Abstract: Formant trajectory characteristics were studied in three groups of individuals with neurogenic speech disorders, as well as a group of normal older speakers. Results indicate that there are certain disorder-specific characteristics which may reflect the classic pathophysiology of the individual diseases. Statistical representations of the data are discussed.

INTRODUCTION

Several studies over the past decade have shown that vowel contrast errors make a substantial contribution to intelligibility deficits in dysarthria. Kent, Weismer, Rosenbek, and Kent (1) and Ziegler and von Cramon (2) have both reported data sets in which global estimates of dysarthric speech intelligibility, such as a percentage of correctly-heard words, can be decomposed into the relative contributions from a limited set of phonetic contrasts involving vowels, consonants, and semivowels. These analyses show that vowels make a significant contribution to the overall intelligibility deficit. Whereas this finding may appear to be counter to the classical view of consonants as the information-bearing elements of the speech wave, Weismer (3) has recently reviewed the speech production literature in dysarthria and concluded that many studies show that individuals with sensorimotor speech disorders have difficulty with the production of vowels. The intelligibility and speech production literature therefore points to a need for an in-depth understanding of vowel production in dysarthria, as well as the specific effects of those productions on speech intelligibility.

One way to gain insight to the production of vocalic segments in individuals with dysarthria is to examine the characteristics of a variety of formant frequency trajectories. Formant trajectories partly, and probably largely reflect the changing vocal tract configuration over time during vocalic segments, and are likely to reveal specific aspects of a speech production deficit. For example, there is evidence that the slope of the major transitional portion of a formant trajectory is highly correlated with speech intelligibility deficits in speakers with amyotrophic lateral sclerosis (ALS) (4), and that for the same speakers overall trajectories becomes more or less centralized with decreases in intelligibility (5). In addition, a fairly simple but powerful statistical model of the interaction between temporal and spectral characteristics of the diphthong /aI/ has been used to show that the formant trajectories of normal speakers and speakers with Parkinson's disease are different in kind, rather than degree (6).

In the present study, we report on a modest data base of formant trajectory characteristics in speakers with Parkinson's disease (PD), cerebellar disease (CD), and bilateral upper motor neuron associated with stroke (CVA). We are interested in knowing if the aberrant trajectory characteristics that have been identified in our past work for two groups (ALS and PD), such as centralization, and reduced formant extents and slopes, are characteristic in other groups of persons with dysarthria. If, for example, we can identify a limited set of trajectory characteristics that are likely to show abnormalities regardless of the specific disease type, this would move us in the direction of a theory of dysarthria that encompasses the variety of neurological dysfunctions associated with speech deficits. A secondary purpose of this study was to explore a simple approach to parameterization of formant trajectories as a way to facilitate comparisons across disease groups.

METHODS

In the present report, formant trajectories are reported for male speakers with PD (N=20), CB(N=6), and CVA (N=6). Twelve neurologically normal men, between the ages of 65-82 years, were also studied.

The speech material consisted of a list of words included in a single-word intelligibility test reported by Kent et al. (1). Data for two of these words (sigh and hail) are described in this report. We have shown previously that the formant trajectories of these two words are sensitive to at least one neurological disease-- (ALS)--and tend to be very stable in neurologically-normal speakers (5).

Formant trajectories were generated with the LPC-based tracking algorithm in Cspeech, which were examined carefully for errors and corrected interactively, when necessary. Standard measures of transition durations, extents, and slopes (5) were obtained from the trajectories, and regression functions were fit to the trajectories to explore an alternate
RESULTS AND DISCUSSION

Transition durations tended to be longer than normal in all groups except PD, where they were shorter; transition extents tended to be smaller than normal in all groups, and transition slopes were shallower than normal in almost all cases of neurological disease. These results are fairly consistent with previous findings and expectations from the general pathophysiology of the diseases.

Figure 1 shows regression curves fit to the first (F1) and second (F2) formant trajectories for the word *sigh*; the four panels shows functions for the four different groups, and within each panel each function is from a single speaker. The plots therefore show trajectory variation across speakers, as displayed in the statistical fits (first or second order), within each group.

Table 1 presents a summary of the regression data, as a function of group. The linear slope data seem to suggest that the statistical parameterization may be a useful way to characterize these trajectories, because the lower-than-normal values associated with PD, and the higher-than-normal values associated with CD, are consistent with other observations of articulatory behavior in these groups.

**REFERENCES**