

Lying for Science: The Linguistic Features of Deceptive Speech

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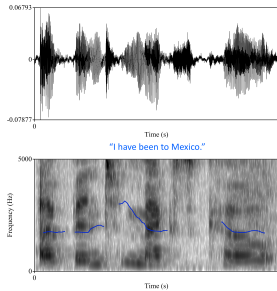
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Introduction

Research on deception within the field of linguistics has been largely focused upon the lexical components, or word selection, of lies. However, while the words a liar uses may reveal the lie in some cases, there are certain prosodic features of speech (e.g. pitch, tempo, etc.) that may also be correlated to lying. This study focuses on these features in an attempt to decode deception. In an experiment with a representative sample of a university campus population, participants were asked to lie for science in a game of 'Two Truths and a Lie'. Each participant's speech was recorded as they constructed spontaneous true and false statements. The resulting data were subjected to acoustic analysis to quantify the average pitch for each of the statements of every participant. The results were then tested for statistical significance.



Research Question:

Does there exist a significant difference in the frequency of pitch between statements of veracity (true) and duplicity (false) that may prove a reliable indicator of duplicitous intent?

Background

Linguistic research on deception largely focused on word choice of lies (Arciuli et al., 2010; Ekman, 2001):

- Liars tend to use...
 - Fewer contractions (e.g. "I did not" vs. "I didn't")
 - Obfuscation (e.g. "sexual relations" vs. "sex")
 - Distancing techniques (e.g. "that woman" vs. "her")

Psycholinguistic research shows high correlation between prosodic features of speech and subconscious emotions (Frick, 1985):

- Prosodic features of speech may change subconsciously due to associated anxieties.
- Underlying anxieties associated with lying may therefore be expressed in these prosodic features.

Data Collection: 'Lie for Science!'

Participants

- 14 individuals (5 male, 9 female)
- Sample of university population (7 students, 7 staff and faculty)
- Ages ranged from 19 – 47

Experiment: "Two Truths and a Lie"

- Participants randomly assigned to groups of 2 to 4 individuals
- Each session comprised of 3 rounds and was recorded for analysis
- Participants take turns telling two truths and one lie about themselves
- Other participants attempt to guess the lie, which is then revealed
- Incentivized to lie effectively with chance to win \$50 gift card

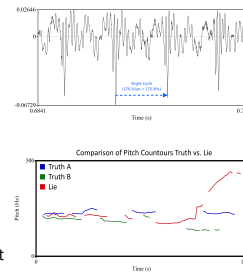
Analysis: Acoustic Measurements

Voice Pitch: Fundamental Frequency

- A person's pitch is determined by the fundamental frequency (F0) of their voice. In speech, F0 is the lowest frequency at which an individual's vocal folds vibrate.
- Frequency is measured in Hertz (Hz) and corresponds to the number of vocal-fold vibrations per second, which varies depending on anatomy.
- F0 remains relatively consistent during normal speech and alters significantly only during pitch change.
- The average F0 for males is considerably lower (~100Hz) than average F0 for females (~200Hz).

Voice-Pitch Analysis

- Pitch was measured for each utterance using an F0 algorithm utilized by the acoustic analysis software Praat.
- The results of the algorithm were cross-checked using single-cycle measurements for each vowel.
- Pitch contours were generated for each utterance.
- Pitch measurements included:
 - Average F0 throughout course of utterance
 - Deviation in F0 from participant baseline



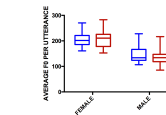
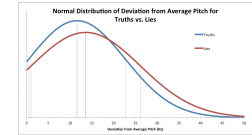
At first glance...

- Some pitch contours display 'uptalk' at point of duplicity. This was later revealed to be an idiosyncratic characteristic of some individuals.

Results

Variation in Average Pitch and Deviation

- Observable difference in pitch between lies and truths measured within participants.
- Two-Way ANOVA of pitch factored by veracity (lie vs. truth) and participant revealed no statistical significance.

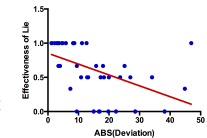


Differences Between Genders

- Women exhibit an observable increase in pitch when lying.
- Men, however, tend toward a more monotone utterance.

Deviation as an Indicator of Deception

- Observable deviation from average pitch when telling lies is seen within participants.
- Pearson's r test shows negative correlation ($p < 0.05$) between the amount of deviation and the effectiveness of the lie (rate of going undetected).



Conclusion

There appears to be an observable variation in average pitch when comparing lies and truths, however the difference is not statistically significant. Additionally, there is a noticeable correlation between the amount of deviation from baseline F0 and the rate at which lies will be detectable by others. This may suggest that we intuitively use deviation in pitch as one indicator when trying to detect lies. This does not definitively suggest, however, that this deviation is in fact a reliable indicator; participants still only had a 38% overall successful detection rate. While this experiment was unable to reject the null hypothesis that pitch does not change when lying, a larger sample size may provide a more powerful statistical analysis. Furthermore, future analysis should include additional prosodic features of speech such as number of pauses, pause length, and tempo.

Selected References

- Arciuli, J., Mallard, D., & Villar, G. (2010). "Um, I can tell you're lying": Linguistic markers of deception versus truth-telling in speech. *Applied Psycholinguistics*, 31(3), 397-411.
- Ekman, P. (2001). *Telling lies: Clues to deceit in the marketplace, politics, and marriage*. New York: W.W. Norton.
- Frick, R. W. (1985). Communicating emotion: The role of prosodic features. *Psychological Bulletin*, 97(3), 412-429.

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