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Review

Prosody and motor speech disorders: A retrospective review of a merger that is imminent

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Abstract

Even though prosody figures prominently in the classification and differential diagnosis of motor speech disorders, the theoretical frame works in which prosody and motor speech disorders have evolved have limited a full integration or merging of these domains. The Mayo Classification continues to be the gold standard and differentiates the motors speech disorders in terms of audible speech deviations including prosody. While briefly challenged by a prosodic classification of the motor speech disorders (Kent and Rosenbek, 1982), it was not until theoretical advances in normal prosody culminated in an objective measurement approach that shows promise to complement the audio-perceptual approach and map the prosodic landscape in motor speech disorders.
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In an era when the terms speech and language were used interchangeably and Broca and Wernicke's constructs of ''aphemia'' and ''aphasia symptom complex'' seemingly found harmonious reconciliation in localizationist theories of language, Kusmaul (1877) broke with tradition as he argued the position that speech was not confined to a cerebral convolution. He also drew a clear distinction between the neurological disorders of speech and those of language. In what is conceivably the first classification of neurogenic communication disorders, he defined as separate from aphasia a group of *articulation* disorders that were due to organic or psychic disturbances of the central nervous system (CNS). He can be credited with having coined the term ''dysarthria'' to which he designated *articulation* disorders to be distinguished from the dyslalias that resulted from peripheral lesions and/or malformations of the articulators or the cranial nerves (Grewel, 1957). Kussmaul's classification, albeit provocative for its time, did not do much more than delimit the concept of dysarthria, confining it to the CNS apart from language and functional/organic speech disorders.

Around the turn of the century localizations within the CNS that, if lesioned, were consequential for the (in) ability to articulate were proposed as was the notion that a graded recovery was associated with different clinical speech defects. For example Marie (1906) claimed that the anatomical substrate for ''pure anarthria'' lay in a 'lenticular zone' of frontal cortex and sub-cortex between the head of the caudate and the posterior end of the lenticular nucleus. Marie and Foix (1917) later made distinctions based on the degree of recovery of the speech impairment. They used the term 'anarthric

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syndromes' for recovered cases with speech impediments that in most severe examples presented with initial complete inability to utter words. They used the label ''dysarthria'' for instances where upon recovery words were mispronounced or phrases could not skillfully be produced. It is clear that this distinction foreshadows the modern classification of motor speech disorders as consisting of ''dysarthria(s) and apraxia of speech''.

In the next two decades or so more refined neurologic classification schemes began to assert a coupling between the still fairly amorphous dysarthria symptom complex and etiologies that were bound within levels/components of the central nervous system. For example, Zentay (1937), Froeshels (1943) and Luchsinger and Arnold (1949) classified dysarthria as emanating from four levels within the central nervous system (cortico-bulbar, cortico-strio-pallido-rubro-bulbar, fronto-pontine, and cerebellar levels). Growing consideration of movement disorders as well speech processes other than ''articulation'', along with a broadening array of ''dysarthric'' symptoms needing theoretical cover, soon refined and even stretched the 4-level classification schemes to also include the peripheral nervous system (PNS).

Interestingly, two major paradigmatic shifts occurred in the fifties and sixties. One was introduced by Monrad Krohn (1948) when he initiated the clinical study of prosody after caring for a native Norwegian woman during WWII who sustained shrapnel injury to the left frontal area causing a Broca's aphasia (Ross et al., 2013). Although the woman made an excellent recovery, her speech no longer sounded like that of a native Norwegian. While her speech had preserved melody, as evidenced by her ability to sing, intone and emote, she had inappropriate application of stresses and pauses, giving her speech a foreign accent quality (Ross et al., 2013). Based on this patient and others, Monrad-Krohn (1963) divided ''prosody'' into four major components: intrinsic, intellectual, emotional and inarticulate prosody. *Intrinsic* prosody enhances and clarifies the linguistic aspects of a language through judicious use of pitch, intonation, duration, pauses and stress. Examples include the pitch declination of the rise of pitch near the end of statements and questions. Prosodic stress along with pausing helps out with potentially ambiguous syntax by defining phrasal boundaries. Intellectual prosody signals the attitude of the speaker vis-a-vis the content that is imparted. For example, the speaker thus may convey a sentiment that is opposite to what is being stated as in ''the lecture was really interesting'' (boring). *Emotional* prosody injects primary types of emotions into speech, such as happiness, sadness, fear and anger. *Inarticulate* prosody is the use of certain paralinguistic nonverbal elements, such as grunts and sighs, to embellish discourse.

Foundational for another major paradigm shift were two publications, one by Grewel (1957) and the other by Peacher (1950). Peacher, who was influenced by Monrad-Krohn's work, added rhythm (if not prosody) to the speech processes of articulation, phonation, resonation and respiration in a manuscript entitled ''The etiology and differential classification of dysarthria''. The title of this publication is telling as it introduced the (modern) era of the classified dysarthrias (plural). Peacher for the first time highlighted the role of speech processes in dysarthria and gave rhythm an overarching role in it. He argued the importance of rhythm in light of research showing its peripheral dependence on respiration, its dependence on auditory feed back (as demonstrated by failure of rhythm to develop in the deaf) but also its relation to ontogenetic factors such as language development and on an even higher level, emotional and intellectual factors. Grewel can be credited with defining praxis and execution in speech along with tying movement disorders to the dysarthrias. Execution was described as the release of a series of reflexes, was thought to be dependent on intact sensibility and required coordination of the successive stages of the speaking procedure (respiration, phonation, articulation). Along these lines, he defined, apraxia of speech as a subtype, albeit at the margins, of dysarthria.

Peacher and Grewel both claimed that a neurological perspective on dysarthria lacked diagnostic power and therapeutic relevance if it was not also complemented by detailed speech analysis. In this regard, they proposed some procedural guidelines for the diagnosis of dysarthria and provided an initial broad description of the speech symptoms in the various dysarthria types. Even so, realizing that descriptions of dysarthric speech were subjective and at best impressionistic, Peacher (1950) called for a resurveying of the entire field using principles of experimental phonetics and speech pathology.

Though not yet employing an experimental method, Darley et al. (1969a,b) attempted to do just that in the first systematic and comprehensive study of the audible characteristics of the dysarthrias. The raw data in this investigation comprised reading samples of 212 patients with dysarthria whose neurological diagnosis fell in one of seven categories: pseudobulbar palsy, bulbar palsy, amyotrophic lateral sclerosis, cerebellar lesions, parkinsonism, dystonia, and choreoathetosis. These neurological disorders were a likely choice, as they had been the subject of earlier dysarthria investigations in some form or another. Listening to the tapes, Darley and his colleagues tried to capture the distinct phenomenology of the dysarthrias, not within neuroanatomic levels as had been done before, but within the audible domain. Toward this goal, they conceptualized a series of speech and voice dimensions along which to rate the speech samples. Ultimately, Darley Aronson and Brown settled for 38 dimensions along seven major categories. They included pitch (level, breaks, tremor, or mono), loudness (level, decay, alternating, excessively varied, or mono), vocal quality (harsh/wet hoarseness, continuous/transient breathiness, strained voice, hypo/hypernasality, and nasal emission) audible aspects of respiration (forced inhalation or exhalation, audible inspiration, grunt at end of expiration), prosody (rate, short phrases, increased overall/segmental rate, variable rate, reduced/excessive stress, silences, short rushes of speech), and articulation (imprecise consonants, vowel distortion, prolonged/repeated phonemes, irregular articulatory

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