Effect of Alcohol Intoxication on the Production of (Dis)fluent Repetitions

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Introduction

- Repetitions of short words or phrases in spontaneous speech may be related to the motor planning and control of a formulated utterance plan (Shriberg 1995).
- Alcohol intoxication has been shown to affect brain functions that relate to speech production, which may lead to salient perception of reduced fluency or disfluency in the produced speech.
- Earlier study has shown that the overall frequency of repetition is increased under alcohol intoxication (spont i):

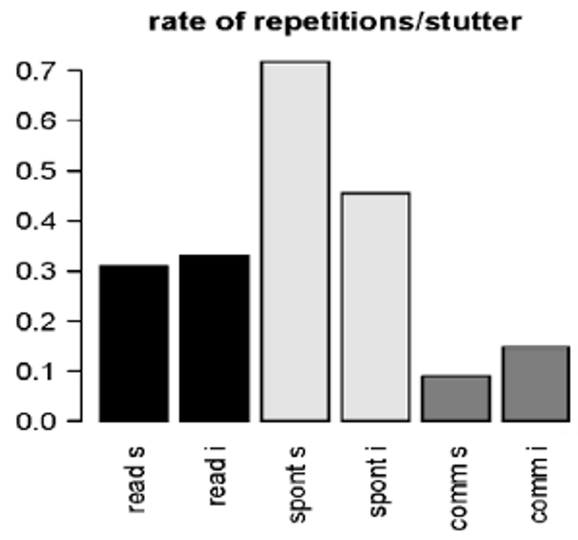

Fig 1 (Schiel & Heinrich 2015).

- Understanding of this change can help with developing hypotheses and theories on utterance planning and control, as well as methods for speech-based anomaly detection.
- Results suggest that difference between speech produced under alcohol intoxication and normative fluent speech can be quantified with the proposed features.

Corpus Description

We performed both acoustic and textual analysis using the Alcohol Language Corpus (ALC, Schiel et al 2008):

- ALC is a corpus of spoken German initially collected for the specific task of in car alcohol intoxication detection.
- The corpus contains speech produced by same subjects in both sober and intoxicated conditions from 162 speakers.
- Each speaker was recorded in two intoxication conditions with potential confounding factors controlled. This setup allows for causal interpretation of the results.
- Acoustic analysis only considers repetitions that repeated the same segment twice.

Methods

Measurements

Acoustic analysis:

- Duration of the first (R1) and second (R2) repeat
- Duration ratio (R1/R2) of the two segments

Textual analysis:

- Absolute word form frequency of repetitions
- Group form similarity between conditions across speakers
- Form similarity for a given speaker between two conditions

Quantitative Analysis

- Repetition form difference–group:
  The spectral norm induced by the 2-norm of the difference matrix, $||\mathbf{B_A} - \mathbf{B_{NA}}||_2$, where $\mathbf{B}$ represents the $nspeaker \times nform$ $0-1$ matrix in each condition.
- Repetition form difference–individual:
  Cosine similarity between repetition form vectors of each individual in each condition.

Results

Duration measurements

- Both R1 and R2 are on average 56 ms longer under intoxication, and the differences are statistically significant ($p = 0.007$ *and* $p = 0.002$ *respectively*).
- The ratio of R1/R2 is not significantly different.

Textual measurements

- Frequency difference between conditions for each speaker (A: Alcohol intoxication; NA: Non-alcohol intoxication):

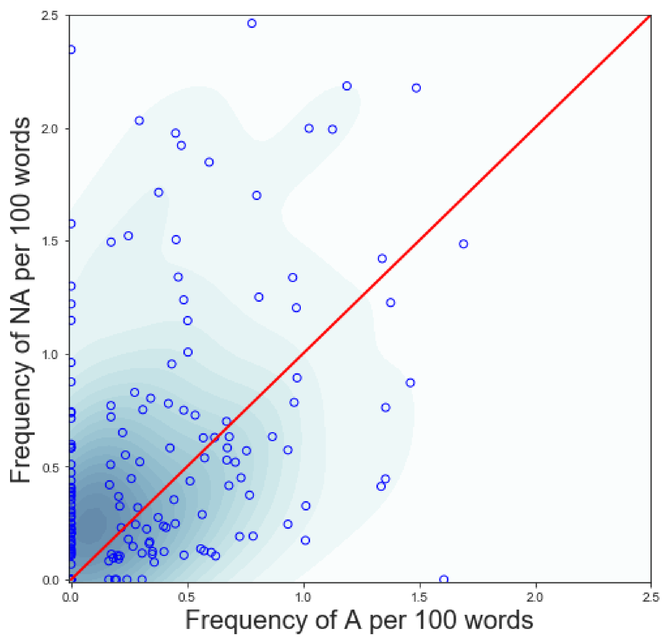

Fig. 2.

- Repetition form similarity between conditions–group:

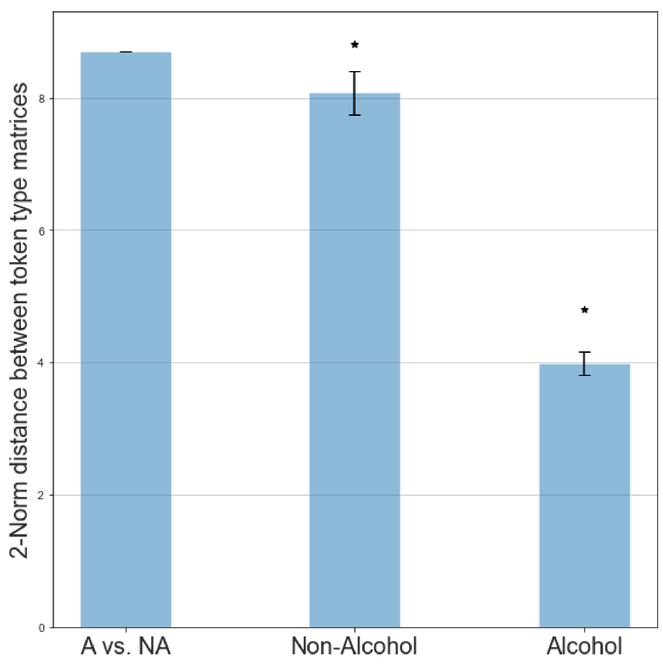

Fig. 3. Columns Non-Alcohol and Alcohol show within comparisons between half samples in the same condition.

- Repetition form similarity between conditions–individual:

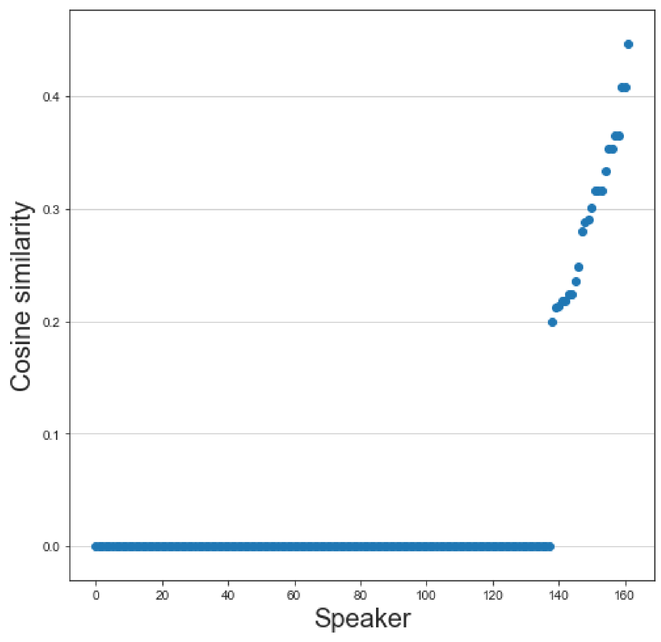

Fig. 4.

Discussion and Conclusion

Alcohol intoxication affects repetitions in spontaneous speech.

- The elongation effect is potentially explained by the reduced movement control caused by alcohol intoxication.
- Reduced repetition frequency under intoxication is associated with a change in the distribution of repeated forms.
- The change in the distribution of repeated forms could be related to other the cognitive processes that are related to message formulation and utterance planning.

Selected references: Clark and Wasow (1998); Dawson and Reid (1997); Hieke (1981); Lickley (2015); Schiel and Heinrich (2015); Schiel et al (2008); Shriberg (1995).