Examining the Effectiveness of Tactile Biofeedback in Charter Schools

ABSTRACT
This study examined the effectiveness of the integration of tactile biofeedback, using the Speech Buddies® tool set, into a typical school-based service delivery model at five New York City charter schools. Students aged 4:10 to 16:00 presented with either articulation goals on their individual education plans (IEP), or a baseline phoneme accuracy of 15% or lower on Secord Contextual Articulation Test (S-CAT) phoneme probes. 77% of students received group-based therapy, 69% had IEP language goals, and 42% were older students with treatment-resistant residual errors. Over the course of the school year, the students were administered an average of 25.2 hours of total speech and language therapy (17.9 hours of articulation therapy) and the student's average accuracy on the S-CAT test increased from 23.2% to 83.4%. The average cost of therapy delivered per student prior to or at the study was $5,900 while the average cost of therapy delivered per student using Speech Buddies was $1,550. These results show a substantial comparative improvement over traditional articulation therapy, an effective administration of group therapy, and a substantial cost savings for schools and school districts.

Subjects
To be included in the study, the students were required to have either: 1) articulation goals as part of an Individualized Education Plan (IEP); or 2) baseline accuracy of 15% or less on at least one phoneme-specific probe for the /t∫/ or /l/, /s/, /∫/, or /t∫/, according to the Secord Contextual Articulation Test (S-CAT). Twelve students were included in the study. 75% of subjects met this inclusion criterion via articulation-based IEP goals; 25% of subjects met this criterion by scoring 15% or less on the S-CAT probes. Of these 12 students, 69% had IEP language goals, and 92% had received therapy in the prior school year or summer. Ages ranged from 4:10 to 16:00, with the average age being 8:7. One subject had moderate bilateral hearing impairment with hearing-related IEP goals and one subject had enlarged adenoids which contributed to a significantly hyponasal voice.

Methods
The Speech Buddies® device set for /t∫/, /l/, /s/, /∫/, or /t∫/ was used in this study. The figures above depict the devices, show the different target locations, and show the /t/ device within the oral cavity. The /l/ device targets the retroflexed (palatal) configuration of /l/. The ridges on the device cue the correct starting position. The subject is then instructed to unroll the coil during real-time production of /l/ in isolation or in words to achieve correct tongue retroflexion. The /s/ and /∫/ devices place the tongue tip target 4mm and 12mm behind the upper front dentition respectively, the /t/ target is centered flush against the alveolar ridge and prompts tongue blade contact, and the /l/ places the tongue tip target behind the upper front dentition. All devices can be used to teach productions in isolation or in words.

Methods (cont.)
All assessment data were gathered by the assigned SLP. S-CAT probes were administered at baseline, at two mid-points during the school year, and during a final assessment. The S-CAT measures accuracy of production for particular phonemes at the word and sentence levels.

Results
As shown in the figures above, average accuracy at producing the error phonemes, as measured by the S-CAT probes, increased from 23.2% to 83.4%. Additionally the estimated cost of therapy averaged $1,550 per student. The estimated average cost of previous therapy, despite generally minimal progress, for the same cohort was approximately $5,900 per student. This cost estimate was derived from documentation of previous therapy, assumed an average of three students per group therapy session, and an average Speech and Language cost of $1,550 per student.

Discussion
The results above suggest that the integration of Speech Buddies into school based therapy programs yielded a significant treatment response. This response was achieved in nearly 1/5 the number of therapy hours and at nearly 1/4 the cost, as compared to previous therapy delivered to study subjects. Therapy gains were consistent for subjects that were either new to treatment or presented with treatment-resistant, residual articulation errors. 42% of subjects were age 11 and older and had been in speech therapy for several years.

The data also compare favorably to industry norms, as reported by Jacoby, Lee, Kummer, Levin & Creaghead (2002), where a similar population treated individually in a hospital-based clinic setting achieved comparable gains. Gains reported by Jacoby et al. were achieved in an average of 40.3 hours at an estimated cost of $3,224 per student while gains with Speech Buddies in a group setting were achieved in an average of 25.2 hours, with an estimated cost of $1,550 per student.2

The study design was intended to reflect current school-based clinical practice. Results were obtained according to the current IEP mandated service delivery paradigm of the vast majority of school districts in the United States: one hour per week of therapy per student, group therapy. The significant improvement in accuracy of production for students using tactile biofeedback within this paradigm would represent a substantial potential cost savings for school districts. Furthermore, this trend could have the potential to reduce caseload sizes and increase SLP retention rates in an environment of reduced public sector spending.

| Timepoint (mean therapy) | Predicted performance accuracy on S-CAT | Lower Bound | Upper Bound | T | Pr(>|T|) | Standard Error |
|--------------------------|----------------------------------------|-------------|-------------|---|--------|----------------|
| Assessment 1 (5.7 hours) | 43.12%                                 | 31.28%      | 54.96%      | 7.60 | <.0001 | 5.68           |
| Assessment 2 (11.4 hours)| 63.33%                                 | 50.91%      | 75.74%      | 10.64 | <.0001 | 6.00           |
| Final Assessment (17.4 hours) | 80.67%                             | 68.80%      | 92.51%      | 14.21 | <.0001 | 6.68           |

Notes:
1. Secord Articulation Test

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