003(0.002)	-0.002(0.002)
	F_0-Sd		-0.007(0.004)	-0.007(0.004)
	Loudness-mean		0.759(0.882)	0.952(0.878)
	Loudness-Sd		-0.252(1.247)	-0.157(1.274)
	HNR-mean		-0.002(0.002)	-0.002(0.002)
	HNR-Sd		0.003(0.004)	0.002(0.004)
	Jitter-mean			6.475(5.149)
	Jitter-Sd			-4.109(3.511)
	Shimmer-mean			-6.210(4.454)
	Shimmer-Sd			0.749(4.277)
Main Effects	T3	-0.106(0.118)	-0.013(0.127)	-0.038(0.129)
	T2	**-0.540(0.123)** ***	**-0.474(0.126)** ***	**-0.500(0.126)** ***
	Game Role	-0.039(0.130)	-0.055(0.129)	-0.073(0.130)
Interactions	Game Role * T3	**-1.426(0.184)** ***	**-1.388(-0.181)** ***	**-1.360(0.181)** ***
	Game Role * T2	**-0.510(0.191)** ***	**-0.502(0.188)** ***	**-0.478(0.188)** *
	Note:		*p<0.1; **p<0.05; ***p<0.01	

Linguistic Indicators of Trustworthiness

Cues of Trustworthiness	Description of Cues	Explanations
Speech quantity	More words / fewer words	Reduce uncertainty / lose clarity
Comprehensibility	High readability	Signals benevolence and competence
Pronouns	More first-person pronouns and second-person pronouns	Suggest responsibility for one's utterances, inclusiveness with others
Emotion	More positive affect	Signals benevolence and intimacy
Fluency	Less disfluency	Reduce uncertainty, create clarity and indicate competence and lesser cognitive load
Hedging	Less hedging	Reduce certainty

Linguistic Analysis Results on Trustworthiness

- Players with a **larger number of words** are rated as being more trustworthy
- Players with a **higher ARI readability score** (an approximation of the US grade level needed to understand the text) are rated as being more trustworthy
- Deceivers are perceived as less trustworthy in T2 and T3 than truth-tellers

Dependent Variable: Trustworthiness Score			
	Variable Names	Baseline Model	Full Model
Control Variables	Gender (Male = 1)	0.044(0.076)	0.012(0.077)
	Game Experience	0.153*(0.087)	0.144(0.088)
	Native English Speaker	-0.007(0.095)	-0.043(0.097)
	Game Status	0.080***(0.028)	0.077***(0.028)
Linguistic Features	Number of Words		0.084**(0.042)
	Positivity		-0.637(1.182)
	Negativity		1.938(1.656)
	Hedge Ratio		-0.468(1.075)
	Disfluency Ratio		0.768(0.942)
	First Person Ratio		1.114(0.781)
	Second Person Ratio		-0.365(1.311)
	ARI Readability		0.026*(0.015)
Main Effects	T3 (After Round 2)	-0.175(0.113)	-0.151(0.134)
	T2 (Round 1 and 2)	-0.632***(0.117)	-0.608***(0.126)
	Game Role (Spy = 1)	-0.028(0.125)	-0.044(0.124)
Interactions	T3 * Game Role	-1.466*** (0.175)	-1.449***(0.173)
	T2 * Game Role	-0.468*** (0.181)	-0.430**(0.179)
Intercept	Constant	3.642*** (0.117)	3.544***(0.181)
	Observations	420	420
	Note:		*p<0.1; **p<0.05; ***p<0.01

Trustworthiness Analysis Summary

In adversarial group settings, cues of perceived trustworthiness include:

- Longer turn-at-talk duration
- More words
- Higher comprehensibility (ARI Readability score)
- ***Deceivers became less trusted as the game progressed***

Nervousness/Emotional Arousal Analysis

Vocalic Indicators of Nervousness

Category of Vocalic Features	Associated Vocalic Parameters	Predicted Relationship
Speech Rate and Fluency	Number of syllables/second Syllable duration Duration of accented vowels Number and duration of pauses	Larger Smaller Longer Larger
Fundamental Frequency and Prosody	F_0 mean (pitch) F_0 std. deviation F_0 range Gradient of F_0 rising and falling	Higher Larger Wider Larger
Vocal Effort and Phonation	Intensity mean Intensity deviation Gradient of intensity rising and falling	Higher Larger Larger

Source: Handbook of affective sciences, Davidson et al., 2009

Nervousness-Vocalic Analysis Results

		Nervousness Score		
		Baseline Model	Simplified Model	Full Model
Control Variables	Gender	-0.071(0.066)	-0.068(0.116)	-0.080(0.118)
	Game Experience	0.039(0.078)	0.059(0.078)	0.058(0.078)
	Native English Speaker	0.003(0.083)	-0.022(0.085)	-0.025(0.085)
	Game Status	0.009(0.023)	0.000(0.024)	-0.002(0.024)
Vocalic Features	TaT duration		**0.012**(0.006)**	**0.010(0.006)**
	F_0-mean		0.000(0.002)	0.000(0.002)
	F_0-Sd		0.000(0.004)	-0.001(0.004)
	Loudness-mean		**-1.385*(8.006)**	**-1.637*(0.008)**
	Loudness-Sd		0.428(1.061)	0.760(1.102)
	HNR-mean		0.000(0.001)	0.000(0.001)
	HNR-Sd		0.000(0.004)	0.001(0.003)
	Jitter-mean			-5.093(3.556)
	Jitter-Sd			**4.329*(2.332)**
	Shimmer-mean			4.626(4.081)
	Shimmer-Sd			-4.282(3.389)
Main Effects	T3	0.016(0.117)	0.164(0.129)	0.142(0.130)
	T2	0.011(0.118)	0.131(0.125)	0.115(0.126)
	Game Role	0.161(0.103)	**0.172*(0.103)**	0.169(0.103)
Interactions	**Game Role * T3**	**-0.352***(0.152)**	**-0.390***(0.146)**	**-0.380***(0.146)**
	Game Role * T2	**-0.379***(0.152)**	**-0.421***(0.151)**	**-0.415***(0.151)**
	Note:		*p<0.1; **p<0.05; ***p<0.01	

Linguistic Indicators of Nervousness/Arousal

Linguistic Cues	Hypothesized Direction	Explanations
Speech quantity	Fewer words/Fewer sentences/Incomplete sentences	High cognitive load/High level of anxiety
Comprehensibility	Lower readability	Due to more disruption/omission/ sentence-incompletion
Emotion	Less emotional diversity	High cognitive load
Disfluency	More disfluencies and disturbance	Reduced certainty and clarity High cognitive load
Hedging	More Hedging	Reduced certainty

Linguistic Analysis Results on Nervousness

- On average, deceivers are perceived as **more nervous** than truth tellers.
- The **more dominant the language used**, the **less nervous a player is rated**.
- Interaction terms show deceivers are rated as more nervous in **T2** and **T3**.

	Dependent Variable: Nervousness Score		
	Variable Names	Baseline Model	Full Model
Control Variables	Gender (Male = 1)	-0.006(0.066)	0.004(0.067)
	Game Experience	-0.044(0.077)	-0.044(0.076)
	Native English Speaker	-0.058(0.085)	-0.054(0.086)
	Game Status	0.036(0.025)	0.034(0.025)
Linguistic Features	Number of Words		0.081(0.098)
	Sentiment Score		-0.178(0.340)
	Hedge Ratio		-0.604(0.915)
	Disfluency Ratio		0.842(0.794)
	Number of Sentences		-0.003(0.003)
	Dominance Ratio		**-0.641*(0.350)**
Main Effects	T3 (After Round 2)	-0.041(0.121)	0.004(0.128)
	T2 (Round 1 and 2)	0.012(0.120)	0.048(0.125)
	Game Role (Spy = 1)	**0.197*(0.107)**	**0.199*(0.107)**
Interactions	**T3 * Game Role**	**-0.414***(0.151)**	**-0.417***(0.151)**
	T2 * Game Role	**-0.464***(0.155)**	**-0.494***(0.155)**
	Observations	419	419
	Note:		*p<0.1; **p<0.05; ***p<0.01

Nervousness Analysis Summary

In adversarial group settings, perceived nervousness includes

- Longer turn length
- Softer amplitude
- More jitter variance
- Less use of dominant language
- ***Deceivers are perceived as more nervous than truth-tellers***

Deception Analysis

Vocalic Indicators of Deception

Characteristics of Deceivers		Associated Vocalic Cues to Deception
Cognitive Load	Increased Cognitive Load	• Disturbances in utterances • Delayed responses • Shorter utterances
Emotions	Fear of Getting Caught	• Decreased loudness • Lower pitch variability • Higher pitch
	Duping Delight	• Higher pitch • Faster and louder speech
	Emotion of Guilt	• Lower voice quality due to distancing and vagueness
Strategic Management of Behavior	--	• Vocalic cues may become less prominent due to asserted control

Linguistic Indicators of Deception

Characteristics of Deceivers		Associated Indicators of Deception
Cognitive Load	Increased Cognitive Load	• Fewer words • Less lexical diversity • More disfluencies
Emotions	Fear of Getting Caught	• Fewer details • Limited speaking time
	Duping Delight	• Excitement /delight expressed by language
	Emotion of Guilt	• More hedging and uncertain language • Negative sentiment
Strategic Management of Behavior	--	• Linguistic cues may become less prominent due to asserted control

	Dependent Variable										
	FF-mean	FF-Std	Loudness - mean	Loudness - Std	HNR-mean	HNR-Std	TaT Duration	Jitter-mean	Jitter-Std	Shimmer -mean	Shimmer -Std
T2	5.472	5.724***	0.034***	0.031***	1.947	0.731	-3.047***	0.003*	0.005*	0.003	0.002
	(3.430)	(1.579)	(0.013)	(0.010)	(3.997)	(1.296)	(0.829)	(0.002)	(0.003)	(0.002)	(0.002)
T3	9.124***	8.492***	0.050***	0.045***	-0.022	1.408	-3.943***	0.004**	0.004	0.004**	0.001
	(3.310)	(1.525)	(0.013)	(0.010)	(3.865)	(1.253)	(0.801)	(0.002)	(0.003)	(0.002)	(0.002)
Role	**-0.850**	**-1.248**	**0.005**	**-0.003**	**6.981**	**-0.551**	**1.727***	**-0.001**	**-0.001**	**0.003**	**0.004**
	(3.647)	**(1.679)**	**(0.014)**	**(0.011)**	**(4.250)**	**(1.378)**	**(0.881)**	**(0.002)**	**(0.003)**	**(0.002)**	**(0.002)**
Gender	- 57.016** *(2.286)	- 16.802*** (1.064)	0.005 (0.009)	0.016** (0.007)	-8.262*** (2.720)	-1.570* (0.882)	1.014* (0.559)	0.003** (0.001)	0.003* (0.002)	0.011*** (0.001)	0.021*** (0.002)
Experience	-3.796	-1.784	0.0002	0.002	-6.654*	-4.459***	-1.327**	-0.001	-0.003	0.001	-0.001
	(2.613)	(1.277)	(0.011)	(0.009)	(3.408)	(1.109)	(0.672)	(0.001)	(0.002)	(0.002)	(0.002)
English	8.072***	0.651	0.024*	0.025***	-2.779	0.004	0.522	0.001	0.001	0.003	0.002
	(2.756)	(1.384)	(0.012)	(0.009)	(3.809)	(1.243)	(0.729)	(0.002)	(0.002)	(0.002)	(0.002)
Status	-0.556	-0.451	0.0003	0.001	-0.547	0.251	0.536**	-0.001	-0.001	0.0004	0.001
	(1.004)	(0.486)	(0.004)	(0.003)	(1.277)	(0.415)	(0.255)	(0.001)	(0.003)	(0.001)	(0.001)
T2*Role	**-2.873**	**1.052**	**0.002**	**-0.005**	**-0.381**	**0.176**	**-2.624****	**0.003**	**0.004**	**-0.002**	**-0.003**
	(5.352)	**(2.462)**	**(0.020)**	**(0.016)**	**(6.228)**	**(2.019)**	**(1.292)**	**(0.003)**	**(0.004)**	**(0.003)**	**(0.004)**
T3*Role	**-2.166**	**-0.976**	**0.002**	**-0.006**	**-0.189**	**0.021**	**-3.055****	**0.004**	**0.004**	**-0.0004**	**-0.002**
	(5.211)	**(2.397)**	**(0.020)**	**(0.016)**	**(6.066)**	**(1.966)**	**(1.258)**	**(0.003)**	**(0.004)**	**(0.003)**	**(0.004)**
Observations	388	388	388	388	388	388	388	388	388	388	388
Note:	*p<0.1; **p<0.05; ***p<0.01										

Deceivers had shorter turn-at-talk duration in middle and end of game

Summary and Discussion of the Deception Analysis

- Turn-at-talk duration is significantly different between truth-tellers and deceivers
- Many deception cues are theorized to be due to high arousal to “leak” out inadvertently.
- In group interaction, these indicators may be muted or subdued. A deceiver may not be under the same level of scrutiny compared to dyadic or smaller group communication, so they were able to act more naturally
- A large group setting may also provide a deceiver more unobstructed time to consider manipulation strategies. Deceivers need not talk as often as others.



Future Directions

Future Directions

- Run the current models on full sample
- Analyze short period of moments when deceivers are most motivated to lie or when the deceptive cues are most likely to leak out
- Include multimodal behavioral features such as facial expression, body movement and heart rate
- Use machine learning algorithms to build predictive models

Questions?

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