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Creating a Mastery Experience During the Voice Evaluation

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SUMMARY

Objectives—Adherence to treatment is a common challenge when working with patients with voice disorders. Improving their self-efficacy through a mastery experience has the potential to improve treatment adherence. An ideal mastery experience gives early and quick evidence that the patient will be successful with the treatment and works for a broad range of patients. This study sought to test whether a brief stimulability trial of forward focused voice could produce sufficient change in acoustic analysis measures to provide visibly improved objective results and, thus, be a potentially useful mastery experience.

Study Design—Prospective, Repeated Measures, Pre- and Post-Treatment

Methods—Twenty-four consecutive patients with varying diagnoses referred for a voice evaluation participated in this study. Acoustic analysis was completed before and after a short stimulability trial of forward focused voice. Acoustic analysis parameters evaluated include: fundamental frequency, jitter, shimmer, noise-to-harmonic ratio and voice turbulence index. Data pre- and post-treatment was analyzed for change and compared with normative values.

Results—Results demonstrated a significant change from pre- to post-trial, as indicated by the objective measure transitioning from being outside to within normal limits, in 75% of patients ($p=0.000$). When less rigid criterion of a positive change in one or more of the 3 acoustic measures of interest is used, improvement was noted in 96% of patients.

Conclusion—Pairing a trial therapy with acoustic analysis during a voice evaluation is a possible mastery experience. Future research is needed to determine if this mastery experience improves self-efficacy, treatment adherence, and treatment outcomes.

Keywords

voice; evaluation; mastery experience; self-efficacy; acoustic analysis

INTRODUCTION

A common difficulty experienced by clinicians is engaging their patients in treatment. Most treatment typically involves health behavior changes. This is especially true for patients who

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require voice treatment. For successful health behavior changes, a patient must have sufficient self-efficacy and motivation to engage in and continue voice therapy. It is documented that many patients with voice disorders do not adhere to therapy.^{1, 2} In 2006, Portone et al in a retrospective review of 294 charts found that 47% of patients who were seen for a voice evaluation adhered to a speech-language pathologist's recommendation for voice therapy. In a follow-up study, Hapner et al found that 65% of patients dropped out of voice therapy. Patient demographics, quality-of-life impact, severity of dysphonia (CAPE-V), and diagnosis (hyperfunctional versus hypofunctional) were not predictive of patient dropout. It is possible that this lack of adherence is related to the inherent difficulty in making health behavior changes.

The transtheoretical model (TTM) describes health behavior change as a process that progresses in a series of stages³. In order to make and maintain a health behavior change, one must progress through all stages successfully. The TTM has been studied and used as a behavior change assessment technique for a number of health concerns. Researchers have determined the TTM to be effective and useful for physical activity exercise, alcohol consumption, and smoking cessation.^{4, 5}

There are five stages of change described in the TTM. Precontemplation, the first stage, occurs when a patient is not yet considering behavioral therapy. This can be attributed to the patient being unaware that a problem behavior needs to be changed or that a change would be beneficial. Congruently, they could be aware of a possible change but are unwilling to pursue it. It is also thought that general indecision may play a role in the precontemplation stage. That is, a patient may be aware that a behavior change is possible, but they are still weighing the pros and cons of making that change.^{6, 7, 8} The contemplation stage occurs when a patient is in fact starting to consider making a behavior change, but they have yet to act on the thought. The preparation stage is characterized by a patient's resolve to pursue change. The action and maintenance stages are regarded as the time period when a person takes steps to modify their behavior and prevent relapse or recycling into previous stages.^{6, 7}

Important to the TTM is the concept of self-efficacy, or an individual's confidence in his or her ability to accomplish a task⁹. Self-efficacy is necessary to achieve and maintain behavior change, and, fortunately, it is changeable within an individual.⁹ A commonly observed characteristic in patients with higher self-efficacy is that they have a better prognosis. The Social Cognitive Theory proposes and has accrued evidence for four sources of self-efficacy: mastery experience, vicarious experience, verbal persuasion, and emotional-physiological state.^{6, 10} Cognitive structures, such as self-efficacy, are most successfully reformed by a personal mastery experience arising from an effective accomplishment or productive behavior.⁹ In order for a mastery experience to be successful in improving patients' confidence in therapy, it must be easily interpretable by patients as presenting an improvement and it must prove advantageous for the majority of patients.

For voice patients, the first opportunity at providing a mastery experience is in the initial evaluation with stimulability trials. A patient's presence or absence of stimulability for therapy must be assessed in order to determine an appropriate treatment plan. The stimulability trial can also be used to determine whether or not a patient believes that a certain treatment has the potential to relieve their symptoms. This time point generally relates to the precontemplation or contemplation stages of the TTM making it an ideal time to increase a patient's self-efficacy. The patient may be in the precontemplation stage at the voice evaluation, because even though they have been referred to a SLP, they may not yet know the extent to which their behavior needs changing or that a change would even be beneficial. The patient is in the process of learning about their behavior and its negative impacts on the voice and weighing the pros and the cons to modifying that behavior. Once

the patient is knowledgeable about their condition and the health behavior changes suggested by the SLP, they may move onto the contemplation stage. This is when the patient is not yet resolved to engage in therapy or put in the effort required to modify their behavior- and/or- they are not yet convinced that the therapy the SLP has to offer will, in fact, prove beneficial. The patient is actively acquiring information about their condition at this point, acknowledging that they have a problem, and investigating their treatment options. Patients may present to the voice evaluation in either the precontemplation or contemplation stages. When patients move to the contemplation stage, they are actively seeking evidence supporting the efficacy of voice therapy; therefore, patients in this stage are prone to benefit from cognitive methodologies used to increase motivation.⁸ The use of the treatment stimulability technique proposed in this manuscript may be helpful in moving patients from the precontemplation and contemplation stages to the preparation, action, and maintenance stages and in preventing reversion into the previous stages.

Prior to evaluating the outcome of a mastery experience for improving a patient's self-efficacy adherence to therapy or voice quality, we needed to develop a viable mastery experience relevant to the majority of patients. The first step was to identify a voice therapy approach to use for the stimulability trial that would benefit and not harm the largest number of patients, while quickly providing notable voice improvement. Based on typical practice patterns and the author's clinical biases, a forward focused (resonant) voice approach was chosen for this study. This approach was chosen based on the concept that both patients with hyperfunctional and hypofunctional voice disorders benefit from forward focused voice therapy. While forward focused voice is predominately touted for its positioning of the vocal folds during phonation to minimize forceful contact and presumably allow for tissue healing, it is also useful for persons with hypofunctional voice disorders for the same reason.¹¹ Since forward focused voice does not require the same level of vocal fold contact as non-forward focused phonation to be produced, it works with the anatomy of patients with hypofunctional voice disorders to also improve their voice quality. Additionally, there is a relatively low possibility of harming the vocal fold tissue during a supervised trial of forward focused therapy during the voice evaluation. As reported by Boone (1994), the approach is generally helpful to voice patients with the exception of those whose disorder involves a hypernasality component.¹² Forward focused voice has the advantage of providing a large amount of innate feedback to the patient. Forward focus voice exercises provide the feeling of vibration or sensation on the lips or in the mouth, a decrease in laryngeal tension, and an immediate change in voice quality. Forward focused voice exercises are ubiquitous in the voice clinic and have been part of many voice therapy approaches advocated by the leaders in the field.^{13, 14, 15} Other voice therapy approaches that may provide similarly fast changes in vocal quality may also be appropriate for this purpose depending on the individual patient characteristics. A non-inclusive list of such therapies that may be explored for this purpose are: the Lessac-Madsen Resonant Voice Therapy, vocal function exercises, the accent method, flow phonation, and Lee Silverman Voice Treatment.

The second step in formulating the mastery experience was to identify the appropriate measure of success that would be readily adopted by the patient. We chose acoustic analysis for this purpose since it is both a biofeedback and measurement technique that provides a clear means for the patient to understand that they are improving. Due to the objective nature, the visual display, and the ability to replay the phonation, acoustic analysis seemed to provide the most opportunity for relaying information on the change from the pre-stimulability trial to post-stimulability trial. Anecdotally, information from acoustic analysis, both the visual image of the red and green diagram from Multi-Dimensional Voice Program (MDVP) and the numerical results, seems to be a measure that naturally resonates with patients.

PURPOSE

The purpose of this study was to evaluate whether objective acoustic analysis paired with a short stimulability trial of forward focused voice provides positive feedback to the majority of patients. If acoustic analysis during a forward focused stimulability trial provides early, quick, positive feedback for the majority of the patients, it may be a useful mastery experience to improve patient adherence to and benefit from voice therapy. The long-term plan for this line of research is to follow patients who are exposed to this mastery experience to determine if this approach does improve self-efficacy, treatment adherence, and behavioral treatment outcomes. The specific research questions for the first step in this process were:

1. Do the acoustic analysis parameters of frequency and amplitude perturbation, noise to harmonic ratio (NHR) and voice turbulence index (VTI) differ prior to and after voice stimulability trials?
2. Is the change of fundamental frequency (Fo), not the change in voice quality due to the treatment, responsible for the changes in acoustic analysis measures between pre- and post-stimulability trial recordings?

METHOD

Participants

Twenty-four consecutive patients referred for voice evaluation at the Medical College of Georgia (MCG) participated in this study. The procedures used in this study were those commonly used for the evaluation of patients with voice disorders. The data for this study was assessed in a retrospective chart review approved by the IRB of the MCG. The patients included in this study were not restricted by any criteria. The patients referred had diagnoses ranging from prenodules to pre-surgery for cysts to unilateral paralysis.

Data Collection

Participants were recorded sustaining /a/ at habitual pitch and volume, high pitch and habitual volume, and low pitch and habitual volume with a headset microphone. Subjects were not guided in the selection of pitch for any of the tasks. Patients then underwent a stimulability trial that ranged from three to five minutes. The trial duration depended on the patient's ease of learning the task. The stimulability trial began by asking the patient to take a breath and hum, the patient was then asked to repeat this and feel for any vibration or sensation on their lips or the front of their mouth. Patients were instructed to specifically attend to their oral cavity were not advised to attend to their nasal cavity as we wished to simply the task for the patient and have only one area of focus for detecting vibration. Once the patient achieved this they were asked to take a breath, sustain a hum until they felt vibration and stop. Next, the patient was asked to take a breath, sustain a hum until they felt phonation and then sustain /i/ while feeling for vibration on their closed teeth. Once the patient was able to sustain the /mi/, they were asked to add a /a/ at the end. When the patient was able to do this, they sustained the resonant /a/ for 2 to 3 seconds while it was recorded. That is, the patients said /mia/ and sustained the last phoneme for acoustic analysis.

The MDVP Model 5105 (KayPENTAX) coupled with a condenser head-mount microphone AKG C420 held at a distance of 4 cm and an angle of 45 degrees from the participant's mouth were utilized to record the acoustic signal. Prior to acoustic recordings, a trial of phonation was captured and the gain was adjusted to prevent peak clipping and maximize the use of the dynamic range. Recordings judged as unrepresentative of the participants' true voice quality or those not following protocol were excluded. Recordings were verified for

Type 1 status as to be applicable for acoustic analysis (Titze, 1995). The acoustic signals were analyzed for Fo, jitter (RAP), shimmer (Shim), NHR, and VTI using MDVP (KayPENTAX).

Analysis

McNemar's test for matched pairs and paired t-test were used to assess whether statistically significant differences in the acoustic analysis measures were achieved. The MDVP normative thresholds were used to group patients into categories: within normal limits or outside of normal limits for analysis using the McNemar's test for matched pairs.

RESULTS

Do the acoustic analysis parameters of frequency and amplitude perturbation, NHR and VTI differ prior to and after a voice stimulability trial?

Overall, the RAP and Shim measures were improved during the stimulability trial from the initial recordings (Figures 1-4). The pre-stimulability habitual pitch average RAP measure of 1.38% was reduced to an average post-stimulability measure of 0.68%. The average pre-stimulability habitual pitch Shim measure of 3.9% was reduced to an average of 2.7% when measured post-stimulability trial. For NHR, the pre-stimulability habitual pitch average NHR measure was 0.116 and post-stimulability trial the NHR measure was 0.115. While the average NHR did not change, the range of NHR measures was reduced and more closely approximated the mean. The pre-stimulability habitual pitch average VTI measure was 0.0267 and post-stimulability trial the VTI measure was 0.0325. Paired t-tests for comparing pre-task and post-task acoustic analysis measures revealed statistically significant differences at the 0.05 level for RAP ($p=0.001$) and Shim ($p=0.002$). Statistically significant differences were not found for NHR ($p=0.08$) or VTI ($p=0.938$) pre- and post-task.

A review of the data based on the normative threshold used by MDVP was completed. The normative threshold values are: 0.68% for RAP, 3.81% for Shim, 0.19 for NHR and 0.061 for VTI. The results were assessed for the percent of patients who were outside of the normative threshold for pre-task habitual phonation. For RAP, Shim, NHR, and VTI, 72%, 36%, 8%, and 0% were outside of normal limits pre-task (Figure 6). Post-task, 61%, 77%, and 100% of these phonations changed from being outside to inside normal limits for RAP, Shim, and NHR, respectively (Figure 7). Results demonstrated a significant change from pre- to post-trial, as indicated by the objective measure transitioning from being outside to within normal limits, in 75% of patients ($p=0.00003$, McNemar's test for matched pairs). Eighteen patients had RAP measures above threshold levels pre-stimulability trial and eleven of those patients had RAP measures below threshold levels after the stimulability trial. Nine patients had Shim measures above threshold levels pre-stimulability trial and seven of those patients had Shim measures below threshold levels after the stimulability trial. The benchmark of the measure crossing threshold is a stringent one, but it is also the most visually appealing (from red to green in MDVP). When less rigid criterion of a positive change in one or more of the acoustic measures evaluated is used, 96% of patients noted improvements.

Is the change of Fo during the stimulability trial responsible for the changes in acoustic analysis measures between pre- and post-stimulability trial recordings?

The average Fo for the four tasks for habitual, high, low, and unloaded tasks were 193, 317, 157, and 218Hz, respectively (Figure 5). Paired t-tests for comparing pre-task and post-task acoustic analysis measures revealed statistically significant differences at the 0.05 level for Fo ($p=0.001$). Differences in the average RAP measures for habitual, high, low, and unloaded tasks were 1.31, 1.46, 1.42, and 0.62%, respectively. Differences in the average

Shim measures for habitual, high, low, and unloaded tasks were 3.8, 3.82, 3.79, and 2.5%, respectively. Differences in the average NHR measures for habitual, high, low, and unloaded tasks were 0.116, 0.116, 0.133, and 0.113, respectively. Paired t-tests for comparing post-task habitual phonation and pre-task high pitch phonation revealed statistically significant differences for Fo ($p=0.000$), RAP ($p=0.000$), and Shim ($p=0.017$). NHR and VTI did not reveal such differences at 0.942 and 0.574, respectively. Paired t-tests for comparing post-task habitual phonation and pre-task low pitch phonation revealed statistically significant differences at the 0.05 level for Fo ($p=0.000$), RAP ($p=0.000$), Shim ($p=0.007$), and NHR ($p=0.012$). VTI did not reveal such differences ($p=0.51$).

DISCUSSION

Do the acoustic analysis parameters of frequency and amplitude perturbation, NHR and VTI differ prior to and after voice stimulability trials?

The recordings made after the stimulability trial had improved acoustic analysis measures compared with the pre-stimulability trial recordings. In most cases this difference was significant enough to move the analysis measure from above normal limits (red) to within normal limits (green). This change is important for a mastery experience for three reasons: 1) acoustic analysis allows the patient to be able to immediately see a difference in their measures during the voice evaluation, 2) acoustic analysis recordings can be replayed to give the patient the chance to listen to and evaluate their voice, and 3) acoustic analysis allows the clinician to test treatment approaches in an easily documentable manner. The quick, positive feedback for patients is important for a mastery experience to increase patient self-efficacy, establish the credibility of the treatment, and motivate the patient to adhere to an at-home therapy regimen. The mastery experience has been charged as the best way to improve self-efficacy which, in turn, has shown to be a strong positive predictor of behavioral change.

Is the change of Fo during the stimulability trial responsible for the changes in acoustic analysis measures between pre- and post-stimulability trial recordings?

The recordings made after the stimulability trial had improved acoustic analysis measures compared to the habitual pitch. Given this significant finding, it was necessary to evaluate that the cause of the change was due to the forward focused voice quality and not due to the change in pitch in the pre- and post-habitual phonations. To achieve this, we compared the acoustic parameters achieved during the post-trial habitual pitch with those from the high pitch and low pitch recordings made pre-stimulability trials. We found an advantage to the forward focus technique beyond high or low pitch change alone. While the Fo on average was higher for the post-stimulability trial recordings than the habitual pre-stimulability trial recordings, it does not appear that the positive changes in the acoustic analysis measures of perturbation are a result of a change of pitch. This interpretation of the findings is most strongly supported by a comparison of acoustic analysis measures from the pre-stimulability trial high pitch recordings and the post-stimulability habitual phonations. This point of evaluation is most important because it has been noted that many patients increase their Fo when performing forward focused voice exercises. The finding of higher perturbation in the high pitch compared with the post-trial recordings indicates that the task benefit was not just from the increased Fo. Furthermore, many patients noted a decreased pitch as part of their voice disorder, so an increase in the Fo in the post-stimulability acoustic analysis recordings may be another indication of improved voice quality.

Limitations

One shortcoming of the study was the absence of a direct control of intensity. The intensity of the microphone was set for each patient in the pre-task habitual pitch condition and was

not changed for the other pre-task or the post-task recordings. Therefore, while exact measures of intensity were not taken, a relative measure of similarity between the two productions occurred. That is, a louder phonation, which would have caused peak clipping, did not occur. Similarly, a softer phonation, that would have indicated a low signal and would not be ideal for acoustic analysis measures, did not occur.

There was no follow through on patient adherence to therapy or patient outcome with voice therapy. This study was limited to a “proof of concept” analysis to examine whether a stimulability trial (forward focused voice) measured by acoustic analysis (objective measures and visual biofeedback) was successful at providing positive feedback and a mastery experience for the majority of patients. There is a need to follow-up this study with research to evaluate whether or not having this positive mastery experience has an impact on self-efficacy, treatment adherence, and treatment outcomes.

Several factors may contribute to a patient mastery experience and improved self-efficacy. Some factors come from the use of the forward focused voice task which provides many feedback mechanisms: oral vibratory sensation, reduced laryngeal tension, and change in voice quality. Other factors are from the multiple benefits of using acoustic analysis in that it affords the ability to replay the phonation, provides objective measures, and provides visual biofeedback. An attempt to specifically report if any of these possible mechanisms alone would provide a mastery experience is not possible given this research design.

CONCLUSIONS

The results of this study demonstrate that a stimulability trial of forward focused voice significantly improves acoustic analysis measures of perturbation in the majority of patients. Given this, it is likely that pairing acoustic analysis with forward focused voice would provide a mastery experience for patients during their voice evaluation. Since a mastery experience is the strongest way to increase self-efficacy, it is possible that it would encourage patients to be diligent in their therapy exercises at home and help establish confidence in the voice therapy process. Further study is needed to test the usefulness of stimulability trials with other treatment techniques. This line of research would also benefit from a study of long-term follow-up data on the difference in the outcomes (voice, exercise consistency, therapy follow through) of patients who receive and do not receive stimulability trials with acoustic analysis used for visual feedback to create a mastery experience.

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Figure 1.

Boxplot of RAP during the four tasks: pre-task habitual pitch, pre-task high pitch, pre-task low pitch and post-task habitual pitch.

Figure 2. Boxplot of Shim during the four tasks: pre-task habitual pitch, pre-task high pitch, pre-task low pitch and post-task habitual pitch.

Figure 3.

Boxplot of NHR during the four tasks: pre-task habitual pitch, pre-task high pitch, pre-task low pitch and post-task habitual pitch.

Figure 4. Boxplot of VTI during the four tasks: pre-task habitual pitch, pre-task high pitch, pre-task low pitch and post-task habitual pitch.

Figure 5. Boxplot of Fo during the four tasks: pre-task habitual pitch, pre-task high pitch, pre-task low pitch and post-task habitual pitch.

Figure 6.
Example of a screen print from a pre-stimulability acoustic analysis demonstrating scores outside of normal limits (red) on a number of acoustic parameters.

Figure 7.
Example of a screen print from a post-stimulability acoustic analysis demonstrating a change from Figure 6 with parameters that were outside of normal limits (red) now within normal limits (green).