The Effects of Articulation on the Perceived Loudness of the Projected Voice

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Summary: Arthur Lessac developed a voice training approach that concentrated on three energies: structural action, tonal action, and consonant action. In Lessac-Madsen Resonant Voice Therapy (LMRVT), speech-language pathologists help patients achieve a resonant voice through structural posturing and awareness of tonal changes. However, LMRVT many not necessarily include the third component of Lessac's approach: consonant action.This study examines the effect that increased effort on consonant production has on the speaking voice—particularly regarding vocal loudness and projection.

Methods. Audio samples were collected from eight actor participants who read a monologue using three distinct styles: normal articulation, poor articulation (elicited using a bite block), and overarticulation (elicited using a Lessac-based training intervention). Twenty graduate students of speech-language pathology listened to speech samples from the different conditions and made comparative judgments regarding articulation, loudness, and projection.

Results. Group results showed a strong correlation between the articulatory condition and the level of perceived loudness and projection. That is, as precision of articulation increased, the ratings of perceived loudness and projection increased, as well.

Conclusions. These findings indicate that articulation treatment may have a positive influence on the perception of vocal loudness and projection. This has implications for future directions in expanding voice therapy modalities.

Key Words: Loudness–Projection–Articulation–Resonance–Perceptual analysis–Actors.

INTRODUCTION

Stage performers are faced with the challenge of delivering their voices to a large audience in a loud and intelligible manner. In a study of acoustic and perceptual analyses, Master et al[1] found that actors were generally perceived as louder than nonactors when reading text with a loud voice, even when the sound pressure level (SPL) was not significantly different between groups. Therefore, the SPL alone does not explain the perceptual differences between actor and nonactor loudness levels. We know that the respiratory and phonatory subsystems of speech are vital factors in loud voice production, but perhaps contributions from another subsystem account for the greater perceived loudness of the actor's projected voice.

A look into the acting literature gives some insight into what projection means to an actor. Mayer[2] defines projection as "controlled energy which gives impact and intelligibility to sound." Machlin[3] defines it as "the vigorous throwing out of the sounds that make up the words you speak." Rodenburg[4] refers to projection as "a marriage between support and the means of articulation." Berry[5] speaks of projection in terms of "filling the space … with sharpness of diction and the precise placing of word and tone." Linklater[6] encourages "freeing the natural speaking voice" by freeing muscle tension of the articulators. The common thread among these definitions is that projection allows the voice to carry with clear loudness and articulation. For the purposes of this study, we used the following definition: "Projection is the extent to which a voice is clear and carries naturally and effortlessly."

Arthur Lessac[7] described voice for the actor in his own terms of structural action, tonal action, and consonant action. With these, the actor must develop a physical awareness of the vocal tract, experience the sensation of oral vibrations, and create an agile and precise articulation system for the intelligibility of speech. The Lessac system emphasizes the necessity to combine these three actions or energies to produce a voice that easily projects—that is, a resonant voice. The field of speech-language pathology has borrowed principles from the Lessac approach to treat vocal pathologies with a program called Lessac-Madsen Resonant Voice Therapy (LMRVT).[8]

The LMRVT approach to voice therapy aims to minimize the impact stress of the vocal folds while maximizing vocal output.[8–11] Vocal fold movement that ranges between barely adducted and barely abducted is said to produce a resonant voice.[8] In resonant voice therapy, the patient works to configure the oral cavity in such a way that allows high frequency energy in the sound source to be reinforced in the vocal tract. Lessac[7] describes this structural action as an arrangement of an open pharynx, open teeth, and loose lips. This method is often used by stage actors to produce loud voice and in voice therapy for dysphonic patients to produce healthy voicing.

Lessac[7] taught that a resonant voice is achieved when structural action, tonal action, and consonant action work in tandem to form a trinity of energies. His philosophy was that a speaker must connect all three energies and give equal weight to each. Verdolini[8] incorporated two of the energies—structural and tonal—into LMRVT. The structural component is the basic training gesture, which is the positioning of the articulators that fosters a more optimal resonating oral cavity. The tonal component involves a sensation of easy phonation at the larynx and of anterior oral vibrations when phonating. These two principles together are effective at establishing healthy voicing

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strategies. However, LMRVT does not routinely include the third of Lessac's energies—consonant action.

Others have speculated that there exists a strong relationship between voice and articulation.[12–16] When asked to increase loudness, normal speakers often heighten the degree of articulation. Loud speech has been shown to be correlated with greater lip and jaw excursions,[12] greater lip displacements and velocities,[13] and higher lip and jaw EMG levels[14,15] in comparison with soft speech. The reverse has also been shown to be true; that is, increased jaw movement and pressure is associated with increased amplitude of vocal fold vibration.[16] These findings hint at the robust connection between the phonatory and articulatory subsystems of speech.

This connection is also supported in studies regarding patients with dysarthric speech secondary to Parkinson disease (PD).[17–22] Hypokinetic dysarthria is characterized by imprecise articulation and weak voice with reduced intensity.[17] These patients often have reduced awareness of vocal effort and output and may benefit from generating loudness via the Lee Silverman Voice Treatment.[18] Individuals with PD who complete Lee Silverman Voice Treatment with the target of loud voicing will often gain significant improvements in the quality of vowel articulation[19] and intelligibility of speech.[20] In fact, when comparing loud speech with amplified speech, patients with PD are considerably more intelligible in loud speech than with mere amplification.[21,22] This increase in intelligibility indicates that creating loud speech involves more than amplifying the intensity of the speech signal.

Clear speech is a term given to the speaking style that one uses to voluntarily maximize the intelligibility of one's own speech for the benefit of the listener.[23] This manner of speech is best achieved with adjustments in articulatory gestures, rather than increasing loudness.[24–26] In other words, the goal is to clarify the speech signal—not intensify it. Picheny et al[27] argue that clear speech should be used when talking with hearing impaired listeners to improve the intelligibility of the speech signal. Hearing impaired listeners were significantly more accurate in their repetitions of clear rather than conversational speech. Clear speech has been shown to improve intelligibility for both normal hearing and hearing impaired listeners.[28] Clear speech has also been found to be effective in noisy backgrounds and with cognitively impaired listeners.[29] Although intelligible speech is by nature adequately loud, the aforementioned studies emphasize that the clarity of articulation is more important than the loudness of voice in effectively communicating a speech signal.

Actors have specific vocal demands that make them an appropriate population for investigating the relationship between articulation and voice. Master et al[1] reported that speech therapists rated actors as being significantly louder and better projected than nonactors, despite no significant SPL difference in acoustic analysis of the two groups. Resonant voicing may be a possible explanation for the perceptual differences in loudness. Raphael and Scherer[30] examined spectral differences between actors' normal conversational voice and their performance ("call") voice and reported finding enhancement at the first formant and the third formant skirt for the call mode. A resonant voice has also been associated with greater articulatory excursions than those with a constricted voice.[31] Radiographic measures revealed greatly increased oral cavity size (by 36 mm) and jaw lowering (by 14.6 mm) in resonant phonation versus constricted phonation. Each of these investigators asked their actors to modify vocal characteristics, and they measured compelling subsequent changes in articulatory gestures.

Although it has been shown that heightened levels of articulation often accompany loud speech, it is not clear if the reverse is true—if improved articulation leads to a louder or better projected voice. The present study investigated the effects of various levels of articulatory precision on the perceived loudness of speech in actors during a staged reading. The purpose of this study was to investigate the effect that articulation may have on vocal loudness. It is hypothesized that clear articulatory precision is perceived to be louder and more projected than poorly enunciated speech. If this is supported, then we may have a foundation for future research relating to voice therapy; articulation may potentially become an additional important component of treatment to target vocal loudness. The present study serves as a preliminary attempt to determine if articulation control has a positive influence on perceived vocal loudness.

METHODS

Participants

Eight amateur actors, five females and three males, volunteered to participate in this study. They ranged in age from 22 to 54 years (with a mean age of 29 years). All participants had experience performing in stage productions ranging from 3 to 36 years (with a mean experience of 13 years). Amateur actors were defined as nonprofessionals who had performed in community or university theater within a year before the study. The amount of acting training for these actors varied from 0 to 7 years (with a mean training of 3 years). Amateur actors were selected under the assumption that they may be more susceptible to change given an intervention, whereas professional actors may have a polished performance voice that uses sufficient articulation, loudness, and projection at baseline. All actors reported that they were nonsmokers and had no hearing problems, voice problems, or upper respiratory tract illnesses at the time of the study. Informed consent was obtained from participants in accordance with the Institutional Review Board of the University of Iowa.

Speech tasks

Each actor performed the same 1-minute monologue from Shakespeare's *King Lear* in three different conditions: normal performance, bite block performance, and overarticulation performance. They were given 5 minutes to independently read through the monologue and practice performing it in a room alone—similar to a cold reading at an acting audition. When the 5 minutes of practice time was complete, each actor reported feeling comfortable with performing the monologue.

Performances were held on a small stage raised off the main floor in a 166–seat lecture hall. First, actors were instructed to read the monologue as if they were performing it for an audition;