Perceptual Characteristics of Children with Rhotic Misarticulation

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Introduction

- English /r/ is typically acquired by age 8 [1]; children over 8 who mispronounce /r/ may be diagnosed with residual speech errors (RSE).
- English /r/ may be difficult to produce for many reasons: complex articulatory configuration [2], variability in tongue shapes across and within individuals, perceptual deficits in differentiating accurate vs inaccurate productions of /r/.
- Previous research indicates children with speech production deficits can exhibit perceptual difficulties compared to typically developing children [3]. Children with RSE tend to show reduced perceptual acuity for the sound(s) they produce inaccurately [4,5].
- Recent research shows that biofeedback-enhanced treatment can eliminate RSEs affecting /r/ in some individuals; however, most studies also report non-responders to biofeedback intervention [6,7,8].
- If there are subtypes within the RSE population (e.g., individuals with and without auditory-perceptual deficits), could explain some heterogeneity in response to biofeedback.

Methods

- Data pooled across multiple sites: New York University, Syracuse University, Haskins Laboratories, University of Cincinnati.
- All received biofeedback treatment, but heterogeneous in type (visual acoustic or ultrasound) and duration.
- Control group: N = 53 age-matched controls.
- Perceptual acuity measure [9]: Synthesized nine-step continuum between /r/ and /w/ (rake-wake), presented 8 times each.
- Auditory acuity measured as width of fitted probit function from 25th to 75th percentile of probability. **Wider boundary reflects less acute perception for /r/** [10].

Perceptual Results

- TD group had narrower mean boundary width than RSE group, indicating **more acute perception**, t(101.24) = -5.21, p < 0.0001.
- Overlapping distributions indicate that some children with RSE show high acuity and some TD children show poor acuity.

Predictors of BL Severity & Response to Biofeedback

- Linear regression was used to test for an association between perceptual acuity for /r/ (measured by boundary width) and severity of /r/ misarticulation at baseline (measured by mean F3-F2 distance) in RSE group.
- Results indicated **no significant association** between perceptual acuity for /r/ and baseline severity of /r/ misarticulation among children with RSE (β = -0.39, SE = 0.26, p = 0.14).
- Logistic regression was used to test for an association between perceptual acuity and response to biofeedback treatment.
- Due to heterogeneity of treatment, participants were coded as responders/non-responders.
- Effect size of change in acoustics of /r/ from baseline to post-treatment was quantified using classical Cohen’s d.
- Cut-off between responders and non-responders was set at 1.0 [12].
- Independent variables: baseline perceptual acuity, baseline stimulability, sex, and age.
- Results indicated **no significant association** between baseline acuity and likelihood of response to biofeedback treatment in children with RSE (β = -0.18, SE = 0.18, p = 0.30).

Discussion

- Group difference in /r/ perception between children with RSE affecting /r/ and typically developing children is consistent with previous literature.
- Children tend to show perceptual deficits affecting the same sounds they mispronounce.
- Contrary to hypothesis, there was no relationship between perceptual acuity and production at baseline.
- Speech sound disorders are multifactorial; auditory acuity is not the only potential predictor driving severity.
- Other predictors, like somatosensory acuity, should be examined as well.
- Likewise, we found no relationship between baseline perceptual acuity and response to biofeedback treatment in children with RSE.
- However, biofeedback in the present multi-site study was heterogeneous in nature. Perceptual acuity may only predict response to a specific type of biofeedback (e.g., visual-acoustic).