Few-shot Learning for Speech Processing and Automatic Transcriptions of Clinical-child Conversation in Danish

Speech Processing for clinical conversations

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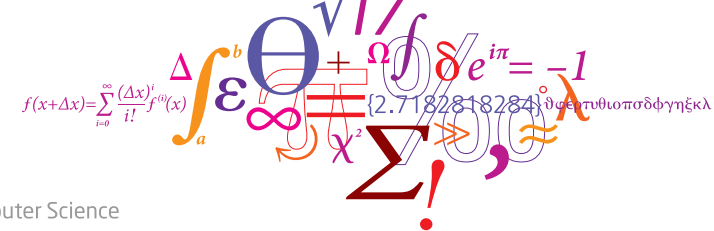

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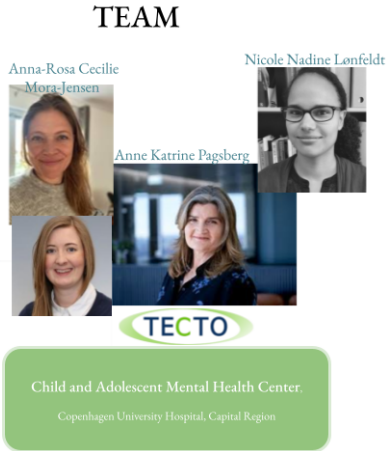
Wrist Angel: Using wearables to predict OCD-events

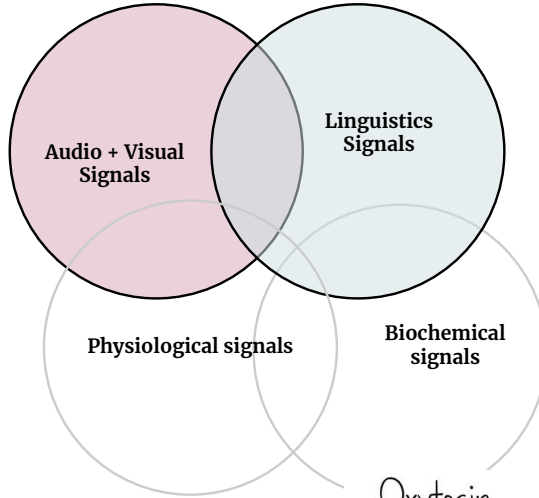
Multiple signal modalities for OCD management (intervention, feedback)



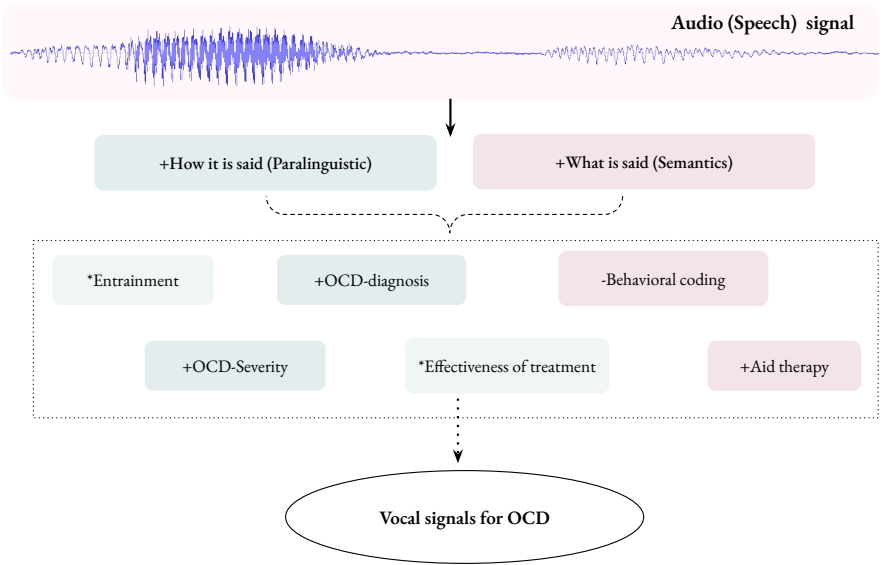
WristAngel: Research for Intervention and Management of OCD

* Progression and severity of disorder.
* Improve efficiency in CIB (Coding Interactive Behavior)
- Identify and predict impending OCD events.
- Aid in delivering cognitive behavioral therapy to patients.
- Provide useful interventions for management.

SPEECH


Audio + Visual Signals
Linguistics Signals
Physiological signals
Biochemical signals
Oxytocin

Audio (Speech) in OCD Management



Speech preprocessing

1. Pre-processing: Conversations → speech segments.
2. Manual pre-processing: resource intensive
3. Approx. 13 minutes /per minute of annotation → 260 individual hours for annotating 10 minute long audio conversation for 120 audio samples.
4. Popular approach: ML pre-trained models pre-processing.

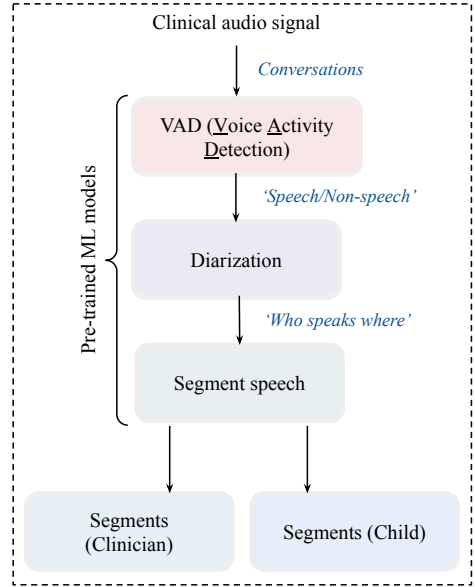
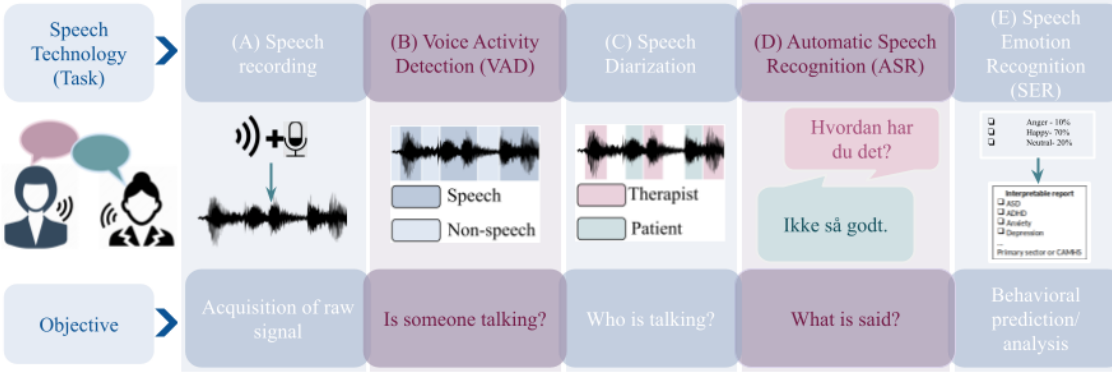


Figure: ML pre-processing pipeline.

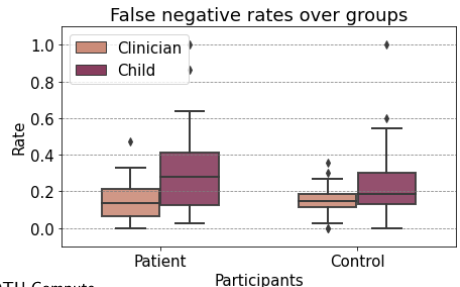
Figure 1: Speech tasks

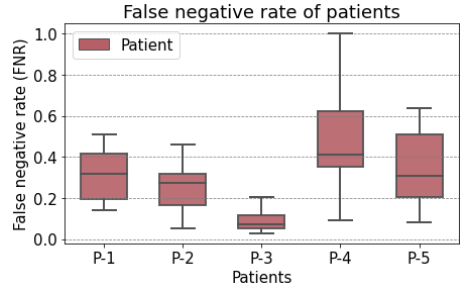


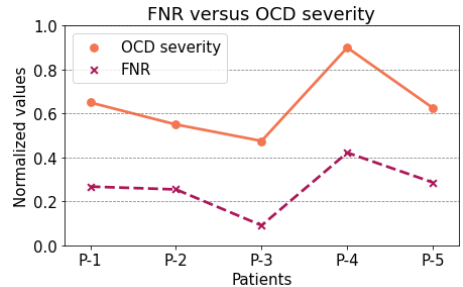
Speech pre-processing

Challenges:

- Performance difference between clinicians and children.
- Errors (variance of error) higher for children in patient group.
- Correlation between error and OCD-severity score!!!







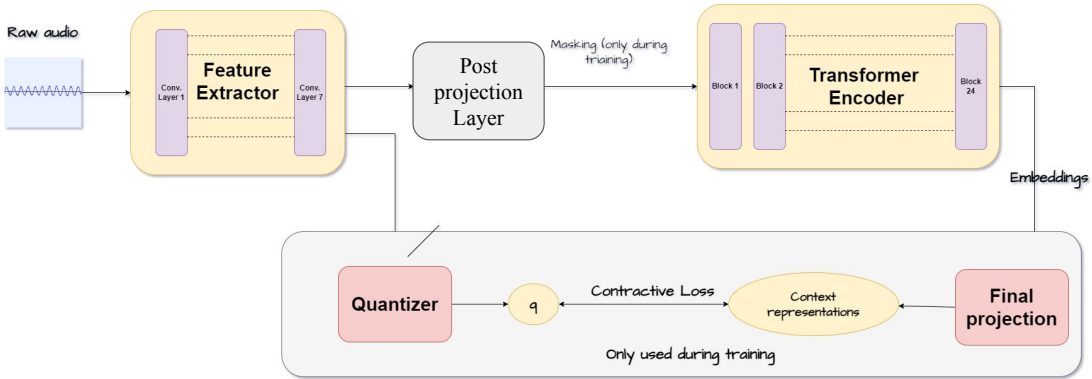
Automatic Speech Recognition and Transcriptions

- Clinical documentation
- Screening, diagnosis, management.

Automatic Speech Recognition and Transcriptions

1. State-of-the-art Models $\rightarrow$ English + Adults
2. State-of-the-model for Danish $\rightarrow$ Alvenir
3. Challenges:
    - Transcribe speech from children in Danish
    - Clinical conversations between clinician and child.
    - Do we have data?

Baseline and Wav2vec Model



What to do when no data?

Data-augmentation

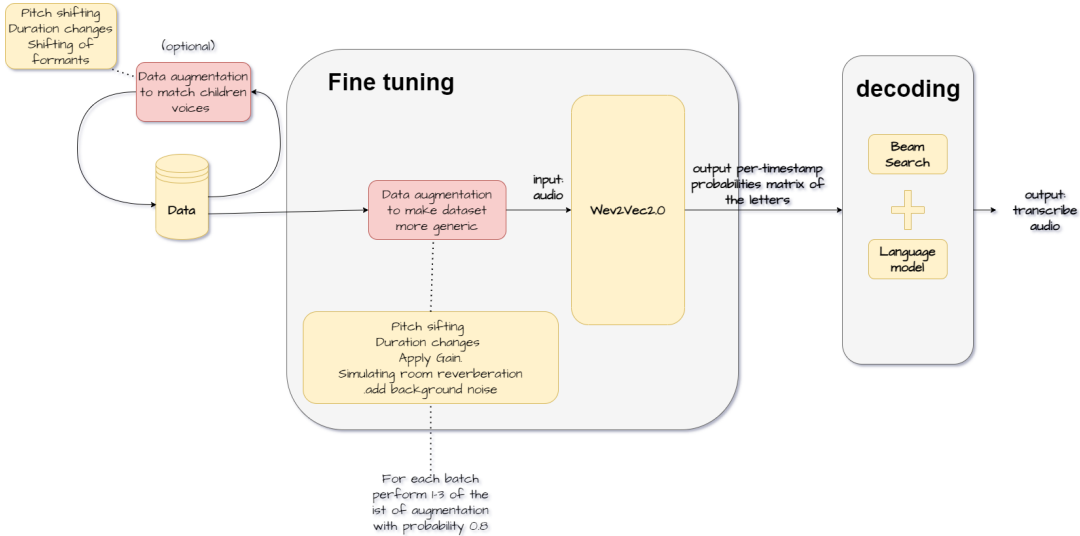
To aid in generalisation

- Gain change
- Reverberation
- Background noise
- pitch and duration modification

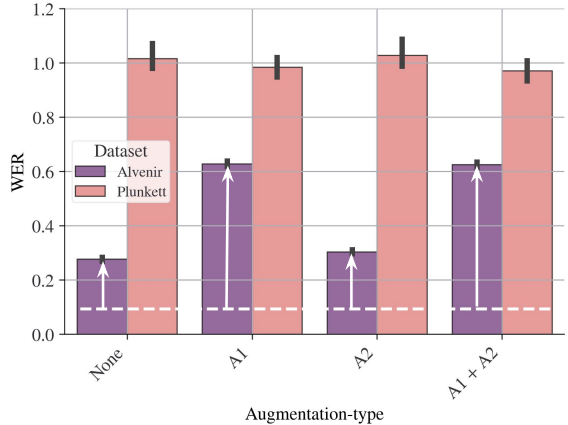
To aid in transfer to children

- Formant-shift
- Pitch modification
- Duration modification

Data augmentation (Synthetic data)



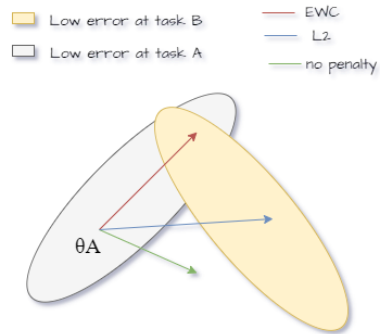
Data augmentation



- Testing on Alvenir + Plunkett
- Catastrophic forgetting → Not acceptable (!)

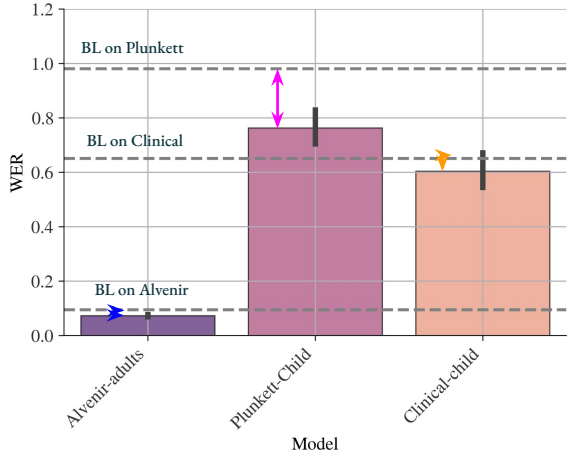
How to avoid Catastrophic forgetting?

- Weight freezing
  - Acoustic variability
  - Pronunciation variability
- Elastic weight consolidation: $L(\theta) = L_B(\theta) + \sum_i \frac{\lambda}{2} F_i(\theta_i - \theta^*_{A,i})^2$



Results

Performance of the best model[1]



[1] Garofalaki. M, Speech and natural language processing for clinical in-the-wild data 2023.

Summary

1. Speech-processing in psychiatry and psychology $\rightarrow$ accelerate and aid
2. Challenges:
    - Models are sensitive to language, age...
    - Lack of resources (data, labels)
3. Need to adapt ASR modelled on adults to children with above challenges.
    - Augmentation
    - Continual learning $\rightarrow$ Elastic weight consolidation.
4. Performance on adults maintained
5. Performance on children improved by $\rightarrow$ 80%, 5%
6. Is this sufficient?

Thankyou!

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