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Differential Outcomes of Functional and Neuropsychological Approaches to Naming Treatment Among Adults with Chronic Nonfluent Aphasia

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Jacqueline Jay Hinckley

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DIFFERENTIAL OUTCOMES OF FUNCTIONAL AND NEUROPSYCHOLOGICAL APPROACHES TO NAMING TREATMENT AMONG ADULTS WITH CHRONIC NONFLUENT APHASIA

By

Jacqueline Jay Hinckley

A DISSERTATION

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Michigan State University
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Audiology and Speech Sciences

1999

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ABSTRACT

DIFFERENTIAL OUTCOMES OF FUNCTIONAL AND NEUROPSYCHOLOGICAL APPROACHES TO NAMING TREATMENT AMONG ADULTS WITH CHRONIC NONFLUENT APHASIA

By

Jacqueline Jay Hinckley

We know relatively little about which type of aphasia therapy is appropriate for which type of aphasic patient. Two predominant treatment approaches, functional and cognitive neuropsychological (CN), should have differential outcomes. Functional treatment should result in large improvements on the trained tasks and other closely related tasks, and CN treatment should improve underlying skills that are broadly generalizable. The present study was designed to compare the outcomes of functional and CN treatment on the naming performances of adults with chronic nonfluent aphasia as it is measured on various standardized language assessments as well as in functional abilities. Twelve adults with chronic nonfluent aphasia were randomly assigned to each of the two treatment groups. The two subject groups were comparable in terms of age, time post onset, socioeconomic status, and aphasia severity. They participated in cognitive assessment and depression screening prior to participation. The pre/post assessment battery included selected standardized measures of

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comprehension, naming, and functional communication, discourse samples, and participation in a specially designed functional task, involving a role-play of catalog ordering. Each subject participated in twenty hours of speech/language therapy weekly for five weeks, all of which was derived from the designated approach, functional or cognitive neuropsychological. Results were consistent with original predictions. Functionally trained subjects improved notably on the trained task, and a task closely related to its performance, oral naming. CN trained subjects improved on broad measures of language abilities, including standardized functional communication assessment and caregiver ratings of communication. Among the functionally trained subjects, those with lower cognitive abilities in new learning and nonverbal problem solving did better than those with better cognitive abilities. There was an important correlation between cognitive abilities and treatment time required to achieve criterion. These findings are important for clinical decision making and ongoing clinical research.

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I would like to thank my teachers who served on my doctoral committee: Tom Carr, John Eulenberg, Antonio Nunez, and Ida Stockman. Special thanks are extended to my committee chair and advisor, Janet Patterson, for all her guidance and input. I am also grateful to Holly Craig, for her support in every way, including access to her facility for data collection. This project could not have been completed without the willing cooperation of the participants with aphasia and their families, to whom I am indebted. Finally, I thank Ken, who was an endless source of help, understanding, and encouragement.

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Chapter 1

APHASIA THERAPY EFFICIENCY

In his oft-cited paper published in 1972, Darley reviewed the literature on aphasia therapy effectiveness and suggested that the field of speech/language pathology pursue the following three questions.

> 1. Does language rehabilitation accomplish measurable gains in language function beyond what can be expected to occur as a result of spontaneous recovery?
> 2. Are the language gains attributable to therapy worth the necessary investment of time, effort and money?
> 3. What are the relative degrees of effectiveness of various modes of treatment of aphasia? (pp. 4-5).

Darley discusses the critical effects of subject selection, measurement of change, and definition of therapy in conducting research designed to address these questions. Over the course of the intervening twenty-six years, many reports have been published regarding the effects of aphasia therapy on ultimate communication performance, and the relationships between subject characteristics and type of treatment selected.

Robey (1998) subjected many of these studies to a meta-analysis in an effort to determine the weight of the accumulated scientific evidence. The meta-analysis was intended to examine questions that are hauntingly similar to those raised by Darley in 1972.

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> Do different amounts of treatment bring about corresponding magnitudes of change? Do different types of treatment result in different magnitudes of change? What is the magnitude of the treatment effect for severely aphasic individuals (or mildly aphasic individuals)? Is one or another form of aphasia more or less responsive to certain treatments? (p. 173)

Robey's results suggest that aphasia therapy is effective on average. Significant outcomes result when therapy is begun in both the acute and chronic stages of recovery. These conclusions are essential to the ongoing practice of aphasia therapy, and respond to Darley's (1972) statement that speech/language pathologists must demonstrate effectiveness of therapy in order to continue having a role in aphasia management.

The startling conclusion of Robey's (1998), however, is that "there are too few studies for examining differential effects of treatments for different types of aphasia" (p. 184). Indeed, only one treatment type, stimulation-facilitation treatment, was targeted and described in a sufficient number of studies to be included in the meta-analysis. Although this treatment approach is commonly used by many aphasia therapy practitioners, it is an older technique originating with Schuell and colleagues (1964), and does not reflect the full range of the newer developments in aphasia therapy. Our inability to match client profiles with appropriate treatment choice is a continued challenge in our field, and Robey's (1998; 1994) meta-analyses once again emphasize this need.

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We are facing a convergence of contradictory forces that pertain to the practice of aphasia therapy. While we have shown that aphasia therapy *in general* is effective as measured by standardized language battery performance, we have not shown that these improved performances are meaningful in terms of the ability of people with aphasia to complete typical daily activities or to change their level of productivity. We also have not demonstrated conclusively that we know, beyond an implicit process based in clinical experience, which treatment approach is best for which individual. This lack of scientific evidence is a major detriment to our field during a period of shrinking health care resources and competition for rehabilitation dollars. Finally, these negative influences are occurring at a time when we have a rapidly growing body of knowledge about brain function and plasticity after injury, which suggests that neurobehavioral change after injury likely occurs for longer periods than previously thought. This extended period of recovery is more highly affected by neurochemical and behavioral individual differences than the medical community has typically assumed. Consequently, research designed to address these issues is critical to the future of adults living with aphasia, the practice of aphasia therapy, and the literature on aphasia rehabilitation.

Comparing Aphasia Treatment Types in Group Studies

The first study to compare different types of aphasia therapy was published in 1970 (Sarno, Silverman, & Sands) and found

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and found no difference between the final performance levels of severely impaired adults with aphasia assigned to each of three treatment groups. Thirty-one adults with aphasia who were comparable in terms of age, time post onset, sex, and education were assigned to either programmed instruction, non-programmed instruction, or no treatment. Programmed instruction involved the practice of six vocabulary items in a pre-established routine involving visual recognition, writing, auditory comprehension, and oral production. Non-programmed instruction allowed the individual clinicians to choose their own approach to training the same vocabulary items. Subjects in each treatment group received up to 40 hours of therapy. The results of the study showed that there were no significant differences between the groups in terms of retention of a speech behavior one month after the therapy. The study was frequently discussed as having a negative influence on the perceptions of aphasia therapy effectiveness overall.

Shewan and Kertesz (1984) compared Language-Oriented Therapy (LOT) with stimulation-facilitation therapy in a group of 50 adults with aphasia randomly assigned to one of the two treatments. All language modalities were addressed in a structured approach of stimulus presentation, response, and reinforcement in sets of 10 stimuli at a time during LOT. A less defined and more clinician-driven approach characterized the stimulation-facilitation approach. Although subjects in both of these treatment groups significantly

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significantly improved on a standardized aphasia battery after treatment compared to a no-treatment group, there were no significant differences between the two treatment groups, and the investigators were unable to make any conclusions about the "treatment of choice", or whether particular subjects performed better in one treatment versus the other. In a literature review published in 1986, Shewan wrote: "To summarize, there is little evidence comparing types of treatment and what there is allows us to conclude little" (p. 40).

Conventional speech/language therapy consisting of language drills has been compared with supportive counseling (Hartman & Landau, 1987). Sixty patients with aphasia were randomly assigned to two groups, either speech/language therapy or counseling. Both groups received therapeutic services two sessions weekly for six months. The investigators found no significant difference in final language performance at posttest between the two types of therapy. This study, however, had a decidedly different goal than those designed to compare different types of language intervention with each other. It also did not control for the support that subjects might have received or perceived during their speech/language therapy participation.

A similar design and treatment rate were applied in a comparison of two forms of treatment for auditory comprehension (Prins, Schoonen, & Vermeulen, 1989).

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Stimulation therapy was contrasted with a systematic treatment program for auditory language comprehension, which presented a specified hierarchy of word and sentence stimuli. Analysis of the pre/post performance results of the subjects randomly assigned to one of the two groups revealed no differences in outcomes of auditory comprehension for the two different treatment types.

Holland and colleagues (1983) compared the performances of six matched pairs of acutely aphasic subjects who received two different types of aphasia treatment. Each pair of subjects was matched on age, type, and severity of aphasia. One member of each pair received 15 minutes of conversational therapy daily, while the other subject received 45 minutes of conversational and didactic therapy daily. A standardized aphasia battery and conversational samples were obtained pre/post therapy, and at one month after hospital discharge. At the time of discharge, the subjects who had received the conversational treatment only showed significantly better performance on the aphasia battery. At one month post-discharge, however, there were no differences between the performances of the subjects receiving the two different treatments. This pattern was also demonstrated in the pragmatic-linguistic analysis of the discourse samples collected at the same time points (Murray & Holland, 1995). The authors suggest that during the acute phase of hospital rehabilitation, 15 minutes of conversationa

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Springer and colleagues (1993) compared linguistically oriented learning (LOL) to a general stimulation approach in the training of wh- question production and prepositions. The criterion task was a short scripted dialogue which required production of the targeted items. Twelve aphasic subjects underwent each of the two treatments, with six receiving LOL training first, and the other six receiving stimulation first. The LOL training was most consistent with larger direct effects of production of the targeted forms, but stimulation was associated with larger effects at follow-up. Unfortunately, the authors do not suggest any particular hypotheses for the different outcome patterns associated with the two different treatments.

With such a limited number of treatment comparison studies available for review, it is apparent why we continue to lack a means of determining the right type of therapy for the right patient. The group studies reviewed all included subject groups with mixed aphasia types and severities. Furthermore, only the linguistic status of the subjects are described in any of these studies, and other cognitive factors have not been taken into account in relation to type of treatment. Some studies have not based their treatments on approaches that are well-defined in the literature, or alternatively were intended to be tests of newly developed treatment approaches. Finally, none of these studies

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provide hypotheses about why certain treatments might be expected to be more efficient than others, or under what circumstances. These shortcomings relate directly to our inability in clinical aphasiology to explain the nature of therapy and the proposed mechanisms for change within our treatments. The nature of the mixed group designs implies that one treatment could be found to be better than another for a variety of aphasic subjects, and precludes the analysis and discussion of particular individual responses to certain treatments with varied outcomes.

The numerous factors that may influence group design studies have led some to pursue the investigation of treatment efficiency through the use of single-subject and small sample research designs (Holland, 1975). Smaller subject designs are advantageous because a larger corpus of data on each subject can be generated and analyzed for within-subject effects. A limitation of single-subject research designs, in particular those intended to address the question of which treatment for which patient, is that it is very difficult to generalize from single subject studies to other patients. These studies may reflect the nature of individual differences as much or more than the efficiency of treatment. Although we have many single subject studies now addressing the comparison of various treatment types, we are still challenged by our inability to summarize across these data and generate working principles that can be a

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Towards a Theory of Aphasia Therapy

The limitations of the research designs applied have been cited by some as the primary stumbling block in the search for treatment efficiency data (Wertz, 1993; Wertz, 1995). A more fundamental problem is the lack of a theoretical basis for investigating the issues in matching individual characteristics to particular treatment regimens and outcomes. A recent series of articles in Aphasiology addressed the need for a meta-theory of aphasia therapy directly. Petharam and Parr (1998) suggest that such a meta-theory would "make the process of selection and combination of approach explicit, and directly link this process with definitions of clinical expertise" (p. 441). In other words, a meta-theory of aphasia therapy should be able to incorporate and address the issues of what therapy to use with whom and when. This meta-theory should be able to accommodate the diversity in the field, from social and psychological issues in aphasia, to cognitive neuropsychological treatments.

Some of the authors in this debate embrace the World Health Organization's (WHO) framework of impairment, disability and handicap as a means to integrate the diverse set of approaches applied in aphasiology today (Petharam & Parr, 1998; Jordan, 1998). The WHO framework has also been advocated

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advocated by ASHA in its development of functional communication assessments (Frattali et al, 1995). The impairment level of analysis includes analysis and treatment of specific language component deficits. Disability issues are defined as the effect of the impairments on the individual's ability to function in life roles that are appropriate for age, gender, and social status. Society's reaction to the disability and the resulting limitations on the individual's lifestyle are incorporated into the handicap level of the framework. Using this framework, cognitive neuropsychological approaches are seen as mapping onto the impairment level of the framework, and other social approaches to aphasia are linked to the disability level of the model.

This model is advantageous because it facilitates communication between many different schools of thought and approaches. It provides a common map on which advocates of various techniques can point to the level of functioning that is being addressed. This encourages interaction between researchers in different sub-specialties of aphasiology at a time when the combination of various approaches at the different levels is seen as advantageous (Sarno, 1991; Lesser & Algar, 1995).

The WHO framework provides a gross conceptualization of different levels of functioning. It fails to meet the requirements set out by Petharam and Parr (1998) for a theory of aphasia therapy, and does not explicitly set out any direction

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Recently, Ross and Wertz (1999) set out to investigate the relationships between impairment- and disability-level assessment measures for determining initial severity and change among adults with aphasia. Two standardized aphasia batteries, the Porch Index of Communicative Ability (PICA) (Porch, 1967)and the Western Aphasia Battery (WAB)(Kertesz, 1982) were administered as measures of impairment, and the Communicative Abilities in Daily Living (CADL) (Holland, 1980) was given as a measure of disability. Initial severity level as determined by the two impairment measures were related, and these were also related to the disability measure. The authors found differential patterns of change on all of the measures after a study period of 2 to 9 months. Change on one impairment measure was not related to change on another, and change on either impairment measure was not related to disability-level performance on CADL. The authors conclude that one measure is not an adequate substitute for another, and that the tests are measuring different kinds of performance. Although the WHO model and the results of this study tend to suggest that these levels do not interact in relation to change over time, it is unclear how this model might guide us in choosing between different therapy regimens.

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Solutions to choosing the most efficient type of treatment for a particular individual are left to specific approaches, which bring with them their own assessment goals, styles, and instruments. Consequently, an individual clinician typically chooses an approach to aphasia therapy and assessment in advance, and may explicitly or implicitly be choosing the approach based on the assessment tools that are used and/or available. A theory of aphasia therapy, then, must be capable of incorporating assessment and management decisions from various schools of thought, but should offer predictive ability unavailable in the WHO model and other related frameworks. Byng (1994) underscores this issue in her position that a description of the nature of the deficit is quite different than questions about therapy choice: "The decision about whether these impairments should be treated and how represents a different set of questions not addressed by the account of the deficit; that issue rests on the development of a theory of therapy" (pp. 272-273).

This turn towards the WHO model as a meta-theory in clinical aphasiology follows a period of enthusiastic pursuit of cognitive neuropsychological models to describe aphasic impairments and as a basis for the design of treatment. Initially, the cognitive neuropsychological (CN) approach offered an in-depth means of assessing an individual patient's pattern of deficits, and was seen as an important new development in the practice of aphasiology

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(Byng et al, 1990). These approaches were criticized for their lack of applicability to the average aphasic patient who does not display an unusual dissociation (Goodglass, 1990) and for their inability to provide a taxonomy that applies to subgroups of the aphasic population (Kertesz, 1990). The replication problem in CN approaches to treatment and the inability of CN to constrain treatment approaches for identified language component breakdowns have been acknowledged by advocates of the CN approach, with subsequent attempts to address these issues (Mitchum & Berndt, 1995).

The strength of the CN approach is its identification of language processes in the system and the ability of its techniques to pinpoint areas of deficit. The theoretical information that it is based on, however, is typically discussed in terms of the language system alone, and ignores other aspects of the individual's cognitive system and functioning. It is also rightly criticized for its difficulty accommodating more functional and holistic issues in aphasiology (Weninger & Sarno, 1990).

External pressures stemming from shrinking health care resources have brought an urgency to our need to address the ability of individuals with aphasia to live productively. The functional perspective to treatment has won over third party payors as a reimbursement standard, because payors want to be assured as much as is possible that treatments are affecting performances on activities of daily living.

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Consequently, the functional approach to treatment is currently the most commonly employed in rehabilitation facilities. A functional approach to treatment emphasizes the communication skills required for independent performance of typical daily activities.

Functional approaches, in particular those emphasizing the pragmatic aspects of language, have been combined with more specific linguistic deficit approaches (Lesser & Algar, 1995; Holland, 1991; Holland et al, 1983). Lesser and Algar (1995) applied a CN approach to assessment and treatment, but used conversational analysis as a basis for determining generalization of the treated behaviors to communication between the two subjects and their caregivers. This is an interesting approach, but it remains unclear how such combinations should occur, when they should occur, and what aspects of the different goals in therapy should be emphasized by the different approaches. It is apparent that the functional and CN approaches are two predominant assessment and treatment paradigms in aphasiology today. Functional approaches are advocated by those taking a holistic view of living with aphasia and reinforced by reimbursement practices, and CN approaches are touted by neuropsychologists, linguists and speech/language pathologists who are attracted to its detailed identification of deficit areas. A CN approach also contributes information to our understanding of normal language proc

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Explaining Therapy Efficiency: A Cognitive Science Approach

Cognitive science approaches have the potential to provide a theoretical basis for both of these treatment approaches. Cognitive science analyzes the mental and neural structures and processes used in the performance of various tasks, in conjunction with a complete task analysis. The levels of analysis include general domains of processing, the algorithms by which the functions are completed, and the neurophysiological substrates which carry out these performances (Marr, 1982). Cognitive science assumes that mental events require time to occur, so that the measurement of speed and efficiency in task performances becomes a critical component of the cognitive analysis. These methodologies have the potential to provide the theoretical foundation on which aphasia treatments can be evaluated, and matched to individual patients, thus meeting the requirements of a theory of aphasia therapy as described by Petheram and Parr (1998).

The expectation of intervention is that the client will learn new information of some type, or learn to retrieve information more efficiently, and be able to use this information in a variety of contexts outside of therapy. In order to characterize these processes more specifically, we must take into account the ability of patients to attend to the important stimuli within a context, maintain in working

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Some evidence already exists suggesting altered executive function and working memory in some aphasic patients, in particular for adults with nonfluent aphasia. Subjects with anterior lesions and nonfluent aphasia have been shown to be impaired at recognition memory for visual or auditory words compared to normals, and are even worse in free recall conditions that require reconstruction or retrieval of items from verbal memory (Beeson, 1993; Ostergaard & Meudell, 1984; Cermak et al, 1984). In a word list learning task, anterior patients were more likely to show performances consistent with impaired LTM storage and retrieval abilities (Beeson, 1993; Risse et al, 1984). Learning curves for new vocabulary items were decreased compared to normals, and also different than those generated from the performances of adults with left hemisphere posterior lesions (Tikofsky, 1971; Risse et al, 1984). Although these nonfluent aphasic patients showed the ability to learn the meaning of a new vocabulary item presented in a functional context, they were significantly impaired at learning the syntactic features and usage of the new word (Grossman & Carey, 1987). Less evidence is available for the profiles of working memory and learning performances among posterior, fluent aphasic patients. This is likely due to the di

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Observations about impaired memory and learning performance among adults with anterior lesions are consistent with neuroimaging results of memory performance in normal adults. Left frontal area was activated in tasks of word list learning (Grasby et al, 1993) and in tasks requiring either deep or shallow encoding of single words (Kapur et al, 1994). Broca's area and surrounding regions have been implicated in silent speech, which may have a relationship to working memory abilities (Habib & Demonet, 1996).

Much of the evidence on memory and attention disorders in nonfluent aphasia is used in support of nonlinguistic hypotheses about the nature of of the deficit. The decreased memory abilities in nonfluent, Broca's-type aphasia is seen as supportive of the need to use economy of effort, resulting in strings of substantive words in oral output. Other linguistic theories of the nature of Broca's aphasia, such as the central syntactic deficit hypothesis and the application of Chomsky's Government and Binding theory, have resulted in a variety of experimental treatments (for a review, see Kearns, 1997). The opposing linguistic and nonlinguistic views about the primary origin of the Broca's symptom complex led Goodglass and Menn (1985) to write: "Parsimony as a metatheoretical principle in neurolinguistics is dead..." (p. 19). These hypotheses about

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the nature of the disorder also have completely separated treatment efforts, without an underlying model or rationale for direct comparison of assumptions about different therapy approaches originating from the two theories of deficit.

Some aphasia interventionists have advocated the incorporation of cognitive stimulation into treatment activities, in acknowledgement of the potential role of cognitive impairments in the disability profile. Chapey (1986) provides specific activities based on convergent/divergent thinking tasks which she suggests will facilitate the use of language and the deployment of linguistic skills in the service of actual functions in daily contexts. Unfortunately, her model and suggested activities have never been the source of a data-based investigation.

An early attempt to apply a cognitive approach to the problem of identifying the processes responsible for impaired naming incorporated picture naming, a modified Sternberg picture recognition, and modified Sternberg random shape recognition (Mills et al, 1979). Reaction times and errors were measured for ten normal and ten aphasic adults. Effects of the uncertainty or certainty with which pictures could be named was shown to vary significantly among the aphasic subjects, based on the accuracy and efficiency of responses. The authors also showed that in the picture recognition task, in which naming was not required, the aphasic subjects responded more slowly and less efficiently than the no

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than the normal controls. The results suggested that naming impairments among adults with aphasia are primarily due to a deficit in the retrieval process rather than in the lexicon itself. They also showed that these mild-moderately impaired aphasic subjects improved their performance in relation to repeated exposures. This was evidenced on an item-by-item analysis rather than in the overall accuracy score. This observation has been supported by more recent work as well (Howard et al, 1985). It suggests that the retrieval process in naming is susceptible to improvement.

Improvement in the process of retrieval was demonstrated to be the result of intensive speech/language therapy that incorporated a variety of cueing techniques (Wiegel-Crump & Koenigsknecht, 1973). The generalization of improvement to untrained items during a treatment study suggested that it was the process and use of a specific skill that improved during intervention, rather than improvement on specific trained lexical items only.

The individual patterns of improvement were emphasized in the work of Laiacona et al (1996). They found different degrees of consistency in picture naming at baseline, and changes associated with treatment were different across two anomic patients in their study. One subject had an initial presentation of low consistency, delayed responses, and self-corrections, and improved in consistency and response time over the course of treatment. The second subject

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improved in overall naming ability, and was better able to name after delay or self-correction than prior to treatment.

Other interesting individual patterns of errors and performance were observed during the rehabilitation of two acalculic patients (Girelli et al, 1996), which suggested to the authors that the nature of the semantic network was reorganized over the course of training. However, this particular training showed effects only on the type of arithmetic problems trained, and did not generalize to other types of problems. The assumed reorganization appears to have only been applied to the particular facts and problem types worked on in the treatment. Analysis of accuracy and efficiency, along with the qualitative analysis of errors, can reveal much about the initial status of the cognitive system and the presumed changes occurring over the course of training. These sorts of analyses also lend themselves to the consideration of individual differences in the patterns of naming disorder presentations, as well as individualized responses to treatment types.

Another commonly used methodology in cognitive science is a secondary task that places additional task demands on the subject. Tasks that depend on the same set of resources should both show a decrease in performance when the two tasks are performed in competition. This logic has recently been applied to the investigation of attentional resources needed for picture description by mildly aphasic adults (Murray et al, 1998). In this study, subjects described a

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picture orally while performing a tone discrimination task under various instructions that altered the importance of completing one or another task. Analysis of oral response times, accuracy, error types, and reaction times in the secondary task suggested to the authors that aphasic subjects had reduced availability to the attentional resources that were needed to perform the two tasks in the experiment. The results were interpreted in the context of resource allocation theory, in which the primary challenge for aphasic adults is a lack of cognitive resources that can be assigned to the completion of various tasks.

Analysis of the time course, nature, efficiency, and competition of tasks are promising technologies that are beginning to be applied in aphasiology. However, as the examples described above underscore, this kind of cognitive analysis has so far been used to describe the nature of the cognitive-linguistic deficit in aphasia. This is, of course, an important endeavor but one that is different, according to Byng (1994), than determining which treatment is effective for whom. It is proposed that these methodologies can reveal additional information about the nature of change associated with particular therapies and the unique responses of individuals to those interventions, just as this general research logic has provided data for models of individual differences in complex skill acquisition and word reading (e.g., Ackerman, 1992, 1990, 1988; Bernstein & Carr, 1996).

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Furthermore, taking into account cognitive profiles of adults with aphasia may reveal important relationships to certain parameters of intervention. Among traumatically brain injured subjects who are not aphasic, measures of new learning ability and executive function correlate with potential for and rate of improvement in cognitive rehabilitation, and total amount of time required for treatment (Lamport-Hughes, 1995). Measures of severity of brain damage were not predictive of success in treatment. It is possible that measures of learning and executive function may also relate to treatment performance among subjects with other types of brain injury and sequelae, such as aphasia.

Cognitive Neuropsychological Approaches to Oral Naming

Cognitive neuropsychological (CN) approaches to treatment have grown out of the experimental literature which has as its goal to identify the language components and processes within the normal system by investigating the breakdowns in language disordered populations, and to apply normal models of language processing to language disorders (Coltheart et al, 1994). Treatment is seen as a means of testing the accuracy of the assessment procedures and hypotheses about the nature of the language system. The language models are also seen as an effective means of focusing treatment efforts specifically to the area of breakdown, thus enabling treatment to be more efficient.

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A CN approach to naming disorders, for example, begins with the identification of an appropriate model of the language components involved in naming. In the model applied by Kay and colleagues (1992), pictures or other visual stimuli are initially recognized as whole entities that then activate the semantic system and process meaning. For oral naming, there is a direct pathway from the semantic system to the phonological output lexicon and buffer, where phonological forms of words are retrieved and temporarily stored during neuromuscular programming. This model assumes a single semantic system for the various types of input. Oral reading can occur either through letter-to-sound rules (phonemic decoding) or by way of the semantic system.

In such a model, deficits in picture naming, such as those that might be observed during administration of typical visual confrontation naming tests, can be attributed to either a semantic or phonological level impairment. Some authors hypothesize additional levels of impairment that correspond to particular behavioral deficits. For example, Ellis et al (1994) suggest four deficit types for naming. A general or specific semantic deficit is associated with impairment of the semantic system, and a frequency-dependent word selection deficit is associated with a breakdown between the semantic system and the speech output lexicon. Phonological approximation errors should be observed with impairment of the speech output lexicon, and feature errors with transpositions are associated with the phoneme level.

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In the CN approach, complete assessment of these levels of processing are critical. Various tasks for naming impairment are presented to the patient to determine whether there are modality-specific strengths and weaknesses. Distractors are presented that are based on semantic or phonological relationships to the target item. The patient's errors then become an important part of determining the locus of the impairment.

Treatment of the identified deficit in general is seen as remediating the impairment by increasing the strength of associations between the stimulus types and the targeted processes, or by increasing the individual's ability to perform the operation through another, related route. This approach requires the identification of routes that are successful for the patient. For example, oral reading of printed words might be a more successful activity for the patient than naming pictures, because connection is by way of the orthographic input lexicon.

Table 1 summarizes the major characteristics of the CN approach. The aim of CN-based treatment is to identify and remediate the particular deficit, rather than any function of the individual. This relates to the impairment level in the WHO framework. The treatment interaction is centered around the type of stimuli presented, including consideration of word frequency, imageability, regularity, and other psycholinguistic features. The cueing hierarchies are developed based on analysis of the language system and

Table 1. Summary of the primary characteristics of functional and cognitive neuropsychological approaches to language treatment, as they are particularly related to the current project. (After Byng, 1995; Byng & Black, 1995).

Table 1. Summary of functional and cognitive neuropsychological treatment approaches

COMPONENTS	FUNCTIONAL	COGNITIVE NEUROPSYCHOLOGICAL
1. AIM	1. Activity-based: personal relevance is emphasized	1. Deficit-based
2. RATIONALE		

Table 1. Summary of functional and cognitive neuropsychological treatment approaches

COMPONENTS	**FUNCTIONAL**	**COGNITIVE NEUROPSYCHOLOGICAL**
1. AIM	1. Activity-based: personal relevance is emphasized	1. Deficit-based
2. RATIONALE	2. Establish compensatory strategies based on the client's strengths to achieve targeted task (disability-based)	2. Remediate deficit area (impairment-based)
3. STRATEGIES	3. Use different means, including various modalities, to achieve goal/task	3. Improve performance in area of deficit by using various modalities as area of strength or means of circumventing the problem
4. INTERACTIONS	4. Centered on problem-solving. Problem-solving feedback interspersed within targeted task	4. Centered on targeted dimensions of performance (e.g., accuracy, speed of response, nature of required cueing)
5. TASKS	5. Role play of phone and mail ordering	5. Picture/word naming (including oral reading); Comprehension of question types

Table 1 (cont'd)

COMPONENTS	FUNCTIONAL	COGNITIVE NEUROPSYCHOLOGICAL
6. MATERIALS	6. Role play scripts, various actual catalogs, practice order forms, phone, credit cards, pen/paper, cue cards as needed [illegible]	6. Stimulus items from targeted vocabulary that combine both picture and written words; [illegible]

Table 1 (cont'd)

COMPONENTS	**FUNCTIONAL**	**COGNITIVE NEUROPSYCHOLOGICAL**
6. MATERIALS	6. Role play scripts, various actual catalogs, practice order forms, phone, credit cards, pen/paper, cue cards as needed for individual client (e.g., cards with personal information written out)	6. Stimulus items from targeted vocabulary that combine both picture and written words; pictured stimuli for auditory comprehension tasks
7. EVALUATION	7. Communication adequacy as determined by listener receiving message	7. Accuracy and efficiency of client response within practice task
8. MECHANISM FOR CHANGE	8. Contextual cues and deployment of cognitive strategies critical to accomplishment of the task/retrieval of context-relevant information; self-generation of cues and strategies required for successful outcome	8. Increase in strength of association between stimuli and response types via remediation of impairment or facilitation of other local skill-based routes

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the patient's responses are evaluated based on their accuracy and efficiency for the specific target that was intended by the presentation of the stimulus.

A classic treatment study by Howard et al (1985) enrolled a total of 12 subjects in each of two forms of CN treatment for anomia, semantic and phonological. The semantic therapy techniques included pointing to a picture from four semantically related pictures when the word was presented auditorily, matching the written word to the appropriate picture in an array of four, and answering a yes/no question requiring the access to meaning. The phonological techniques were repeating the picture name, producing the picture name with a phonemic cue, and judging whether the name rhymed with another word. Half of the subjects received the semantic treatment first, and the other received the phonological treatment first. Results at posttest suggested that the semantic treatment resulted in greater generalization to untrained items, but no differences between the therapy results were noted at the six week follow-up.

LeDorze & Pitts (1995) report the case of a patient who was entered into an alternating treatments study, including semantic treatment and word form (phonological) treatment. Semantic matching and oral reading tasks were compared with uncued naming opportunities as a control condition. The authors conclude that the administration of treatments that were directed to the patient's deficits resulted in much greater im

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greater improvements than activities that were not aimed at the particular language breakdowns.

Oral naming, oral reading, and written naming were used as tasks in a phonologically-based treatment applied to four patients with varying deficit profiles (Raymer et al, 1993). These four patients all showed improvement and some generalization, to various degrees, in contrast to the lack of generalization in the phonologically treated patients of Howard et al (1985). The authors do not satisfactorily explain why their results differ from other authors, or if there are particular characteristics of the subjects that might facilitate generalization. Specifically, this study and others like it only report the linguistic profile of the patient, without taking into account attention, memory, or other executive function abilities which are often hypothesized as being related to generalization ability (Ackerman, 1990). In short, we know little that could help us predict how the subjects can and will be able to use the skill that was targeted in the treatment.

Nickels and Best (1996) review the CN treatment literature on naming disorders and conclude that for some patients semantic therapy seems to result in more generalization than other phonological tasks, but this result is inconsistent. CN approaches in general would predict that if a level of processing has improved, then all tasks dependent on that process should also be improved in performance. Similarly, untrained stimuli should show an

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improvement when the action required relies on the same process (Hillis, 1989; 1994). Nickels and Best (1996) suggest that one of the areas to be addressed in future research is determining which variables affect generalization, especially to spontaneous speech. This is one of the critical issues in the development of a theory of therapy. CN approaches have helped us identify possible loci of breakdowns in the language processing system, and have improved the techniques available for comprehensive assessment of language disorders.

A Functional Approach to Aphasia Therapy

The goal of aphasia rehabilitation, in a functional frame of reference, is to improve a person's ability to communicate in everyday life. The functional approach assumes that context is an important factor underlying language processing, and that adults with aphasia perform best when materials and goals are personally relevant. The general characteristics of the functional approach are listed in Table 1.

A functional approach to treatment is often seen as incorporating many general aspects of aphasia rehabilitation, including discussion of cognitive abilities and the importance of psychosocial state. This is likely due to its broad perspective and reliance on the client and his/her social environment to determine the relevant issues to be addressed. Sarno (1991) suggests that handling of psychol

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psychological, social, and functional communication issues is critical to the long-term view of aphasia management.

Aten (1986) and Chapey (1988) describe the importance of the cognitive aspects of functional treatment, albeit in general terms. Functional intervention is seen as a method in which real world meanings are stimulated as both inputs and outputs within the contexts in which they normally are relevant. The use of various compensatory strategies in order to achieve message transmission within a context is an objective of the approach, and requires the deployment of various cognitive skill.

Assessment from a functional perspective includes the analysis of the aphasic adult's ability to communicate messages in a variety of contexts, in particular ones that are important to the individual. Although standardized language testing is used to inform the clinician about the strengths and weaknesses of the language system, the emphasis is placed on the development of personally relevant strategies for particular situations in which the client is likely to find him/herself in the course of normal daily events. Consequently, comprehensive interviewing and choice of what is personally relevant for a particular client is an important part of this approach.

The interactive nature of communication is emphasized, and the therapist is expected to take the role of both message sender and receiver during the course of intervention. Chapey (1988) writes: "We become more effectiv

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effective communicators as a result of using language in communication with others" (p. 185). The clinician serves as a facilitator of appropriate compensatory strategies as well as a conversational interactant in the course of therapy. Role-playing and conversation are primary therapeutic activities in this approach.

Incorporating these guidelines, Holland (1980; Holland, Fromm, & Swindell, 1999) has developed a standard assessment tool for functional communication in aphasia (Communicative Abilities in Daily Living). It is based on the premise that role-playing is, first of all, possible with adults with aphasia, and secondly, an informative source of information about the actual communication abilities of adults with aphasia. In the development of the assessment, Holland actually observed the communicative abilities of adults with aphasia in a variety of settings and related their performance to that sampled by the assessment tool.

Evidence for the efficacy of the functional approach was originally described in a study conducted in 1982 (Aten et al). Seven adults with aphasia received functional communication treatment, which included the development of compensatory strategies in personally relevant activities. Differences in pretest and posttest scores on a standardized aphasia battery (Porch Index of Communicative Abilities) did not show any change over the seven weeks of treatment. However, scores on the Communicative Abilities in Daily Living test (Holland, 1980) were significantly improved and

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were maintained at that level for six weeks after the end of the treatment. These adults with aphasia were all several years post onset, and the authors argue for the importance of the personally-relevant, compensation-based treatment approach. The results of this study also support the differential outcomes of a particular treatment, and the relative independence of impairment and disability level assessment measures.

Evaluation of the effects of this type of therapy is rooted in successful message communication and the ability of the aphasic adult to perform various speech and conversational acts. Most studies of the effects of functional treatment, then, analyze posttreatment results based on the ability of the clients to participate conversationally or perform a greater number of speech acts. For example, Doyle et al (1991) demonstrated that an adult with Broca's aphasia could be trained to initiate requests for information within conversational settings, and that this training generalized to conversations with a variety of partners. Interestingly, this report of results does not include the number or type of words or phrases used to convey the requests. Indeed, an important part of the operational definition for request behaviors in this study was the use of prosodic cues.

The requisite set of skills to accomplish specific functional and productive activities is also an important theme of functional approaches. Sarno and Buonaguro (1983)

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investigated the language and cognitive characteristics associated with meal preparation among female aphasic patients. They found that there was no particular relationship between meal preparation, severity of aphasia, or performance on a battery of memory and perceptual skills (the Parietal Lobe Battery of the Boston Diagnostic Aphasia Examination). The authors suggest that the independence of the communication abilities to the performance of a productive task of daily living such as meal preparation can serve as a rationale for the pursuit of various instrumental goals, and has important implications for treatment. They suggest that adults with aphasia are able to learn a variety of tasks that are important to daily living despite the language impairment.

In contrast to CN approaches, functional treatment is most appealing for its emphasis on activities of daily living and social communication. However, there is a lack of systematic assessment of the results of this approach. Although proponents of functional treatment allude to the use of cognitive abilities in the completion of the tasks that are targeted, there has not been a systematic attempt to identify what these abilities might be, and whether success in functional treatment might depend on residual cognitive strengths. This is particularly important since functional treatment emphasizes the development of compensatory strategies, particularly those that are self-generated. This assumes that clients are able to identify, learn,

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learn, and recall the appropriate compensatory strategies, which are characterized as volitionally used tools, in the appropriate contexts with effective results. Functional training assumes an emphasis on broader cognitive abilities than CN approaches, however, these broad-based abilities may be more contextually-bound than more specific skills. For example, mastery of strategies that facilitate independent ordering in a restaurant may make an important difference in the context of a restaurant, but those same strategies may not be deployed in other functional situations. An actual analysis of learning and use of strategies within the functional approach has not yet been attempted.

Research Questions

A project was conceptualized that compares the two predominant approaches to current aphasia therapy. Subject description and data collection were designed to maximize consideration of cognitive factors, as potential indicators of future performance, possible correlates of actual performance and learning, and relationships of cognitive abilities to transfer and generalization. Concurrent task methodology is one means of investigating the role of attention and other executive functions on task performance and possible improvement associated with different training techniques.

The present study was designed to focus on two different approaches to aphasia therapy, cognitive neuropsychological and functional. Naming impairments are common to

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common to all aphasia types, and are a critical feature of the aphasic syndrome. Naming is consistently and chronically impaired across all vocabulary categories in nonfluent aphasia compared to all other aphasia types (Knopman et al, 1984). Additionally, nonfluent aphasia is relatively well-studied and has a foundation of literature that can be used as a basis for discussing results. Therefore, the study has been limited in scope to naming within nonfluent aphasia, to focus on variation of other subject descriptors and performances during and after treatment.

The research questions addressed by this project are as follows.

Do functional and cognitive neuropsychological treatments aimed at single word production yield different treatment outcomes among adults with chronic nonfluent aphasia? Specifically:

1) Are there differences in performance between subjects trained using a functional approach or subjects receiving cognitive neuropsychological treatment on a functional criterion task?

2) Are there differences in performance between subjects trained using functional or cognitive neuropsychological treatments on standardized functional communication or standardized psycholinguistic tests?

3) Does treatment for single word production generalize to discourse? Are there differences in

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generalization to discourse between subjects trained using functional versus cognitive neuropsychological treatment?

Additional issues were identified for exploratory analysis. What cognitive-linguistic characteristics are the best predictors of success in treatment of single word naming? Specifically:

4) Are there differences in cognitive-linguistic predictors of success, as measured by performance on functional and standardized tests, for each of the two types of treatment, functional or cognitive neuropsychological?

5) Are there differences in cognitive-linguistic predictors that best predict generalization of single word production treatment to discourse?

Predictions

Based on the previous literature, it was predicted that subjects in both training types would make improvements (Robey, 1998; Robey, 1994). However, the nature of the improvements should differ based on the training types. Subjects undergoing the functional training should make substantial improvements on the catalog ordering task. This improvement should take the form of increased accuracy of naming production as well as improved efficiency and accuracy of performance in the concurrent task conditions. Specific task training has been shown to have these effects in other language areas for adults with aphasia (Doyle et al, 1991; Avent et al, 1995). These subjects should similarly show some improvement in their performance on the

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CADL-2, in particular on some items that are most similar to items on the catalog ordering task, since improvement on this test has been reported as an outcome of functional treatment (Aten et al, 1986). The functionally trained subjects are unlikely to show improvement as measured by the subtests of the PALPA or the BNT, since these tasks are specifically designed to inhibit the use of the kind of compensatory strategies that would have been trained in the functional treatment.

Subjects in the CN treatment should make fewer improvements overall in the catalog ordering task, since the catalog ordering task is a complex task requiring multiple strategies in addition to the trained vocabulary. Observable improvement for this group of subjects might include increased production of specific lexical items, but less overall efficiency during performance of the catalog ordering task. Subjects in the CN treatment group may also show improvement on the posttesting of the CADL-2, since it requires multiple skills deployed in the role-playing of various situations, and impairment-based training is typically broadly generalizable (Calvanio et al, 1993). The CN treated subjects should show more improvements on their BNT and PALPA scores than functionally trained subjects, particularly the Picture Naming subtest of the PALPA, again due to the expected generalization of the training procedures. In summary, the CN subjects are likely to show some improvements across a wide range of contexts, whereas the functionally trained subjects should show greater improvement in tasks that are most similar to the trained context, and less improvement in tasks that are least similar to the training.

Assuming that most or all of the subjects improve in some way during treatment, then there should be greater increase in the discourse measures, particularly in the Correct Information Unit analysis, for subjects in the CN treatment than in the context-based functional treatment. We expect that broader generalization will occur for the subjects in the CN treatment, based on the theoretical model. However, subjects in the functional training might show an improvement in procedural and narrative discourse samples, since they have been treated within a sequenced activity. In this case, the procedural and narrative discourse samples are highly similar to the trained activity in the functional treatment.

As an exploratory measure, the cognitive profiles of the subjects in each of the two treatments can be analyzed to determine whether there is a pattern between cognitive abilities and outcome in either of the two treatments. It is unknown whether particular cognitive abilities are specifically related to outcome in aphasia therapy. Although it would appear that subjects with greater new learning and memory abilities should have better outcomes than subjects with lower learning abilities, this relationship has not been previously explored in the literatur

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literature. Therefore, relationships between cognitive abilities and outcome on standardized tests, including generalization to discourse, were investigated.

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Chapter 2

METHODS

Design and Rationale

A between groups design with multiple outcome measures and a comprehensive battery for collection of cognitive/linguistic predictors was employed to address the project questions. Subjects who met all eligibility criteria were assigned to one of two treatment type groups, and underwent all pre-post testing.

The between groups design is an appropriate context in which to address the issues of cognitive-linguistic predictors and differential outcomes. Since different therapy types may result in qualitatively different patterns of change, it is important to investigate these differences between groups of subjects. Alternating and contrasting treatment designs are within subject models in which performance quality as a result of each therapy could obscure differences between therapies.

Subjects

Eligibility Criteria

Subjects were 12 adults with aphasia who were enrolled in a therapy program at the Communicative Disorders Clinic at the University of Michigan. Initial eligibility requirements for all potential subjects included a time post onset of brain injury of at least 3 months, to ensure that

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the subjects were beyond the spontaneous recovery period. All subjects demonstrated a nonfluent aphasia, according to the classification criteria of the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass & Kaplan, 1983). According to these classification criteria, auditory comprehension performance must be at the fiftieth percentile or higher for the four auditory comprehension subtests combined. This ensured that subjects had sufficient auditory comprehension to follow the directions and requirements of the project's tasks. Oral expression was characterized by single words or short phrases, anomia, and agrammatic production of phrases and sentences.

Severity of aphasia was determined by administration of the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass & Kaplan, 1983) and application of the BDAE Severity Rating Scale. Severity ratings for the eligible subjects were required to be between 1-3 on the 6 point scale (0 = no usable speech; 5 = difficulties not apparent to the listener). Ratings of 1-3 correspond to a moderate or moderate-severe level of impairment.

All subjects had a history of a single left cerebral hemispheric CVA of thromboembolic or hemorrhagic origin. Subjects were also required to: be medically stable, have corrected vision and hearing to within normal limits, no other history of neurologic, psychiatric, or communicative disorder, and be speakers of English as a native language. Any subject with a known history of substance abuse was excl

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excluded from participation. All eligible subjects were also required to have at least a high school diploma to ensure a premorbid functional literacy level.

Sources for eligibility criteria were the medical records (time post onset, lesion localization, other significant medical history, medical stability, visual status), and a client/family interview (native language). Medical records were reviewed to ensure that a report of a neuroimaging procedure, minimally a CT scan, was available. Subjects were eligible for the study if they had documented lesions in the primary language zone (left fronto-temporo-parietal areas). No further criteria for lesion loci were set for this project, due to the frequent report of individual differences in lesion site among patients with similar behavioral profiles (e.g., Knopman et al, 1984; Basso et al, 1985). A hearing screening using a portable audiometer with pure tones presented at 1000, 2000, and 4000 Hz at 20 dB HL (ASHA, 1985) was administered and passed by each subject.

One important component of the functional task assessment used in the project is the comprehension of wh-questions, specifically 'what' questions referring to a noun or adjective (e.g., 'what size?', 'what color?' 'what item?'). These question types are among the easiest of the various wh- forms for adults with aphasia to understand (Gallagher & Guilford, 1977). (These data are especially relevant since the research was conducted at the University of Michigan

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of Michigan Aphasia Program, and are derived from a similar subject sample to the one targeted in the present study.) It is critical that the subjects comprehend this question type, and yet it is not specifically tested on any of the BDAE subtests. Consequently, an assessment of relevant wh-questions was administered to all potential subjects. Performance at a criterion level of 75% accuracy was required for participation in the study.

The question comprehension assessment included 12 question items of the syntactic form, Wh + copula + noun. This is consistent with the procedures presented in Gallagher & Guilford (1977) and is the form that is relevant to the experimental task. Photographs of steps in two familiar sequenced events (making an omelet, going to a doctor's appointment) were selected from the "Social Sequences" photo set (Communication Skills Builders). There are 6 picturable steps in each event sequence. The two sequenced events were chosen for their presumed familiarity for adults, and their congruence with the content of items included in other portions of the pre/post assessment. Specifically, items relating to visiting the doctor are presented on the Communication Activities of Daily Living (Second Edition) test (CADL-2) (Holland, Frattali, & Fromm, 1999), and a cooking-related item is included in the procedural discourse protocol. The question stimuli and task instructions are listed in Appendix A. The examiner presented each question auditorily with the corresponding

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photograph. The subject is expected to point to the correct item from among a four choice array presented along with the picture. This brief assessment of wh- question comprehension is appealing because comprehension of the questions is embedded in a familiar routine, similar to what is required to perform the experimental task. The length of the stimuli ranged from 4 to 8 words per question, with an average of 5.75 words per question.

Subject Selection

Thirty three consecutively enrolled clients at the University of Michigan's Aphasia Program were screened for eligibility. Nineteen of these clients met the strict eligibility criteria for possible participation in this study, including single left CVA of thromboembolic or hemorrhagic origin with resulting nonfluent aphasia of moderate severity, and were at least three months post onset. All of these nineteen potential subjects spoke English as a native language, were premorbidly right handed, with normal or corrected to normal hearing and vision. All of the nineteen potential subjects were asked to participate in the study according to approved consent procedures. One subject did not wish to participate because he did not want to be randomly assigned to a treatment type, and two other subjects thought that the study activities would be too tiring. Two subjects consented and began the study activities, but fell ill for reasons unrelated to the study and were unable to complete the protocol. Two other subjec

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subjects who met all other eligibility criteria performed the functional criterion task above criterion performance at pretest and were ineligible to continue in the treatment portion of the study.

The twelve remaining subjects all consented to the project procedures and completed all activities. These twelve subjects all reached criterion performance on the wh-question task (minimum 75% accuracy). The average performance for these twelve subjects was 85% accuracy.

Subject Description

The overall average age was 51 years (range = 24-67), and the average time post onset was 26.5 months (range 4-102). All but one of these subjects were male, and all subjects were Caucasian. All but one subject was of high or upper middle socioeconomic status (SES) based on education and most recent occupation, as determined by The Four Factor Index of Social Status (Hollingshead, 1975) (Appendix B). This index weights scores for previous occupation and educational level to generate SES on a five point scale, from 1 (major professionals) to 5 (menial laborers). Nine subjects had experienced thromboembolic strokes, and eight subjects had lesions documented by CT or MRI in frontal-parietal regions of the left hemisphere. See Table 2. Nine of these subjects had persistent right hemiparesis. All subjects passed a depression screening, the Geriatric Depression Scale - Short Form (Parmalee & Katz, 1990; Brink et al, 1982; Yesavage et al, 1983) (Appendix C). This

Table 2. Subject description information.

SUBJECT ID	AGE (YEARS)	GENDER	TPO (MONTHS)	SES	TYPE OF STROKE	LESION LOCUS	GDS-SF	APHASIA SEVERITY RATING
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Table 2. Subject description information.

SUBJECT ID FUNCTIONALLY TRAINED SUBJECTS.	**AGE (YEARS)**	**GENDER**	**TPO (MONTHS)**	**SES**	**TYPE OF STROKE**	**LESION LOCUS**	**GDS-SF**	**APHASIA SEVERITY RATING**
F1	63	M	58	2	O	Fronto-pareital	2	3
F2	58	M	6	2	O	Frontal (deep)	3	2
F3	45	M	15	2	O	Temporo-pareital	4	3
F4	58	F	12	2	O	Fronto-pareital	5	3
F5	24	M	43	4	H	Pareital	2	3
F6	62	M	27	2	O	Temporo-pareital + basal ganglia	4	1
Mean (s.d.)	**51.6 (15.0)**		**26.8 (20.1)**	**2.3 (0.8)**			**3.3 (1.2)**	**2.5 (0.8)**

Table 2 (cont'd)

SUBJECT ID	AGE (YEARS)	GENDER	TPO (MONTHS)	SES	TYPE OF STROKE	LESION LOCUS	GDS-SF	APHASIA SEVERITY RATING
CN								

Table 2 (cont'd)

SUBJECT ID CN TRAINED SUBJECTS	AGE (YEARS)	GENDER	TPO (MONTHS)	SES	TYPE OF STROKE	LESION LOCUS	GDS-SF	APHASIA SEVERITY RATING
CN1	53	M	21	1	O	Temporo-pareital	4	3
CN2	67	M	4	1	O	Fronto-temporo-pareital	2	1
CN3	63	M	102	1	O	Fronto-pareital	3	3
CN4	36	M	8	2	O	Fronto-pareital	6	3
CN5	49	M	6	1	H	Fronto-pareital + basal ganglia	5	1
CN6	34	M	17	2	H	Fronto-pareital	3	2
Mean (s.d.)	**50.3 (13.6)**		**26.8 (37.6)**	**1.3 (0.5)**			**3.8 (1.5)**	**1.8 (0.9)**

Table 2 (cont'd)

SUBJECT ID	AGE (YEARS)	GENDER	TPO (MONTHS)	SES[1]	TYPE OF STROKE[2]	LESION LOCUS[3]	GDS-SF[4]	APHASIA SEVERITY RATING[5]

Table 2 (cont'd)

SUBJECT ID	AGE (YEARS)	GENDER	TPO (MONTHS)	SES[1]	TYPE OF STROKE[2]	LESION LOCUS[3]	GDS-SF[4]	APHASIA SEVERITY RATING[5]
Overall Means (s.d.)	51 (13.6)		26.5 (28.8)	1.8 (0.8)			3.6 (1.3)	2.1 (0.9)

[1] SES = Socioeconomic status determined by the Four Factor Index (Appendix B).
[2] H = Hemmorhagic; O = Occlusive.
[3] Based on CT and/or MRI reports.
[4] Number of negative statements on the GDS-SF (Appendix C).
[5] Based on the BDAE Severity Rating. 0 = No usable speech or comprehension; 1 = Communication through fragmentary expression; 2 = Conversation about familiar subjects is possible with help; 3 = Patient can discuss almost all everyday problems with little or no assistance; 4 = Some loss of fluency in speech or comprehension; 5 = Minimal discernible speech handicaps - difficulties may not be apparent to the listener.

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instrument has been successfully used as a depression screening with older adults. It is particularly advantageous for use with adults with aphasia because the standard administration technique allows either visual or auditory presentation of stimulus items, or both. Eleven of the twelve subjects scored within the normal range on the depression screening (0-5 negatives on the 15 item short form), and one subject scored 6 negative statements, which is borderline for a mild depression.

Assessment of Cognitive-Linguistic Indicators

Subjects participated in additional cognitive and linguistic assessment to determine whether these assessment results can be used as indicators of success in treatment. The Global Aphasia Neuropsychological Battery (GANB) (van Mourik et al, 1992) (Appendix D) is an appropriate and useful tool with which to collect cognitive performance information on adults with chronic aphasia. The battery includes assessment of the following cognitive abilities: attention in a visual cancellation task, memory in a task of delayed recognition of object and facial pictures, and a task of nonverbal auditory recognition of environmental sounds. The battery also includes administration of the Raven's Colored Progressive Matrices (RCPM) (Raven et al, 1979). The RCPM is a measure of nonverbal problem solving, and requires the subject to point to the correct response choice from among those presented visually. The GANB also includes assessment of visual perception through administrat

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administration of the Developmental Test of Visual Perception (Hammill, Pearson, & Voress, 1993). Working memory was assessed via the administration of digit span and pointing tasks.

Subtests of the Psycholinguistic Assessments of Language Processing in Aphasia (PALPA) (Kay, Lesser & Coltheart, 1992) were administered, specifically Digit Repetition, Digit Recognition, and Pointing Span subtests. The Pointing Span subtest requires the subject to listen to groups of words and point to corresponding pictures in sequence. The Digit Recognition subtest requires a yes/no response from the subject to indicate whether pairs of digit groups match. These latter two subtests are useful in the event that subjects have decreased oral repetition abilities. Finally, rule-learning was assessed by performance on the Wisconsin Card Sorting Task (WCST) (Grant & Berg, 1993). This assessment tool is sensitive to frontal lobe injury (Milner, 1963) and is particularly appropriate for patients with nonfluent aphasia who have anterior lesions.

Pre/Post Testing

The pre/post measures included standardized language assessments, performance of a functional task under conditions of quiet and concurrent task, a measure of social validity, and discourse measures. The standardized measures relate to previous literature on outcomes of aphasia therapy, and are representative of the theoretical orientations

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orientations of the two training approaches used. One criticism of standardized assessment measures however, is their lack of ecological validity. The administration of the functional task provides a naturalistic measure of communication performance, which can be correlated to performance on the standardized tests. It is also critical to know whether changes observed on assessment measures administered in the clinic relate to communication behaviors as perceived by caregivers, or whether caregivers perceive changes that may not be observed in the clinic, so an instrument designed to collect this information was administered. Finally, the set of discourse tasks provide a measure of generalization from the treatment to communication performance in other contexts.

Pre/Post Standardized Language Assessments

Standardized assessments representative of the two treatment approaches, functional and cognitive neuropsychological, were administered to all subjects. A standardized measure of functional communication, the Communication Activities of Daily Living test (Second Edition) (CADL-2) (Holland, Frattali, & Fromm, 1999) was administered. This test involves role playing, presentation of pictured stimuli and auditory questions about common events to measure the ability of adults with aphasia to respond in an informative and socially appropriate manner. A three point scoring system is used to measure the communicative adequacy of the response, regardless of modality

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modality used in the response. The original version of the test demonstrated its validity by correlating performance on the test with direct observation of the proportion of communication acts appropriately completed in samples of actual, daily behavior and in family interviews (Holland, 1980). The correlations between these two measures for noninstitutionalized adults with aphasia was approximately .70. The CADL was also highly related to other standardized aphasia batteries. High measures of internal consistency reliability and interexaminer reliability have also been reported (above .95 on all measures).

Selected subtests of the PALPA were administered to all subjects. This test is derived from an information processing, modular approach to language processing. Its aim is to provide a collection of standard assessment tools that can be used to complete an in-depth assessment of the deficits of a patient's language processing system. The PALPA includes 60 subtests, from which the examiner selects the appropriate subtests that will reveal the individual patient's specific impairment. Some of these subtests have descriptive statistics, and others do not.

For the purposes of this study, a few subtests that are most likely to relate to the skills required in the training task were chosen to be administered to all subjects in the study. Auditory comprehension was assessed by performance on subtest 55, Sentence-Picture Matching: Auditory Version. This subtest presents four types of sentences, including reversib

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reversible, non-reversible in both active and passive voice, gapped, and converse relations. The examiner reads the stimulus sentence aloud and the subject points to one of three line drawings that corresponds to the sentence. Descriptive statistics are provided for control subjects. In addition, Spoken-Word Picture Matching (subtest 47) was administered as a measure of single word auditory comprehension. This subtest also includes descriptive statistics for control subjects.

Reading comprehension was assessed at the single word level since written sentence level comprehension is not required in the targeted functional task. The Written Word-Picture Matching subtest of the PALPA (subtest 48) was administered, which reports mean performance levels for normal control subjects. It requires the subject to demonstrate comprehension of a single written word by pointing to the matching picture from an array of six.

To assess naming performance, the Picture Naming subtest was administered. This subtest requires the subject to name pictured items which are matched for frequency, familiarity, concreteness, age-of-acquisition, letter length and number of syllables. The subject is also required to orally read the written words corresponding to the same set of stimuli, repeat the same words, and spell these same items to dictation. The presentation of these tasks using the same stimuli enables the examiner to observe dissociations between these language processing skills.

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Finally, all subjects were administered the Boston Naming Test (BNT) (Kaplan et al, 1983) as a standardized measure of visual confrontation naming before and after treatment. This test is a common reference point among many reports in the literature and has a long history of application with extended norms (Ferraro et al, 1998; Ferraro et al, 1997; Flanagan & Jackson, 1997). It is also commonly used clinically.

Pre/Post Functional Task

The non-standardized functional task chosen for pre/post assessment is two forms of a catalog ordering task, phone ordering and mail ordering. The ability to complete catalog ordering was chosen as a measure of functional communication ability for several reasons. Firstly, catalog ordering is an activity specifically listed by groups of patients, asked to identify communication situations that are important to them and also problematic since the onset of aphasia (Lomas, Pickard, & Mobile, 1987). Independently being able to do shopping in any way is considered an instrumental activity of daily living, and appears on several instruments that measure functional independence in communication, or activities as they relate to quality of life (Lomas et al, 1989; Frattali, 1993). Catalog ordering can be completed in two modalities, auditory-verbal (phone ordering) and reading-writing (mail order form). There is a routinized script for completing catalog ordering, and such a script can be analyzed in terms of cognitive and

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linguistic components. Sarno (1991) suggests that many adults with aphasia speak best when on the telephone, which might relieve some anxiety associated with face-to-face interactions and also restricts the language choices and increases language redundancy typically used on the phone. Finally, most adults have had experience completing catalog ordering, and independent shopping is likely to be a highly motivating task for adults in rehabilitation.

Development of the Catalog Ordering Task

The first step in the development of this task was the establishment of a representative sequence of events within the ordering script. This was accomplished by transcribing three scripts taken from three nationally known mail order businesses. Each catalog ordering phone call was transcribed, and the sequence of events analyzed. Transcripts from each of the three calls appear in Appendix E. Subroutines that did not vary in sequence across the three transcripts were the Opening and the Closing. The Opening consisted of an introduction ("thank you for calling x") and the polite form of a question ("may I help you?"). The Closing sequence included all of the following types of information across all three transcripts: total amount to be billed, delivery information, and thanks for calling.

Across the three transcripts, the remainder of the script during which specific types of information were requested from the caller varied in sequence. There were a to

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total of seven different subroutines which appeared in the three transcripts, six of which appeared in all three of the transcripts. These six subroutines and their embedded subroutines are listed in Table 3. For each subroutine, the ordinal position in which it appeared in each of the three transcripts is listed.

Based on the actual sequence of events in the three transcripts, a prototypical sequence was derived to be used in the catalog ordering task of this study. The Opening includes an initial request ("may I help you?"), followed by the six routines that were common to all three transcripts in this order: catalog number, phone number, name (last, first), address (zip code, city/state, street address), credit card number and expiration date, and ordering the target item (item number, quantity, color, size). Finally, there is a Closing sequence that includes total amount to be billed, delivery time, and thank you.

The range and average sentence length in words for items transcribed from the actual examples appear in Table 4, and served as a guide for the development of the phone ordering task. The overall average sentence length across all three examples was 6.6 words per sentence (range = 3-20). The average number of sentences per ordering event was 18. The syntactic forms in the actual transcripts were also counted. The most frequent question types in the actual transcripts were wh-questions ("what"), embedded questions ("delivered to home or office") and ellipticals ("and the

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Routine	Positions
1. Address	3, 4, 3
Zip code	1, 1, 3
City/State	2, 2, 2
Street address	3, 3, 1
2. Catalog number	2, 1, 0
3. Credit card	5, 5, 4
Card number	1, 1, 1
Expiration date	2, 2, 2
4. Name	1, 6, 2
First name	1, 0, 0
Last name	2, 1, 1
5. Order item	6, 3, 5
Item number	1, 1, 1
Quantity	2, 2, 0
Color	3, 3, 3
Size	2, 4, 4
6. Phone number	4, 2, 1
7. Place of delivery	0, 0, 6

Table 3. Ordinal position of each routine and embedded subroutine among the actual calls to representative catalog ordering companies.

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	ASL (range)	**No. of sentences**
Example 1	7.07 (3-17)	14
Example 2	7.5 (3-20)	21
Example 3	5.2 (3-11)	19
Overall	6.6 (3-20)	18

Table 4. Average sentence length (ASL) in words per sentence and number of sentences for each of the three actual examples of phone ordering.

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zip code?”). Consequently, these forms were emphasized in the development of the task.

The phone and written versions of the catalog ordering task appear in Appendix F. The phone version has an average sentence length of 6.8 words, close to the average number of sentences in the sampled transcriptions. Vocabulary used in the phone version and the mail order form version are similar but not equivalent since the nature of each of the two tasks requires slightly different vocabulary. See Appendix G for a list of the vocabulary items used in the phone and mail order versions of the task.

Target stimuli for the task were chosen from a familiar category (clothing) that is frequently ordered from catalogs. The top ten items mentioned in response to the category name by normal subjects was used as a basis for selection of the target items (Battig & Montague, 1969). From among these ten items, the items that were equivalent across gender were selected as the six target items (for example, “dress” and “tie” were omitted). The six selected target items were as follows: pants, coat, shirt, hat, shoes, sweater. These target items were randomly assigned to each presentation of the task for each subject.

An actual catalog was selected to be used as the experimental stimulus, and appropriate examples of each of the six target items were selected. Color names were chosen for each item according to plausibility, while maintaining an emphasis on frequently used color names (e.g., “green” was cho

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was chosen over "taupe"). The catalog ordering task requires the presentation of an incorrect item by the examiner, and the six target items were assigned in random order to be used as the incorrect item for each target. The incorrect price required in the catalog ordering script was created for each item by adding 50% of the actual listed price. A table listing the target items and their corresponding colors and prices is presented in Appendix H. Simulated credit cards were also created for use in the task. Twelve digit credit card numbers were created to include each of the digits 0 through 9 in each credit card number.

Responses generated during the task represent the following categories: personal information (name, address, phone number), object names (clothing items), adjectives (colors, sizes), number and letter names (credit card number, item number), and action ("order"). Exemplars from these categories have been assessed among adults with chronic aphasia in both comprehension and expression tasks (Goodglass et al, 1969). Adults with nonfluent aphasia tend to have equal difficulty in naming across all categories.

Validity of the task was assessed by comparing performance on the phone ordering simulation to actual performance on an audiotaped phone call to a catalog. Three adults with aphasia were recruited to call actual catalog companies and place an order at the request of the examiner.

The descriptive information for these three subjects is presented in Table 5.

These phone calls were audiorecorded and transcribed (see Appendix I). Performance on the actual call was compared to the first performance of the simulated phone version task in the quiet condition. Accurate responses were totaled and errors characterized. The error types listed in Table 5 are failures to communicate the complete information requested, including no responses or saying "I don't know", related errors which included providing all or part of an address when item number or phone number was requested, and unrelated errors would have included the production of words or phrases that were not related to the catalog ordering task. As suggested in Table 6, performance levels and nature of errors occurring during the actual phone calls were similar to those of the same subjects during the phone ordering task. Subject 1 was much more successful in the simulated phone task than in the actual phone ordering. One reason for this was because she chose to open and use a communication notebook as a self-cueing device during the simulated catalog ordering task, whereas she did not choose to use any of these cues during the actual phone call even though she had equal opportunity to do so across both situations. This is particularly interesting since she did the simulated catalog ordering first prior to performing the actual phone call. Secondly, her failure to communicate her phone number during the

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Table 5

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Subject	**Age (years)**	**Aphasia type-BDAE Classification**	**Aphasia severity (BDAE Severity Rating)**
1	52	Broca's	3/5
2	23	Broca's	3/5
3	13	Anomic	4/5

Table 5. Subject description for the three subjects with aphasia placing catalog ordering phone calls.

	Actual Call	Catalog Ordering Task

	Actual Call				**Catalog Ordering Task**			
	Overall Accuracy	Error Types			Overall Accuracy	Error Types		
Subject		Failure	Related	Unrelated		Failure	Related	Unrelated
1	17%	3	2	0	71%	2	3	0
2	95%	2	0	0	89%	0	2	0
3	100%	0	0	0	100%	0	0	0

Table 6. Overall accuracy and error types for the three subjects with aphasia in actual calls and in the simulated catalog ordering task.

actual call, which was the first item asked, caused a fatal error in the actual ordering event, and she aborted the phone call. In the simulated task, her first error was not fatal to the completion of the entire sequence, which provided her with more opportunities later in the task to be successful. The type of errors she made in both circumstances was similar.

Concurrent Task Condition

Both forms of the functional task were performed under two conditions, one of which was designed to assess functional abilities under cognitive load. During one condition subjects performed the functional task assessment in a quiet environment. The subjects were also required to perform the task in a concurrent task condition, during which a secondary reaction time task was presented to the subjects. Significant differences in lexical decision and picture description performance have been reported among aphasic subjects under quiet, focused attention, and divided attention conditions, similar to the one proposed here (Murray et al, 1997; Murray et al, 1998).

A 1000 Hz tone was computer-generated using Sound Blaster software on a Power Macintosh computer. PsyScope software (Cohen et al, 1993) was used to set up the reaction time task. The stimulus duration was set at 150 msec and the response interval at 3000 msec. The response interval was determined by reviewing reaction times reported in previous literature for performances of adults with aphasia

in divided attention tasks (Murray et al, 1997; Murray et al, 1998), and then creating a response interval long enough to accommodate these times. Randomized intertrial intervals (ITI) were set to range between 5000 msec and 11000 msec, with an average ITI of 8000 msec. A relatively long ITI was chosen based on the experiences of Murray et al (1998) as well as on empirical reports of response latency in picture naming for adults with aphasia. In Murray's experiment, ITI was set at 1000 msec, and this created a task that was extremely difficult even for subjects with a mild aphasia (Murray, personal communication). Consequently, a longer ITI was chosen for the present experiment to allow subjects with a broader range of severity levels to participate, and to accommodate the more complex catalog ordering simulation that was the target. Furthermore, adults with aphasia have been observed to require 2-5 seconds in response time for a simple picture naming task (Mills et al, 1979). Therefore, 5000 msec was chosen as the lowest ITI. A single switch mounted on a metal foot stand was connected as an input device. This response option was chosen since many of the subjects had residual hemiparesis, with limited use of the upper extremities. Instructions to the subject during the concurrent task condition emphasized the importance of completing the ordering task while responding to the presented tones as quickly as possible. These instructions appear in Appendix F.

Scoring for the Catalog Ordering Task

A three point scale, similar to the one used in the CADL-2, was developed and applied to scoring for accuracy of both phone and written versions of the catalog ordering task. A score of "2" on the three point scale was given for complete, accurate responses. A score of "1" was assigned when the response was related to the stimulus item or the target, or was incomplete. A score of "0" was assigned if the response was unrelated to the item, inaccurate, or if there was no response. A list of the specific criteria, and examples for each item in the catalog ordering task, are given in Appendix J. Total duration in minutes and seconds for each run of the catalog ordering task was also recorded, as a measure of general efficiency during task performance.

Pre/Post Measure of Social Validity

Another pre/post measure was the Communicative Effectiveness Index (CETI) (Lomas et al, 1989) which provided a measure of the perceptions of caregivers at the beginning and end of the treatment program. The CETI has 16 items to which the caregiver rates the person with aphasia's performance on a visual analogue scale, ranging from "as able as before stroke" to "unable to do". At post-testing, caregivers mark their current perceptions on the pretest form with previous markings visible. This administration procedure has been established as a valid and reliable method. The CETI score is the change score between the pre/post test administrations.

Pre/Post Discourse Tasks

Spoken discourse is an important tool used in many different daily living situations, and consequently it is critical to determine the relationship between discourse outcomes in aphasia therapy and its relationship, if any, with other functional task performances. The discourse tasks are designed to assess the subjects' ability to apply targeted communication skills in different situations that relate to the functional communication task to various degrees. Three discourse types were collected, expository, procedural and narrative discourse. Expository discourse was collected pre/post treatment using the Cookie Theft picture from the BDAE, or one of a related set of pictures that has also been developed for this purpose (Craig et al, 1993). Each subject was asked to tell the examiner 'everything you see going on in this picture'. A procedural discourse sample was elicited by asking the subject to recount the steps for accomplishing a set of tasks that were either similar to the catalog ordering task, or were topics commonly used in the collection of procedural discourse of adults with aphasia. The subjects were asked to recount how to order something from a catalog, both before and after the treatment program. Subjects were also asked to describe the steps to ordering a pizza, since the task sequence should be similar to catalog ordering but the required vocabulary will differ. Samples from two additional topics which are common to many analyses of procedural discourse in aphasia, how to make toast and jelly, and how to get groceries from the market, were also collected (Li et al, 1995; Ulatowska et al, 1983; Terrell & Ripich, 1989).

The narrative sample was elicited by asking the subjects to retell the Cinderella story. The retelling of this story has been used as a standard procedure in aphasia discourse research (Saffran, Berndt & Schwartz, 1989). Subjects were asked to tell the story "as though you are telling it to your children/grandchildren". All of these samples were audiorecorded for later transcription and analysis.

Order of Presentation

Order of presentation of the pre/post assessment measures were randomized across subjects as much as possible within certain constraints. During both pretesting and posttesting, all subjects performed the discourse tasks first, followed by all other assessment measures. Within the catalog ordering task, presentation of the phone and written versions in quiet and concurrent task conditions were randomized for each testing period for each subject.

Treatment Procedures

Subjects who met all eligibility criteria were assigned to one of two treatment approaches. The two treatment types were commonly used aphasia treatment approaches that are representative of common clinical practice in addition to being well-represented in the aphasia treatment research literature. The research treatment sessions were provided as part of the therapeutic activities that the subjects were receiving in their program at the University of Michigan Aphasia Program. All treatment activities for each subject were representative of the assigned treatment type.

Eligible, consenting subjects underwent all pretesting as described above during the first week. For the next five weeks, the subjects participated in therapy sessions that were based on either the functional or cognitive neuropsychological treatment approaches. Subjects participated in 4-5 naming treatment sessions weekly which were derived from the catalog ordering task, in addition to 15-20 additional treatment sessions that made up the total program. Catalog-based naming treatment sessions were all provided by one of two trained therapists, including the experimenter. All subjects entered into the study had naming as goal in treatment.

The other 15-20 weekly treatment sessions were oriented to the assigned treatment. Each subject had a total of three therapists, and these therapists were trained on the characteristics of the two treatment approaches. All treatment goals and activities were audited by the experimenter to ensure compliance with the characteristics of the targeted treatment approaches. The parameters of the two treatment approaches described in Table 1 were used as guidelines. A description of the treatment goals and strategies for each subject are listed in Table 7.

Due to the coordinated nature of the University of Michigan's Aphasia Program, it was possible to ensure that all therapists were in compliance with the targeted treatment approach by reviewing documentation such as progress notes and by direct observation of treatment sessions. The residential component of the program also provided an element of control for the activities that subjects participated in outside of the experiment. All subjects were exposed to the same living situation and similar social activities during the course of the experiment. This element of environmental control is extremely unusual and advantageous for a treatment research study.

Cognitive Neuropsychological Treatment

The cognitive neuropsychological approach assumes two main potential sources for naming impairments, semantic and phonological. Consequently, two training procedures with their aim to address each of the two levels of impairment were devised for use in the CN treatment. Subjects who were assigned to the CN treatment group underwent additional testing to assess the level of function that was most severely impaired, and to identify input and output modalitiesof strength and weakness. The most severely

Table 7. Description of additional treatment goals and strategies for each subject.

Table 7. Description of additional treatment goals.

Subjects	**Goals/Strategies**
Functionally trained subjects.	
F1	Naming and conversational skills using multimodality strategies; auditory comprehension of complex questions and sentences in conversational contexts
F2	Oral and written production of functional vocabulary words; use of multiple modalities to communicate messages; reading comprehension of single word functional vocabulary
F3	Naming in conversation and with the use of categorical and semantic cueing; comprehension of money and time concepts; writing personally relevant single words
F4	Verb naming and short phrase production in conversation; auditory comprehension of complex sentences in conversation; writing personally relevant single words
F5	Verb naming in conversation using multiple modality compensatory strategies; writing short phrases using compensatory strategies; reading comprehension of short paragraphs
F6	Naming and use of multimodality compensatory strategies in conversation; writing personally relevant phrases

Table 7 (cont'd)

Subjects	Goals/Strategies
CN trained subjects.	
CN1	Generating oral and written phrases using HELPSS (Helm-Estabrooks, 1981); comprehension of when/where questions; reading comprehension of paragraphs
CN2	Visual Action Therapy; writing personal information in a drill format; naming and recognizing gestures
CN3	Oral naming given phonemic and rhyme cues; single word reading comprehension; phoneme to grapheme matching; writing words and nonwords to dictation
CN4	Oral naming given semantic cueing; writing single words and phrases; reading comprehension of paragraphs
CN5	Oral and written naming of single words given semantic and phonemic cues; auditory comprehension of commands; silent and oral reading of words and word combinations
CN6	Oral and written naming given semantic and phonemic cues; reading comprehension of sentences; formulating word strings to picture description

impaired area was addressed by selecting either the semantic or phonological route to treatment.

Assigned subjects were assessed using the PALPA subtests to identify details of their linguistic profiles. Subjects who demonstrated a predominant semantic impairment showed lower than normal performance levels on single word comprehension and production subtests. Errors consisted primarily of the selection of semantically related distractors. Subjects with predominant phonological impairment exhibited few semantic errors but made sound selection errors in oral reading and naming tasks.

Table 8 lists the assessments and performance levels for each CN subject, which determined the nature of the naming impairment in each case. Subjects CN1, CN5, and CN6 had a similar profile. All three of these subjects had relatively good semantic processing of auditory and written words, as measured by their ability to match words and pictures. All three had poor oral naming performance, including poor repetition and oral reading abilities. This profile implicates the lexical phonological system as an origin for the oral naming disorder, with minimal involvement of the semantic system. These three subjects were all administered the same cueing hierarchy during treatment.

Subject CN2 had a severe impairment of the both the semantic and phonologic systems. This subject at pretesting was unable to sort the pictured stimulus items into semantic

Table 8. Description of assessments and performances used to determine the nature of the naming disorder for each CN subject.

Table 8. Assessment information.

Subject	**Assessment/Performance**
CN1	Auditory word-picture matching = 90% Written word-picture matching = 95% Written picture naming = 45% Oral picture naming, baseline vocabulary = 60% Oral reading = 66%
CN2	Auditory word-picture matching = 45% Written word-picture matching = 45% Written picture naming = 0 Oral picture naming, baseline vocabulary = 0 Oral reading = 0 Category sorting of pictured items = 0
CN3	Auditory word-picture matching = 95% Written word-picture matching = 73% Written picture naming, baseline vocabulary = 100% Oral picture naming, baseline vocabulary = 33% Oral reading = 18% Oral spelling = 13% Phoneme-grapheme matching = 73% Spoken word - initial letter matching = 13%
CN4	Auditory word-picture matching = 98% Written word-picture matching = 100% Written picture naming = 95% Oral picture naming, baseline vocabulary = 95% Oral reading = 95% Naming to auditory definition, baseline vocabulary = 17% Sentence production to pictures = 83%
CN5	Auditory word-picture matching = 80% Written word-picture matching = 88% Written picture naming = 3% Oral picture naming, baseline vocabulary = 46% Oral reading = 13%
CN6	Auditory word-picture matching = 90% Written word-picture matching = 93% Written picture naming = 10% Oral picture naming, baseline vocabulary = 65% Oral reading = 85%

categories (e.g., numbers, letters, clothing). This subject was administered a treatment program that emphasized semantic processing. Subject CN3 had a relatively good semantic system, and was able to correctly name all the baseline picture items with written words at pretest. He was unable to orally read any of the items he had written, nor was he able to orally name these pictured items. His profile was consistent with a downstream phonological deficit which affected his ability to match phonemes and graphemes singly or in words. His treatment focused on phonological processing and oral reading.

Subject CN4 was relatively good at single word auditory and written comprehension, and naming pictured items. In spite of these strengths, he was exceptionally poor at naming given an auditory definition. His conversational output at pretest was sparse and limited to single words and short phrases in spite of his relatively good naming skills. His sentence production skills were also relatively good, given a pictured stimulus item. Overall, his performance was relatively good given visual, pictured input, and poor under conditions of auditory input. This subject displayed a specific semantic naming deficit related to the auditory input channel. Therefore, his treatment focused on naming the target vocabulary given auditory definitions.

The stimuli were 54 items derived from semantic categories associated with the catalog ordering task. The semantic categories included: number names, color names, clothing names, letter names, and fruit names. The category "fruit" was selected because these items could plausibly be ordered from a catalog but are not included as targets in the catalog ordering task. Items in each category were matched for word frequency. A list of the 54 vocabulary items is given in Appendix K.

Baseline sessions consisted of the first three sessions of treatment. During each baseline session, all of the 54 stimuli items were presented in random order and the subject asked to name each item upon picture presentation. Items missed during all three baseline trials were selected for training and probes. Half of the consistently missed items were targeted for treatment, and the other half were untrained. The items to be trained were divided into two training sets.

At the beginning of each treatment session after the baseline sessions were completed, half of the training set items were presented without cues. Half of the items were alternated each day to create two different treatment probes. Performance on this probe was used to chart progress during training as well as to determine whether the subject had achieved criterion. Following the probe, treatment began when the clinician presented a picture stimulus randomly chosen from the training set and applied the cueing hierarchy (see Table 9) when the subject attempted to orally name the pictured item. The clinician and subject continued with the cueing hierarchy for each

Subject	Cueing hierarchy
CN1	1) Semantic cue 2) Phonemic cue 3) Repetition
CN2	1) Sort pictured stimuli by category 2) Semantic cue 3) Phonemic cue 4) Repetition
CN3	1) Match graphemes to phonemes 2) Phonemic cue 3) Repetition
CN4	1) Match definition to name 2) Describe by semantic feature 3) Repetition
CN5	1) Semantic cue 2) Phonemic cue 3) Repetition
CN6	1) Semantic cue 2) Phonemic cue 3) Repetition

Table 9. Cueing hierarchy for each CN subject.

stimulus item in the trained set. The entire set was repeated with the cueing hierarchy. The probe and the two passes through the training stimuli with the cueing hierarchy constituted one training session. A sample training data form is shown in Appendix L. This procedure continued for four-to-five sessions per week until a 90% criterion was achieved. Once criterion was achieved, the second training set was presented in the same way. Training on this set of items continued until criterion was achieved or until the subject's participation had reached five weeks. Once the training period ended, the complete post-testing protocol was administered to measure naming performance on both trained and untrained items. The treatment cueing hierarchy for each CN subject is presented in Table 9. The trained and untrained items for each subject in the CN treatment are listed in Table 10.

CN1, CN5, and CN6 each received the same cueing hierarchy, which reflected their similar deficit patterns (Greenwald et al, 1995). CN2 was asked to sort training items into semantic categories, and then these items were named using semantic and phonemic cues (Howard et al, 1985; Le Dorze et al, 1994). CN3 was administered a phonological therapy (Howard et al, 1985; Le Dorze & Pitts, 1995) with an emphasis on oral reading (Cherney, 1995). CN4's treatment focused on a semantic procedure, requiring the naming of

Table 10. List of trained and untrained items for each subject in the CN treatment. * = items required for performance in the phone version of the catalog ordering task.

Table 10. List of trained and untrained items.

Subject	**Trained Items**		**Untrained Items**
	Set A	**Set B**	
CN1	Y, coat*, pineapple, R, blue*, T, O (7)	J, V*, purple, G, K*, banana, H (7)	U, gray, Q, red*, M*, lemon, Skirt, X*, peach, W, D*, P, I* (13)
CN2	Blue*, black*, grey, coat*, skirt, pants*, peach, pineapple, orange (9)	pink, purple, red*, dress, shirt*, socks, apple, pear, banana (9)	Letter names Number names (36)
CN3	Purple, red*, shirt*, pineapple, orange (5)	Blue*, pink, socks, peach, banana (5)	Brown*, grey, skirt, pear, apple (5)
CN4	Black*, city*, size*, dress, apartment, (5)	Pink, shirt*, red*, phone number*, skirt (6)	Blue*, credit card*, coat*, catalog*, gray, socks, state*, purple, address*, pants* (11)
CN5	Black, one, D, K, R, coat, peach, apple (8)	Pink, zero, skirt, pear, Y, N, T, H (8)	Purple, F, I, M, P, S, U, V, W, Y, Z, dress, pineapple (13)
CN6	Gray, D, F, H, M, J (6)	E, G, I, K, L, N (6)	O, P, Q, R, S, T (6)

items given auditory definitions, with a semantic map and semantic features as cueing devices (Lowell et al, 1995).

Functional Treatment

The functional approach assumes that contextual influences and self-generation of cues are powerful modifiers of behavior within specific contexts. Consequently, the functional treatment emphasized practice within the targeted activity and the application of self-generated strategies. Subjects who were assigned to the functional treatment group practiced targeted communication strategies within the actual catalog ordering task.

The materials for this treatment included various catalogs, a phone, practice credit cards, pen, and paper. The same phone ordering script used in the pre/post assessment was used for the training sessions. This is consistent with the functional emphasis on practice in relevant contexts. The treatment probes consisted of half of the trained items administered without cueing, so that there were a total of two probes which were alternated. A baseline performance for this treatment was already established during the pretesting of the catalog ordering task. A list of the items that a subject needed to be able to produce to perform the catalog ordering task during treatment is given in Appendix M.

Only half of the items used for pre/post assessment on the catalog ordering task were used for training. These trained items in the semantic categories of "colors" and “clothing names” were also included in the CN treatment baseline. Trained items that were required in the catalog ordering task were compared to untrained items at posttest to determine whether there was an effect of training on the vocabulary produced.

After the treatment probe was administered at the beginning of each treatment session, the clinician and subject worked through the training script. For each item that was difficult for the subject, the clinician used a problem-solving approach to assist the subject in generating a successful strategy for communicating the information in the appropriate modality for the task. Each training session consisted of one pass through the phone version with cueing and practice of strategies, after the training probe. A sample data recording form for the functional treatment is shown in Appendix N. Criterion performance of 90% of information conveyed appropriately and accurately was required for completion of training. All of the training sessions were videorecorded for later analysis. Training continued until criterion was reached or until the five week training period ended.

The specific strategies used for each subject are listed in Table 11. All of the strategies were designed to achieve the goal of completing the phone ordering task. Whenever possible, oral reading was used as a strategy to accommodate specific oral naming deficits, like difficulties

Subject	Strategies
F1	Oral reading of keywords in communication notebook Subvocal counting; using fingers during counting Use of electronic device to cue key words
F2	Oral reading of keywords in communication notebook Subvocal counting Use of electronic device to cue key words
F3	Oral reading of keywords in communication notebook Use electronic device to name letters/oral spelling
F4	Oral reading of keywords Write out information needed in advance
F5	Oral reading of keywords in communication notebook
F6	Oral reading of number words Use of electronic device to name letters

Table 11. Treatment strategies used for each functionally trained subject for the catalog ordering task.

with number or letter naming or saying personal information. When this was not an option, other strategies like subvocal counting for number naming, or use of an electronic device with speech output were used. This required the subject to identify the specific needs for a particular response, and choose the correct compensatory strategy. Each strategy, in turn, could have multiple steps, in particular use of the electronic device. In this case, items needed were stored in a personalized list in advance, and the subject was required to perform a series of keypresses that selected the target item and produced speech output. Therefore, each functionally trained subject was learning a compensatory strategy that might require a few steps for each response item, and learned to use these strategies to produce accurate and efficient responses.

Reliability

Transcription and scoring reliability were determined by having 12% of all of the discourse samples, catalog ordering, and standardized testing re-transcribed and coded by an independent observer. This observer was a certified speech/language pathologist unfamiliar with the study or its goals, who was blinded to test time information. Samples were randomly selected from the data corpus. Transcription reliability was calculated with a point-to-point comparison at the word level by dividing the number of agreements by the number of agreements plus disagreements. The transcription reliability was 96.6%.

Scoring reliability was also calculated by point-to-point comparison, and this yielded a scoring reliability of 97.7%.

Chapter 3

RESULTS

Comparability of the Two Groups: Demographics

Eligible, consenting subjects were randomly assigned to one of two treatment groups, cognitive neuropsychological (CN) or functional (F). The demographic characteristics of the two subject groups were compared. The two subject groups were similar in average age (CN mean = 50.3 years, F mean = 51.7 years), time post onset (CN mean = 26.3, F mean = 26.8), socioeconomic status ratings (CN mean = 1.3, F mean = 2.3) and severity rating (CN mean = 1.8, F mean = 2.5). The CN group was slightly higher in SES and the F group was slightly less severe as measured by the Severity Rating of the BDAE. Details for each subject are provided in Table 2.

Comparability of the Two Groups: Cognitive Battery

Each subject was administered a cognitive battery. Results of the cognitive testing for each subject are offered in Table 12. All subjects performed well on visual cancellation (overall mean = 98.4) and recognition memory (overall mean = 95.3). All but one subject (F1) performed well on a measure of nonverbal problem solving, the RCPM. Subjects ranged in performance from 80% to 100% on this

Table 12. Performance of subjects on the cognitive battery.

Subjects FUNCTION-ALLY TRAINED SUBJECTS.	**Visual Cancella-tion**	**Recogni-tion Memory**	**RCPM**	**Visual-Perceptual**	**Nonverbal auditory recogni-tion**	**Digit repetition span**	**Digit matching span**	**Pointing span**	**WCST**[1]
F1	100%	100%	41%	71%	100%	2	3	2	0
F2	95%	93%	86%	82%	75%	CNT	0	2	2
F3	100%	100%	90%	83%	100%	3	3	3	4
F4	100%	100%	100%	95%	100%	5	3	2	4
F5	100%	93%	97%	92%	100%	7	7	4	3
F6	98%	100%	92%	93%	100%	3	6	3	2
Mean (s.d.)	**98.8 (2.0)**	**97.6 (3.6)**	**85.3 (19.4)**	**86 (9.1)**	**95.8 (10.2)**	**3.3 (2.4)**	**3.7 (2.5)**	**2.6 (0.8)**	**2.5 (1.5)**
CN TRAINED SUBJECTS.									
CN1	100%	100%	100%	90%	100%	3	7	3	5
CN2	90%	65%	89%	75%	100%	CNT	CNT	CNT	2
CN3	100%	100%	85%	98%	100%	CNT	2	2	1
CN4	100%	93%	97%	90%	100%	7	7	6	3
CN5	98%	100%	91%	99%	75%	2	2	0	3
CN6	100%	100%	80%	96%	100%	3	7	2	3

[1] No. of categories learned on the Wisconsin Card Sorting Test (Grant & Berg, 1993).

Table 12 (cont'd)

Mean (s.d.)	98 (4.0)	93 (14.0)	90 (7.4)	91.3 (8.9)	95.8 (10.2)	2.5 (2.6)	4.2 (3.2)	2.2 (2.2)	2.83 (1.3)
OVERALL MEAN (S.D.)	98.4 (3.1)	95.3 (10.0)	87.8 (14.3)	89 (9.0)	95.8 (9.7)	2.9 (2.4)	4 (2.8)	2.4 (1.6)	2.7 (1.4)

measure, except F1, who achieved a score of 41%. This is consistent with F1's equally poor achievement on the WCST, during which he learned no categories. This poor learning and cognitive performance was not demonstrated by any other subject. F1's language performance, discussed in more detail later, was comparable to the other subjects and was consistent with the diagnosis of nonfluent aphasia. Subjects also performed relatively well overall on the visual-perceptual assessment, comprised of selected subtests of the DTVP (overall mean = 89%). Both treatment groups had comparable performance on the assessment of nonverbal auditory recognition (overall mean = 95.8%).

Digit repetition span was similar across the two treatment groups. Three subjects were unable to perform the task because they could not repeat numbers, and at least one of these subjects was assigned to each group. Similarly, one subject in each of the treatment groups was able to perform within normal limits on the digit repetition span (span = 7 digits). A wide range of performance was also observed on the digit matching span task. Five subjects overall achieved a normal span on this task (span = 6-7), and three of these subjects were assigned to the CN group. The remaining subjects could not perform the task (two subjects), or achieved low scores of 2-3 (five subjects).

Performances on the pointing span task ranged from 0 to 6, and all of these performances were notably below normal levels of performance (Kay, Lesser, & Coltheart, 1992). The good recognition memory performance of all the subjects in contrast to the relatively poor recall performance as evidenced by scores on the digit repetition and pointing span tasks is a typical profile for anterior aphasic adults (Beeson, 1993).

The generally poor category learning performance of all of the subjects, with the exception of CN1, is consistent with average performances reported for adults with frontal lobe injury (average number of categories learned for adults with frontal lobe injury = 3.46)(Grant & Berg, 1993). F1, however, is notable for being totally unable to learn the task at all during the entire 128 trial period, and CN1 performed two standard deviations above the mean for frontal lobe injured adults. Although CN1's language performance was consistent with a nonfluent aphasia, CT documentation suggested a temporo-parietal lesion rather than a frontal lesion. It is tempting to suggest that his more posterior lesion might partially explain his different WCST performance, but three other subjects also had documented temporo-parietal area lesions (CN3, CN5, and CN6) and none of these subjects performed better than the subjects with more anterior lesions. CN1 was reported to be highly gifted prior to his stroke by his wife, but this may not be significantly different than the other subjects, most of whom were college educated with high level occupations.

All portions of the cognitive battery were subjected to correlational analysis. The RCPM and the WCST were highly correlated (r = 0.76, p< 0.01). The digit repetition span task of the PALPA was correlated with the digit matching span task (r = 0.75, p<0.01) and with the pointing span task (r = 0.75, p< 0.01). There were no other relationships between components of the cognitive battery. This suggests that the assessment measures that comprised the cognitive battery were tapping relatively separable skills, with the exception of problem-solving/new learning as measured by the WCST and RCPM, and the three span tasks.

All subjects performed relatively well on visual cancellation, recognition memory, visual-perceptual assessment, and nonverbal auditory recognition. The cognitive assessments that detected differences between the subjects are those that measure nonverbal problem-solving, executive function, and memory span. This suggests that basic processing of stimuli, like that required in the visual cancellation, visual-perceptual, immediate recognition memory, and nonverbal auditory recognition are relative strengths in these twelve subjects. However, there was more variability between subjects among the higher level cognitive functions.

Because the RCPM is part of the Western Aphasia Battery (Kertesz, 1980), it has been routinely used in the assessment of subjects with aphasia. The RCPM has occasionally been observed to be related to auditory comprehension abilities, although it is not related to other linguistic abilities (Kertesz, 1988). Correlations between single word and sentence level auditory comprehension and the RCPM were run to determine whether such a relationship existed in the current data set. Pretest oral and written naming abilities, as well as functional communication, were also analyzed for potential relationships to performance on RCPM. There were no relationships between any of the pretest language abilities and the RCPM.

Consequently, inspection of the RCPM, WCST, and digit/pointing span tasks together yields the distinctive cognitive profiles for each subject. Among the functionally trained subjects, F1, F2, and F6 displayed the lowest cognitive profile (Table 12). F1 had the lowest performance on RCPM and WCST of all of the subjects, and F2 and F6 showed the next lowest performances on WCST. These three subjects also had the lowest performances on digit/pointing span tasks. The other three functionally trained subjects had moderate levels of performance on WCST, RCPM, and digit span tasks.

Among the CN trained subjects, CN2 and CN3 had the most severe cognitive profiles based on their performances on the WCST, RCPM, and digit/pointing span tasks (Table 12). CN1 had the best cognitive profile overall for all twelve subjects in the study. CN2 and CN5 sustained deep lesions to the frontal-parietal-temporal regions.

Comparability of the Two Groups: Language Testing

Pretest performances of standardized language testing, functional communication measures, and reaction times during concurrent task performance were compared between the two groups. All subjects were relatively good at understanding single written words (overall mean = 88.3), with the exception of CN2 (score = 45%). This subject was equally poor at spoken word-picture matching and sentence-picture matching subtests of the PALPA (35% and 0, respectively). CN2 was the most linguistically impaired of all of the subjects. On the BDAE, which measures auditory comprehension primarily through spoken word picture matching tasks, CN2 performed at the 45th percentile, qualifying him as a nonfluent, Broca's-type aphasia according to the Rating Profile, and meeting the eligibility criteria of this study. His performance on the standardized PALPA subtests, which are controlled for word frequency, imageability, and age of acquisition, were notably worse than his performance on the BDAE. This is consistent with his semantic impairment. The remaining subjects performed well for spoken word-picture matching, and demonstrated decreased performance overall for sentence comprehension. Specific test scores for each subject are provided in Table 13.

The subjects overall demonstrated variable performance on the naming assessments. Generally, the subjects scored higher on the Spoken Picture Naming subtest of the PALPA than on the BNT. This is likely due to the controlled stimulus characteristics of the PALPA, including controls for word frequency, imageability, and age of acquisition.

Subjects	**Reading Comprehension**	**Auditory Comprehension**		
FUNCTIONALLY TRAINED SUBJECTS.	**Written Word-Picture Matching - PALPA**	**BDAE Auditory Comprehension (percentiles)**	**Spoken Word-Picture Matching - PALPA**	**Sentence-Picture Matching - PALPA**
F1	85	75	100	73
F2	95	72	100	75
F3	90	70	93	83
F4	100	80	100	73
F5	95	80	100	75
F6	100	95	100	100
Mean **(s.d.)**	**95.8 (5.6)**	**78.7 (8.9)**	**98.3 (2.9)**	**78.7 (8.9)**
CN TRAINED SUBJECTS.				
CN1	95	80	90	60
CN2	45	45	35	0
CN3	73	60	98	37
CN4	100	85	98	93
CN5	88	60	80	68
CN6	93	70	90	70
MEAN (s.d.)	**82.2 (20.4)**	**66.7 (14.7)**	**83.3 (19.9)**	**55 (32.3)**
OVERALL MEAN (s.d.)	**89 (15.9)**	**72.7 (13.2)**	**90.8 (15.6)**	**67.5 (26.5)**

Table 13. Pretest performances (percentages) on standardized measures of comprehension for the two subject groups.

In contrast, the BNT samples picture naming abilities from high frequency words (e.g., "tree") to low frequency words ("abacus"). The specific performances of each subject are listed in Table 14. Five of the twelve subjects were severely impaired in oral picture naming, and three of these were assigned to the CN group (CN2, CN3, and CN5) and two to the functional group (F2, F6). Three subjects were relatively good at picture naming (F4, F5, CN4).

There was a similarly wide range of abilities in written picture naming, as measured by performance on that subtest of the PALPA. Subjects who were poor at oral naming were not necessarily poor at written naming (e.g., CN3), and subjects who were poor at written naming were not necessarily poor at oral naming (F1, CN6). However, three subjects were quite poor at both oral and written naming (F2, CN2, and CN5). These patterns of impairment are indicative of the nature of the language breakdown and were taken into consideration when designing the subsequent treatments.

Assessment of functional communication on the standardized CADL-2 test demonstrated relatively preserved functional communication abilities, despite poor naming and comprehension performances on decontextualized assessments. All but one subject (CN2) achieved at least a score of 70% or better (overall mean = 78%, range = 71-93%). CN2, who achieved a pretest CADL-2 score of 17%, also performed the lowest of all of the subjects on auditory comprehension.

Subjects FUNCTIONALLY TRAINED SUBJECTS.	**Boston Naming Test**	**Spoken Picture Naming - PALPA**	**Written Picture Naming - PALPA**	**Cognitive-Linguistic Ratingss**
F1	41	72	0	Low
F2	22	0	5	Low
F3	62	68	83	Moderate
F4	77	88	90	Moderate
F5	66	93	88	Moderate
F6	6	35	60	Low
MEAN (s.d.)	**45.5 (27.9)**	**60.8 (37.1)**	**48.2 (40.5)**	
CN TRAINED SUBJECTS.				
CN1	56	73	55	High
CN2	0	0	0	Low
CN3	17	10	45	Low
CN4	85	95	95	Moderate
CN5	3	0	3	Moderate
CN6	38	80	10	Moderate
Mean (s.d.)	**31.7 (34.2)**	**41.3 (43)**	**36.0 (38.4)**	
Overall Mean (S.D.)	**38.6 (30.6)**	**51.1 (39.6)**	**42.1 (38.1)**	

Table 14. Pretest performances (percentages) on standardized measures of naming for both subject groups.

This may have impeded his ability to understand the questions and role-playing required in this test. Summaries of each subject's performance on functional communication pretesting are given in Table 15. Pretest performance on CADL-2 was related to performances on the phone version of catalog ordering in quiet ($r = 0.73$, $p<0.01$) and in the concurrent task ($r = 0.72$, $p<0.01$). CADL-2 performance was also related to pretest accuracy on the written version in quiet ($r = 0.85$, $p<0.01$) and with the concurrent task ($r = 0.67$, $p<0.01$). These correlations show that the two functional communication assessments were related to each other. In addition, the CADL-2 performances were related to a number of modality-specific tasks, including single word auditory comprehension ($r = 0.90$, $p<0.01$), sentence level auditory comprehension ($r = 0.87$, $p<0.01$, and single word reading comprehension ($r = 0.96$, $p<0.01$), and naming as measured by BNT to a lesser extent ($r = 0.60$, $p<0.05$). This suggests that the CADL-2 measures a broad range of communication skills.

The phone version of the catalog ordering task, being a functional task requiring a variety of skills, was also related to a number of other language measurements. The phone ordering task was less reliant on auditory comprehension skills than CADL-2, with a moderate correlation between pretest phone task accuracy and single word auditory comprehension ($r = 0.62$, $p<0.05$). There was

Table 15. Pretest performances on functional communication tasks for both subject groups.

Table 15. Pretest performances on functional communication tasks

Subjects	Standardized Assessment	Functional Criterion Task (Catalog Ordering)			
		Phone Version[a]		Written Version[a]	
	CADL-2 (%)	Accuracy (%)	Task Duration (min:sec)	Accuracy (%)	Task Duration (min:sec)
FUNCTIONALLY TRAINED SUBJECTS.					
F1	77	36	9:58	36	10:45
F2	86	27	5:45	71	8:20
F3	93	58	9:51	83	9:10
F4	88	75	7:08	94	3:16
F5	90	69	2:40	78	8:05
F6	83	36	3:39	50	5:08
Mean (s.d.)	**86.3 (5.7)**	**50.2 (19.8)**	**6:23 (3:03)**	**68.7 (21.7)**	**7:34 (3:10)**
CN TRAINED SUBJECTS.					
CN1	85	72	2:17	76	2:53
CN2	17	0	5:52	0	2:52
CN3	71	39	6:18	50	5:43
CN4	89	75	3:45	94	5:48
CN5	76	19	3:19	72	3:31
CN6	78	61	2:48	44	9:15
Mean (s.d.)	**69.3 (26.4)**	**44.3 (30.4)**	**3:37 (1:44)**	**56 (32.9)**	**5:31 (2:32)**

Table 15 (cont'd)

[a] Task performance in quiet condition.

	Standardized Assessment	Functional Criterion Task (Catalog Ordering)			
		Phone Version[a]		Written Version[a]	
	CADL-2 (%)	Accuracy (%)	Task Duration (min:sec)	Accuracy (%)	Task Duration (min:sec)
OVERALL MEAN (s.d.)	77.8 (20.3)	47.25 (24.7)	5:20 (3:10)	62.4 (27.4)	6:32 (3:00)

[a] Task performance in quiet condition.

no relationship between phone ordering and performance on the sentence-picture matching task. There was a moderate correlation between phone catalog ordering and single word reading comprehension ($r = 0.72$, $p<0.01$). Phone catalog ordering was more strongly correlated with all aspects of naming than CADL-2, including BNT ($r = 0.89$, $p<0.01$), oral naming as measured on PALPA ($r = 0.88$, $p<0.01$), and writtennaming ($r = 0.76$, $p<0.01$). Overall, the phone version of the catalog ordering task relied more on naming abilities and less on auditory comprehension than CADL-2.

The written version of the catalog ordering task was related to performance on the written naming subtest of PALPA ($r = 0.70$, $p<0.05$) and single word reading comprehension ($r = 0.82$, $p<0.01$). Performance on the written version of catalog ordering was not related to performance in oral naming. The two versions of the catalog ordering task draw on modality-specific aspects of naming.

The baseline reaction times were also compared to ensure that all subjects had sufficient motor skills to perform the concurrent task and were comparable in speed and ability. The reaction times for subjects to respond to the computer generated tones by hitting the foot switch in the baseline condition are given in Table 16. The functional and CN groups were comparable on baseline reaction times, and all subjects were able to perform the baseline task.

Subjects	
Functionally trained subjects.	Baseline RT (ms)
F1	436
F2	267
F3	471
F4	591
F5	609
F6	365
Mean (s.d.)	**456.5 (131.3)**
CN Trained Subjects.	
CN1	523
CN2	428
CN3	177
CN4	420
CN5	697
CN6	286
Mean (s.d.)	**421.8 (181.3)**
Overall Mean (s.d.)	**439.2 (152.0)**

Table 16. Concurrent task baseline reaction times for each subject.

In summary, the subjects assigned to the two groups were comparable on basic cognitive skills such as recognition memory, visual cancellation, visual-perceptual skills, and on nonverbal problem solving as measured by RCPM. They varied in their abilities to do digit and pointing span tasks, and to perform on the WCST. The twelve subjects were all relatively good at single word comprehension, but showed impairments of sentence level auditory comprehension. There was a wide range of naming performances, which were correlated with performance on the functional communication assessments. Only written naming and single word reading comprehension were related to performance on the written version of catalog ordering. This general profile is consistent with the typical abilities of people with nonfluent, Broca's type aphasia. It demonstrates both the consistency of the diagnostic category and the wide range of skills that such a categorization tolerates.

Pre/Post Differences

Difference scores for all of the pre/post assessment measures were calculated by subtracting the pretest score from the posttest score. Difference scores render the performances more interpretable for the purposes of this study. It is possible to determine "clinical significance" by inspecting the difference scores within and between subjects. Clinically significant change for some standardized measures have been determined as at least one point out of ten possible on a standardized aphasia battery subtest which is scored correct or incorrect, or at least five points on a summary of several subtests (Katz & Wertz, 1997). Clinically significant change on the CADL-2, a test with a three-point scoring interval for each item, has been defined as 10 points (Elman & Bernstein-Ellis, 1999). This method was deemed appropriate for analyzing change in response to the two treatment methods in the present study.

The following criteria were adopted for analyzing clinically significant change. A criterion of 5 points was established for clinically significant change on standardized measures of comprehension and naming, which all used +/- scoring. This was set as a more stringent measure than the 1 point criterion applied in other work. The previously established criterion of 10 points for difference scores on the CADL-2 and also the catalog ordering task, which used the same scoring procedure as CADL-2, was applied to these two measures of functional communication. A criterion change score of 10 points was also established for clinical significance on the CETI. This was based on original reports of an average change score of 0 for a stable group of aphasic adults, and an average change of 11 points on this instrument for recovering patients (Lomas et al, 1989). Similarly, reported average change for the Correct Information Unit analysis applied to the discourse samples for session-to-session stability served as a basis for determining criterion on the discourse measures. Since an average change of 5 to 7 CIUs was observed between sessions (Nicholas & Brookshire, 1993) across all discourse types, a criterion of 10 CIUs was set as suggesting clinically significant improvement for the pre/post discourse measures.

Difference scores for all three standardized measures of comprehension are shown in Table 17. Neither group demonstrated any particular improvement overall on the single word measures of reading and auditory comprehension. Two of the six CN subjects (33%) and one of the functionally trained subjects (17%) made clinically significant improvement on sentence-picture matching, but this was not a pattern of either group overall.

Both subject groups made improvement on measures of oral and written naming. See Table 18. Five out of six subjects in each group (83%) made clinically significant change (a difference score of at least plus five points) on at least one measure of oral naming. Three subjects in the functional group (50%) and four subjects in the CN group (67%) improved in written naming. The CN trained subjects made the most improvement on written picture naming (mean = 9.67), compared to their performance on the BNT (mean = 7.5) and the PALPA naming subtest (mean = 7.5). The functionally trained subjects made more improvement on oral naming, including the BNT (mean = 11.5) and the PALPA naming subtest (mean = 13.5) than on written naming (mean = 7.5).

Subjects	**Reading Comprehension**	**Auditory Comprehension**	
Functionally Trained Subjects.	**Written Word-Picture Matching - PALPA**	**Spoken Word-Picture Matching - PALPA**	**Sentence-Picture Matching - PALPA**
F1	5	0	10
F2	0	0	0
F3	-3	-5	-10
F4	0	0	0
F5	2	-2	3
F6	0	0	0
Mean (s.d.)	**0.7 (2.65)**	**-1.16 (2.04)**	**.5 (6.4)**
CN Trained Subjects.			
CN1	0	-5	-17
CN2	-5	-10	33
CN3	0	0	20
CN4	0	0	0
CN5	3	10	5
CN6	0	5	-10
Mean (s.d.)	**-.33 (2.58)**	**1.67 (6.83)**	**5.16 (18.67)**
Overall Mean (s.d.)	**.17 (2.55)**	**.25 (5.02)**	**2.83 (13.54)**

Table 17. Difference scores on standardized measures of comprehension for both subject groups.

Subjects Functionally Trained Subjects.	**Boston Naming Test**	**Spoken Picture Naming - PALPA**	**Written Picture Naming - PALPA**
F1	25	5	3
F2	3	37	0
F3	5	14	5
F4	5	5	3
F5	4	-3	16
F6	27	23	18
Mean (s.d.)	**11.5 (11.27)**	**13.5 (14.55)**	**7.5 (7.55)**
CN Trained Subjects.			
CN1	2	22	22
CN2	3	0	0
CN3	0	5	8
CN4	6	3	3
CN5	15	18	17
CN6	19	-3	8
Mean (s.d.)	**7.5 (7.71)**	**7.5 (10.13)**	**9.67 (8.35)**
Overall Mean (s.d.)	**9.5 (9.44)**	**10.5 (12.36)**	**8.58 (7.68)**

Table 18. Difference scores on standardized measures of naming for both subject groups.

Difference scores for the functional communication tasks, the CADL-2 and the quiet phone and written versions of the catalog ordering task, were calculated and are shown in Table 19. The functionally trained subjects did not make particular improvement on the CADL-2 (mean = 0.5), but the CN subjects did (mean = 9.83). The average CADL-2 performance for the CN subjects was essentially at the level of clinical significance. Three of the CN subjects obtained difference scores of +10 or greater (50%), and none of the functionally trained subjects reached this criterion.

The functionally trained subjects improved notably on the phone version of the catalog ordering task, which had been included in their training (mean = 32.3). All of the functionally trained subjects (100%) reached or exceeded the level of clinically significant improvement on the phone version of catalog ordering. None of them, however, achieved clinical significance on the written version, which had not been trained. The CN subjects on average improved more on the written version of the catalog ordering task (mean = 11.83) than the functional subjects (mean = 6.83). Four of the six CN subjects (67%) achieved clinically significant improvement on the written version of catalog ordering, and two of them attained this level of improvement on the phone version of catalog ordering.

Performance of the functionally trained subjects on the phone-related items of the CADL-2 were analyzed to determine

Subjects	**Standardized Assessment**	**Functional Criterion Task (Catalog Ordering)**	
Functionally Trained Subjects.	**CADL-2**	**Phone version[a]**	**Written version[a]**
F1	7	47	2
F2	0	54	-9
F3	-4	17	-2
F4	-1	25	6
F5	-5	20	11
F6	6	31	33
Mean (s.d.)	**.5 (5.01)**	**32.3 (15.01)**	**6.83 (14.52)**
CN Trained Subjects.			
CN1	12	-22	12
CN2	14	0	16
CN3	9	-6	17
CN4	5	17	-5
CN5	16	14	3
CN6	3	-6	28
Mean (s.d.)	**9.83 (5.11)**	**-.5 (14.41)**	**11.83 (11.54)**
Overall Mean (s.d.)	**5.17 (6.86)**	**15.91 (22.16)**	**9.33 (12.78)**

Table 19. Difference scores on functional communication tasks for both subject groups.

[a] Performance in quiet condition.

whether there was improvement on items that were specifically related to the functional training. Items 40, 41, and 42 require subjects to identify a phone number in a directory, dial the phone, listen to a tape recorded message, and report back to the examiner. The three-point scoring system is applied to these items according to the standard scoring procedures. The pretest and posttest performances for each of the functionally trained subjects on these three CADL-2 items combined appear in Table 20. Overall, the functionally trained subjects performed relatively well at pretest on these items leaving little room for improvement. Two subjects improved by one point each and one subject decreased by one point on the selected items. There was essentially no change on these items for the functionally trained subjects.

Since the CN subjects improved on both the CADL-2 and written naming and catalog ordering, an item analysis was conducted to determine whether improved CADL-2 scores were attributable to an improvement in writing skills overall. Since the CADL-2 uses a three point scoring system that assigns points on the communicative effectiveness of the response, regardless of response modality, it is possible that improvement on this test could be due to a particular modality-specific pattern. The response modality of each item with an improved score at post test was determined.

Some items were improved at posttest because the subject was able to completely verbalize the appropriate

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Table 2

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Subject	**Pretest**	**Posttest**
F1	5/6	6/6
F2	6/6	6/6
F3	6/6	6/6
F4	6/6	6/6
F5	4/6	3/6
F6	4/6	5/6

Table 20. Pretest and posttest performances of the functionally trained subjects on the three phone-related items on CADL-2.

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response. For example, for the stimulus item "if you saw this [picture of a house burning], what would you do?", a full credit verbal response would be "call 911" , compared to a partial credit response like writing down the word "fire". Other items either accept or require written responses, such as completing a 'patient information form' during a doctor's visit role-play. Furthermore, many items receive full credit for gestural responses, including pointing to the correct portion of a bus schedule given the question "what time does Bus #3 leave Maintown?".

The percentage change for each response modality for each subject is given in Table 21. The written response modality did not improve more than either verbal or gestural responses. Overall, the CN subjects had a more generalized pattern of improvement across all modalities than the functional subjects.

The CETI provided ratings by significant others of perceived change within the family environment, and these scores are displayed in Table 22. The CN trained subjects overall received higher change ratings (mean = 13.67), indicating more perceived improvement overall, than the functional subjects (mean = 9.83). Two functional subjects and five of six CN subjects achieved clinically significant change on the CETI.

Subject Functio Trained Subject
F1
F2
F3
F4
F5
F6
Mean
CN Trai Subject
CN1
CN2
CN3
CN4
CN5
CN6
Mean
Overall

Table 2

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Subject Functionally Trained Subjects.	**Verbal**	**Written**	**Gesture**
F1	90	10	0
F2	50	50	0
F3	0	0	100
F4	100	0	0
F5	50	25	25
F6	25	25	50
Mean	**45**	**18.3**	**29.2**
CN Trained Subjects.			
CN1	33	12	55
CN2	15	20	65
CN3	25	30	45
CN4	80	20	0
CN5	42	8	50
CN6	0	0	100
Mean	**32.5**	**15**	**52.5**
Overall Mean	**38.75**	**16.7**	**40.85**

Table 21. Percentage of the total change on CADL-2 attributable to improvements in different response modalities for each subject.

Functi subjec
F1
F2
F3
F4
F5
F6
Mean (s.d.)
CN tra
CN1
CN2
CN3
CN4
CN5
CN6
Mean (s.d.)
Overal (s.d.)

Table

Subjects Functionally trained subjects.	**CETI score**
F1	18
F2	7
F3	9
F4	10
F5	9
F6	6
Mean **(s.d.)**	**9.83** **(4.26)**
CN trained subjects.	
CN1	14
CN2	7
CN3	18
CN4	18
CN5	12
CN6	13
Mean **(s.d.)**	**13.67** **(4.13)**
Overall Mean **(s.d.)**	**11.75** **(4.47)**

Table 22. CETI scores for both subject groups.

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Efficiency of performance was assessed by measuring task duration on the functional communication tasks. Difference scores for duration were calculated by subtracting the pretest duration from the posttest duration for the CADL-2 and the catalog ordering task. The duration differences are given in Table 23. There was essentially no change between pretest and posttest task durations on the catalog ordering task for both subject groups. Two of the six functionally trained subjects (33%) substantially increased their task duration for the phone version of catalog ordering. Otherwise, the functional subjects, who had been trained specific strategies for the phone version, did not change in task duration between pretest and posttest. The functional subjects also maintained their average task duration for CADL-2. Four of the six CN subjects (67%) decreased task duration time for CADL-2 performance, suggesting an improvement in efficiency. Robustness of the training effects was analyzed by comparing performances on the catalog ordering task under conditions of load. The accuracy and duration difference scores were calculated for the catalog ordering task in the concurrent task condition, and these are shown in Table 24. These performances were compared to accuracy levels observed during the quiet condition, shown in Table 19, and task duration in the quiet condition, shown in Table 23.

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F1
F2
F3
F4
F5
F6
Mean (s.d
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Subjects	**Standardized Assessment**	**Functional Criterion Task (Catalog Ordering)**	
Functionally Trained Subjects.	**CADL-2**	**Phone version**[a]	**Written version**[a]
F1	5	2.5	.6
F2	3	6.67	-2.86
F3	-2	-.19	-1.07
F4	-4	-.84	-.04
F5	2	.91	2.52
F6	0	.89	2.46
Mean (s.d.)	**0.67 (3.32)**	**1.65 (2.71)**	**.27 (2.08)**
CN Trained Subjects.			
CN1	-5	.28	-.18
CN2	-4	-.3	-.2
CN3	-16	-.99	1.11
CN4	-9	.13	1.56
CN5	0	-.03	-.01
CN6	7	.99	.28
Mean (s.d.)	**-4.5 (7.81)**	**.00 (1.45)**	**.42 (.73)**
Overall Mean (s.d.)	**-1.92 (6.33)**	**.83 (2.06)**	**.35 (1.49)**

Table 23. Difference scores for task duration in minutes on functional communication tasks for both subject groups. Negative values represent an improvement from pretest to posttest.

[a] Performance in quiet condition.

	Phone Version		**Written Version**	
Subjects Functionally Trained Subjects.	**Accuracy**	**Duration**	**Accuracy**	**Duration**
F1	22	6.06	10	-0.9
F2	33	5.25	43	-0.45
F3	14	-0.1	7	0.72
F4	6	-1	6	-0.83
F5	20	0.62	55	-1.95
F6	50	0.77	25	1.89
Mean (s.d.)	**24.17 (15.49)**	**1.65 (2.71)**	**24.3 (20.65)**	**-0.25 (1.36)**
CN1	-6	0.2	26	-0.08
CN2	0	0.7	16	-0.8
CN3	0	-1.72	17	0.15
CN4	25	0.86	-11	-1.23
CN5	8	-0.05	11	-0.86
CN6	17	-0.68	28	2.76
Mean (s.d.)	**7.33 (11.76)**	**-0.12 (0.96)**	**14.5 (14.04)**	**-0.00 (1.45)**
Overall Mean (s.d.)	**15.75 (15.79)**	**0.91 (2.36)**	**19.42 (17.59)**	**-0.13 (1.35)**

Table 24. Differences in accuracy and task duration for catalog ordering with concurrent task performance for both subject groups.

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Comparison across these tables reveals a slight disruption of accuracy on the phone version from the quiet condition to the concurrent task condition for the functionally trained subjects (mean in quiet condition = 32.3; mean in concurrent task condition = 24.17), although they improved overall from pretest to posttest in both conditions. Interestingly, the functionally trained subjects improved only marginally onthe written version of the task in quiet (mean = 6.83), but their performance improved even more so in the concurrent task condition (mean = 24.3).

Two of the six CN subjects (33%) made clinically significant improvements on the phone version in the concurrent task condition from pretest to posttest. The average improvement for the CN group (mean = 7.33) was better than their average performance in quiet from pretest to posttest (mean = -0.5). Comparison of individual difference scores for accuracy in the quiet condition to accuracy in the concurrent task condition shows that four of the six CN subjects (67%) improved under conditions of load in the phone version. This pattern of improved performance under conditions of load was also observed in the written version of the task for the CN subjects overall (mean = 14.5). Five of the six CN subjects (83%) made clinically significant improvement on the written version in the concurrent task condition from pretest to posttest (Table

24). Their overall improvement on the written version was similar across both quiet and concurrent task conditions.

Task duration during the concurrent task condition did not change from pretest to posttest for any of the subjects in either group, with the exception of two functional subjects (F1 and F2), who prolonged task performance at posttest compared to pretest for the phone version under both conditions (Tables 23 and 24). For the CN subjects, task duration remained essentially the same from pretest to posttest in both conditions and both versions of the task.

Another measure of efficiency of function is the analysis of reaction time data from the concurrent task. Reaction times to each presented tone were recorded in milliseconds and mean reaction times for each subject and each condition at pretest and posttest were calculated. Difference scores were generated by subtracting pretest reaction times for each condition from posttest reaction times. These differences are listed in Table 25. There was no particular pattern of performance for reaction times for the two subject groups. Subject CN2 missed a large number of tone presentations at pretest, however he was able to perform the concurrent task quite well at posttest. Four of the six CN subjects (67%) improved their reaction times at posttest in the phone version of the task, and only one of the functional subjects (17%) did. In the written version of the task, three of six subjects in each group (50%) improved their reaction times. Overall there was a high

Subjects Functionally Trained Subjects.	**Phone version**	**Written version**
F1	314	261
F2	44	65
F3	234	350
F4	-460	-543
F5	158	-30
F6	74	-20
Mean (s.d.)	**60.67 (273.95)**	**13.83 (313)**
CN Trained Subjects.		
CN1	-30	40
CN2	-2352	581
CN3	143	-100
CN4	162	-49
CN5	-141	-510
CN6	-259	-95
Mean (s.d.)	**-412.83 (963.73)**	**-22.17 (351.49)**
Overall Mean (s.d.)	**-176.08 (719.33)**	**-4.17 (317.87)**

Table 25. Difference scores for reaction time (msec) on the catalog ordering task for both subject groups. Negative scores indicate an improvement in speed at posttesting.

degree of variability across the subjects for reaction time data, as evidenced by the large standard deviations.

Generalization of the treatment effects from trained to untrained vocabulary items was analyzed for each treatment group. Functionally trained subjects were trained on half of the target items used during pre/post testing on the catalog ordering task. Only two functional subjects (33%), F1 and F6, failed to produce items during posttesting on catalog ordering that had been trained. Each of these subjects failed to produce a single item each, and did so in the quiet condition of the phone version. Two of the functional subjects (33%), F4 and F6, produced items at posttest that had not been trained and had not been produced at pretest. F4 produced "blue coat" and "yellow sweater" at posttest that had not been trained, and F6 produced "hat" which had not been trained. None of the other functionally trained subjects produced any untrained items.

Training items for the CN subjects had been selected by identifying consistently missed items on the 54-item baseline assessment. Half of these items had been trained across two training sets. The 54-item baseline was re-administered after treatment. Four of the CN subjects (67%) produced at least two untrained items at re-administration of the 54 item assessment at the end of treatment. The individual percentages are reported in Table 26. In general, the CN subjects tended to show more generalization

	Untrained items produced
CN1	42%
CN2	0
CN3	40%
CN4	100%
CN5	0
CN6	33%

Table 26. Percentage of untrained items produced at posttesting for each of the CN subjects.

to untrained items than subjects in the functional treatment group.

In summary, subjects in both treatment groups improved on written naming and on the written version of catalog ordering in the concurrent condition. Subjects in the CN group made clinically significant improvement on the _CADL-2_, the _CETI_, and in both conditions of written catalog ordering. They also tended to show more generalization to untrained items. Subjects in the functional treatment group made clinically significant improvements on two measures of oral naming, the _BNT_ and the _PALPA_, and on both quiet and concurrent conditions of the phone catalog ordering task.

Patterns of Transfer to Discourse

All of the discourse samples were orthographically transcribed and the total number of Correct Information Units (CIUs) were calculated based on the procedures of Nicholas & Brookshire (1993). The sampling contexts for the Nicholas and Brookshire (1993) data include expository, narrative and procedural discourse measures. Non-brain-damaged adults produced no fewer than 50 CIUs on average across all elicitation contexts, and 49 CIUs was identified as the cut-off score for non-brain-damaged adults. The number of CIUs produced in each discourse sampling context at pretest for each of the subjects in the present study is shown in Table 27. Only one subject produced a total number of CIUs that fell within the normal range, subject F4 in the narrative discourse task. This subject produced a 15 minute

Subjects	**Expository Discourse**	**Narrative Discourse**	**Procedural Discourse**			
Function-ally trained subjects.			**Toast & Jelly**	**Pizza**	**Groceries**	**Catalog**
F1	11	23	6	22	29	18
F2	29	0	1	0	3	0
F3	17	20	10	27	14	15
F4	14	212	8	20	15	14
F5	10	0	10	5	3	4
F6	0	1	0	0	0	1
Mean (s.d.)	**13.5 (9.52)**	**42.67 (83.6)**	**5.8 (4.4)**	**12.3 (12.0)**	**10.7 (10.9)**	**8.7 (7.9)**
CN trained subjects.						
CN1	5	18	15	14	12	14
CN2	0	0	0	0	0	0
CN3	0	0	1	2	5	4
CN4	10	0	20	0	7	4
CN5	2	2	6	0	6	0
CN6	13	5	5	10	10	6
Mean (s.d.)	**5.0 (5.4)**	**4.2 (7.0)**	**7.8 (7.9)**	**4.3 (6.1)**	**6.7 (4.2)**	**4.7 (5.2)**
Overall Mean (s.d.)	**9.25 (8.6)**	**23.4 (60.0)**	**6.8 (6.2)**	**8.3 (10.0)**	**8.7 (8.2)**	**6.7 (6.7)**

Table 27. Number of Correct Information Units (CIUs) at pretest for each of the three discourse types for the two subject groups.

sample relating the story of Cinderella. She reported that this had been a favorite story of hers which she had listened to everyday during her childhood, and she had retold to her children and grandchildren. The number of CIUs subject F4 produced in the other sampling contexts was more consistent with the rest of the subjects in the study. With the exception of F4's Cinderella story, the number of CIUs for these subjects across discourse contexts was consistent with previous reports of nonfluent aphasic performances (Nicholas & Brookshire, 1993; Yorkston & Beukelman, 1980; Craig et al, 1993).

Difference scores were calculated by subtracting the total number of CIUs produced in each elicitation context at pretest, from the total number produced at posttest. Difference scores for each subject in each discourse context are shown in Table 28. Overall, there was a wide range of variability in performance between pretest and posttest, as evidenced by the large standard deviations.

None of the functionally trained subjects and one of the CN trained subjects made clinically significant improvement on expository discourse. One subject in the functional group (17%) and three subjects in the CN group (50%) made clinically significant improvement in the narrative discourse context. One to two subjects in each group improved in the various procedural discourse contexts. Three subjects in the functionally trained group (50%) made

Table 28. Difference scores on number of CIUs for each of the three discourse types for both subject groups.

Table 28. Difference scores for CIUs.

Subjects	**Expository Discourse**	**Narrative Discourse**	**Procedural Discourse**			
			Toast & Jelly	**Pizza**	**Groceries**	**Catalog**
Functionally trained subjects.						
F1	-9	2	1	-16	-22	-5
F2	-19	5	0	3	-3	0
F3	3	5	-3	20	8	4
F4	0	-92[a]	4	-5	-1	12
F5	0	14	3	6	12	16
F6	5	7	1	3	1	14
Mean (s.d.)	**-3.33 (9.0)**	**-9.8 (40.5)**[b]	**1.0 (2.5)**	**1.8 (11.9)**	**-0.8 (11.8)**	**6.8 (8.4)**
CN trained subjects.						
CN1	3	33	2	5	14	5
CN2	0	0	0	0	0	0
CN3	1	3	-1	0	-4	-4
CN4	12	34	0	23	4	10
CN5	1	-2	-3	5	2	4
CN6	6	10	8	-3	-2	0
Mean (s.d.)	**3.8 (4.5)**	**13.0 (16.4)**	**1.0 (3.8)**	**5.0 (9.4)**	**2.3 (6.4)**	**2.5 (4.9)**

Table 28 (cont'd)

[a] This subject provided a 15 minute narrative because the targeted sample, the Cinderella story, was a favorite of hers. At posttest she significantly decreased the length of her sample to 8 minutes. This value does not reflect a change in language ability.
[b] The standard deviation reflects the performance of subject F4.

	Expository Discourse	Narrative Discourse	Procedural Discourse			
			Toast & Jelly	Pizza	Groceries	Catalog
Overall Mean (s.d.)	0.25 (7.8)	1.5 (31.8)	1.0 (3.0)	3.4 (10.4)	0.75 (9.2)	4.7 (6.9)

a notable improvement in the describing how to order something from a catalog, and all three of these subjects improved more than the one CN subject who improved in this context.

For the expository and narrative discourse samples, subjects with the largest magnitude of improvement were in the CN treatment group. This was also true for the procedural discourse samples with the exception of the catalog ordering description.

Cognitive-Linguistic Influences on Treatment Success

As previously reported, the two groups of subjects differed on measures of high-level cognitive abilities (Table 12) and displayed variable pretest naming abilities (Table 14). Inspection of difference scores on the pre/post assessment measures suggested differential outcomes between the two groups. It is important to consider the potential role of initial cognitive and language status on the patterns of outcomes.

The three functional subjects with the lowest cognitive abilities (F1, F2, and F6) also achieved the lowest pretest naming scores of the six functional subjects (Table 14). F1, F2, and F6 consistently demonstrated the most severe cognitive and linguistic impairments of the six subjects in this group. These three subjects also had deeper lesions, extending into subcortical gray matter, than the other three functional subjects.

After the six week functional treatment, inspection of difference scores reveals that these three subjects improved more on oral naming and the phone version of catalog ordering in the quiet condition than the other three subjects, although the other three subjects also improved in these areas. Two of these three subjects, F1 and F6, improved on the CADL-2 as well (difference scores of +7 and +6, respectively, although these scores did not achieve the criterion set for clinical significance). However, the three functional subjects with milder cognitive-linguistic impairment at pretest made no change on CADL-2 and in fact obtained negative difference scores.

The role of cognitive-linguistic factors in the robustness of the treatment effects can be analyzed by inspecting the effects of the concurrent task on performance accuracy. The difference in performance between the quiet and concurrent task conditions at pretest were subtracted from that difference at posttest. Positive values reflect improved performance in the quiet condition, and negative values reflect improved performance in the concurrent task condition. These difference scores for each subject are shown in Table 29.

The performance of four of the six functional subjects was better in the quiet condition than in the concurrent task condition of the phone version and the performance of three of these four subjects was substantially facilitated (F1, F2, and F4). F1 and F2 are two of the three subjects

Subjects. Functionally trained subjects.	**Phone**	**Written**	**Cognitive-Linguistic Rating**
F1	+25	-8	Low
F2	+21	-52	Low
F3	+3	-9	Moderate
F4	+19	0	Moderate
F5	0	-44	Moderate
F6	-19	+8	Low
Mean (s.d.)	**8.17 (16.71)**	**-17.5 (24.54)**	
CN trained subjects.			
CN1	-16	-14	High
CN2	0	0	Low
CN3	-6	0	Low
CN4	-8	6	Moderate
CN5	6	-8	Moderate
CN6	-23	0	Moderate
Mean (s.d.)	**-7.83 (10.52)**	**-2.67 (7.12)**	
Overall mean (s.d.)	**0.17 (15.72)**	**-10.08 (18.89)**	

Table 29. The difference of difference scores for catalog ordering performance under quiet and concurrent task conditions for each subject.

with the most severe cognitive-linguistic profiles. In contrast, F6, who also had a more severe cognitive-linguistic profile, demonstrated a facilitation of his catalog ordering performance with the concurrent task. The three subjects who were most substantially aided by the quiet condition, F1, F2, and F4, all had frontal lesions.

CN1 and CN5 made the largest improvements in oral naming of the CN group, although overall there was slightly less improvement in naming among the CN subjects than for the functionally trained subjects. The two CN subjects with the worst cognitive profiles improved the least on oral naming. All of the CN subjects made some degree of improvement on the CADL-2. There did not seem to be a relationship between cognitive-linguistic profile of the subject and improvement on CADL-2 after CN treatment. Nor was there any apparent relationship between improvement on the written version of the catalog ordering task after CN treatment and cognitive-linguistic profiles.

In contrast to the functionally trained subjects, five of the six CN (83%) subjects showed either no effect of load in the concurrent task condition, or experienced a facilitation of performance in the phone and written versions of catalog ordering. Five of the six CN subjects had lesions affecting the left frontal lobes.

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Cognitive-Linguistic Influences on Rate of Improvement

The amount of treatment time, number of sessions, and average amount of time per session for each subject in the two treatment groups are given in Table 30. There was a relationship, particularly for the functionally trained subjects, between cognitive ability as measured by the WCST and RCPM and the amount of training time required to achieve criterion. In general, the subjects with the lowest scores on WCST in each group required the greatest amount of time in total minutes for the training. However, subjects with the highest cognitive profiles did not necessarily achieve criterion in the least amount of time.

Among the functionally trained subjects, there was a statistically significant negative correlation between performance on the WCST and total number of training sessions ($r = -0.89$, $p<0.05$). There was also a statistically significant negative correlation between performance on the RCPM and total training time ($r = -0.88$, $p<0.05$) and between the RCPM and the total number of training sessions ($r = -0.89$, $p<0.05$). These relationships were not observed among the CN trained subjects. The observed correlation is a general pattern only, and does not suggest a direct relationship for each individual between the two measures of cognitive ability and treatment time.

Subjects	Total	Total Number	Average amount	Cognitive-

Subjects	**Total Training Time (minutes)**	**Total Number of Sessions**	**Average amount of time per session (minutes)**	**Cognitive-Linguistic Rating**
Functionally trained subjects.				
F1	597	18	33	Low
F2	403	12	34	Low
F3	328	11	30	Moderate
F4	72	6	12	Moderate
F5	62	11	6	Moderate
F6	188	12	16	Low
Mean (s.d.)	**275 (208.3)**	**11.7 (3.82)**	**21.8 (12.0)**	
CN trained subjects.				
CN1	257	12	21	High
CN2	299	15	20	Low
CN3	342	12	29	Low
CN4	181	11	16	Moderate
CN5	82	10	8	Moderate
CN6	70	11	7	Moderate
Mean (s.d.)	**195.2 (129.2)**	**11.8 (1.7)**	**16.8 (8.4)**	
Overall Mean (s.d.)	**235 (170.5)**	**11.8 (2.8)**	**19.3 (10.2)**	

Table 30. Amount of treatment time required to achieve criterion for each subject.

Training time equals total session time minus probe time.

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Cognitive-Linguistic Influences on Transfer to Discourse

There did not appear to be any relationship between performance on the cognitive battery and the generalization patterns to discourse. The subject with the best cognitive performance, CN1, showed one of the best discourse performance improvements, but so did CN4, who was in the mid-range of subjects for cognitive abilities. Among the functional subjects, F4, F5 and F6 made the most improvements in discourse. One of these, F6, had one of the most severe cognitive profiles, and F4 and F5 had mid-range cognitive performances.

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Chapter 4

DISCUSSION

General Effects of Treatment

The first of the study's predictions was that subjects in both treatment groups would show improvement. This prediction was supported as demonstrated by improvements in oral and written naming, at least one measure of functional communication, and on caregiver ratings of the CETI across both treatment groups. Furthermore, some individuals made additional improvements in specific areas such as auditory sentence comprehension. These results are in agreement with many other studies showing the effectiveness of treatment of various types among adults with chronic aphasia (Robey, 1994; 1998).

Differential Outcomes of the Two Treatments

The two different treatment approaches compared in the present study were predicted to differ in patterns of outcomes and transfer, and these predictions were generally supported by the data. It was predicted that subjects in the functional treatment group would show much more improvement on the catalog ordering task, which had been trained, than subjects in the CN group, and this difference

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was observed. Improvement in accuracy was demonstrated in both quiet and concurrent task conditions for these functionally trained subjects. However, these subjects suffered a disruption in their performance under conditions of load, and this effect of the concurrent task was greater than the disruption obtained at pretest. The functional subjects showed little improvement on CADL-2, and this improvement was not attributable to increased ability on phone related items on the test, contrary to predictions. The functional subjects were predicted to show little improvement on standardized measures of naming, and this prediction was not supported. Indeed, the functionally trained subjects demonstrated greater improvement on the naming subtest of the PALPA and the BNT than the CN subjects.

The CN subjects made the little amount of improvement on accuracy in the catalog ordering task that had been predicted. However, these subjects appeared to improve in general efficiency of function as measured by the lack of disruption on performance made by the concurrent task. These subjects also showed marked improvement on CADL-2, and this improvement had been predicted due to the nature of this test, which requires the deployment of multiple abilities and strategies. The CN subjects were predicted to show greater improvements on the standardized measures of naming than the functional subjects, and this prediction was not supported. The caregiver ratings on the CETI were

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greater in magnitude for the CN subjects, and this observation tends to support the prediction that CN subjects' improvement will be observed in a wider variety of contexts.

The results of CN treatment were consistent with predictions. It is quite interesting to note that an important outcome for this group of subjects was on measures of functional communication, specifically, CADL-2 and CETI. These measures are typically not administered in studies of CN treatment, and so this outcome has not previously been observed. These results are consistent with observations that CN treatment which targets semantic representations is most likely to generalize to a broad range of communicative abilities. The generalized effect of the CN treatment regardless of cognitive ability of the subject tends to suggest that this treatment approach is in fact focused on the language system, and does not require additional cognitive abilities to support its outcomes.

Only three of the six CN subjects made notable improvement on standardized measures of oral naming, and this was contrary to the original prediction. This result can be interpreted as being consistent with the previous literature, however, in which some studies show an improvement on generalized naming, while other studies do not (Hillis, 1989; Howard, 1986; Howard et al, 1985; LeDorze & Pitts, 1995; Nickels & Best, 1996; Raymer et al, 1993). It appears that a more reliable method of detecting changes based on a semantic treatment may be assessment of overall language abilities, rather than a reliance on modality-specific tests.

Generalization to Discourse

Although the pattern of transfer to discourse was not conclusive, the results were suggestive of the initial prediction. Half of the CN subjects improved on the discourse task requiring the greatest variety of skills, the narrative discourse task. Half of the functional subjects improved notably on the catalog ordering procedural discourse task, due to the use and generalization of trained vocabulary to this particular discourse context.

The results generally support theoretical predictions about the nature of the two contrasting treatments. The functional treatment resulted in improvements attributable to the contexts trained, with some generalization to closely related discourse tasks, and demonstrated more of a reliance on cognitive abilities. The CN treatment resulted in improvements in tasks requiring a broader range of abilities, some generalization in discourse tasks requiring the most manipulation of cognitive and linguistic abilities, and less dependence on cognitive abilities.

Possible Influences of Cognitive-Linguistic Ability

The subjects with the lowest cognitive profiles made the greatest magnitude of change in the functional training. Subjects with the best cognitive profiles tended to make the broadest improvements on several measures, including di

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discourse tasks, in the CN treatment (e.g., CN1). However, subjects with mid-range cognitive abilities also showed this pattern of improvement in response to CN treatment.

The subject with the best cognitive profile made somewhat broader improvements than other subjects in their respective groups. Response to CN treatment tended to be less reliant on cognitive ability overall. Subjects with mid-range cognitive profiles varied in performance. This pattern of response to treatments suggests that aphasia type and severity are not the only characteristics that may be critical when making treatment decisions. Furthermore, clients with more cognitive impairment may require greater treatment time to achieve goals. This observation should be further considered when making treatment decisions.

Possible Explanations for Patterns Observed

Two aspects of the functional treatment outcomes are not totally consistent with original predictions. It was surprising to observe that the functionally trained subjects improved on standardized measures of oral naming, and less on CADL-2, than expected. The broad oral naming improvement could be due to an effect of the type of contexts in which most of the training occurred. A large percentage of the total therapy involved conversational contexts, and this has previously been reported as being associated with a generalized improvement in naming (Holland et al, 1983) as measured by standardized batteries. In contrast, other investigations of functional treatment outcomes have shown an improvement on CADL-2 performance in the absence of improved standardized test or naming performance (Aten et al, 1982). The mixed pattern of results could be attributable to individual differences in cognitive and linguistic abilities across these studies; unfortunately, cognitive abilities were not assessed in previous work.

The potential role of cognitive abilities and the omission of cognitive description information in previous work is particularly important since in the present study, subjects with more severe cognitive abilities were more likely to show improvements on CADL-2 after functional treatment. It is possible that both CADL-2 and oral naming improvements are outcomes of functional treatment, depending on the characteristics of the individuals enrolled in the treatment.

Functional treatment has been often discussed as relying on cognitive skills for the development of multi-step strategies which require cognitive resources to deploy (Aten, 1986; Chapey, 1988). It is necessary for individuals using such strategies to recognize the need for the strategy, recall the entire sequence of the strategy, and implement it. Functional treatment has also been characterized as stimulating real world meanings as inputs and outputs of the training context.

All of the subjects in the present study had sufficient cognitive abilities to learn these types of strategies and use them. However, subjects with lower cognitive profiles required more time to learn and master them. Once mastered, these subjects performed these strategies reliably across multiple contexts. This accounts for their improvement on CADL-2 in addition to improvements in oral naming and phone ordering.

The cognitive resources involved in use of these strategies are evidenced by the functionally trained subjects' response to load in the catalog ordering task. These subjects experienced a disruption of performance in the concurrent task condition compared to their performance in quiet that reflects the effortful processing required in this task. The functional training appeared to result in an even greater difference between performance in quiet and with the concurrent task at posttest than at pretest. Communication strategies targeted during functional training required general cognitive resources to implement. It is unclear whether, with additional training, these strategies would have become less effortful and more automatic.

The apparent improvement of the semantic and language system in response to CN treatment is also supported by pattern of performances under conditions of load. CN subjects displayed little difference in performance between quiet and concurrent conditions of catalog ordering task at posttest. This pattern of performance was equally observed in the written version of the task on which they had notably improved. This suggests that their improvement did not depend on effortful processing, but rather, that the language system became more efficient in a manner that was more automatic. The large magnitude of improvement on tasks that required the greatest cognitive resources, such as the concurrent task condition, role playing in a variety of tasks in CADL-2, and the narrative discourse task which required telling a story from memory, also tends to support this hypothesis.

Although the wide degree of variability among the subjects' discourse performances precluded any particular conclusion regarding pattern of generalization to discourse based on treatment type, the results are suggestive. The large magnitude of improvement for three of the CN subjects in the narrative task, and the large improvement for three of the functional subjects in the catalog ordering procedural discourse, might suggest a pattern that is consistent with the results of standardized testing. Improvements in the catalog ordering procedural discourse task among the functionally trained subjects were due to the use and generalization of trained vocabulary from training sessions to the discourse context. Improvements in the narrative discourse among some of the CN trained subjects might reflect the richness of the sampling context, which provides the opportunity for demonstration of the breadth and flexibility of the improvements made in response to the CN treatment.

Results of this study should be interpreted with caution due to the size of the sample and the likelihood that the sample may not be representative of the population. Although every effort was made to obtain a homogenous sample based on characteristics deemed important, there was still quite variable performance on many measures among the twelve subjects. Furthermore, the analysis of multiple variables requires sufficient sample size and increasing the study group will result in the statistical power required for additional analysis. Small sample size increases the likelihood of a Type II error, falsely accepting a result of no difference. Therefore, it will be imperative to replicate these results with a larger sample.

In addition to the replication of the results with a larger sample of subjects, additional future questions should be addressed. This project addressed the broad, conceptual issues underlying two different treatment approaches. Future research should attempt to identify the specific components of each approach that result in differential outcomes. The amount and duration of treatment required to obtain the response also needs to be identified. Finally, the interaction between these treatment approaches and different types of aphasic subjects will need to be further addressed.

Overall, the project design and results are promising first steps to answer questions about the most effective therapy for particular individuals. Theory can and should serve as a basis for making predictions about the underlying mechanism and action of a treatment, and the cognitive-linguistic characteristics of individuals who might benefit the most. It is from theoretically driven clinical research that we will be able to address the issues of treatment effectiveness and efficiency that remain.

APPENDICES

APPENDIX A

WH- QUESTION ASSESSMENT TASK

Instructions to Subject: "I will be showing you some pictures. For each picture, I will ask you a question. Point to the item that best answers each question." *A single repetition of each item is allowed if requested by the subject.*

	Stimulus	**Target Response**
1.	What color is her blouse?	Yellow
2.	What is he touching?	Ear
3.	What is the item around the doctor's neck?	Stethoscope
4.	What sound does the doctor hear?	Heart
5.	What is the doctor writing?	Notes
6.	What is on the door?	Sign
7.	What is on the stove?	Pan
8.	What is next to the bowl?	Salt/pepper, milk
9.	What is in the bowl?	Fork
10.	What is in the pan?	Butter
11.	What do you put the omelet on?	Plate
12.	What is next to the omelet?	Tomato

APPENDIX B

SUMMARY OF THE FORMULA FOR CALCULATING SOCIOECONOMIC STATUS BASED ON THE FOUR FACTOR INDEX (HOLLINGSHEAD, 1975).

Occupational Score

9	=	Higher executives, proprietors of large businesses
8	=	Administrators, proprietors of medium sized businesses
7	=	Smaller business owners, managers
6	=	Technicians, semiprofessionals
5	=	Clerical and sales workers
4	=	Skilled manual workers, craftsmen
3	=	Machine operators and semiskilled workers
2	=	Unskilled workers
1	=	Farm laborers

Education Score (level of school completed)

7	=	Graduate degree
6	=	University graduation
5	=	Partial college (at least one year)
4	=	High school graduate
3	=	Partial high school
2	=	Junior high school (9th grade)
1	=	Less than 7th grade

Formula

Occupation score x 5 = _____

Education score x 3 = _____

Total: _____

Range of computed scores

	Social Strata	Range of scores
1	Major business and professional	66 - 55
2	Medium business, minor professional	54 - 40
3	Skilled craftsmen, clerical, sales	39 - 30
4	Machine operators, semiskilled workers	29 - 20
5	Unskilled laborers	19 - 8

APPENDIX C

PROTOCOL FOR THE GERIATRIC DEPRESSION SCALE - SHORT FORM (GDS) (PARMALEE & KATZ, 1990)

NAME/ID________________________________**DATE**______________

EXAMINER ______________________________

PRESENTATION MODALITIES: **Visual only** **Auditory only** **Visual + Auditory**

Please circle the answer that best describes how you have been feeling recently. You may read the questions silently to yourself, have them read to you, or both.

1. Are you basically satisfied with your life?
   Yes No

2. Have you dropped many of your activities and interests?
   Yes No

3. Do you feel that your life is empty?
   Yes No

4. Do you often get bored?
   Yes No

5. Are you in good spirits most of the time?
   Yes No

6. Are you afraid that something bad is going to happen to you?
   Yes No

7. Do you feel happy most of the time?
   Yes No

8. Do you often feel helpless?
   Yes No

9. Do you prefer to stay at home, rather than going out and doing new things?
   Yes No

10. Do you feel you have more problems with memory than most?
    Yes No

11. Do you think it is wonderful to be alive now?
Yes No

12. Do you feel pretty worthless the way you are now?
Yes No

13. Do you feel full of energy?
Yes No

14. Do you feel that your situation is hopeless?
Yes No

15. Do you think that most people are better off than you are?

Yes No

Scoring

	Score (# of negatives)
Normal range	0-5
Mildly depressed	6-10
Severely depressed	over 10

APPENDIX D

FACE SHEET FOR THE COGNITIVE BATTERY (FROM VAN MOURIK ET AL, 1992)

COGNITIVE BATTERY

SUBJECT ID____________________ **DATE**________________

EXAMINER _________________

Global Aphasia Neuropsychological Battery

	Task	Raw Score	%correct
1.	Visual Cancellation Task	________	________
2.	Subtests of the Rivermead Behavioral Memory Test[1]		
	Facial Recognition Test	________	
	Object Recognition Test	________	
	Total for RBMT subtest	________	________
3.	Raven's Coloured Progressive Matrices[2]	________	________
4.	Developmental Test of Visual Perception[3]		
	General Visual Perceptual sum of subtests	________	________
5.	Nonverbal Auditory Recognition		
	Environmental sounds from CADL[4]	________	________

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[1] Wilson, Cockburn, & Baddeley, 1985
[2] Raven et al, 1979
[3] Hammill, Pearson, & Voress, 1993
[4] Holland, 1980

Memory Tasks

6. Digit span (from PALPA[5]) ________

7. Pointing span (from PALPA) ________

[5] Kay, Lesser, & Coltheart, 1992

APPENDIX E

TRANSCRIBED SCRIPTS FROM THREE ACTUAL CALLS MADE TO NATIONALLY KNOWN CATALOG ORDERING COMPANIES BY THE EXPERIMENTER.

Sample #1

Thank you for calling xxxx. This is Bernice. How may I help you?

May I have the C number above your name on the back of the catalog?

May I have your phone number starting with the area code?

May I have the first item please?

And the color?

And the size?

OK that's the plaid turtle neck.

Your next item please.

May I have your credit card number?

And the expiration date?

Your name as it appears on the card?

OK the total comes to $26.50 including shipping and your turtleneck will be delivered Thursday this week.

Sample #2

(recorded) Please make your selection from the following items: To place an order, press 1, to....

Chris may I help you?

Your home phone number with the area code first?

Your first name?

Your last name?

Spell it please.

And your address?

And the city?

And the zip code?

Do you have a xxxxx's charge?

Do you have it with you?

What is the number?

The catalog item number?

And the size?

And the color number?

OK that's the taupe pantsuit.

Did you want to use your xxxxx's charge?

Did you want it delivered to your home or the store?

This item will be available on Thursday after 5 p.m. Remember to bring your xxxx's charge with you.

<u>Sample #3</u>

This is Jeannie. How may I help you?

Will you be using your credit card?

Can I have the spelling of your last name?

May I have your billing zip code?

May I have the "S" number - "s" as in "sam" - on the back of the catalog?

You live in Ypsilanti, Michigan?

May I have your billing address?

Does your address include an apartment number?

Will you be shipping to that address?

May I have your home phone number starting with the area code?

May I have your credit card number?

The expiration date?

May I have your first item number and the quantity?

Ms. Hinckley, that catalog has some daily specials in it. Would you like me to tell you about those?

Thank you. Your total today is $26.50, that includes the shipping and handling.

Your package will arrive in 10-14 business days and your credit card will be billed when the order is shipped.

Thank you for calling xxxx. Have a nice day.

APPENDIX F

PROTOCOL FOR THE CATALOG ORDERING TASK, PHONE AND MAIL ORDER FORM VERSIONS

TOTAL TIME______________

PHONE ORDER TASK
PRE/POST ASSESSMENT

SUBJECT ID____________________ **DATE**__________ **EXAMINER**___________

TEST TIME: **PRE** **POST**

CONDITION: **QUIET** **TONE**

ORDER OF PRESENTATION (RUN NO.): B 1 2 3 4 5

TARGET ITEM:______________________________
(randomized from list)
COLOR:______________________________
SIZE:______________________________
PRICE:______________________________
INCORRECT ITEM:_______________________________
INCORRECT PRICE:______________________________

CREDIT CARD NO:1 2 3 4 5 6

Equipment: RT Task, video recorder setup, stopwatch.

Task Materials Required: Catalog, pen and scratch paper, play credit card, phone.

Instructions to Examiner: Read each item with a normal rate of speech and with normal intonational contours. Your job is to sound as much like a phone salesperson as possible. Read each item naturally, allowing 20 seconds after the item for the subject to respond. If the subject has not responded after twenty seconds, read the item a second time. Allow an additional 20 seconds for a response. If the subject still is unable to respond, then move on to the next item. Repetitions of any item are allowed if requested by the subject, but this should be noted in the response column. If the subject responds incorrectly, move on to the next item.

Instructions to Subject:

"We are interested in how well you can do activities that you would normally do at home. We are going to pretend to make a purchase from a catalog using the phone. Here are all the things you will need: a catalog, a pen, a credit card, and a phone. We are going to do this a few different times, each time ordering a different item. Occasionally you will be doing the tone task in addition to the ordering task. Some parts of this may be difficult for you now, but just do the best you can."

Examiner Item	Subject Response	Elapsed Time	Score
1. Thank you for calling. May I help you?			
2. What is the number above the name on the back of the catalog?			
3. What is your home phone number starting with the area code?			
4. What is your last name and the spelling, please?			
5. What is your first name and the spelling?			
6. What is the zip code of your billing address?			
7. What is the city and state of your billing address, please?			
8. What is the number and street of your billing address including any apartment number?			

9. What credit card will you be using, mastercard or visa?			
10. What is your credit card number and the expiration date, please?			
11. (Repeat credit card number and expiration date back to subject)			
12. What is your first item number and the quantity?			
13. OK, that's a (incorrect item).			
14. I'm sorry - that's the (correct item). What color do you think you would like?			
15. What size would you like that in?			
16. What is your next item and the quantity?			
17. Your order total comes to (incorrect amount).			

TOTAL TIME____________

MAIL ORDER TASK
PRE/POST ASSESSMENT

WRITTEN

SUBJECT ID______________________**DATE**_________
EXAMINER__________

TEST TIME: **PRE** **POST**

CONDITION: **QUIET** **TONE**

ORDER OF PRESENTATION: **B 1 2 3 4 5 6**

TARGET ITEM (randomized from list):____________________
COLOR:____________________
SIZE:____________________
PRICE:____________________

CREDIT CARD NO.:1 2 3 4 5 6

Equipment: RT Task, video recorder setup, stopwatch.

Task Materials Required: Catalog, pen and scratch paper, play credit card, calculator.

Instructions to Examiner: Read the instructions below to the subject. Keep track of the total time for task completion. You may NOT read aloud any item on the order form, unless the subject specifically requests you to read a word out loud. You may NOT, under any circumstance, explain the meaning of any word to the subject, nor may you provide any feedback to the subject regarding the accuracy of what they have written. If the subject indicates that he/she does not know what to write, say "Skip that item if you need to. Just do your best."

Instructions to Subject:

"We are interested in how well you can do activities that you would normally do at home. We are going to pretend to make a purchase from a catalog using the phone. Here are all the things you will need: a catalog, a pen, a credit card, and a phone. We are going to do this a few different times, each time ordering a different item. We may be asking you to do this task while listening to tones and pressing the foot pedal. Some parts of this may be difficult for you now, but just do the best you can."

SPECIAL CLOTHING COMPANY
1-555-5252
East Lansing, Michigan

Ship to: ______________________________
Last name *First name*

____
Address

____
Apartment number

____
City *State* *Zip code*

Daytime Phone Number: (_____) ________________
Area code

Item Number	Size	Quanti ty	Color	Description	Price	Total

Subtotal _____

Shipping/Handling _____

Total _____

Payment By: Check AMEX
Visa Mastercard

Card Number: ______________________________

Expiration Date: ________________

Signature: ______________________________

Your merchandise will be shipped within 24 hours of receipt of your order, and should be received within 10 days. If you are in a hurry, please contact us for rush delivery charges.

APPENDIX G

RECEPTIVE VOCABULARY USED ACROSS THE ORAL AND WRITTEN VERSIONS OF THE CATALOG ORDERING TASK

Oral (Phone)	Written (Order Form)	
help		
catalog		
above		
name	name	
back		
home		
phone number	phone number	
starting		
area code	area code	
last name	last name	
first name	first name	
zip code	zip code	
billing		
address	address	
city	city	
state	state	
street	street	
apartment number	apartment number	
credit card	credit card	
expiration date	expiration date	
first		
item number	item number	
quantity	quantity	
name of clothing article		
color	color	
size	size	
next		
package	package	subtotal
arrive	arrive	total
10 days	10 days	payment
ship	shipping	check, AMEX,
Visa, MC		
order		
	handling	signature
	description	price

APPENDIX H

TARGET STIMULI OF THE CATALOG ORDERING TASK FOR
PRE/POST ASSESSMENT

MEN'S TARGET ITEMS

SUMMER 1998 LAND'S END

	PAGE NO.	**COLOR**	**SIZE**	**PRICE**	**INCORRECT ITEM**	**INCORRECT PRICE (+ 50%)**
1. SHIRT	168	BLUE	REGULAR	28.50	COAT	42.75
2. PANTS	79	BLACK	REGULAR	37.50	SHOES	56.75
3. SHOES	175	TAN	10	95.00	SWEATER	142.00
4. COAT	92	GREEN	LARGE	19.50	PANTS	30.00
5. HAT	8B	RED	ONE SIZE	7.50	SHIRT	11.50
6. SWEATER	82	YELLOW	REGULAR	36.50	HAT	54.75

WOMEN'S TARGET ITEMS

SUMMER 1998 LAND'S END

	PAGE NO.	**COLOR**	**SIZE**	**PRICE**	**INCORRECT ITEM**	**INCORRECT PRICE (+50%)**
1. SHIRT	40	GRAY	REGULAR	18.50	COAT	27.50
2. PANTS	74	GREEN	12	44.50	SHOES	66.75
3. SHOES	148	BLACK	8	26.50	SWEATER	39.75
4. COAT	92	BLUE	LARGE	19.50	PANTS	30.00
5. HAT	8B	RED	ONE SIZE	7.50	SHIRT	11.50
6. SWEATER	82	YELLOW	REGULAR	36.50	HAT	54.75

APPENDIX I

TRANSCRIPTS FROM ACTUAL CALLS MADE BY THREE ADULTS WITH APHASIA TO CATALOG ORDERING COMPANIES

Sample #1

Salesperson	Adult with aphasia (Subject 1)
Holly may I help you?	
	Hi How are you doing? Marge Naber, I'm stroking, I understand everything but slow down please. I'm sorry, get it?
Hm mm.	
	OK, um, um, xxx's please, OK, right it out please, let's see (counting to herself) 9 4
What are you giving me ma'am your phone number or what?	
	Um...
Do you wish to place an order?	
	Yes please.
What is the area code of your phone number?	
	1 2 3 4
The area code of your phone number ma'am	
	Um, Cross please, Cross please
Cross? What do you mean ma'am?	
	Well that's wrong again. I guess so I can't say it. Pardon me I'm sorry thank you very much thank you very much. Bye.

Sample #2

Salesperson Adult with aphasia (Subject 2)

This is Cathy may I help you?

Hi could I have um um one..um T-shirt.

What would you like?

The T-shirt.

Oh. OK first I need your phone number with the area code.

OK um …603 xxx-xxxx (correct).

OK. And your name please.

Alexis

And the last name.

Kxxxx (correct).

OK and is there anyone in the home that usually orders?

Uh no.

Is there are you the head of the household?

Yeah

The only we ask is people don't like so many catalogs coming to their home, so I have an Arlene showing here.

Really? My um mother.

So that would be your mom.

Yeah.

And she lives there doesn't she?

Yes.

OK so now on this order, do you mind if I just leave it in Arlene's name or do you want me to change it to your name?

No that's fine, Arlene is fine.

OK could you verify the address and zip code.

Um again?

I don't think you told me the address and zip code did you?

Oh OK OK. Um, 130 xxx Drive, Manchester, NH.

And the zip code is 02134?

Yeah.

Do you want this order to come to your home or the store?

Um I think um my house.

If it comes to your home, do you have a charge card to put it on?

Yes.

OK. For home delivery? Are you under 18 or over?

23

26?

23.

Oh 23 you know how to do things. May I have the catalog number of your first item?

OK um I want um embroidery T.

OK, the number is on the plate there should be a letter in front of seven numbers. Do you see that anywhere?

Yeah it's um and the numbers?

Yeah.

It's um 6 or um 8 8 4 2 dash 7 6 9 2.

And the first letter was a C like Charles?

Um..

At the beginning of the number?

Um…C or um Carol, yeah.

OK and what size?

At um Misses' medium

Misses' medium, and which color?

At um the 37 navy um stripe.

OK a navy stripe medium T shirt.

Hm mm.

OK and how many?

Just one.

OK and the next item?

That's it.

And which credit card would you like to use?

Um, visa.

And the visa number?

Or um xxx's.

OK you'd rather do xxx's.

Yeah.

OK and the xxx's number?

Um xxx xxx xx x xx (correct).

OK and oh boy after we did all that I found out the T shirt in that color is not available.

Oh.

We only have the ocean stripe in that size. Is medium the only size you can try?

`Um OK it's other color is the same thing this time?

Do you like that color?

Sure.

OK good. I'll put you for that. OK good, then an ocean stripe medium T-shirt will be coming to you. The total is $12.49, and thanks for shopping xxx's catalog.

Sample #3

Salesperson — Adult with aphasia (Subject 3)

This is Jean may I help you?

I wanna place an order please.

OK what is your home telephone number with the area code please?

xxx-xxx-xxxx (correct).

And your first and last name?

David Dxx, D - X -X (spelled correctly).

Alrighty and for verification your street address and zip code.

323 Cxxx Rxxx xx.

OK and for verification your zip code?

43xxx (correct).

Thanks and the catalog number of your first item.

Uh, 3504227D.

The first letter is C as in Charles?

Yeah.

OK what size?

Extra large.

Color?

Black.

How many?

One.

OK that's a pocket tee shirt in the extra large black. And your next item?

Nothing else.

OK is this cash or charge?

Uh, charge.

Xxx's?

Yeah.

Account number?

Xxx xx xxxx (correct).

OK delivered to your home or office.

Home.

OK unfortunately that item is not currently available in the black I only have navy or white.

Navy please.

OK and I have that on order. That will be delivered to your home in 3-4 working days with a shipping charge of $2.50, and thank you for shopping xxx's catalog.

Alright. Thank you.

APPENDIX J

SCORING GUIDELINES AND EXAMPLES FOR THE CATALOG ORDERING TASK

Catalog Ordering Task

Scoring Criteria/Examples

Score	Characteristics
0	No Response (NR) "I don't know" (IDK) Unintelligible response Completely unrelated to task Completely inappropriate Related to task, but not to item answers "blue" when asked for size
1	Related to item, but incorrect says "red" for "blue" Partially correct Misses one digit on credit card number Incomplete Gives credit card no. but not expiration date Correct information provided in inappropriate modality Says "mastercard" but doesn't circle it on written form
2	Communicates message completely Appropriate to question/item Judged to be effective in real ordering situation

Examiner Item	**Subject Response Examples**	**Elapsed Time**	**Score**
1. Thank you for calling. May I help you?	*I'd like to place an order - 2* *Yeah - 1* *NR - 0*		
2. What is the number above the name on the back of the catalog?	*124293242 - 2* *Mr. Victor Vaughan - 1* *I don't know - 0*		
3. What is your home phone number starting with the area code?	*Actual or made up (for normals) phone number and area code - 2* *Phone number correct but no area code - 1* *Gives address - 0*		
4. What is your last name and the spelling, please?	*Name and spelling correct - 2* *Gives name but no spelling - 1* *NR - 0*		
5. What is your first name and the spelling?	*Name and spelling correct - 2* *Gives name but no spelling - 1* *NR - 0*		
6. What is the zip code of your billing address?	*Gives zip code correctly - 2* *Missing digit - 1* *"I don't have that" - 0*		
7. What is the city and state of your billing address, please?	*Gives city and state correctly - 2* *Gives city (or state) only - 1* *Unintelligible response - 0*		
8. What is the number and street of your billing address including any apartment number?	*Gives number and street - 2* *Gives street name only - 1* *Says "apartment" - 0*		

9. What credit card will you be using, mastercard or visa?	*Responds correctly - 2* *Says "mastercard" instead of "visa" or vice versa - 1* *Says "credit card" - 0*		
10. What is your credit card number and the expiration date, please?	*Gives number and expiration date completely - 2* *Gives number but no expiration date - 1* *Gives incorrect numbers - 0*		
11. (Repeat credit card number and expiration date back to subject)	*Says "yes" or "correct" and that is true, or corrects error - 2* *Says "correct" but number is incorrect - 1* *No response - 0*		
12. What is your first item number and the quantity?	*Says item number and quantity - 2* *Says quantity only - 1* *Says "shirt" - 0*		
13. OK, that's a (incorrect item).	*Corrects examiner by saying "no", or "no that's a (correct item) - 2* *No response - 0*		
14. I'm sorry - that's the (correct item). What color do you think you would like?	*Says correct color - 2* *Says "green" for "blue" - 1* *Says "large" for "blue" - 0*		
15. What size would you like that in?	*Says targeted size - 2* *Says related but not targeted size - 1* *Says "blue" for "regular" - 0*		
16. What is your next item and the quantity?	*"nothing else" or anything like it - 2* *No response - 0*		
17. Your order total comes to (incorrect amount).	*"no", "that's not right", or anything like it - 2* *"OK" - 0*		

18. I'm sorry - your order totals (correct amount), plus shipping and handling. Your package will arrive in 10 days and your credit card will be billed when the order is shipped. Thank you for calling.	*"Thank you", "OK", "bye" - 2* *No response - 0*		

APPENDIX K

LIST OF THE 54 BASELINE STIMULI FOR THE CN TREATMENT, DERIVED FROM RESPONSES ON THE CATALOG ORDERING TASK

<u>COLORS</u>

BLUE, BLACK, GREY, PINK, PURPLE, RED

<u>NUMBER NAMES</u>

ZERO, ONE, TWO, THREE, FOUR, FIVE, SIX, SEVEN, EIGHT, NINE

<u>LETTER NAMES</u>

ALL 26 LETTERS A THROUGH Z

<u>CLOTHING NAMES</u>

COAT, SHIRT, PANTS, SOCKS, SKIRT, DRESS

<u>FRUIT</u>

PEACH, PINEAPPLE, ORANGE, APPLE, PEAR, BANANA

APPENDIX L

DATA RECORDING FORM FOR CN TREATMENT

Subject ID ________________ **Date**___________

Session #_________________

Training Cue =____

Probe (no cues)

Target	Response	Accuracy
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Total____________________

Training (with cues and feedback)

1 = First trial; 2 = Second trial; 3 = Third trial

Target	Response	Accuracy	Cue	Repetition
Set #______				
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Total___________

APPENDIX M

LIST OF THE TARGETED ITEMS FOR PRODUCTION DURING FUNCTIONAL TRAINING

<u>COLOR NAMES</u>

BLUE, BLACK, RED

<u>NUMBER NAMES</u>

ZERO, ONE, TWO, THREE, FOUR, FIVE, SIX, SEVEN, EIGHT, NINE

<u>LETTER NAMES</u>

LETTERS REQUIRED TO SPELL FIRST AND LAST NAME

<u>CLOTHING NAMES</u>

COAT, SHIRT, PANTS

<u>PERSONAL INFORMATION</u>

NAME, STREET ADDRESS, CITY AND STATE, ZIP CODE, PHONE NUMBER

APPENDIX N

DATA RECORDING FORM FOR FUNCTIONAL TREATMENT

Data recording form for functional treatment

Examiner Item	Subject Response	Cueing/Comments
1. Thank you for calling. May I help you?		
2. What is the number above the name on the back of the catalog?		
3. What is your home phone number starting with the area code?		
4. What is your last name and the spelling, please?		
5. What is your first name and the spelling?		
6. What is the zip code of your billing address?		
7. What is the city and state of your billing address, please?		
8. What is the number and street of your billing address including any apartment number?		
9. What credit card will you be using, mastercard or visa?		
10. What is your credit card number and the expiration date, please?		

11. (Repeat credit card number and expiration date back to subject)		
12. What is your first item number and the quantity?		
13. OK, that's a (incorrect item).		
14. I'm sorry - that's the (correct item). What color do you think you would like?		
15. What size would you like that in?		
16. What is your next item and the quantity?		
17. Your order total comes to (incorrect amount).		
18. I'm sorry - your order totals (correct amount), plus shipping and handling. Your package will arrive in 10 days and your credit card will be billed when the order is shipped. Thank you for calling.		

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