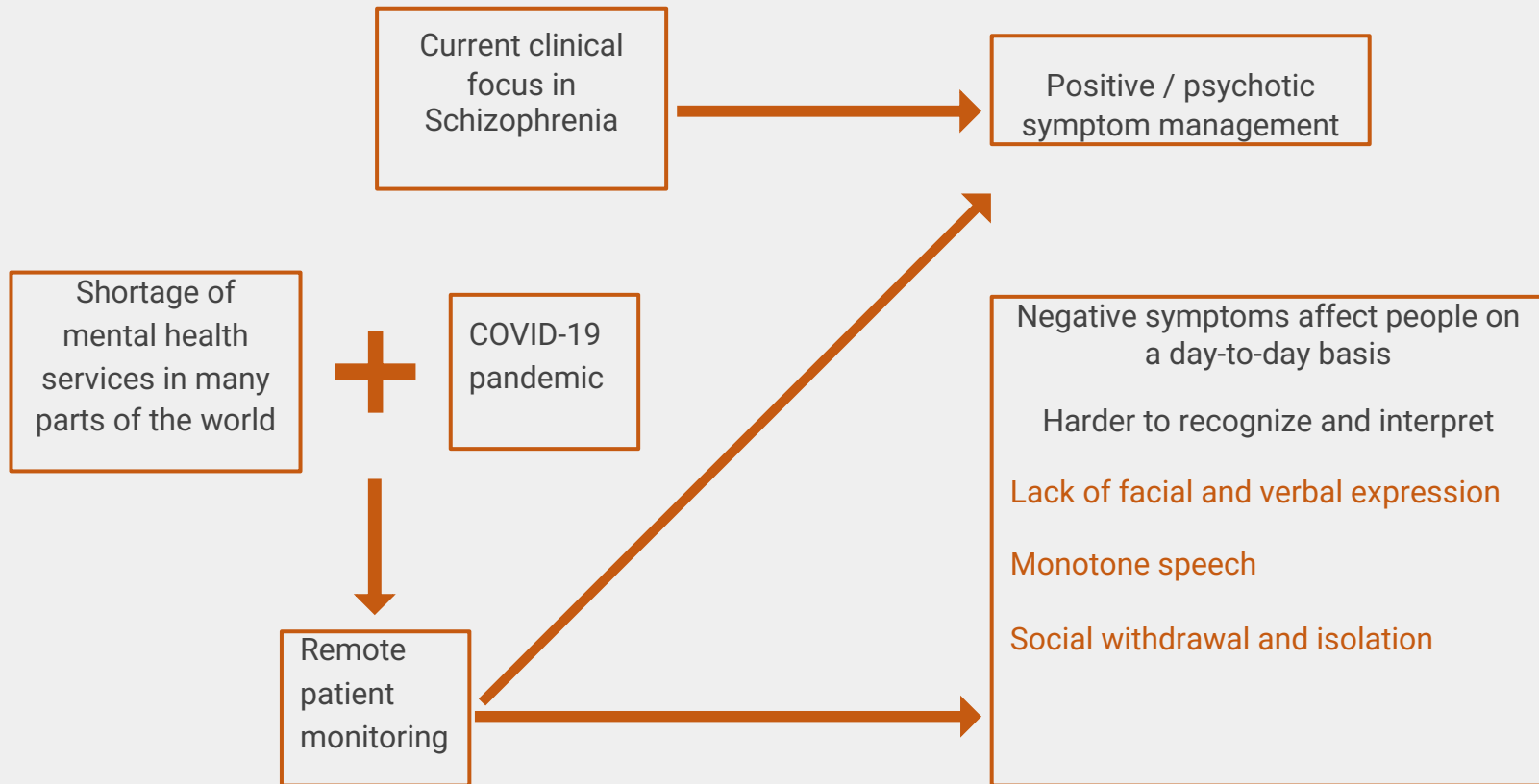# modality.ai

Multimodal conversational technology for remote assessment of symptom severity in people with schizophrenia

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The need for multimodal remote assessment

Current clinical focus in Schizophrenia → Positive / psychotic symptom management

Shortage of mental health services in many parts of the world **+** COVID-19 pandemic

Remote patient monitoring

Negative symptoms affect people on a day-to-day basis

Harder to recognize and interpret

Lack of facial and verbal expression

Monotone speech

Social withdrawal and isolation

Multimodal conversational platform

Remotely-administrable

Easy access through a weblink

Low-cost

Virtual conversational agent (Tina)

Interactive session

Captures audio-visual data

Automatic extraction of speech and facial metrics

Metrics displayed on a user-friendly dashboard

Ramanarayanan, Vikram, et al. "Toward Remote Patient Monitoring of Speech, Video, Cognitive and Respiratory Biomarkers Using Multimodal Dialog Technology." *INTERSPEECH*. 2020.

21 people diagnosed with Schizophrenia (5 females)

Mean age = 37.57 ± 16.61 years

Also underwent a neuropsychological battery

- Wide Range Achievement Test - 4 Reading
- Positive and Negative Syndrome Scale (PANSS)
- Brief Negative Symptom Scale (BNSS)
- Calgary Depression Scale for Schizophrenia (CDSS)
- Clinical Global Impression - Schizophrenia scale (CGI-S)
- Simpson-Angus Scale
- Abnormal Involuntary Movement Scale (AIMS)
- Brief Adherence Rating Scale (BARS)

Protocol

- Open-ended question about difficulties in speaking, salivating or swallowing

- Phonation of /ɑ/

- Oral diadochokinesis Alternating Motion Rate (DDK-AMR): repeat the syllables /pa/ /ta/ /ka/

- Sentence Intelligibility Test: repeat sentences

- Reading passage: Bamboo passage

- Spontaneous speech

Participants with greater symptom severity are louder and exhibit slower articulatory kinematics during repeated speech	Pearson's r	p-value
PANSS Positive Subscale Total		
Open-Ended Question Articulation Loudness (dB)	0.48	0.0284
Phonation of 'ah' Eyebrows Maximum Vertical Position	0.60	0.0234
PANSS Negative Subscale Total		
Bamboo Passage Articulation Loudness (dB)	0.64	0.0018
PANSS General Psychopathology Subscale Total		
Bamboo Passage Articulation Loudness (dB)	0.57	0.0071
DDK-AMR Maximum Jaw Velocity	-0.59	0.0261
PANSS Total		
Bamboo Passage Articulation Loudness (dB)	0.60	0.0137
DDK-AMR Maximum Jaw Velocity	-0.57	0.0319
Spontaneous Speech Articulation Loudness (dB)	0.52	0.0390
DDK-AMR Syllable Count	-0.49	0.0266
Open-Ended Question Articulation Loudness (dB)	0.53	0.0137

Participants with greater negative symptom severity are louder and exhibit greater eyebrow displacement	Pearson's r	p-value
	BNSS Total	
Bamboo Passage Articulation Loudness (dB)	0.49	0.0228
Sentence Intelligibility Test Eyebrows Maximum Vertical Position	0.58	0.0309
Reading scores correlate with the temporal dynamics of speech production during reading / repeating	Wide Range Achievement Test - 4 Reading	
Bamboo Passage Articulation Rate (words / min excluding pauses)	0.48	0.0414
Bamboo Passage Speaking Rate (words / min including pauses)	0.51	0.0321
Bamboo Passage Speech Duration (seconds)	-0.48	0.0425
Sentence Intelligibility Test Articulation Rate (words / min excluding pauses)	0.62	0.0058
Sentence Intelligibility Test Speaking Rate (words / min including pauses)	0.49	0.0403

Correlations are also observed with standard scores used to track depression, treatment responses, parkinsonism and tardive dyskinesia	Spearman's rho	p-value
	Calgary Depression Scale for Schizophrenia (CDSS) Total	
Bamboo Passage Eyebrows Maximum Vertical Position	0.59	0.0267
DDK-AMR Maximum Lip Aperture	-0.56	0.0366
DDK-AMR Syllable Rate (syllables / sec)	0.51	0.0180
	Clinical Global Impression - Severity Total Score	
DDK-AMR Average Lip Aperture	0.62	0.0185
DDK-AMR Maximum Lip Aperture	0.59	0.0271
DDK-AMR Eyebrows Maximum Vertical Position	-0.57	0.0319
	Simpson-Angus Scale Total Score	
Bamboo Passage Articulation Loudness (dB)	0.52	0.0166
DDK-AMR Syllable Count	-0.47	0.0387
	Abnormal Involuntary Movement Scale Total Score	
Sentence Intelligibility Test Eyebrows Average Vertical Position	-0.55	0.0428
Spontaneous Speech Eyebrows Average Vertical Position	0.67	0.0325

Takeaway

Audio-visual measures extracted through multimodal conversational interfaces could be an effective tool for remote monitoring of:

- Positive *AND* negative symptoms
- The efficacy of treatment strategies in people with schizophrenia.

Thank you!

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