Oral Presentation #1
Clinical Analysis of Speech Rhythms in Language Development using MATLAB

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What is Specific Language Impairment?

- Specific Language Impairment (SLI) is a language-disorder where patients exhibit decreases in ability to form proper grammar and can also have decreased vocabulary.
- People with SLI have also been shown to have a decreased ability perceive and produce rhythmic language.

Numerical Representation of SLI

- Creation of phrases to have half and whole note emphasis (Dig For a Dog)
- Matched metronome beat to phrase
- Patients would listen to metronome and attempt to construct given phrase to the proper metronome beat
- Analyzed using circular statistics
  - Regards metronome as perfect and records the phase lag or anticipation of when speech was produced. (SHOW GRAPH HERE)
  - Final product is unit vector representing both how precise and accurate the data is.
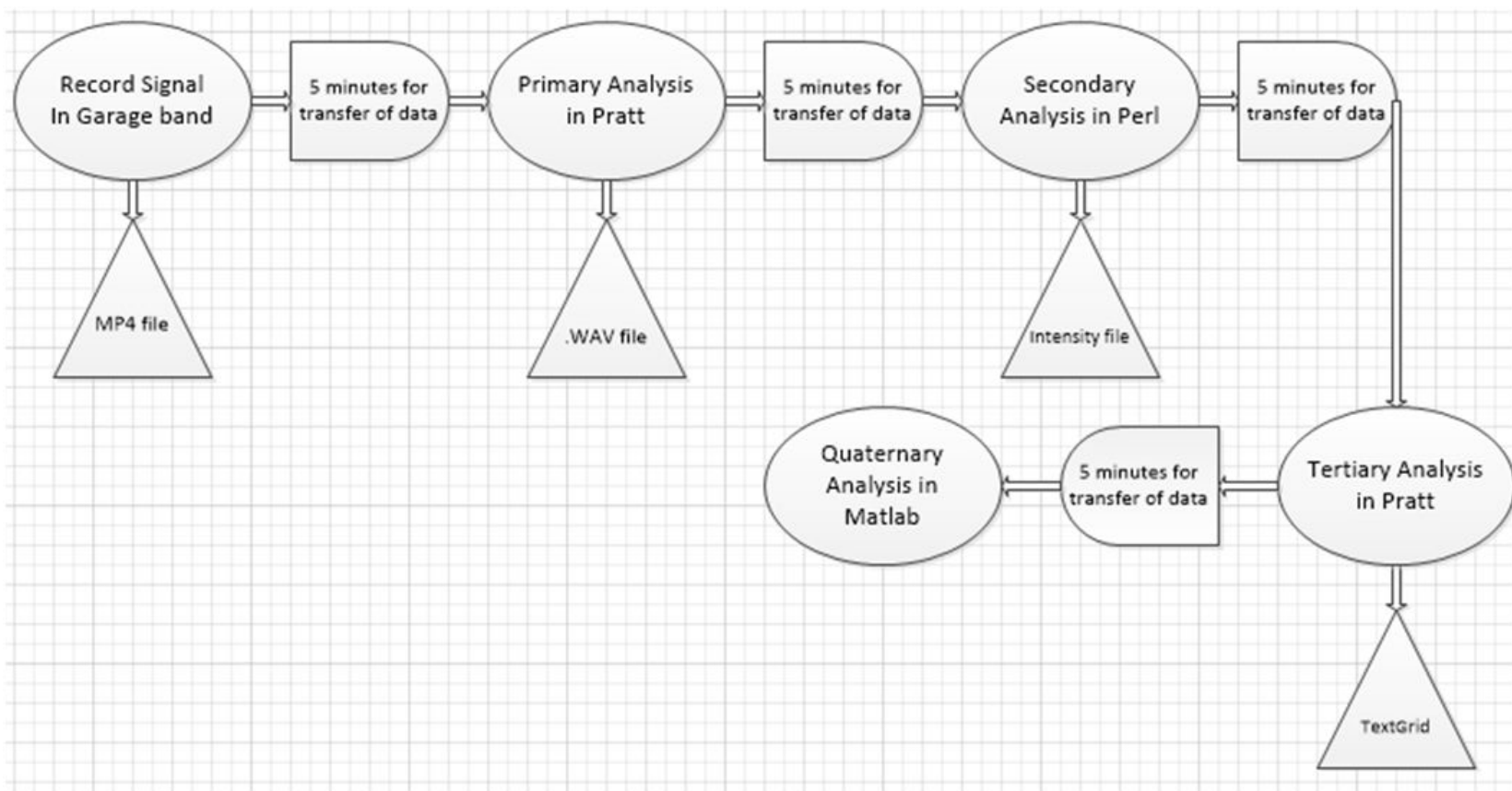
Problem Statement

Preliminary research has been conducted that indicates a correlation exists between an **individual's rhythmic capabilities and language development.**

Currently, the data analysis process used to determine an individual's rhythmic abilities is **inefficient** and **impractical** in a clinical setting.

No data analysis process or system exists to assess an individual's speech rhythm. There is a need in the industry for **a diagnostic technique** that efficiently analyzes the individual's recorded speech to determine whether their rhythm is considered good or bad.

There is an immediate need in the Gordon lab for **a data analysis** process that quickly and efficiently judges rhythm in speech. Beyond the Gordon lab, there is a **clinical need for a device** with an intuitive interface that is capable of immediate analysis and display of feedback

Needs Assessment

- Must:
  - **Detect the rhythm of the English language.**
  - Detect the rhythm of various types of music.
  - Compare rhythms of English language and music.
- **Data** collected from instrument **should be stored** for analysis and future retrieval.
- Design must **not exceed NIH grant budget.**
- Instrument **must be safe**, **physically compatible** with children, and **comfortable**.
- Design must allow for **variability between patient speech** and disorders.
- Lab setting must induce positive reinforcement for child compliance.
- Must be compatible with data files of past research.

Needs Assessment

Newer needs:

- Must streamline data in one software program
- Must reduce time needed to analyze data
- Must use consistent analytics
- Must provide feedback to user and lab staff
- Must have intuitive interface

Software Design Components

- MATLAB program:
    - Collect and analyze speech and metronome tracks
    - Utilization of toolbox functions and circular statistics
    - Feedback and user interface to assess patient rhythm consistency and accuracy
- Data analysis program must be compatible with:
    - Various computer operating systems
    - A microphone
    - Headphones
- The design of the study will:
    - Determine the rhythm baseline by sampling a population of individuals with normal speech development
    - Longitudinally assess impact of musical training on speech rhythm therapy

Conclusions

- Faster analysis
    - More time to devote to actual research
    - Ability to collect and analyze more data
- A common analysis method to be used in different research labs
    - Improve consistency between data from different studies
- A verified diagnostic technique in clinics
- Therapeutical use by speech pathologists

Next Steps

- Filter and smooth the sound signal to get an intensity curve by either;
  - Translating existing code from Pratt to MATLAB
  - Use other filtering techniques
- Eliminating initial spike in amplitude
- Obtaining the metronome signal in MATLAB
- Determining the best way to compare the two signals