Introduction
Continuous Positive Airway Pressure (CPAP) technology is traditionally used to treat sleep apnea by delivering positive air pressure through the nasal cavity to keep the soft palate open.

CPAP technology has been successfully used to treat hypernasality in patients with craniofacial abnormalities (Kuehn, 1991, Kuehn, 2002).

Minimal research has been conducted regarding CPAP as a treatment for hypernasality secondary to brain injury associated dysarthria (Cahill, 2004).

Research Question
Will combining CPAP technology with multi-subsystem dysarthria treatment result in significant functional outcomes?

Methods
Participant
Single subject case study with a 21-year-old female with spastic ataxic dysarthria secondary to brain infection nine years post-onset

The participant had participated in prior speech therapy at the onset of illness, but had not participated in speech therapy in the year prior to CPAP treatment.

The participant’s dysarthria was characterized by velar, labial, and lingual weakness; reduced speed of movement; decreased pitch and intonation variability; imprecise articulation; decreased breath groups; and excessive hypernasality.

Procedure
Treatment for 50 minute sessions, 2 days a week.
- Articulation drills at word, phrase, and sentence level to improve articulatory precision, specifically with stop consonants
- Instruction and trials of breathing exercises to increase breath groups during speech to attain more natural breaks for breath
- Imitation of clinician model of phrases/jokes to target natural speed, rhythm, pitch, and intonation
- Education was provided and use of auditory playback with self-rating scales was utilized to increase participant awareness and ability for self correction

Home treatment with CPAP machine 6 days a week for 10 weeks (as designed by David P. Kuehn, PhD)
- Pressures increased over time from 4.0 to 8.0 cm H2O
- Minutes per CPAP home use increased over time from 10 to 24 minutes
- Participant produces words (with vowel, nasal consonant, obstruct consonant, and vowel structure) and sentences while wearing CPAP device over nose delivering positive airway pressure

Raters, communication disorders graduate students, listened to the 10 sentence level speech productions. The same sentences were recorded pre, mid, and post treatment and played in random order two times each. Raters used a 7 point Likert scale to assign severity values to each speech feature.

Results
Descriptive statistics generated the mean ratings pre, mid, and post treatment (Tables 1 - 4). Repeated Measures ANOVA explored the Within-Subjects Contrasts between pre-treatment ratings and the ratings given mid and post treatment (Table 5). Mid measures were at 4 weeks. Post measures were at 8 weeks immediately following the conclusion of the treatment program.

Discussion
The clinician and participant began to notice improved speech naturalness at 5 weeks, although raters did not determine significant levels of improvement for speech features evaluated until post-treatment ratings.

Though the clinician and participant noticed improved naturalness, including decreased nasality, raters did not report significant improvements for nasality.

After treatment, the participant reported being able to volitionally control velum which improved velopharyngeal competence for non-speech tasks such as swallowing.

The participant was cognitively high-functioning with prior speech therapy immediately post onset of illness.

The participant was very self aware and quickly learned to reliably compare and judge speech productions both in reviewing recordings and in conversation.

Clinical Implications
Patients with dysarthria resulting in hypernasality may improve speech naturalness from the velar resistance training provided by use of CPAP technology in addition to a multi-subsystem approach.

Future Research
Evaluation of speech after the conclusion of CPAP home program and speech services to investigate possible withdrawal effect or continued improvement.

Outcome of CPAP technology use with a broader range of participants (e.g. cognitive deficits, age, post onset).

Include control groups comparing CPAP with multi-subsystem approach, CPAP alone, and multi-subsystem approach.

References

