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Research Article

Predicting and Influencing Voice Therapy Adherence Using Social–Cognitive Factors and Mobile Video

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Purpose: Patient adherence to voice therapy is an established challenge. The purpose of this study was (a) to examine whether adherence to treatment could be predicted from three social–cognitive factors measured at treatment onset: self-efficacy, goal commitment, and the therapeutic alliance, and (b) to test whether the provision of clinician, self-, and peer model mobile treatment videos on MP4 players would influence the same triad of social cognitive factors and the adherence behavior of patients.
Method: Forty adults with adducted hyperfunction with and without benign lesions were prospectively randomized to either 4 sessions of voice therapy enhanced by MP4 support or without MP4 support. Adherence between sessions was assessed through self-report. Social cognitive factors and voice outcomes were assessed at the beginning and end of therapy. Utility of MP4 support was assessed via interviews.
Results: Self-efficacy and the therapeutic alliance predicted a significant amount of adherence variance. MP4 support significantly increased generalization, self-efficacy for generalization, and the therapeutic alliance. An interaction effect demonstrated that MP4 support was particularly effective for patients who started therapy with poor self-efficacy for generalization.
Conclusion: Adherence may be predicted and influenced via social–cognitive means. Mobile technology can extend therapy to extraclinical settings.

Poor patient adherence to behavioral voice therapy presents a known problem in clinical voice care (Behrman, 2006; Stemple, 1993). As behavioral interventions, direct voice therapy protocols typically require daily practice and generalization of a target voice-production technique between treatment sessions (e.g., Carding, Horsley, & Docherty, 1998; Ramig & Verdolini, 1998). Individuals participating in voice therapy report self-regulatory, motor learning, and psychosocial barriers to adherence (van Leer & Connor, 2010). These include, but are not limited to, (a) forgetting how to reproduce a target voice technique without clinician assistance, (b) difficulty judging the accuracy of practice and generalization attempts independently, and (c) concerns about appearing unnatural when using the target technique conversation. Patients report that they need substantial personal motivation to succeed. They list their own commitment to treatment goals and the quality of their relationship with the voice therapist as instrumental to overcoming adherence barriers and avoiding drop-out.

Little is known about the manipulation and prediction of adherence to voice therapy homework. Strategies to improve adherence have received limited empirical investigation and have been designed for highly structured treatment programs. For example, the *LSVT Companion* software, providing loudness and pitch feedback, shows potential to replace the therapist altogether (Halpern et al., 2012), but it has limited utility outside of pitch and loudness goals. *Motivational Interviewing* strategies have been suggested to improve patient adherence to direct voice therapy protocols (Behrman, 2006; van Leer, Hapner, & Connor, 2008), but no empirical studies have tested their efficacy experimentally. Provision of an example audio compact disc (CD) is part of the vocal function exercise protocol (Stemple Lee, D'Amico, & Pickup, 1994), but it has not been compared to vocal function exercise without CD provision in an efficacy trial. Thus, we do not know whether individuals practice more frequently or accurately when provided with adherence support and for whom these strategies are useful.

The factors that predict adherence to voice therapy are also not known. Attempts have been made to predict

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session attendance from demographic and voice-related measures routinely obtained in the clinic, yielding mixed results (Duarte de Almeida, Santos, Bassi, Teixeira, & Cortes-Gama, 2013; Hapner, Portone-Maira, & Johns, 2009; Portone, Johns, & Hapner, 2008; Smith, Kempster, & Sims, 2010). No studies have attempted to predict adherence to treatment between sessions. Without studies that predict or improve adherence between sessions, clinicians are left without an evidence base with which to determine who is at risk for poor adherence or how to adjust therapy accordingly. Therefore, development of a data-driven model of patient adherence behavior in voice therapy holds both theoretical and clinical importance to clinical voice science.

Social–Cognitive Determinants of Adherence

Although the factors that govern adherence have not been identified for voice therapy, such factors have been empirically established for adherence to other tasks and treatments. Fundamental tenets of social cognitive theory (Bandura, 1986) have predicted adherence to health programs and medication regimens, as well as to academic homework and work tasks (Glanz, Rimer, & Lewis, 2002; Schunk, 2008). Specifically, individuals' confidence in their own ability to achieve a goal (i.e., their self-efficacy) is empirically established as the primary determinant of goal attainment for a wide variety of health behaviors (Bandura, 2006; Clark & Dodge, 1999; Gwaltney, Metrik, Kahler, & Shiffman, 2009; Holden, 1991; Ilgen, Tiet, Finney, & Moos, 2006; Luszczynska & Sutton, 2006; Matthew, 2004). Self-efficacy is measured by examining patient confidence to overcome perceived barriers to goal attainment (Bandura, 2001). Closely related to self-efficacy, determination to achieve a goal ("goal commitment") predicts adherence to a variety of health behavior changes and work-related tasks (Klein, Wesson, Hollenbeck, Wright, & DeShon, 2001; Locke & Latham, 2002; Miller & Rollnick, 2002). Lastly, the quality of the patient–clinician relationship is the greatest predictor of outcomes across psychotherapy interventions (Horvath & Symonds, 1991). These three social–cognitive factors are consistent with our qualitative findings regarding patient-perceived adherence barriers, importance of commitment to the treatment goal, and the quality of the relationship with the therapist (van Leer & Connor, 2010). Thus, these social–cognitive constructs may represent hypothetical determinants of adherence behavior in voice therapy.

Unlike factors that cannot be changed by the patient or therapist (e.g., patient personality, age, or classroom size), social–cognitive factors are mutable and can therefore be manipulated to improve adherence. Self-efficacy can be increased through video observation of one's own mastery of a task (i.e., video self-modeling), a strategy used successfully for a variety of behaviors, including fluent speech (Bellini & Akullian, 2007; Buggey, 2005; Cream, O'Brian, Onslow, Packman, & Menzies, 2009; Cream et al., 2010; Delano, 2007). Observing the successes of others with whom one identifies (i.e., peer models) also improves self-efficacy and goal attainment (e.g., Ng, Tam, Yew, & Lam, 1999). Furthermore, increasing the simplicity and concreteness of a target task can positively influence goal commitment and self-efficacy (Earley & Lituchy, 1991; Hollenbeck & Klein, 1987; Locke & Latham, 1990). The therapeutic alliance can be built by attaining client–clinician agreement on the tasks and goals of therapy, although strategies to attain this are a source of debate (Bordin, 1994).

The authors previously tested the use of clinician- and self-as-model therapy videos to assist patients in the recollection and self-evaluation of their voice technique between sessions and to reduce their concern about appearing unnatural (van Leer & Connor, 2012). Videos were provided on portable MP4 players that patients borrowed from the clinic. In a randomized crossover trial, 12 patients with a variety of voice disorders (i.e., adducted hyperfunction, age-related voice changes, and unilateral paralysis) were assigned to receive either written instructions in the first week of therapy, followed by MP4 support in the second week, or vice versa. Patients tracked their practice frequency during each week and completed the Readiness Ruler at the end of each week (Miller & Rollnick, 2002), an instrument that measures self-efficacy and goal commitment for practice. Patients were found to practice significantly more frequently during the MP4 condition, and they scored significantly higher on the Readiness Ruler after a week of MP4-supported practice. In semistructured interviews, they reported that the intervention helped them recall treatment tasks, feel more confident about their practice accuracy, and note that target voice use appeared natural.

Present Study

Results of the prior qualitative and crossover study were promising in demonstrating the role of social–cognitive factors in voice therapy adherence and the positive effect of a mobile video modeling intervention. The current study builds on these two studies in several ways. First, the mobile intervention was elaborated to include peer model interviews because these are a known source of self-efficacy (e.g., Ng et al., 1999). Second, the design was changed from a (within-subjects) crossover design to a (between-subjects) randomized trial. Because treatment conditions did not change within participants, social–cognitive factors could be examined for their (predictive) effect on adherence, and measures obtained at the end of therapy (generalization and voice outcomes) could be included in assessment. Third, the study population was narrowed to adducted hyperfunction: the use of excessive, tightly adducted, phonotraumatic glottal closure in laryngeal voice production (Hillman Holmberg, Perkell, Walsh, & Vaughan, 1989). Adducted hyperfunction is a common voice disorder, responds to voice therapy (Verdolini-Marston, Burke, Lessac, Glaze, & Caldwell, 1995), and requires daily practice and generalization of a challenging motor skill: the use of voice with reduced force of vocal fold adduction (Verdolini, Druker, Palmer, & Samawi, 1998).

Study Purpose

The purpose of our study was twofold: (a) to examine whether adherence to treatment could be predicted from a triad of social–cognitive factors measured at treatment onset, self-efficacy, goal commitment, and the therapeutic alliance, and (b) to test whether the provision of clinician, self-, and peer model mobile treatment videos on MP4 players would influence the same triad of social cognitive factor and patients' adherence behavior. The hypotheses were that social–cognitive factors could be used to predict a significant amount of adherence variance (i.e., both practice and generalization). Provision of MP4 support was expected to increase social–cognitive factors, adherence, and outcomes.

Methods

Research Design

A randomized prospective clinical trial of voice therapy included four weekly sessions during a 1-month period that compared adherence (i.e., practice and generalization) for an experimental MP4 group provided with video examples of voice therapy on portable MP4 players as well as written instructions, and a control group, who received only written instructions. Approval for this study was granted by the University of Wisconsin Health Sciences Institutional Review Board (UW HS-IRB).

Participants and Clinical Care

Recruited from the University of Wisconsin (UW) Voice and Swallow Clinic, 48 patients received a diagnosis consistent with adducted hyperfunction through team evaluation by a speech language pathologist and laryngologist after full rigid stroboscopic exam and clinical assessment of vocal function. UW laryngologists made determinations of laryngeal status (e.g., vocal fold edema; mid-membranous lesions), whereas the treating speech-language pathologist further determined inclusion based on functional status such as the presence of strained voice quality, increased closed phase on stroboscopic exam, and positive response to resonant voice therapy probes (e.g., improved voice quality and reduced patient-perceived laryngeal effort). Both individuals with and without vocal fold tissue consequences of adducted hyperfunction were included in this study because this disordered vocal behavior may exist in the absence of lesions (initially accompanied by vocal fatigue and effort) and over time may result in the development of benign lesions or edema of the middle one third of the medial vocal fold edge(s) or development of vocal process lesions (Hillman et al., 1989; Scherer et al., 1987).

Further inclusion and exclusion criteria (see Table 1) were chosen to increase likelihood that patient progress would be due to voice treatment adherence and not spontaneous recovery, and that progress would not be halted by organic limitations. Of 48 recruited, eight participants were excluded, four due to randomization error, and four due to poor treatment fidelity. Of 40 patients included, three MP4 and two control group patients dropped out during the study period.

Among the 35 study participants, 17 were in the MP4 group (mean age: 41.1 years, standard deviation [*SD*] = 12.7 years; 12 women and five men) and 18 were in the control group (mean age: 42.8 years, *SD* = 14 years; 14 women and four men). Associated with adducted hyperfunction, 10 control and nine MP4 participants also presented with mild laryngeal changes (see Table 2); frequency of occurrence of vocal fold lesions did not differ significantly between groups, $\chi^2(1) = 0.25$, $p = .6$.

For each of the six speech-language pathologists who provided voice therapy, patients were randomized to condition within blocks of four to create a stratified random sample by therapist. This was done to minimize the possibility that a particular clinician would primarily contribute to one treatment condition over another and consequently bias the results for clinician effects rather than treatment effects. Clinicians were not provided with this randomization schedule, so that participant referral to the study could not be biased.

Intervention

All patients received a resonant voice therapy approach (Verdolini-Marston et al., 1995). They were given two adherence goals: (a) to practice prescribed voice exercises five times per day and (b) to use the target resonant voice technique (in speaking) throughout the day. Both the control group and MP4 group were provided written therapy homework instructions by their treating clinician. The MP4 group also received three types of digital videos on portable MP4 players from the clinic, which included (a) multiple, brief (about 1-min) clinician videos of both standard and weekly individualized exercises and cues; (b) brief (about 1-min) patient "self-as-model" videos recorded weekly; and (c) an 11-min peer testimonial video (UW HS-IRB–approved) of three previous patients that had good voice therapy outcomes. These testimonials were interviews that discussed adherence difficulties and solutions and also provided examples of voice exercises to illustrate several points (e.g., a lip-trill showing that voice exercises are "weird").

Adherence Measures

Practice was operationalized as self-reported frequency of uninterrupted voice exercise practice of at least 2-min periods outside of the clinic. A period of 2 min was established to capture even brief practice periods and thus avoid a floor effect in which brief practice was "missed" in measurement. Participants tracked their practice with a small plastic tally counter attached to their personal key chain or purse and reported the resulting value at Sessions 2, 3, and 4.

Table 1. Participant inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Adults ages 21–65 years	Individuals ages <21 or >65 years
Chronic (>2 months) voice disorder	Uncontrolled laryngopharyngeal reflux
Stimulability for resonant voice at initial evaluation (i.e., improved vocal mechanics and quality in response to trial resonant voice therapy probes)	Stimulability for normal voice at initial evaluation with vegetative tasks but not with resonant voice tasks
Recommendation for at least four voice therapy sessions	Neurogenic speech or voice disorder
Adducted hyperfunction with or without middle one third of vocal fold edema or benign striking zone or vocal process lesions thought secondary to hyperfunction	Inability to see or manipulate a small object
	Active tobacco use
	Non-adducted hyperfunction (i.e., dysphonia or aphonia in absence of laryngeal pathology and abducted vocal glottal configuration on laryngeal exam)
	Undergoing any surgery requiring intubation during the course of voice therapy

Table 2. Description of vocal fold characteristics for MP4 and control groups.

Age	Sex	Vocal fold abnormality
		Control Group
57	F	None
53	M	Laryngopharyngeal reflux
37	M	Laryngopharyngeal reflux, small vocal process granuloma
21	M	Laryngopharyngeal reflux
43	F	Laryngopharyngeal reflux
49	F	None
23	M	Middle one-third edema
58	F	None
41	F	None
53	F	Middle one-third edema, irregularity or nodules
51	F	Mild overall vocal fold edema and erythema
59		Middle one-third edema and erythema
28	F	Vocal nodules
21	F	Middle one-third edema versus nodules
56	M	Question of unilateral true vocal fold scar
53	M	Question of unilateral sulcus
23	F	Vocal nodules
46	F	Vocal nodules, laryngopharyngeal reflux
		MP4 Group
39	F	Laryngopharyngeal reflux
54	F	Laryngopharyngeal reflux, small vocal process granuloma
39	F	Laryngopharyngeal reflux
35	M	Laryngopharyngeal reflux, vocal fold erythema
46	F	None
62	F	Laryngopharyngeal reflux
42	F	Possible laryngopharyngeal reflux
64	M	Right true vocal fold stiffness
43	M	Laryngopharyngeal reflux, unilateral middle one-third excrescence
38	F	Laryngopharyngeal reflux, middle one-third edema or nodules
21	F	Middle one-third cyst unilaterally; unilateral reaction change on opposing edge
53	F	Possible bilateral middle one-third scar
25	F	Vocal nodules
45	F	Vocal nodules
22	F	Vocal nodules, erythema, bilateral scarring or stiffness
43	F	Unilateral polyp with opposing edge reaction
28	M	Mild overall vocal fold edema

Generalization was operationalized as the self-reported percentage of time participants used their target voice production technique in the past week (in connected speech) and was recorded at the start of each session. When patients achieved the target voice technique during Session 1, they were asked, "Did you ever use your voice that way before?" and if so, "How much in the past week?" to capture pre-study use of healthy voice production. This represented their "Session 1 adherence %" values noted in the Results section.

To compare these adherence measures to data from voice therapy efficacy studies, patients also completed two overall retrospective compliance questions at the end of the study. Identical to the approach used by Roy et al. (2003), participants were asked, "To what extent did you comply with the treatment program?" and responded on a 5-point Likert scale ranging from *not at all* to *a lot*. Likewise, they rated their compliance on a 10-cm Visual Analog Scale (VAS) to the question, "Please show on the line how much you complied with the treatment program," identical to the procedure used by Behrman in 2008.

Social–Cognitive Measures

Social–cognitive factors of self-efficacy, goal commitment, and the therapeutic alliance were assessed via established scales completed at the end of Sessions 1 and 4. For the first session, participants were asked to "think aloud" when completing each scale; any item that was unclear was then explained to ensure validity of responses for all items. Clarification was individualized to meet participants' specific needs for understanding.

Self-Efficacy

Overall self-efficacy for practice and for generalization was assessed with Item 1 of the Readiness Ruler (DiIorio et al., 2003; Miller & Rollnick, 2002). Self-efficacy to overcome specific barriers to practice and generalization was assessed with the Voice Therapy Self-Efficacy scale (see Table 3), a longer version of our previously developed scale (van Leer & Connor, 2012; van Leer & Hapner, 2005). For both scales, the response format was an equal-appearing

Table 3. Voice Therapy Self-Efficacy scale items (van Leer & Connor, 2010; van Leer & Hapner, 2005).

Section 1: Practice
When you have time to yourself (in the car)
When you are busy
When you are tired
When you are traveling (vacation, business)
When you don't have time alone
When other people can hear you practice
When people around you are unsupportive
When the exercises are silly
When you're not sure if you're practicing correctly
When you just don't feel like it
Section 2: Generalization
During voice therapy (in the voice clinic)
At work
In a professionally demanding situation
On the phone
In a loud environment
With people who are unsupportive of your voice problem
With your significant other
With your family
When you raise your voice or shout
When you are socializing
When you are under stress
When you are tired
When you are relaxed
When you are excited
When you can't concentrate on your voice
When people push your buttons
When you're talking to strangers (people who don't know you)

interval scale guided by a visual analog response ranging from 0 (*low*) to 10 (*high*).

Goal commitment was measured with the Goal Commitment scale (Klein et al., 2001) and Items 2 and 3 of the Readiness Ruler. Response format for the Goal Commitment scale was a 5-point Likert scale ranging from *strongly agree* to *strongly disagree*.

The therapeutic alliance was assessed with the Session Rating scale (Duncan et al., 2003). The Session Rating scale is composed of four items reflecting Bordin's three dimensions of the alliance (Bordin, 1979) and an overall perception of the session. Participants rated each treatment session by putting a hash mark on a 10-cm visual analog line anchored at the left with a negative statement and at the right with a positive statement about the session.

Voice Outcome Measures

Voice outcome measures were obtained prior to and after completion of the four therapy sessions included in this study. Voice-related quality of life was assessed with the Voice Handicap Index (VHI; Jacobson et al., 1997) at initial evaluation (pretherapy) and study completion. Participants were instructed to circle the value that most closely reflected their perception for each of a total of 30 items.

Auditory-perceptual evaluation of voice was achieved through the Consensus Auditory Perceptual Evaluation of Voice–V (CAPE-V; Kempster et al., 2009). Participants were recorded for all CAPE-V tasks and asked to describe "how to make a peanut butter and jelly sandwich." Voice recordings of CAPE-V tasks were obtained by a voice clinician before therapy at either the time of initial evaluation or the beginning of Session 1, and by an investigator (EvL) or treating clinician at the end of Session 4 using a Computer Speech Laboratory unit, Model 4500 (KayPentax, Montvale, NJ), and headset microphone at an 8-cm mouth-to-microphone distance.

After completing the study, two speech-language pathologists with voice expertise served as perceptual raters; they were unfamiliar with the participants. All CAPE-V recordings were placed onto one audio file and presented in random order. Raters judged only the characteristic of overall severity of dysphonia because the reliability of rating other (subcomponent) aspects of voice is disputed (Eadie & Baylor, 2006; Kreiman Gerratt, Kempster, Erman, & Berke, 1993). Overall severity was marked along a 100-mm line with 0 as the anchor for *normal* and 100 as the anchor for *most severe*. To encourage interrater reliability, judges listened to a training sequence that did not include test items until 90% agreement was reached for ratings within 10 mm (Eadie, Sroka, Wright, & Merati, 2010). Raters listened to anchors of this training sequence every 20 samples during rating of pre–postintervention recordings. Interrater reliability was adequate ($r = .71$). Twelve samples were included twice to measure intrarater reliability, which was calculated at $r = .93$ for the first rater and $r = .78$ for the second rater.

Qualitative Analysis

To assist in interpretation of the results for Purpose 2 (i.e., effect of MP4 support), semistructured interviews regarding participant experience with the MP4 video were conducted at the end of Session 4. Participants were asked to discuss any adherence difficulties they had experienced during the course of therapy, what kinds of strategies helped them, and in what way they used MP4 support. Full qualitative analysis of transcribed interviews was completed by a speech-language pathologist who did not provide therapy for this study, and by investigator EvL, yielding 42 content categories and 93% interrater agreement. In this article, report of qualitative analysis is limited to their relevance to significant quantitative findings.

Statistical Analyses

A power calculation was completed to identify an estimated increase in practice frequency with 80% power based on our preliminary data (2.09 practice sessions per day [$SD = 1.4$] in the MP4 condition and .98 times per day [$SD = .76$] in the control condition), yielding a necessary sample size of 13 individuals per group; 20 per group was set as the goal (to manage participants who dropped out).

Purpose 1

To examine the effects of social–cognitive factors on adherence, simple multiple regression analyses were completed.

Prior to building regression models, both self-efficacy and both goal commitment measures were examined for their relationship with the dependent variable. Because these constructs had each been measured with two different redundant scales, the scale for which scores most highly correlated with the dependent variable was chosen to represent that construct in regression. Average practice and generalization were regressed onto social–cognitive measure scores that had been obtained at Session 1. Models were built by performing a multiple regression in which all three social–cognitive factors were entered at once. An F test was performed to examine the statistical significance of the predicted relationships.

Purpose 2

Independent t tests were used to examine treatment group differences on adherence, social–cognitive variables, and voice outcome. To examine differences between groups in adherence, average practice over the course of therapy and generalization at Session 4 were compared. To examine group differences in social–cognitive constructs, participant scores obtained at Session 4 were compared between groups. Voice outcome was assessed by calculating the percent change in VHI scores at study completion (Session 4) relative to baseline measures (pretreatment Session 1). For results that were significant, effect size was calculated using Cohen's d procedure.

Secondary Statistical Analysis

Multiple regression analyses were performed to examine a possible interaction effect between self-efficacy and treatment condition suggested by the results obtained for Purpose 1 and Purpose 2. Details are explained in the Results section.

Group Equivalence at Study Onset

A chi-square test was used to examine group equivalence at study onset. No significant differences for any measures were observed between treatment groups prior to the start of voice therapy (see Table 4). The frequency of occurrence of vocal fold lesions did not differ significantly between groups, $\chi^2(1) = 0.25$, $p = .6$.

Effectiveness of Therapy

For both groups combined, voice therapy was effective, as indicated by mean score reductions from pre- to post-therapy for both VHI and CAPE-V scores. VHI scores reduced a mean of $M = 17$, $SD = 16.60$, that was found to be significant: $t(34) = 6.04$, $p = .0001$. Mean reduction in CAPE-V ratings of $M = 7.43$, $SD = 10.57$ was also significant: $t(27) = 3.7$, $p = .0001 = 3.7\ (27)$, $p = .001$.

All statistical analyses of data were initially performed using SPSS Statistics software version 17 and subsequently IBM SPSS Statistics version 21. Criterion for statistical significance was set at $\alpha = .05$ for both the primary and secondary outcome variables. Experimentwise error was not controlled in this study because of its exploratory nature and because a conservative approach could increase the probability of Type 2 errors and mask clinically meaningful differences that may guide future work.

Results

Purpose 1

Predicting Adherence and Outcomes (Regression Analyses)

Predicting practice. Voice Therapy Self-Efficacy scale, Readiness Ruler Goal Commitment scores, and Session Rating scale scores (i.e., the therapeutic alliance) were entered into a simple multiple regression equation. Shown in Table 5, the overall significance of the resulting model was $p = .012$, $F = 4.26$, $R = .54$, predicting 29% of practice variance (R^2). Within this model, the regression coefficient was significant, $p = .026$, only for Voice Therapy Self-Efficacy scale scores, beta = .394, but not for Goal Commitment, beta = .311, $p = .089$, and Session Rating scale scores, beta = −.199, $p = .248$, such that only self-efficacy predicted unique variance.

Predicting generalization. Voice Therapy Self-Efficacy scale Section 2 (i.e., self-efficacy for generalization) scores, Goal Commitment Scale scores for generalization, and Session Rating scale scores were entered into a simple multiple regression equation. Analysis (see Table 6) resulted in a significant model ($R = .508$, $R^2 = .26$, $F = 3.37$, $p = .032$), with beta values of .56 associated with the therapeutic

Table 4. Group equivalence at treatment onset: Pretherapy or Session 1 values.

Measure	MP4 Group ($M \pm SD$)	Control Group ($M \pm$ SD)	$t(df)$	p
Voice Handicap Index	44.65 ± 23.1	44.11 ± 25.0	0.31(33)	.76
Consensus Auditory Perceptual Evaluation of Voice–V (pretherapy)	17.53 ± 9.9	19.27 ± 12.3	0.41(26)	.69
Readiness Ruler Item 1: *overall self-efficacy for practice*	8.06 ± 2.0	7.72 ± 1.8	0.525(33)	.60
Self-Efficacy scale, Section 1: *self-regulatory self-efficacy for practice*	5.54 ± 1.7	5.73 ± 1.5	0.847(26)	.40
Readiness Ruler Item 1: *overall self-efficacy for generalization*	2.94 ± 2.8	3.44 ± 3.0	0.510(33)	.61
Self-Efficacy scale, Section 1: *self-regulatory self-efficacy for generalization*	4.34 ± 2.5	3.73 ± 2.7	0.684(33)	.50
Goal Commitment scale *(practice)*	4.42 ± 0.62	4.52 ± 0.45	0.54(33)	.59
Readiness Ruler Item 2 and 3 average: *goal commitment (practice*)	8.22 ± 2.3	8.31 ± 1.2	0.23(24.2)	.82
Goal Commitment scale *(generalization)*	3.87 ± 1.1	4.17 ± 0.75	0.85(26)	.41
Readiness Ruler Item 2 and 3: *goal commitment for generalization*	5.64 ± 3.7	5.28 ± 3.7	0.29(330)	.77
Session Rating scale *(therapeutic alliance)*	9.24 ± 0.8	9.05 ± 0.88	0.64(33)	.53
Generalization (*% target voice use)*	0.58 ± 2.4	3.33 ± 14.4	0.79(33)	.44

Table 5. Multiple regression of practice onto social–cognitive variables.

Variable	*B*	*SE B*	β	*t*	*p*
Self-efficacy	1.688	0.719	.394	2.346	.026*
Session Rating Scale (therapeutic alliance)	–1.56	1.32	–.199	–1.178	.248
Goal commitment	1.17	0.669	.311	1.755	.089

Note. $R^2 = .292$ ($p = .012$).
*$p < .05$.

alliance ($p = .005$) and beta values of .08 ($p = .67$) for goal commitment and .086 ($p = .64$) for self-efficacy scores, respectively. Thus, only Session Rating scale scores uniquely predicted generalization variance.

Purpose 2

Effect of MP4 Support: Group Differences in Adherence, Motivation, and Outcome

Effect of MP4 support on adherence. Participants in the MP4 group achieved significantly greater generalization by Session 4 ($p = .03$), corresponding to a moderately large effect size of .77 (Cohen's *d*). There was no group difference in practice frequency participants ($p = .041$). Group differences are shown in Table 7.

Effect of MP4 support on social–cognitive variables. Consistent with MP4 participants' greater generalization behavior, overall self-efficacy for generalization was also significantly greater for MP4 participants than for control participants ($p = .05$). This difference corresponded to a moderately large effect size (Cohen's $d = .71$). Likewise, corresponding to an absence of differences in practice frequency, no measures of self-efficacy for practice differed by group. Interestingly, MP4 participants rated the quality of the therapeutic relationship significantly higher ($p = .01$), yielding a large effect size (Cohen's $d = .94$). No significant group differences were noted on either measure of goal commitment.

Effect of MP4 support on voice therapy outcomes. At study completion, average reduction in VHI scores was greater for the MP4 participants than for the control group. Also, CAPE-V scores were, on average, lower for MP4 participants than for control participants at the end of four sessions. However, contrary to the study hypothesis, these differences were not significant.

Table 6. Multiple regression of generalization onto social–cognitive variables.

Variable	*B*	*SE B*	β	*t*	*p*
Session Rating Scale (therapeutic alliance)	13.54	4.48	.560	3.045	.005**
Goal commitment	–2.538	5.99	–.082	–4.23	.67
Self-efficacy	–1.124	2.36	–.086	–0.475	.63

Note. $R^2 = .258$ ($p = .032$).
**$p < .01$.

Exploratory Analysis

Although this was not a study hypothesis, we examined whether patients' perceived vocal handicap severity determined how much they practiced or adhered to generalization. However, in regression analysis, initial VHI scores were not significantly correlated with practice ($r = .007$, $p = .929$) or generalization ($r = -.17$, $p = .306$).

Secondary Analysis: Interaction Effect between Self-Efficacy and Intervention Type

On average at Session 4, MP4 participants had achieved 16.37% more generalization than the control participants regardless of their level of initial self-efficacy for generalization in barrier conditions when entering the study ($p = .034$). Given the significant effect of treatment condition on generalization and overall self-efficacy for generalization, further analyses were performed to examine whether self-regulatory self-efficacy interacted with the treatment condition. Voice Therapy Self-Efficacy scale (Section 2: Generalization) scores, treatment condition, and the interaction term of these variables were used as independent variables in a regression procedure with generalization as dependent variable. Self-regulatory self-efficacy for generalization and treatment condition was found to interact (beta = .75), as indicated by significant interaction term ($p = .012$) and *F* change for the model at 5.99 ($p = .003$).

To understand the nature of this interaction, regressions of self-efficacy scale ratings for generalization were run separately by condition to examine how the relationship between initial self-efficacy scale ratings for generalization and generalization differed by treatment group. In the control condition, self-regulatory self-efficacy was predictive of generalization such that an increase of one point on the Voice Therapy Self-Efficacy scale resulted in a nearly 10% increase in generalization as indicated by the unstandardized beta coefficient value of 9.79 ($p = .04$), and this explained 23% of the generalization variance ($F = 4.84$). However, in the video condition, a similar relationship was not found, as indicated by a nonsignificant slope of the regression coefficient ($B = -.069$, $p = .81$). On average at Session 4, MP4 participants had achieved 16.37% more generalization than the control participants regardless of their level of initial self-efficacy for generalization in barrier conditions when entering the study ($p = .034$).

Because all video participants achieved greater generalization than controls, the effect of treatment condition was further examined by level of self-efficacy at Session 1. Regression analyses were completed with generalization as dependent variable and treatment condition as independent variable according to level of self-regulatory self-efficacy for generalization at treatment onset. High initial self-regulatory self-efficacy was defined as scores at or above 6.5 on the initial Voice Therapy Self-Efficacy scale Section 2 (Generalization), whereas scores less than 6.5 were defined as low self-regulatory self-efficacy. The cutoff of 6.5 was

Table 7. Descriptive statistics, *t*-test result, and *p* value for group differences between the MP4 and control groups at Session 4 (study completion).

Variable	MP4 Group (*M* ± *SD*)	Control Group (*M* ± *SD*)	*t*(*df*)	*p*
Voice outcome				
VHI raw score reduction	20.76 ± 13.6	13.3 ± 18.7	1.3(33)	.19
CAPE-V score reduction	8.86 ± 10[a]	5.85 ± 11.7	0.72(24)	.48
Adherence				
Average no. practice sessions/week	13.9 ± 6	15.9 ± 11.7	0.84(33)	.41
% generalization reported	74.8 ± 19.4	58.4 ± 23.9	2.2(33)	.03*
Social cognitive variables				
Session Rating scale score *(therapeutic alliance)*	9.74 ± 0.37	9.26 ± 0.6	2.8(33)	.01*
Readiness Ruler Item 1 (*overall self-efficacy for practice)*	7.82 ± 2.6	7.61 ± 2.4	0.25(33)	.80
Self-Efficacy scale, Section 1 *(self-regulatory self-efficacy for practice)*	6.13 ± 1.25	6.23 ± 2	0.18(33)	.86
Readiness Ruler Item 1 (*overall self-efficacy) for generalization*	8.0 ± 1.4	6.78 ± 2.1	2.0(33)	.05*
Readiness Ruler Goal Commitment Items *item 2 &3 average for practice*	7.71 ± 2.5	7.9 ± 1.6	0.38(33)	.71
Goal Commitment scale score *for practice*	4.25 ± 0.75	4.43 ± 0.55	0.84(33)	.41
Readiness Ruler Goal Commitment Items *item 2 & 3 average for generalization*	8.07 ± 1.8	7.86 ± 1.7	0.36(33)	.72
Goal Commitment scale score *for generalization*	4.25 ± 0.75	4.43 ± 0.55	0.84(33)	.41

[a]$N = 17$.

*$p < .05$.

informed by pilot data that had yielded an average score of 7.2 for adherent patients and 5.2 for dropouts (van Leer & Hapner, 2005). Individuals who started treatment with poor self-regulatory self-efficacy for generalization achieved 28% greater generalization in the video condition than in the control condition, whereas those with high initial self-efficacy did not have an interaction effect with condition; that is, they did not make greater gains in the video condition than in the control condition. For individuals who started therapy with low self-regulatory self-efficacy, treatment condition significantly predicted generalization (beta = .613, $p = .001$). This relationship was not found for individuals who had high self-efficacy scores ($B = -.15$, $p = .72$). Consistent with the hypothesis of this study that video support would improve generalization, these interaction findings further specify for whom this intervention is particularly useful: individuals with low initial self-efficacy.

Qualitative Results

Patient comments regarding MP4 support were comparable to our previous qualitative findings regarding utility of clinician- and self-as-model MP4 videos (van Leer & Connor, 2012). As in our previous work, participants reported that the videos aided and motivated practice. Participant perceptions of peer model interviews, which had not been used in our previous research, were positive: Examples are provided in Table 8. Two patients found the devices not to be user-friendly.

Discussion

This study examined the prediction and manipulation of patient adherence to voice therapy, with two hypotheses: (a) Adherence can be predicted from a triad of social–cognitive factors measured at treatment onset, and (b) a mobile intervention can positively influence adherence behavior, associated social–cognitive beliefs, and treatment outcome. Results partially supported these hypotheses with three major findings. First, social–cognitive factors were found to be significant determinants of patient adherence in regression analysis. Second, mobile MP4 therapy videos significantly improved generalization, self-efficacy for generalization, and the therapeutic alliance when compared to written instructions in a randomized trial. Corresponding effect sizes were moderately large to large. Third, secondary analysis revealed that MP4 support was particularly useful to individuals with low initial self-efficacy for generalization;

Table 8. Excerpts of qualitative results from MP4 semistructured interviews: peer model videos.

Theme	Content category (no. participants)	Excerpt/example
Normalization	Testimonials decrease shame (2) and normalize challenge (1) of voice therapy	"It took the shame away to see someone in the field (singing) have the same issues." "They were frustrated too."
Motivation	Video testimonials are encouraging and provide vicarious learning (11)	"What was most useful was hearing the woman who was in my situation"; "it was nice to hear how she dealt with it and how she solved it."
		"I love the testimonials. I like the people in them. It gives me hope."
		"The more you can relate, the better."
		"Everyone has to find their own way to monitor and change their voice."

they achieved significantly higher generalization in the MP4 group than the control group. Thus, study results suggest that voice therapy adherence is to a significant extent governed by the degree to which patients believe they can change relevant vocal behavior and by the support they receive in doing so.

Predictive Role of Social–Cognitive Factors

The predictive role of social–cognitive factors in this study is consistent with theoretical and applied studies of volitional, goal-directed learning and behavior change outside of the field of speech pathology, including health behavior and academic learning (Anczak & Nogler, 2003; Bandura, 1997; Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; DiIorio et al., 2006; DiMatteo, 2004; DiMatteo, Giordani, Lepper, & Croghan, 2002; Dishman & Buckworth, 1996; Lemoncello, Sohlberg, Fickas, Albin, & Harn, 2010; Locke & Latham, 2002; Meichenbaum & Turk, 1987; Pajares & Schunk, 2001; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). Explaining 29% of practice and 25% of generalization variance, social–cognitive factors are interpreted as clinically meaningful determinants of patient adherence behavior in voice therapy. Specifically, self-efficacy was a significant predictor of practice variance in both groups and of generalization variance in the control group. Furthermore, the significant predictive role of the therapeutic alliance (measured at Session 1) in determining generalization suggests that this relationship may develop more quickly in voice therapy than in psychotherapy, wherein the alliance becomes predictive after three sessions (Horvath, 1991).

A finding related to previous research findings was the absence of a relationship between VHI scores and adherence behavior in our exploratory analysis. In previous research, typical clinical voice and demographic measures have not been predictive of patient adherence to session attendance (Hapner, Portone,-Maira, & Johns, 2009; Portone, Johns, & Hapner, 2008; Smith, Kempster & Sims, 2010) or have yielded conflicting results (Duarte de Almeida et al., 2013). Taken together, study results provide preliminary evidence that perceived vocal limitations may lead individuals to seek voice care, but social–cognitive factors determine their readiness to change vocal behavior.

Although a large amount of adherence variance was explained by social–cognitive factors, a greater percentage was not. In order to build a comprehensive model of voice therapy adherence, approximately 75% of the remaining variance requires explanation. Because over 200 factors potentially contribute to the completion of physical exercises (Dishman & Bosworth, 1996; Lemoncello et al., 2010), not all of these factors are social–cognitive in nature, and not all are mutable (Schwarzer et al., 2008). For example, disorder-specific personality traits and past vocal behavior (Roy, Bless, & Heisey, 2000) may affect adherence, but these cannot be altered through therapy. A comprehensive model of adherence has the potential to inform both the development of adherence strategies and the determination of patient candidacy for behavioral intervention.

Significant Effects of MP4 Support

As hypothesized, video models increased generalization, overall self-efficacy for generalization, and alliance with the therapist. These findings are consistent with our previous research, which showed a benefit of clinician- and self-as-model videos (van Leer & Connor, 2012), and in studies of self- and peer modeling across behavioral interventions and fluency therapy (Buggey, 2005; Cream et al., 2009, 2010; Dowrick, 1999). Patients' responses to the peer model video (e.g., "What was most useful was hearing the woman who was in my situation") underscore the importance of peer models as a source of vicarious self-efficacy and motivation. The interaction effect between self-efficacy and the MP4 intervention has further clinical implications: Additional support is critical to those with low self-efficacy for voice therapy and possibly unnecessary for those who are confident to adhere.

Positive effects on the therapeutic alliance may have been achieved through the increased goal and task agreement with the clinician, representing two of three dimensions of the alliance (Bordin, 1994). However, patient comments about the benefit of "having the clinician with me all the time" on mobile video also suggest an effect on the third dimension: patient–clinician bond. Mobile clinician videos may be interpreted as an alliance-building approach. One bonus of this approach was that the alliance was improved without teaching clinicians any alliance-building therapy strategies.

The absence of group differences in practice frequency and self-efficacy for practice is unexpected and puzzling. Findings contradict those of our crossover study (van Leer & Connor, 2012). Results cannot be interpreted conclusively because practice duration and quality were not recorded in this study. Thus, participants in the MP4 group may have practiced more accurately or for longer periods of time per practice session than those in the control group, explaining their advantage in generalization. Although a self-report approach presents the initial methodological step in developing adherence measures and remains widely used across health behaviors and medication adherence research (DiMatteo, 2004; Vitolins, Rand, Rapp, Ribisl, & Sevick, 2000), acoustic field recording should be implemented in future studies for objective and perceptual assessment (Granqvist, 2003) of practice and generalization.

Scale Development

Careful scale development is critical to the study of social–cognitive factors in voice therapy. Successful prediction of voice therapy adherence demonstrated a type of scale validity– predictive validity (DeVellis, 1991; DiIorio, 2006) for the Session Rating scale and the Voice Therapy Self-Efficacy scale. The predictive power of a self-efficacy scale varies with its identification of patient-perceived barriers (Bandura, 2006). Consistent with Bandura's recommendations, the Voice Therapy Self-Efficacy scale was composed of such barriers and was indeed predictive of behavior, whereas the Readiness Ruler, a global measure, was not.

In comparing our adherence measures to estimates of adherence in the extant literature, participant responses to Behrman and Roy's compliance questions correlated significantly with practice frequency but not with generalization (Behrman, Ruttledge, Hembree, & Sheridan 2008; Roy et al., 2003). Perhaps patients interpret the term "compliance" in these questions as completion of discreet practice but not as generalization of voice technique. Wording should be taken into account in the future scale development research.

Limitations

There are several limitations to this study that limit the interpretation of results. First, differences could represent a novelty effect of the MP4 player rather than an actual benefit of video examples. Given patients' specific comments regarding the usefulness of video content, this explanation is unlikely. However, to rule out a placebo or novelty effect, an MP4 video condition would need to be compared to an MP4 "sham" condition in which patients would be provided with MP4 players containing written voice-related information but no treatment videos. Second, several participants were eliminated from the study because treatment fidelity was not maintained. Exploratory examination of factors that determine adherence outside of the context of a specific therapy (i.e., without limiting therapist behavior to a particular approach) should be conducted. Third, sample size ($N = 35$) limited the power to determine the contribution of more than one factor per regression equation. The lack of significant unique variance explained by goal commitment may have resulted from its correlation with self-efficacy or from limited statistical power. Last, our inclusion criteria may have resulted in the participation of patients with purely functional dysphonia in both (randomized) groups. If this occurred, effect sizes may have been reduced, because personality characteristics differ between these patients and those who develop mid-membranous lesions (Roy, Bless, & Heisey, 2000). Future research should encompass a wide variety of well-defined voice disorders to build disorder-specific models of adherence behavior.

Clinical Implications

Results of this study provide several preliminary suggestions for clinical practice, in particular, because the study was completed in a working voice clinic. Clinicians may wish to consider some approaches used in this study: assessment of self-efficacy to estimate patients' need for adherence strategies; development of (IRB-approved) peer videos to motivate patients; and use of mobile practice videos to support adherence. The low cost of MP4 players may be worth a line item in a voice clinic budget for those patients who do not own smart phones.

Conclusion

In the field of clinical voice research, this study uniquely identified several patient beliefs that predict and improve adherence through a theory-driven approach. The role of social–cognitive factors was established in relation to understanding voice therapy adherence, and social–cognitive factors may hold relevance for other areas of speech-language pathology. Efficacy of mobile voice therapy videos was also demonstrated, in particular, for individuals with low self-efficacy for voice therapy. This study provides a starting point for moving voice care from an episodic to a continuous model via mobile technology.

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Appendix

Methods Extension: Scale Psychometrics

Reliability

The Voice Therapy Self-Efficacy scale, Goal Commitment scale, and Session Rating scale demonstrated excellent internal consistency as indicated by high values of Cronbach's alpha ranging from .865 to .967. The Readiness Ruler was not examined for internal consistency because it had too few items for such analysis. Spearman correlations were calculated to examine the association between items across scales that measured related constructs. The Readiness Ruler Item 1 and the Voice Therapy Self-Efficacy scale score, two measures of self-efficacy, were significantly correlated with each other for both practice (Spearman's $\rho = .343$, $df = 33$, $p = .04$) and generalization self-efficacy ($\rho = .48$, $df = 33$, $p = .004$). Likewise, the two measures of goal commitment (Readiness Ruler Items 2 and 3 averaged, and the Goal Commitment scale) were significantly correlated for both practice ($\rho = .63$, $df = 33$, $p < .0001$) and generalization ($\rho = .640$, $df = 33$, $p < .0001$).

Validity

The Voice Therapy Self-Efficacy scale was recently developed (van Leer & Hapner, 2005) according to established methods of self-efficacy scale development (Bandura, 2006); scale items represent patient-reported barriers to practice and generalization. To ensure participant understanding of scale items, participants were asked to "think aloud" when completing scales in the first treatment session: Any item that was unclear was explained to insure validity of responses for all items. This procedure was repeated for all social–cognitive scales in this study; no difficulties were encountered.

Construct validity of the Voice Therapy Self-Efficacy scale was examined through a convergent validity approach as outlined by DeVellis (1991) and Dilorio (2006): Scales that measure theoretically related constructs should yield significant correlation of participant scores. In our study, the constructs of self-efficacy and goal commitment are thought to be theoretically closely related aspects of motivation for change (Earley & Lituchy, 1991; Hollenbeck, Klein, O'Leary, & Wright, 1989; Miller & Rollnick, 2002). Therefore, Spearman correlations were calculated for scores obtained at Session 4, when participants were most familiar with voice therapy tasks. Indeed, Voice Therapy Self-Efficacy scale scores for practice significantly correlated with averaged goal commitment items of the Readiness Ruler ($\rho = .468$, $p = .005$) and with the Goal Commitment scale ($\rho = .428$, $p = .01$) for practice, as well as with overall self-efficacy captured by Readiness Ruler Item 1 ($\rho = .567$, $p = .04$). For generalization, Voice Therapy Self-Efficacy scale scores were significantly correlated with the averaged Readiness Ruler Goal Commitment score ($\rho = .559$, $p = .000$) and with the Goal Commitment scale scores ($\rho = .361$, $r = .033$) and were moderately and significantly associated with Readiness Ruler Item 1 (overall self-efficacy for generalization; $\rho = .48$, $df = 33$, $p = .004$). Association between the Readiness Ruler Goal Commitment average score (Items 2 and 3) and Goal Commitment Scale score was moderate to large for both practice ($\rho = .63$, $df = 33$, $p < .0001$) and generalization ($\rho = .640$, $df = 33$, $p < .0001$), indicating that these measures of goal commitment may be redundant. Therefore, for prediction of adherence and outcomes, those scores most closely associated with the dependent variable were included in regression analysis.

Practice and Adherence Measures

Roy and Behrman's retrospective compliance questions were highly and significantly correlated ($\rho = .85$, $p < .0001$); they differed only in response format (i.e., Roy's question used a Likert response format, whereas Behrman applied a 0 to 10 equal-interval scale). Participant scores on these questions were strongly and significantly associated with total practice frequency ($\rho = .504$, $p = .002$, and $\rho = .619$, $p = 000$, respectively) but not with generalization, indicating that these retrospective questions represent participant perceptions about practice and not generalization.

A significant moderate negative correlation between self-report of generalization and final VHI scores ($\rho = -.378$, $p = .02$) indicated that greater generalization was associated with reduced voice handicap outcomes. This finding provides some support for the use of self-report of generalization, but true validity testing would require comparison of self-report to field recordings of voice use outside of the voice clinic.