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Computerized Script Training for Aphasia: Preliminary Results

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Abstract

Purpose—This article describes computer software that was developed specifically for training conversational scripts and illustrates its use with three individuals with aphasia.

Methods—Three participants with chronic aphasia (Broca's, Wernicke's and anomic) were assessed before and after nine weeks of a computer script training program. For each participant, three individualized scripts were developed, recorded on the software, and practiced sequentially at home. Weekly meetings with the speech-language pathologist occurred to monitor practice and assess progress. Baseline and post-treatment scripts were audio-taped, transcribed, and compared to the target scripts for content, grammatical productivity and rate of production of script-related words. Interviews with the person with aphasia and their significant other were conducted at the conclusion of treatment.

Results—All measures (content, grammatical productivity and rate of production of script-related words) improved for each participant on every script. Two participants gained more than five points on the Aphasia Quotient of the Western Aphasia Battery. Five positive themes were consistently identified from the exit interviews - increased verbal communication, improvements in other modalities and situations, communication changes noticed by others, increased confidence, and satisfaction with the software.

Conclusion—Computer-based script training potentially may be an effective intervention for persons with chronic aphasia.

Aphasia requires long-term treatment to ensure participation in a full range of vocational, recreational and social activities. In the United States, most speech and language therapeutic intervention occurs during the acute stage of aphasia. However, it is during the chronic stage, when reduced resources severely limit available services, that individuals with aphasia often learn the full meaning of being “aphasic” in a communicating world. Those affected by aphasia report social isolation, loneliness, loss of autonomy, restricted activities, role changes, and stigmatization (Black-Schaffer & Osberg, 1990; Hermann, Johannsen-Horback, & Wallesch, 1993; LeDorze & Brassard, 1995; Parr, 1994; Parr, Byng, Gilpin, & Ireland, 1997; Sarno, 1993, 1997).

For these reasons, it is essential that we identify innovative and cost-effective ways for individuals with aphasia to continue to receive much needed but often unavailable help beyond the acute stage of this disability. A program that uses computer treatment as a cost-effective

medium for therapy, emphasizes the development of conversational skills, and facilitates participation in everyday life activities, may have positive implications for individuals with aphasia.

An extensive literature exists concerning treatment for aphasia (see for e.g., Cherney & Robey, 2001) with emphasis traditionally on improving linguistic processing. The results of individual studies and meta-analyses (Robey, 1994, 1998), together with expert opinion (Albert, 1998; Holland, Fromm, DeRuyter, & Stein, 1996), indicate that individuals with aphasia benefit from treatments that focus on improving linguistic skills. However, even in the presence of linguistic gains, people with aphasia experience residual communication problems that have a significant impact on their daily lives. As a result, there has been an important recent shift from traditional approaches that focus on treatment of the language impairment to more socially-oriented approaches that enhance the ability to live successfully with aphasia's effects on daily life. A major goal is to facilitate participation in personally relevant activities, and to achieve and maintain a good quality of life

Script training is a functional approach to aphasia therapy that can facilitate participation in personally relevant activities. Scripts guide and facilitate identification of participants and actions involved in a social situation (Sharkey & Mitchell, 1985; Walker & Yekovich, 1984). Script knowledge includes understanding, remembering and recalling the temporal organization of events in a routine activity. Research has indicated that script knowledge is not seriously compromised by aphasia, at least when the language deficit is mild to moderate (Armus, Brookshire, & Nicholas, 1989; Cannito, Jarecki, & Pierce, 1986; Germani & Pierce, 1992; Hough, Pierce, & Cannito, 1989; Lojek-Osiejuk, 1996; Ulatowska, Freedman-Stern, Weiss-Doyle, Macaluso-Haynes, & North, 1983), thus making individuals with aphasia candidates for script training.

Script training methodology, as we approach it, is situated in instance theory of automatization (Logan, 1988). Instance theory suggests that automaticity of skills is achieved by retrieving memories of complete, context-bound, skilled performances. In this view, many highly routine tasks are more appropriately practiced as a whole task, rather than being broken down into its component sub-skills.

Holland and colleagues (Holland, Milman, Munoz, & Bays, 2002) initially developed and tested a script training approach with six participants with aphasia (3 conduction, 2 Broca's, and one primary progressive aphasia) using a multiple baseline single subject design. Scripts were specifically designed to meet a communicative need of each participant. For example, one individual's script concerned giving directions to his home over the phone; another involved conversational routines for initiating and maintaining dialogue with strangers. All participants learned their respective scripts in 4–34 sessions. There was little generalization to traditional aphasia measures of language assessment measured by the Western Aphasia Battery (WAB) (Kertesz, 1982) or the Boston Naming Test (BNT) (Kaplan, Goodglass, & Weintraub, 2001).

More recently, Youmans, Holland, Munoz, and Bourgeois (2005) used a single subject, multiple baseline design across behaviors to examine the effects of the script training approach with two persons with non-fluent aphasia. Scripts were trained one phrase at a time, using a cuing hierarchy that began with simultaneous production with the clinician, and ended with independent production. Scripts were considered mastered when they were produced at the initiation of the session, without cuing, with 90% accuracy, for two consecutive sessions. When a script was mastered, training of the next script was begun, until all three scripts had been mastered. Following script mastery, scripted speech was practiced in conversation, both with the clinician and with novel conversation partners.

Behaviors of interest were the percent of the script performed correctly, error production measures, speaking rate and total word production (Youmans et al., 2005). Both participants produced each of their three scripts consistently with 97% to 100% accuracy at the end of script training. Script performance improved only as training on each specific script was implemented, while baseline measures for other scripts remained low and stable. Thus, it was suggested that script training resulted in acquisition of automatized, effortless production of scripted speech, both in therapy situations and with novel conversation partners. While “islands of automatic speech produced more fluently” were anticipated, changes in underlying linguistic competence were not expected. Therefore, the authors did not report performance on traditional standard language measures such as the WAB (Kertesz, 1982) or the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass, Kaplan, & Barresi, 2001).

Scripts are designed to help speakers with aphasia use short self-chosen monologues and dialogues in natural, conversational contexts. Training scripts are basically written or dictated by the person with aphasia, with modifications suggested by the clinician. Thus, training is largely under the control of the person with aphasia. To promote automatization of script use, cue-based massed drilling of the entire script is required. This massed practice and drill can be accomplished in a cost-effective manner by using computers.

There is an existing and well-documented body of literature to support the positive effects of computer treatment for people confronting the long-term effects of aphasia (Katz, 2001; Loverso, Prescott, & Selinger, 1992). Additionally, several studies have established that people with aphasia are able to use computers independently with minimal therapist intervention (Katz & Wertz, 1997; Mortley, Enderby, & Petheram, 2001)

This article presents a computer software program, AphasiaScripts™ (© 2007, Rehabilitation Institute of Chicago), that was developed specifically for script training. This computer software is different from current aphasia treatment computer programs which typically focus on tasks at the single word level including verbal and written word-finding, single word auditory comprehension skills, and single word visual recognition and reading comprehension (Fink, Brecher, & Schwartz, 2002; Katz & Wertz, 1997; Mortley et al., 2001; Pedersen, Vinter, & Olsen, 2001; Petheram, 1996; Raymer, Kohen, & Saffell, 2006). In an editorial on computers in aphasia, Petheram (2004) noted that “there is a big difference between, for example, retrieving a word in response to a picture presented in a treatment context and retrieving the same word in the course of everyday conversation” (pp.189). AphasiaScripts™ provides a more realistic conversational context for practicing language skills rather than working on single word tasks.

The purpose of this article is to provide a detailed description of AphasiaScripts™ and the training protocol that was employed in a study that assesses the positive effects and utility of the program. In this initial paper, we present data from three individuals whose performances were fairly prototypical of the larger group to illustrate the use of the software and provide a blueprint for computer-based script training.

Computerized Conversational Script Training

AphasiaScripts™ is a software program using an animated agent that serves as a virtual therapist for script training for individuals with aphasia. The virtual therapist is programmed to produce natural speech with correct movements of the speech articulators (Cole et al., 2003). AphasiaScripts™ provides repeated opportunities for the client to practice individualized conversations that have been pre-recorded. Practice occurs with various forms of assistance (written word, choral speaking, oral-motor movements of the virtual therapist), depending upon the clients' needs. Script practice has three phases: first the client listens silently to the entire script; next, each sentence that is part of the client's conversation turn is

practiced repeatedly; and finally the entire conversation is practiced in turn-taking with the virtual therapist. Figure 1 shows examples of screens from the AphasiaScripts™ software program.

The sentence practice is a modified version of oral reading in which the person with aphasia repeatedly reads aloud sentences in unison with the therapist (Cherney, 1995; Cherney, Merbitz & Grip, 1986). In AphasiaScripts™, the sentence appears on the screen while the virtual therapist reads the sentence aloud. Next, the client reads the sentence twice in unison with the virtual therapist. If there are any problems with specific words, these words can be practiced repeatedly by clicking on the word. Finally, the whole sentence is read aloud independently by the client. This response is recorded by the computer and clients have the option to listen to the sentences they have uttered.

Conversational practice is carried out with varying degrees of support being provided by the virtual therapist. Maximum support comprises the written sentence with each word highlighted when it is spoken by the virtual therapist. Cues are faded over time – the virtual therapist’s voice, the written word, and movement of the articulators – according to individual needs of the client. Finally the client practices the conversation without cues, as in a real conversation. The software permits clients to maintain control over their own practice sessions. That is, they can choose to practice individual words, sentences, or the entire script as often as they wish.

Authoring

Each individualized script is recorded by a normal speaker. Scripts can be up to 20 turns long, with each turn being initiated either by the client with aphasia or by the virtual therapist. Scripts also may be monologues, such as telling the story of their stroke or giving a short lecture. Once a script has been developed it is typed into the program and recorded. Each spoken word is aligned automatically with each written word. Pause time between sentences and the amount of time allotted for each utterance can be adjusted to provide individualized optimal speaking time for each participant.

Data Summarization

During practice, each key stroke is automatically recorded by the computer and then summarized to provide daily and weekly practice logs showing how much time was spent in each part of the program as well as the number of times each sentence was practiced. In addition, speech attempts made by the client with aphasia are digitally audio-recorded, providing the speech-language pathologist with another means of assessing change over time.

Treatment Protocol

Table 1 shows the treatment protocol that is used for the development, assessment and training of the scripts for each client.

Weeks 1–5: Development and Automation of Personal Scripts—The initial four weeks of the treatment program are devoted to the development of the conversational scripts by a speech-language pathologist (SLP) in partnership with the individual with aphasia. Sessions are once weekly for approximately one hour. First, a needs assessment is conducted with the client and his/her significant other to identify daily activities and associated conversational requirements. The client identifies and prioritizes three script scenarios. Based on the input of the client, the SLP writes highly individualized initial drafts that are subsequently reviewed and modified several times until the client is satisfied with its content. Scripts target routine communication events based on the client’s life-style needs. One of the three scripts is a monologue, such as telling a story and the other two scripts are dialogues with the client with aphasia being a responder in one and an initiator in the other. The SLP then

records each script on to a laptop computer that is loaned to the client for home practice. Scripts are recorded at a rate appropriate for each particular client.

Week 6–15: Script Practice—Baseline measures are taken for each script to measure stability. These measures are taken with the written script available to the client and with the SLP reading aloud the lines of the virtual therapist. Then, the SLP instructs the client in the use of the computer and its software in a one hour session using the client’s first script. The client agrees to work on scripts at home for a minimum of 30 minutes per day. Practice begins with maximum cues including visual cues of the highlighted words, the sound of the words, and the opportunity to observe appropriate articulation for each word. The client is responsible for progressively removing the cues as follows: the sound is turned down and practice is only with two visual cues; the view of the articulators is removed; and finally all cues are removed. Each script is practiced for three weeks. The client makes weekly visits to the SLP who observes the client practicing for 30 minutes to ensure that practice has been proceeding correctly. The SLP also administers weekly language probes to monitor progress and downloads computer data regarding amount of home practice.

Case Examples

Participants

We report on three participants who had aphasia subsequent to a left-hemisphere stroke confirmed by medical history, and Computerized Tomography or Magnetic Resonance Imaging. Participants were at least six months post stroke. They were right hand-dominant, with no history of other pre-morbid neurological or psychiatric disorders. The participants all had completed at least twelfth grade and were literate in English prior to their strokes. Visual acuity was no worse than 20/100 corrected in the better eye; auditory acuity was no worse than 30 dB HL at 500, 1000 and 2000 Hz, aided in the better ear. All participants provided written informed consent under the approval of the Northwestern University Institutional Review Board

Participant 1 was a 65 year old right-handed female with a diagnosis of moderately-severe Broca’s aphasia following an ischemic stroke 4 years prior to her participation in this study. Participant 2 was a 78 year old right-handed male with a moderate Wernicke’s aphasia following an ischemic stroke 19 months previously. Participant 3 was a 65 year old female with a moderate anomic aphasia following an ischemic stroke 18 months prior to her participation in this study. Type and severity of aphasia were determined by performance on the WAB (Kertesz, 1982) and Table 2 shows their baseline Aphasia Quotient scores.

Following enrollment, the participant completed the treatment protocol as described previously and as outlined in Table 1. The three scripts developed for each participant are included in Appendix A.

Compliance

Because much of the computer practice was completed independently, mechanisms to ensure compliance were developed. Log on and log off times were time stamped on the computer and lists of all stimuli that were practiced were generated and stored. In addition, participants were asked to complete written practice logs. These were reviewed by the SLP at each clinic visit and any discrepancies between the computer records and the practice logs were discussed with the participant. Although there was some discrepancy between the participant logs and the computer summary charts, all exceeded the agreed upon 30 minutes of daily practice time (i.e. 3.5 hours per week). According to the computer logs, participants 1, 2 and 3 practiced an average of 7.4 hours, 5.8 hours and 4.71 hours per week, respectively, over the nine weeks.

Results

Baseline and post-treatment scripts were audio-taped, transcribed, and compared to the target scripts for content, grammatical productivity and rate. Measures of content included number and percent of script-related words. Grammatical productivity was measured by total number of script-related morphemes, nouns (excluding pronouns), verbs and modifiers. Rate was defined as the number of script-related words produced per minute. Additional or extraneous words including empty words or comments to the SLP were not counted in the measurement of rate. Pre- and post-scripts were scored by two of the authors (LC, ASH). Twenty-five percent of the scripts were rescored independently by two additional trained raters to establish inter-rater reliability, which was more than 96% on each measure. In addition, baseline stability was determined over two or three trials and measured by the number of script-related words. Baseline scores were relatively stable. For Participant 1, baseline scores were as follows: 12, 12, and 12 for script 1; 24, 26, and 29 for script 2; 14, 11 and 12 for script 3. For Participant 2, baseline scores were as follows: 13, 5 and 10 for script 1; 7 and 6 for script 2; 19, 16 and 15 for script 3. For Participant 3, baseline scores were as follows: 12 and 28 for script 1; 27, 29, and 22 for script 2; 30, 28, and 25 for script 3.

Standardized testing was completed before and after nine weeks of script training using the WAB (Kertesz, 1982), Communication Abilities of Daily Living – 2 (CADL-2) (Holland, Fratalli, & Fromm, 1999) and the Quality of Communication Life Scale (Paul-Brown, Frattali, Holland, Thompson, & Caperton, 2003). Additionally, at the time of the post-treatment assessment, an exit interview was conducted with the participant and/or significant other to determine their perception of change resulting from the script training, and their satisfaction with the treatment program. Feedback regarding modifications to improve the computer treatment program was also solicited.

Figure 2–Figure 4 show each participant’s first baseline script performance and performance following three weeks of training for each measure for each script. Measures for the target scripts are also shown where appropriate. Improvements were seen for all measures on all three scripts for each participant.

For Participant 1, who had non-fluent aphasia, improvements were characterized by the inclusion of more scripted content words, including nouns, verbs and modifiers. She produced more complete sentences. For example, in a monologue about her family at baseline she stated “//two boys no-no / girls / two / one.” Following three weeks of training with the same script she stated “We have 3 children, two girls and one boy.” In addition, she was able to produce these script-related words faster. At baseline of her first script she produced 6.9 script-related words per minute; she achieved a rate of 50.6 script-related words per minute at the end of training on her final script.

Participants 2 and 3 (both of whom had fluent aphasia) demonstrated reductions in the amount of empty speech and circumlocutions following training on each script. This was particularly evident in the changes in percent script-related words. For example, Participant 3 produced over 95% of script-related words following training on scripts 2 and 3. The same participant showed improved sentence form with use of a larger number of appropriate grammatical morphemes. This is evident in the following exchange pre- and post-treatment:

Pre-Treatment

Participant: You like // you like / ss / no can’t / on the //

Animated Therapist: What else?

Participant: I / I uh / I uh / I'll / in a / water watering / of a watering // water water uh sorry

Post-Treatment

Participant: “you could see the reflection on the water”

Animated Therapist: “What else?”

Participant: I'm working on a couple of other paintings

Although overall rate of speech for both participants 2 and 3 did not change, the number of script-related words increased, as did the rate of script-related words per minute.

Table 2 shows the results of standardized testing for each participant. Participants 1 and 3 improved more than five points on the WAB AQ, which is beyond the standard error of measurement for this test. No changes were noted for any of the three participants on the CADL-2. Only Participant 1 showed positive changes on the QCL.

Exit interviews from participants were transcribed and analyzed by two independent reviewers for recurring themes. Five themes were identified as follows: increased verbal communication, improved communication skills evident in other modalities and situations, changes in communication noticed by others, increased confidence, and satisfaction with the computer program. Table 3 provides verbatim examples of each of these themes. Some of the verbatim examples may provide evidence for more than one theme, but they are included in only one category in the Table.

Discussion

The results of this study provide quantitative data showing positive changes in the content, grammatical productivity and rate of script production following training with AphasiaScripts™. These changes are consistent with those previously shown by Youmans et al. (2005) that script training is a potentially efficacious intervention for persons with non-fluent aphasia. Results suggest that positive changes resulting from script training occur regardless of differences in the way in which the scripts are practiced (computer versus therapist-presented). The current study also demonstrates the positive effects of script training with individuals with fluent aphasia.

It was interesting that two of the three participants in the script training made more than a five point gain on the Aphasia Quotient of the Western Aphasia Battery. This was unexpected, because the underlying rationale for script training is that it is a whole task procedure in which generalization is anticipated only to a similar task. It is possible that the multi-modal nature of the training that engaged auditory and reading comprehension as well as verbal production contributed to this positive language change. However, there was minimal change on the QCL and CADL-2 possibly reflecting insensitivity of these measures to the specific language structures that were practiced by the participants.

The exit interviews with the participants with aphasia and their significant others provide qualitative evidence of change and generalization not only to other situations such as talking on the telephone, but also to reading and writing. Given the multi-modal approach in combination with the oral reading, these results are not surprising. In addition to improvements on the trained scripts, the individuals with aphasia and their significant others commented on overall increased verbalizations. These improvements may be related to the increased

confidence with communication that the participants and their family members reported resulting from practicing the scripts and achieving a degree of self-mastery on them.

None of the participants had used a computer prior to their enrollment into this study. Yet, they all learned to independently set up the computer, open and navigate their way through the program and turn off the computer when they had finished each session. They had few suggestions for modification of the program. Throughout the treatment, the participants reported anecdotes about their verbal interactions with the virtual therapist. These included expressions of frustration as well as enthusiasm directed to the agent whom we all refer to as “Miss Pat” (Personal Animated Therapist).

Script training is based on the theory that massed practice of a whole task is likely to result in automatic and effortless language output. In this study, the computer allowed practice to be undertaken independently by the person with aphasia. Because the scripts were individualized for the participants based on their particular communication needs, they were willing to practice these personally relevant scripts at their own pace. Additionally, they stated that they enjoyed the interaction with the virtual therapist who provided supported stimulation without passing judgment.

This work provides an interesting opportunity to speculate about the future use of virtual therapists in clinical settings. Computer software such as this could ease the burden on clinicians by administering some of the repetitive treatment tasks and monitoring patient responsiveness, thereby freeing the SLP for aspects of clinical practice that are more demanding and require more creativity. With AphasiaScripts™, clinician interaction with the client is essential for the development of the personalized scripts that are relevant to the client’s needs and that are consistent with the client’s language skills. In the future, it may be possible to have a repository of scripts that can be quickly modified for the client. Importantly, the current software also shows that virtual therapists could provide feasible opportunities for intensive practice that is largely precluded by healthcare restraints.

This paper has described a script training software program for individuals with aphasia and has presented data on three participants who have undergone computer based script training. The case series has been conducted without an experimental control group. Further research is currently underway to evaluate the positive effects of computer based script training for a larger heterogeneous group of individuals with aphasia. Exploration of the optimum amount of practice, the content, complexity and length of scripts that are best for each type of aphasia, and the use of personally relevant versus generic scripts is needed. Nevertheless, the combination of quantitative and qualitative positive findings over three participants with aphasia suggest that the computer software, AphasiaScripts™, has the potential to be a cost-effective means of delivering script training.

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APPENDIX A

TARGET SCRIPTS

Please Note: In the following target scripts, names have been changed to protect the personal identity of the person with aphasia (PWA). Similarly, addresses and phone numbers have been left blank.

PARTICIPANT 1

Script 1 Ordering in Restaurant—

Waitress: Welcome to River Field Restaurant. I'm Karen. Can I get you a drink?

PWA: Water is fine. Please bring a straw.

Waitress: Sure. I'll be right back.

PW: Rena, let's split a dinner.

Rena: How about the pot roast?

PWA:: Sounds good to me.

Waitress: Are you ready to order?

PWA: I'll have the pot roast dinner. Gravy on the side.

Waitress: Anything else?

PWA: Bring some extra napkins, please.

Waitress: Okay.

PWA: What is the dessert tonight?

Waitress: We have rice pudding and cheesecake.

PWA: I'll have rice pudding. Whipped cream on the side.

Waitress: Okay. I'll be back with your entrées.

PWA: We need an extra plate.

Waitress: Oh sure. I'll bring that with your dinner.

PWA: Thank you, Karen.

Script 2 Personal Information—My name is Jean Davis.

I live in ____ ____

My address is ____ West 102nd Street

My phone number is _____ - _____

My birthday is November 2nd.

I married Sam in 1961.

We have 3 children.

Two girls and one boy.

Joan lives in Georgia.

Her daughters are Amy and Lisa.

Tom lives in River Field

He has Judy, Ellen and Ann.

Rena lives at home with us.

I used to work as a waitress.

Boy, that's a hard job.

I love to go shopping.

Chicago Ridge is my favorite mall.

I love playing the slots, too.

Script 3 Talking to grandchildren—

PWA: How was school today?

Grandchild: Oh just fine.

PWA: How's your report card?

Grandchild: Really good. All A's and B's.

PWA: Ellen, how was basketball practice?

Grandchild: Good. We just had a game.

PWA: Did you win?

Grandchild: Yeah, we did.

PWA: That's great. Did you score any points?

Grandchild: Oh yes. I got 12 points.

PWA: Judy, how are the piano lessons?

Grandchild: They're okay.

PWA: Play a song for me sometime.

Grandchild: Okay I will.

PWA: Ann, find any dinosaur bones yet?

Grandchild: Oh no, I'm still looking.

PWA: Have you learned anything new?

Grandchild: Yeah, I learned that the oviraptor doesn't really eat eggs.

PWA: That's interesting. You are so smart.

Grandchild: I read it in my book.

PARTICIPANT 2

Script 1: Ordering in a restaurant—

Waitress: Hi, how are you tonight? Would you like a drink?

PWA: Yes. Decaf coffee, please.

Waitress: Do you want soup or salad to start?

PWA: Salad with blue cheese dressing.

Waitress: Are you ready to order your entree?

PWA: Yes, I'd like the hamburger steak with onions.

Waitress: How would you like it cooked?

PWA: Rare.

Waitress: Do you want baked or mashed potatoes?

PWA: Mashed potatoes.

Waitress: That's hamburger steak, mashed potatoes and salad. Any thing else?

PWA: Yes, I'll order dessert now.

Waitress: What would you like?

PWA: Do you have tapioca or rice pudding?

Waitress: No, not tonight.

PWA: Okay then make it butter pecan ice cream.

Waitress: Sure, I'll bring that at the end of your meal.

PWA: Thank you, Jennie

Script 2: Talking to daughter on the phone—

PWA: Hi Linda, how are you doing?

Daughter: Oh, just fine Dad.

PWA: Any progress with the business?

Daughter: " Not a whole lot.

PWA: Has Jim heard from the insurance company?

Daughter: Not this week. Lots of red tape.

PWA: How are the girls?

Daughter: They're good. Busy week for them.

PWA: How is Tracy. doing with basketball?

Daughter: She's doing really well, seems to like it.

PWA: Any skating competitions coming up?

Daughter: There's one in two weeks.

PWA: Is Janet still playing piano and flute?

Daughter: Yes, there's a concert next month. You should come.

PWA: We'll plan to be there. Bye, Linda.

Daughter: Bye, Dad.

Script 3: Telling a story—This is a picture of our dog, Danno, a Great Dane.

The picture was taken in 1960.
 Jake was 8 and Linda was 4 years old.
 One time we went out to dinner.
 We came home and saw the sofa arm was torn off.
 Upstairs, we saw feathers everywhere.
 It was a mess to clean up.
 The vacuum cleaner got clogged.
 The broom and dust pan didn't work, either.
 We didn't have to punish him.
 Danno went to the basement by himself.

PARTICIPANT 3

Script 1: Monologue - Graduation Toast—Hello everyone. We're so glad you could join us today.

I'd like to say a few words about my son Bob.
 Today we celebrate yet *another* one of Bob's accomplishments.
 His MBA from Notre Dame.
 Bob is an amazing man, a wonderful son.
 He has a great sense of humor and just loves to laugh.
 He's a great husband, father, and friend.
 To say the least, he is intelligent and driven.
 That's obvious today, isn't it?
 A mother deserves to brag once in a while!
 Your father and I are so proud of you.
 Here's to Bob!

Script 2: Interests—

PWA: I want to tell you about my new hobby, painting.

Personal Animated Therapist (PAT):: Painting?

PWA: I recently took up watercolor and love it.

PAT: How did you get into that?

PWA: I took a class in Florida. The instructor was very good.

PAT: Have you finished any pieces?

PWA: A picture of a pelican on the water. It's very simple.

PAT: Sounds nice.

PWA: You can see the reflection on the water.

PAT: What else?

PWA: I'm working on a couple of other paintings.

PAT: Where do get your inspiration?

PWA: I sit by the window. It overlooks our magnolia tree.

PAT: Is that where you paint?

PWA: No, I always start with a pencil sketch.

PAT: Have you sold any artwork?

PWA: Well, someone in Florida wanted to buy one.

PAT: That's impressive.

PWA: Ray thinks so. I'm not sure if I want to sell my artwork.

PAT: Oh.

Script 3: Florida Vacation—

PAT: You've got a suntan.

PWA: Ray and I were in Ft. Meyers, Florida.

PAT: On vacation?

PWA: We have a cute, little house that we are planning to renovate.

PAT: What are you having done?

PWA: We are replacing the old windows in the lanni and recarpeting.

PAT: That's a project.

PWA: Not to mention, getting new appliances for the kitchen.

PAT: What do you do when you're not remodeling?

PWA: Mondays, Wednesdays, and Fridays I go to a watercolor class.

PAT: I didn't know you were artistic.

PWA: It's a fairly new hobby.

PAT: What else?

PWA: Well, on Tuesdays and Thursdays, I swim.

PAT: And Ray?

PWA: We'll go out walking together early in the morning. We like to wave at all of the golfers.

PAT: Golfers?

PWA: Oh yeah, our place overlooks a nice golf course.

PAT: Well, PWA! I think I need a Florida vacation!

PWA: Maybe we can work out a rental arrangement.

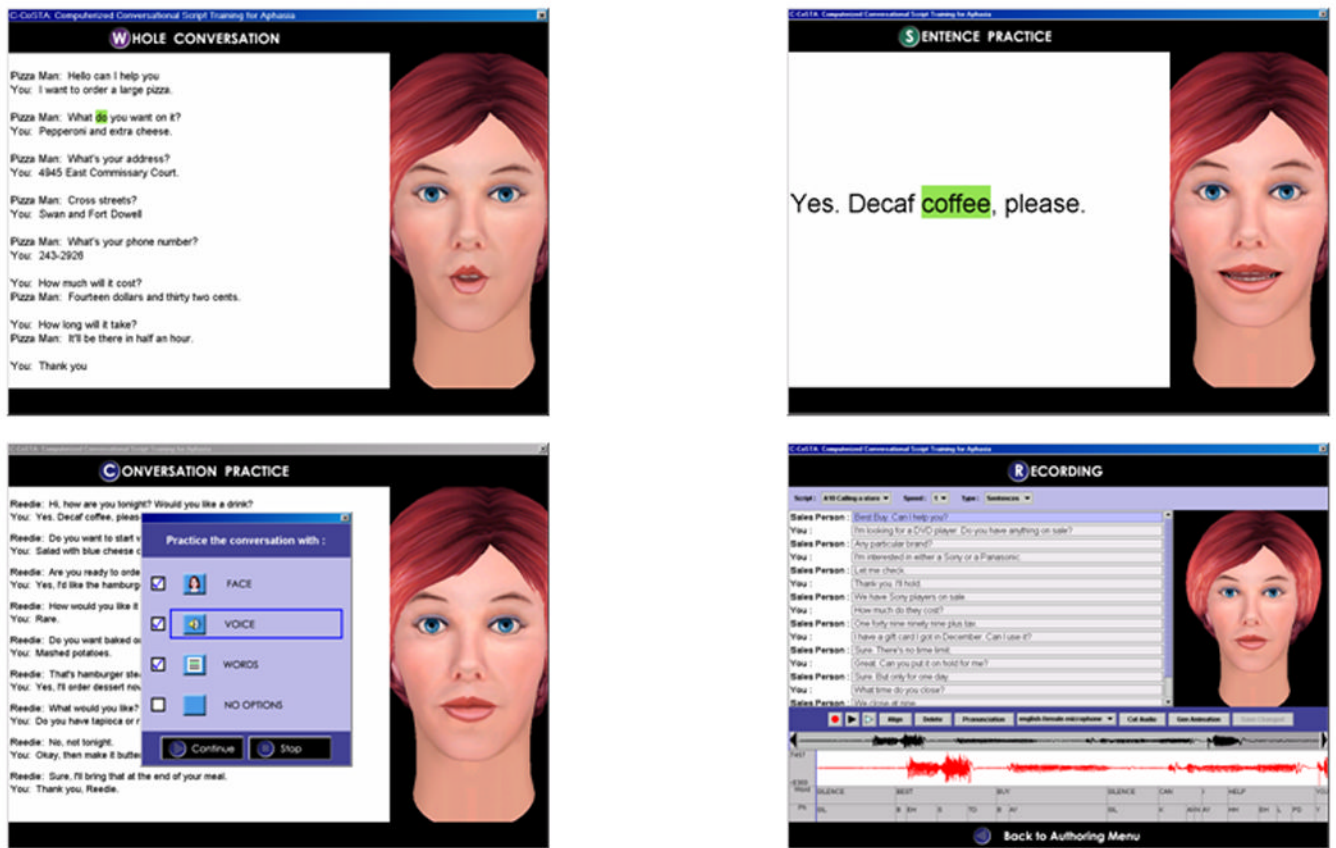


Figure 1. Screens of AphasiaScripts™ Software Program Showing: a) whole conversation; b) sentence practice; c) cues; and d) authoring

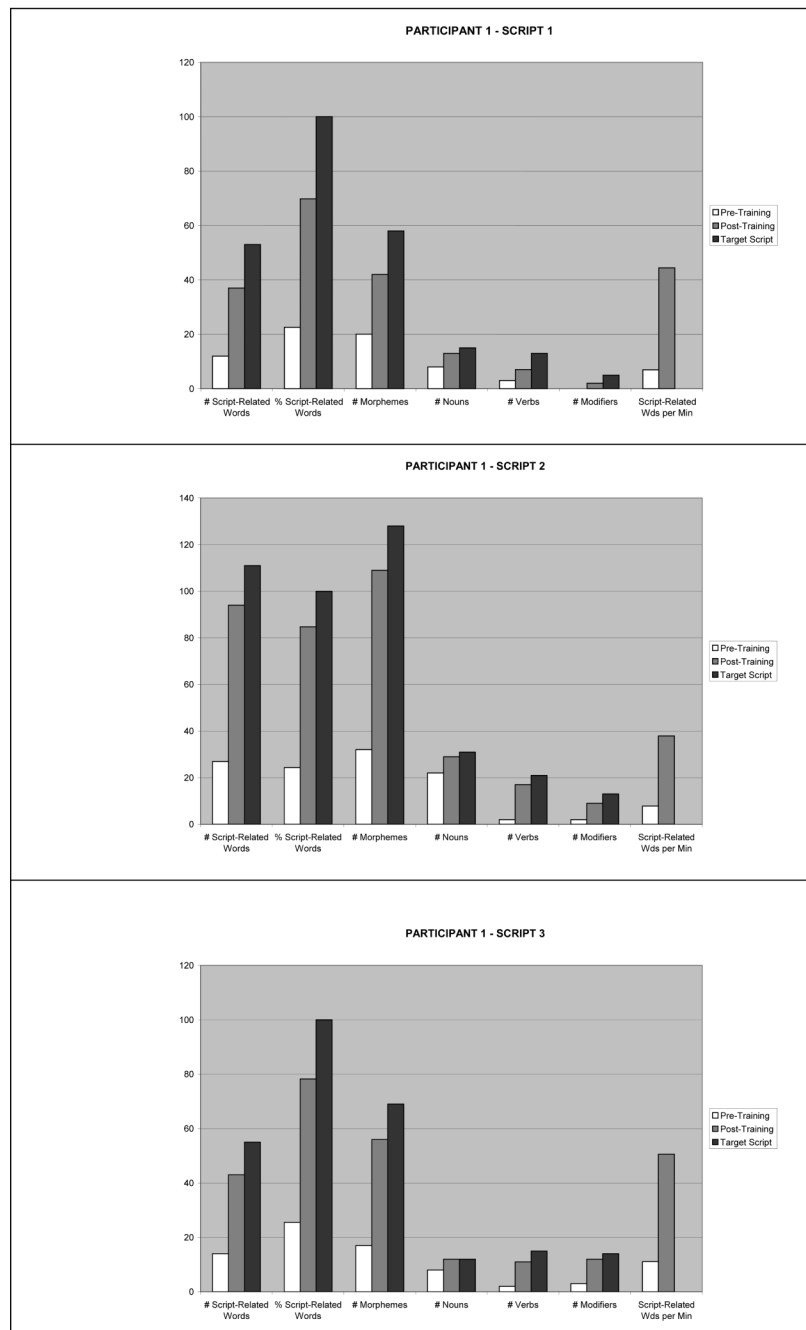


Figure 2. Pre-Treatment and Post-Treatment Script Performance for Participant 1 with Comparison to Target Performance

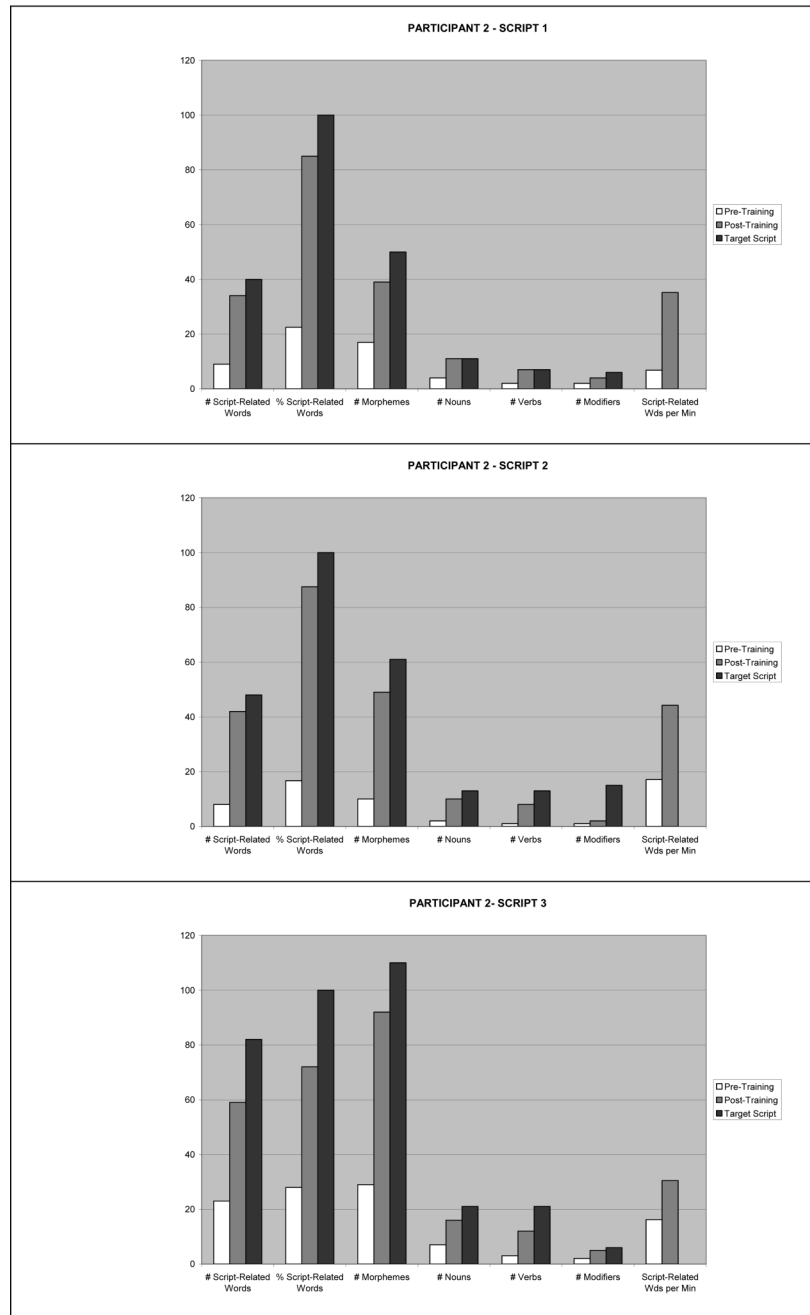


Figure 3. Pre-Treatment and Post-Treatment Script Performance for Participant 2 with Comparison to Target Performance

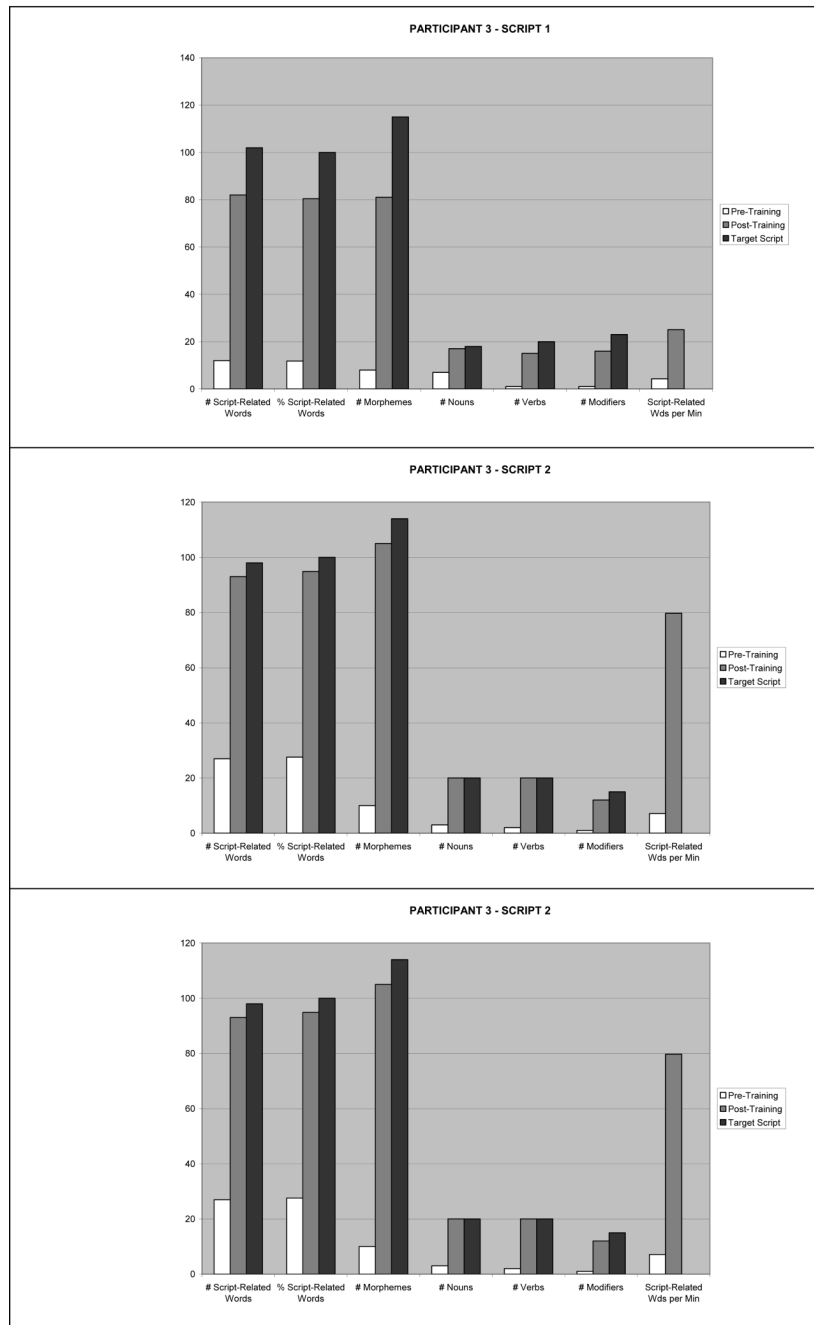


Figure 4. Pre-Treatment and Post-Treatment Script Performance for Participant 3 with Comparison to Target Performance

Table 1

Treatment Protocol Timeline of Activities

• Week -1:	Pre-treatment assessment of speech, language and quality of communication life
• Week 0:	Enroll participant
• Week 1:	Needs assessment and identification of potential script scenarios and prioritization Initial brainstorming for content of scripts
• Weeks 2–4:	Develop three different short scripts or one long script that can be divided into three parts
• Week 5:	Computer automation of script
• Week 6:	Baseline measures of script performance Training on use of laptop computer and software and completion of practice log
• Weeks 7–9:	Home Practice on Script 1 (minimum 30 minutes a day) Weekly measures of script performance
• Weeks 10–12:	Home Practice on Script 2 (minimum 30 minutes a day) Weekly measures of script performance
• Weeks 13–15:	Home Practice on Script 3 (minimum 30 minutes a day) Weekly measures of script performance
• Week 16:	Post-treatment assessment of speech, language and quality of communication life

Table 2

Pre- and Post-Treatment Test Data

	Participant 1 (Broca's aphasia)		Participant 2 (Wernicke's aphasia)		Participant 3 (Anomic aphasia)	
	PRE-TX	POST-TX	PRE-TX	POST-TX	PRE-TX	POST-TX
WAB AQ ¹	50.4	56.7	73.2	69.5	62.8	71.3
Spontaneous Speech	9.0	11.0	16.0	16.0	13.0	17.0
Comprehension	6.4	6.45	8.6	7.55	7.5	7.95
Repetition	3.5	5.5	5.1	4.7	6.9	6.9
Naming	6.3	5.4	6.9	6.5	4.0	3.8
QCL ²	63/85	68/85	54/85	49/85	72/85	72/85
CADL-2 ³ RAW SCORE	63/100	61/100	83/100	83/100	92/100	88/100

¹Western Aphasia Battery – Aphasia Quotient (Kertesz, 1982)²Quality of Communication Life (Paul-Brown et al., 2003)³Communication Abilities of Daily Living-2 (Holland et al., 1999)

Table 3

Exit Interview Themes with Examples

THEMES	PARTICIPANT 1	PARTICIPANT 2	PARTICIPANT 3
Increased verbal communication	<p>C: You were starting to tell me, you've noticed some changes in her, since starting...</p> <p>S: Yeah I think she was able to put together words by herself, a lot easier and she's coming up with phrases, phrases spontaneously, other than what was in the script.</p> <p>P: Yeah</p> <p>C: Any examples you could give me</p> <p>S: Yeah sure, when she's watching TV</p> <p>P: Yeah</p> <p>S: Well in the evening, she'll ask me, she'll say 'shoes.' But now, she's to the point where she'll say, 'take shoes off.'</p> <p>P: Yeah</p> <p>C: So you're saying more words</p> <p>P: Words words</p>	<p>S: ...and the biggest progress is that he can talk in sentences so now he can talk to people better</p> <p>S: Well, it's before when he was in a group he'd answer everybody in one or two words. Now he can say a sentence and he can say a couple sentences and some people don't even realize that he's having a problem. Or before they knew of it</p> <p>P: They don't. Much better basically. And that's good. They don't know</p> <p>S: Even the girl at the restaurant tests him, and the last time we were there she says, "Do you know he said three sentences in a row to me?" Which he didn't.</p>	<p>C: Can you give us some examples of times when, since you started working on the program, your speaking has gotten better?</p> <p>P: Yes / when I first / I can / tek anything / I couldn't talk anything / and / just little bit / maybe one or two / that's I'll say / and now I can / ray lout / lout of things I can talk of 'em /so...</p> <p>S: She can now name our children, which she couldn't do before without being prompted</p> <p>S: I do know she communicates a lot more with me</p> <p>S: But she's much better now getting it out</p> <p>P: and other people too</p> <p>S: Since she started the program. And she's much better now, talking with her friends sometimes</p>
Generalization to other modalities and situations	<p>S: And she's made a few phone calls by herself, too</p> <p>P: Yeah</p> <p>C: Is that since the start of the program?</p> <p>S: Yeah</p> <p>S: She called up a couple of people. Her sister she called up the other day. They were coming over to play cards. So she called up to find out if her sister's husband was going to come. So she dialed the phone and asked her sister, Lenny is his name, 'Lenny come over ?'</p> <p>C: You did it</p> <p>P: Yeah</p> <p>C: All by yourself</p>	<p>C: Now before we started, you weren't ordering on your own in the restaurant.</p> <p>P: No, I wasn't when I started. I do now. I do all the way down.</p> <p>P: And I tree to use the telephone even more now.</p> <p>S: Now he uses the telephone more, a lot more than he did.</p> <p>S: The telephone! Is fabulous. I mean now he - before he wouldn't even go on the phone. And he, he'll say, "Oh, I'm gonna try and take care of that. Now let me try first."</p>	<p>S: She's more eager now. She looks at her mail by herself. Magazines, literature when it comes, advertisements. She begins to see things and sort of read them. Not as good as she could before, of course, before she had her stroke. But she's at least able now to be able to pick out things that she wants to do, wants to see, and understands. Where before she started this program, there was hardly any of that. She couldn't recognize it.</p> <p>S: But one of the biggest things that I've noticed about P, since she started this program is that, her ability to</p>

THEMES	PARTICIPANT 1	PARTICIPANT 2	PARTICIPANT 3
		<p>C: Now what about talking to Nancy (<i>Participant's daughter</i>)? Do you talk to her more now?</p> <p>P: I'm not sure. I talked to her yesterday.</p> <p>S: ... because at first he didn't talk to her at all. It was shortly after you gave him that program, he started talking to her. He talks to her at least once or twice a week</p>	<p>be able to read a little more than what she could before. She now picks up signs, words. She could always read to a degree, a very small degree, the menu in a restaurant, where today I think she pretty well can read the menu as a whole and understand pretty much what's there</p> <p>S: She's expressing herself much better now, with her pen and pencil, which she couldn't do before. She now draws pictures She can now write it, which she couldn't do before. Sometimes she has to ask how to spell a word, but she knows the word that she wants</p>
Improvements noticed by others		<p>C: Have you noticed any changes in the nine weeks, ten weeks, eleven weeks or so you've been coming here, any kinds of changes that you've noticed?</p> <p>P: Well, the people know the people around me know, at least knows more by me.</p> <p>S: Our friends say that he now speaks some sentences, where he didn't do that and they were even counting how many sentences he can say in a row, up to four</p> <p>S: But I've heard it so much in the last couple of weeks from friends, and some of them we haven't seen for... and they say, "Oh, he's doing so much better!" So you know, if it's, I know it's helped him cause I get this report back</p>	<p>S: One of the things that we notice is that people who don't see her on a daily basis, friends of ours, and even from week to week, have told her repeatedly that they see a change from week to week, and have noticed tremendous change.</p>
Increased confidence	<p>S: And her attitude seems to be more motivated and she's uh, you could see that in her personality.</p> <p>P: Yeah</p> <p>C: Do you feel more motivated about things?</p> <p>P: Yeah</p> <p>C: Is that things in general in your life, or in speaking</p> <p>S: It's uh, overall I would say,</p>	<p>C: And you've even gone by yourself to the restaurant, right?</p> <p>P: Yes, I get, I try all do much all the time</p>	<p>S: Talking quite a bit. So she's not afraid to talk now about some things.</p> <p>S: Whether it be the fact that the programs have given her confidence, because she has seen what she's been able to do with the program speaking to her, and then she responding with the computer, that has been good for her. And maybe it's because she was so religiously</p>

THEMES	PARTICIPANT 1	PARTICIPANT 2	PARTICIPANT 3
	<p>P: Yeah</p> <p>S: Her general personality seems to be happier</p>		<p>involved in the program. She did it every night.... and that was good for her, because that gave her a purpose. Give her something to do.</p>
Satisfaction with program	<p>S: She wouldn't let me leave in the morning until I put the computer out. She would tell me, 'computer, computer.' So I had to set it up for her every morning.</p> <p>C: And did the treatment meet your expectations?</p> <p>P: Yeah</p> <p>S: Based on what the original prognosis was from everybody, it was pretty grim, that she would never talk again, so this is so above my expectations</p>	<p>C: We like to ask what you thought about the computer and the program..</p> <p>P: I think it was good. I liked it. Even now I talk, even now, even with talking. After you been through it and I can go through it with her, she ~~~ and I can find it and keep it, keep it there, and I have this credit that's good for that, some of it.</p> <p>C: So, all in all, would you say that the treatment met your expectations?</p> <p>S: I think so. I think it met more because he's talking, like I say, in sentences. People just come up to me and tell me, "Oh, he's doing so much better.</p>	<p>C: Have you noticed any changes for yourself? P Can / I can / I can / I cannot very wuh/ I cannot talk beautiful but I can / I'm very now / from you guys / you're great / thank you very much</p> <p>C: Did we meet your expectations?</p> <p>C: Did we meet your expectations? P: Oh yes / beautiful / thank you so much / so much / I wanna call / I wanna/ I want some more (all laugh)</p>

KEY: C = Clinician; P=Study Participant; S=Spouse