Why study language in schizophrenia?

PSYCHIATRIC SYMPTOMS
- e.g. auditory verbal hallucinations, thought disorder

COGNITIVE SEQUELAE
- verbal abilities particularly compromised, particularly early on (or even prior to dx)

PSYCHOSOCIAL DIFFICULTIES
- e.g. relations with friends & family, employment, self-care

What leads to abnormalities in language understanding in schizophrenia?

ABNORMAL PERCEPTION HYPOTHESIS

Abnormalities in low-level perception in schizophrenia may trickle up to higher-level language representations and processes

Prediction: Patients’ ability to perceive and learn new information about speech sounds in context should be less compromised than their ability to perceive speech sounds in isolation

ABNORMAL GENERATIVE MODELS HYPOTHESIS

Abnormalities in hierarchical generative models of language may disrupt both higher-level language understanding and lower-level speech perception via a self-reinforcing cycle of abnormal inference and abnormal prediction error signaling

Hierarchical generative models of language in healthy adults:

- Goal: Optimal inference of intended message, given available information
- Word representations
- Inferences about higher-level sentence structure & meaning used to generate predictions about upcoming lower-level input

Prediction errors (discrepancies between predictions and actual input) used to update models at successively higher levels

Hypothesized breakdown of generative models in patients:

Abnormal predictions and prediction error signals disrupt the links between higher- and lower-level representations

Prediction: Patients’ ability to perceive and learn new information about speech sounds in context should be more compromised than their ability to perceive speech sounds in isolation

Task 1: Speech adaptation in word context

Approach: Expose listeners to words with systematically mispronounced speech sounds, then assess whether they categorize these sounds differently in isolation

Patient population: Outpatients from McLean Hospital Schizophrenia and Bipolar Disorder Program meeting DSM-5 criteria for schizophrenia or schizoaffective disorder (assessed using SCID), all on stable medication regimen, age 22-56

Exposure phase: Lexical decision for words in which either /s/ or /sh/ has been systematically replaced with a /s/-/sh/ blend

7S condition
- All /s/ sounds replaced by /s/
- 7 patients, 11 controls

7SH condition
- All /sh/ sounds replaced by /s/
- 7 patients, 9 controls

Test phase: All participants categorize same set of sounds as /s/ or /sh/

Preliminary results: Healthy adults, but not patients, are more likely to categorize /s/ as whichever sound had been replaced in the exposure words that they heard

Task 2: Adaptation of isolated speech sounds

Approach: Expose listeners to many prototypical instances of /ba/, then assess the extent to which they are more likely to categorize ambiguous sounds as /da/

Preliminary results: Similar adaptation effects across groups (see also 19)

Task 3: Tone perception adaptation

Approach: Measure tone perception thresholds with and without a fixed reference

Preliminary results: Fixed reference in fact has a stronger effect on SZ thresholds (NC: 42 vs. 38; SZ: 96 vs. 57)

Conclusions & implications

- Patients’ perception adapt to lower-level context, such as surrounding speech sounds (Task 2) and tones (Task 3), but not to higher-level word context (Task 1)
- Suggests that patients are specifically less able to use higher-level word context to dynamically adjust their representations of speech sounds
- Supports abnormal generative models hypothesis over abnormal perception hypothesis
- Potential implications for understanding why current cognitive remediation programs are consistently somewhat successful despite quite different approaches
- Possible that an integrated approach would have synergistic benefits

References & acknowledgments

4. Schizophrenia Research, 57, 40-49.

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