Acoustic patterns in schizophrenia: A systematic review and meta-analysis

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INTRODUCTION

- We aimed at identifying evidence for atypical voice patterns in schizophrenia: poverty of speech, increased pauses, distinctive pitch and intensity (mean and variability).
- Atypical voice patterns are associated with poverty of speech, increased pauses, distinctive pitch and intensity (mean and variability).
- However, there is uncertainty about the underlying mechanisms how voice atypicalities relate to motor, cognitive, social and clinical factors.
- We systematically reviewed the literature and performed a meta-analysis of the evidence quantifying acoustic patterns in schizophrenia.
- We aimed at identifying evidence for acoustic markers of schizophrenia and its clinical features, as well as needs for further research and barriers to collective advancements on these issues.

METHODS

- We adopted the “PRISMA Statement” guidelines and pre-registered the study at Open Science framework (OSF) and PROSPERO (details and pre-registration at: https://goo.gl/H4YDpm).
- Literature search conducted on Pubmed and Google Scholar: (prosody) OR (infection) OR (intensity) OR (pitch) OR (fundamental frequency) OR (speech rate) OR (voice quality) OR (acoustic) OR (intonation) OR (vocal) AND (schizo*).
- Inclusion criteria were: (a) empirical study, (b) quantification of acoustic features in the vocal production, (c) at least two individuals with schizophrenia, (d) inclusion of a comparison group, or acoustic features in relation to severity of clinical features.
- The meta-analysis consisted of random-effects regression models, one per each relevant acoustic feature.

RESULTS

META-ANALYSIS OF SPEECH PRODUCTION (PERCENTAGE)

- Reduced speech production.
  - A total of 159 participants with schizophrenia and 130 healthy controls.
  - The variance in effects due to true between-studies variance (Q-stats: 98.4, p < .001).
  - No influential study.
  - The data did not reveal any likely publication bias (Kendall’s tau = -0.47, p = .27).

META-ANALYSIS OF PITCH VARIABILITY

- Reduced pitch variability.
  - A total of 351 participants with schizophrenia and 226 healthy controls.
  - Variance in effects due to true between-studies variance (Q-stats: 47.7, p < .001).
  - No influential study.
  - The data revealed a likely publication bias (Kendall’s tau = -0.89, p < .001).

META-ANALYSIS OF PAUSE DURATION

- Increased pause duration.
  - A total of 221 participants with schizophrenia and 150 healthy controls.
  - The variance in effects due to true between-studies variance (Q-stats: 75.6, p < .001).
  - No influential study.
  - The data revealed a likely publication bias (Kendall’s tau = 0.67, p = .013).

META-ANALYSIS OF SOCIAL IMPAIRMENT (

- Systematic assessment of social impairment.
  - A total of 367 participants with schizophrenia.
  - The variance in effects due to true between-studies variance (Q-stats: 179, p < .005).
  - No influential study.
  - No publication bias (Kendall’s tau = 0.16, p = .60).

CORRELATION - SPEECH PRODUCTION (PERCENTAGE) AND ALOGIA

- Reduction in speech production associated with alogia.
  - A total of 138 participants with schizophrenia.
  - The variance in effects due to true between-studies variance (Q-stats: 73.3, p = .12).
  - No influential study.
  - The data did not reveal any likely publication bias (Kendall’s tau = 0.33, p = .44).

CORRELATION - PITCH VARIABILITY AND FLAT AFFECT

- Reduction in pitch variability associated with flat affect.
  - A total of 367 participants with schizophrenia.
  - The variance in effects due to true between-studies variance (Q-stats: 179, p < .005).
  - One influential study (Compton et al., 2018). Removing it yielded an overall effect size of -0.27 (95% CI: -0.38 -0.16, p < .001).
  - No publication bias (Kendall’s tau = 0.16, p = .60).

CONCLUSIONS

- Clear effects of reduced speech production (speech percentage, pause percentage and speech rate), and pitch variability and pause duration (but with evidence for publication bias).
- No effects of pitch mean, mean intensity, number of pauses and mean utterance duration.
- Limited effect sizes, in contrast with the large effect sizes reported by studies using clinical rating scales.

DISCUSSION

- Clear effects of reduced speech production and pitch variability and pause duration.
- Limited effect sizes, in contrast with the large effect sizes reported by studies using clinical rating scales.

OPEN ISSUES

- Barriers to open data: of the 71 authors contacted, 21 have non-working email addresses (29.5%), 36 responded (51%), but only 9 (13%) provided at least some of the data requested.
- Lack of a systematic approach.
- Lack of theory driven hypotheses.

RECOMMENDATIONS

- Larger sample sizes.
- Systematic assessment of multiple acoustic features and multiple speech tasks, standardized acoustic processing methods.
- Shared standards are needed to make individual level data available, as well as more extensive data sharing possible within privacy and ethical constraints.

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