Data Collection

Results of the literature search yielded the following types of design consistent with the previously stated criteria: With group repeated measures which have a level 2 of evidence.

Results

The apparatus was very similar for all within group experiments examined. The subjects typically sat in a sound treated room and vocalized a predetermined utterance. Utterances were recorded using a microphone and then filtered and amplified before they were sent to a recorder. A harmonizer then transformed the pitch of the signal accordingly. To reduce the impact of natural acoustic feedback through bone conduction, the pitch-shifted signals were mixed with 75 dB SPL pink noise and multi-speaker babble (Jones & Munhall, 2000), 40 dB SPL pink noise (Larson, Sun & Hain, 2007) or 40 dB SPL low pass filtered masking noise (Chen, Liu, Xu & Larson, 2007) Subjects received their own altered auditory feedback amplified through insert (Jones & Munhall, 2000) or Sennheiser headphones (Chen et al. 2007 & Larson et al., 2007). The pitch shifting process introduced a small de1 0 0 1 72.024 515.47 Tmo-5( )-122(i)-10(n)6(s)345BT1 A3(o)-5(47 Tmo5(r)-)6((47

compensatory effect occurred. Accordingly, there was an increase in amplitude when compared to the shift-down condition. During both the shift-up and shift-down conditions, the response magnitude was similar. The direction of the Fo shift did not alter the results when combined with a change in loudness since the amplitude response to the +50 cent -3dB stimulus was much smaller than the response to the -50 cent +3 dB. The direction of Fo shift did not produce a significant change in the Fo response latencies. Furthermore, the direction of Fo shift did not produce a significant change in voice amplitude response latencies. This data suggests that Fo and loudness of Fo share neural circuitry and are intertwined until being decoded in the auditory cortex since there was no consistent change in Fo across the interactions. Nevertheless, under simultaneous conditions, they can function independently. It was concluded that subjects perceive an increase in Fo to be greater than a decrease in Fo and thus, nonlinear interactions exists between the direction of change of inputs and the size of the response.

In this study, order effects were not controlled. Only a portion of the data was analyzed which may prevent the reader from obtaining reliable results since bias could have been introduced. Baseline measures were not mentioned so, it is unclear how the participants perform with no alterations in Fo auditory feedback. Since all the testing was done in one session, vocal fatigue may have affected the Fo amplitude and pitch responses since vocal fatigue produces a corresponding rise in intensity.

Chen, Liu, Xu & Larson's (2007) study evaluated the voice Fo response to pitch shifted auditory feedback during a sustained vowel task and a speech task. The

was a greater change in the cents of speech production with an increase in Fo compared to the condition where the Fo auditory feedback was decreased.

Clinical Implications

This evidence implies that if a short term change in pitch Fo is needed, the individuals vocal pitch should be heard with a increase in Fo pitch shift since a decrease in Fo pitch shift does not produce as much of a change. This may be helpful in treating speech disorders where the desired outcome is a decrease in speech Fo. Also, treatment plans should implement speech as the vocal stimuli rather than sustained vowel tasks since altering the Fo of speech produces greater response magnitudes compared to a sustained vowel task.

References

Burnett, T., Freedland, M., & Larson, C. (1998). Voice Fo response to manipulations in pitch feedback. *Journal of the Acoustical Society of A*