Improving Prosody and Intelligibility in Young Adult Cochlear Implant Users

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Overview

- Cochlear Implant Outcomes
- Information on 440 Students receiving Speech Therapy
- Therapy Outcomes
- Description of Prosody Assessment and Intervention
- Case Studies
- Conclusions and Questions
Overview of Prosody and Cochlear Implants
General Outcomes of CI Users

- CI vs. HA
- Speech Perception
- Speech Production
- Language
Variables influencing outcomes

- Access and use of sound prior to implantation
- Age at implantation
- Quality of sound processor
- Quality of services
- Time on task
- Parent commitment and involvement
Early Access to sound is critical!
Outcomes of prosody assessment and intervention with children with cochlear implants

- Prosody and Voice/Pitch
- Prosody and Intelligibility
- Prosody and Language
Can we do better?
Access to prosodic cues

- Typically not complete.

- Problems possibly due to lack of deep insertion (Med-El deeper) and resultant lack of access to lower frequencies (F0) that equate to fundamental pitch level and pitch changes used to convey linguistic meaning (intonation and syllabic stress).
Speech Coding Strategies

Goal of the newer strategies is to better represent the input speech spectrum:

- Offer more channels
- Capture more sound
- Faster processing rate
- Better frequency/pitch resolution for
  - Speech in quiet
  - Speech in noise
  - Temporal processing
  - Music appreciation
Speech Coding Strategies

- Advanced Bionics
  - SAS
  - Hi Res
  - Fidelity 120
- Cochlear
  - SPEAK
  - CIS
  - ACE
- Med-El
  - CIS, CIS+
CI Coding Strategies Demo

- How a CI Hears.pdf
Speech Therapy

Students and Strategies
NTID population

- 1100 Deaf and hard-of hearing students

- Enrolled in associate degree programs at NTID or in baccalaureate programs at other colleges of RIT

- 23% (n=255) with Cochlear Implants
Incoming Students: Amplification

- %None
- %CI
- %HA

All Incoming Students: Preferences for Receiving Information

- 1997, n=299
- 2000, n=269
- 2003, n=294
- 2007, n=355

% Sign Alone
% Sim/Comm
% Speech/Listening
% Other/Text
Incoming Students w/CI’s Preferences for Receiving Information

- % Sign Alone
- % Sim/Comm
- % Speech/Listening
- % Other/Text

1997, n=9
2000, n=14
2003, n=51
2007, n=74
NTID Students in Speech Therapy

- Over the past 5 years, 440 students have voluntarily pursued individual speech-language therapy at NTID.
- 26% (n=115) of speech therapy students have been Cochlear Implant users
  - 79% graduated from mainstream HS
  - All received some level of speech-language support growing up
  - The majority were late implanted
Intelligibility Ratings of Students Seeking Speech Therapy
CI Users n=115; Non-CI Users n=325
Outcomes

- Brown & Weyman, 2005

- 55% of students had measurable gain in intelligibility after 2 or more quarters.

- 87% feel their communication has improved.
Intelligibility gains for CI students

- Percent who improved
  51% improved
  40% stayed the same
  9% scored lower

- Average gain
  Pre=71% of key words understood; 3.4
  Post=82% of key words understood; 3.8
NTID Voice Evaluation Form – Prosody ratings

**Rate:** Circle descriptor - "fast" or "slow"
- Cannot control rate of syllable articulation
- Much too fast or slow for efficient communication
- Moderately fast or slow
- Slightly fast or slow, but monitored well for clarity
- Normal

**Stress and Inflection:**
- Cannot evaluate
- Severe problem
- Moderate problem
- Mild problem
- Normal

**Blending and coarticulation:**
- Cannot evaluate
- Severe problem
- Moderate problem
- Mild problem
- Normal

Description of Prosody Problems

- Rainbow Passage example
- Clark Sentence example
- Word level example
Initial Evaluation Prosody Ratings

- Normal/Mild Problems
- Moderate/Severe Problems

CI Users
Non-CI Users
Speech Therapy Strategies

- Listening to intonation and stress patterns
- Reduction of vocal tension and/or fundamental pitch
- Teaching about intonation & stress patterns
- Using visual feedback instrumentation
Therapy Demos

- NTID website for SLP's
  www.ntid.rit.edu/speechlangpros

- Question Intonation
  intonation_3.mov

- Monitoring Intonation & Pitch
  Web_Demo_of_VP_SS.mov
Therapy Demos, cont’d.

- Pitch Control
  5_levels_of_practice.mov

- Pitch and Amplitude
  Demo_of_VP_1.mov

- Pitch Games
  Web_Demo_of_VP_2.mov
Case Studies

3 Students with Prosody as a Focus of Therapy
Student DB
Speech Intelligibility 2.6

- CI at age 16
  - Used for 5 years
  - Nucleus 24 3G
  - ACE coding strategy
  - Frequency Range
    120 Hz – 8658 Hz

- Therapy:
  - Prosody Focus 4 Qtrs.
  - Improvement
    - Rate 2+ to 4+
    - Stress/Inflection 2 to 3

- Pre-Therapy

- Post-therapy
Student DB

- **Pre-therapy:**
  - Speaks with reduced rate, syllable-by-syllable
  - “…has poor prosody particularly blending syllables and using correct stress”

- **Post-therapy:**
  - When verbal model given with correct word and phrasal prosody, can learn and copy, but doesn’t retain and incorporate into spontaneous speech
Student JG
Speech Intelligibility: 3.8

- CI at age 12
  - Used for 8 years
  - Clarion Platinum BTE
  - SAS coding strategy
  - Frequency range 250 Hz – 6800 Hz

- Therapy:
  - Focus on pitch control, then prosody
  - Improvement
    - Stress/Inflection 3 to 4

- Pre-Therapy

- Post-therapy
  - Year 1
  - Year 2
Student JG

- **Pre-therapy**
  - Fluctuations in pitch control are disruptive to prosody and intelligibility.
  - Focus of therapy was on pitch control.

- **Post-therapy 1st year**
  - “He continues to use an appropriate vocal pitch overall, but there continues to be a pattern of pitch fluctuation wherein a sentence begins at a lower pitch and ends at a higher level. This has been very resistant to change.”
Student JG

- **Pre-therapy**
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Student JG

- Therapy 2nd year- Focus on prosody
  - Increase speech intelligibility through improved co-articulation and intra-, inter-syllable blending
  - Listen for stress and inflection
  - Produce sentence inflection utilizing feedback from CSL Real Time Pitch
  - Incorporate terminal pitch fall and appropriate word stress in conversational speech
Student MR
Speech Intelligibility 3.7

- CI at age 16
  - Used for 3 years
  - Nucleus 24 Freedom
  - Coding strategy ACE?

- Therapy:
  - Moderate problems with stress & inflection and pitch control
  - Prosody Focus 2 Qtrs.
    - Receptive/expressive
Student MR

- Pre-therapy
  - “Speech characterized by moderate breathiness leading to problems with stress and inflection including pitch control.”
  - Equal stress on all words and equal pausing between words

- Receptive and expressive practice of intonation patterns in everyday sentences

- Pitch, intensity, rhythm and rate addressed in terms of intended meaning
Student MR

- Resources utilized:
  - *Hear2Learn* program
  - Randall’s ESL lab [http://www.esl-lab.com/](http://www.esl-lab.com/)
Student MR

- Intonation
  - Statement
  - Question

- ESL conversation

- Post-Therapy comments
  - In structured situations could alter intonation to match communicative intent, however minimal carryover to spontaneous speech.
Summary

Questions?

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