CHAPTER

16

Generalization Research in Aphasia:
A Review of the Literature

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Generalization is an essential aspect of aphasia intervention that has received increasing attention of both clinicians and researchers in the past decade. That is, it has been recognized that effective treatment requires both facilitation of selected language responses and ensurance that the effects of treatment will endure over time and generalize to a variety of untrained language responses and environments.

Generalization research in aphasia, although limited, indicates that in spite of often marked acquisition effects, generalization behaviors not trained directly and to contexts other than those in which training is conducted is not always forthcoming (Doyle, Goldstein, and Bourgeois, 1987; Holland and Levy, 1971; Kearns and Salmon, 1984; Thompson and McReynolds, 1986; Thompson, McReynolds, and Vance, 1982; Wambaugh and Thompson, in press). Clinicians treating aphasic patients also report limited generalization (Thompson, in press), an observation that raises questions regarding treatment efficacy. That is, if response generalization (the emergence of untrained language responses) does not occur as a result of treatment, then, in theory, clinicians must endeavor to train all responses that the aphasic patient will use. Further, if stimulus generalization (the transfer of trained behaviors to stimulus conditions or situations that differ from those in which training takes place [Guess, Keogh, and Sailor, 1978]), does not occur, treatment may be deemed unsatisfactory, since it is this carry-over of responding from the clinic to natural settings that is the ultimate goal of any rehabilitation program.

METHODS

Generalization studies in the literature were identified by reviewing treatment studies published between 1970 and 1987 in the *Journal of Speech and Hearing Disorders,* the *Journal of Speech and Hearing Research,* the *Journal of Communication Disorders, Cortex, Brain and Language, Brain,* the *Archives of Neurology,* and the proceedings of the Clinical Aphasiology Conferences, *Clinical Aphasiology.* Studies reviewed were ones in which (1) behaviors under study were clearly specified and (2) generalization was tested using defined measures or probes other than standardized tests. In addition, only studies in which acquisition of target behaviors was demonstrated were included because without this demonstration, generalization could not be evaluated. Studies reviewed are listed in Table 16-1.

RESULTS

Table 16-1 indicates that 35 studies addressing aspects of generalization have been published. Most studies (N = 31; 88%) addressed response

generalization, and far fewer focused on stimulus generalization (N = 12; 34%). Further, only three studies reported measuring generalization to the natural environment, and only six studies focused on identification of methods for facilitating generalization when it was not observed as a natural outcome of treatment.

Table 16-1 also indicates that few aphasic behaviors have been studied and that the types of treatment used in training have been limited. Most research was focused on production training: 35 percent trained morphosyntactic responses, 22 percent focused on naming, and 16 percent trained nonverbal responses. Very few generalization studies have addressed the effects of training auditory or reading comprehension. Further, many studies have included a very small corpus of training items.

Methodological problems were also common in the literature searched, further reducing the number of studies in which reliable conclusions could be drawn about generalization. Many studies have included an inadequate number of subjects to satisfy experimental design requirements. In 37 percent, only one subject was studied. Further, 20 percent of the studies reviewed did not report minimal subject data (month post-onset and type of aphasia). In the remaining 80 percent, other important subject variables (Brookshire, 1983) were also sometimes lacking. Of further interest is the Broca's aphasia was most often studied, with 54 percent of the studies involving Broca's aphasic patients.

Other methodological problems were also evident. Athough continuous measurement of dependent variables was accomplished in 77 percent of the studies, interobserver reliability data were reported in only 54 percent. Further, several generalization studies were lacking in experimental control, with internal validity demonstrated in only 58 percent. Some reports of generalization were based on case study investigations that are inherently lacking in interval validity, and although investigators are beginning to use controlled single-subject experimental designs for studying generalization (Barlow and Hersen, 1986; Barlow, Hayes, and Nelson, 1984; Kazdin, 1982; McReynolds and Kearns, 1983), several investigators have used them inappropriately by overlooking important design requirements such as replication, counterbalancing, and so on. No controlled group studies investigating generalization were found in the literature. Further, the external validity of findings reported could not be evaluated. That is, neither group studies nor single-subject studies have included sufficient numbers of subjects or replications such that findings may be generalized to other aphasic patients with confidence.

SUGGESTIONS FOR FACILITATING GENERALIZATION

Despite limitations in the data base, four variables to consider in establishing generalization in aphasic patients were identified from the available

TABLE 16-1. GENERALIZATION RESEARCH IN APHASIA

	Subject data						Response generalization	
Author	No.	MPO	Type	Behavior trained	Treatment method	Design	Measure	Observed
Doyle, Goldstein, Bourgeois, and Nakles (in press)	4	29+	Broca's	Topic-specific verbal requests	Loose training: specific question types or structures not trained, a variety reinforced	Multiple baseline across behaviors and subjects	Probes across topics	No
Wambaugh and Thompson (in press)	4	11+	Broca's	Production of *what* and *where* + *is* + *nominative* and *what* and *where* + *transposed noun phrase* sentences	Modeling, forward chaining, and feedback	Multiple baseline across behaviors and subjects	Probes of untrained exemplars of trained and untrained question types and structures	Obtained to untrained question types only
Coetho and Duffy (1987)	12	6+	Nonfluent	Manual sign production	3 training steps: sign imitation, sign recognition, and sign production	Group study; no control group	No	
Davis and Tan (1967)	1	6	Broca's	Oral sentence production	Three-level stimulation procedure	Multiple baseline across behaviors	Probes of untrained sentences	No
Bernstein-Ellis, Wertz, and Shubitowski (1967)	1	4	NR	Decreased rate of speech production during picture description task	Pacing board and clinican feedback	ABA	Probes to untrained picture; rate, content units, and accuracy/ syntax measured	Decreased rate obtained
Doyle, Goldstein, and Bourgeois (1967)	4	30+	Broca's	Production of 5 sentence types	Helm Elicited Language Program for Syntax Stimulation (HELPS)	Multiple baseline across behaviors	Probes to untrained exemplars of trained and untrained sentence types	To untrained exemplars of trained sentence types only
Simmons, Kearns, and Potechin (1967)	1	48	Broca's + spouse	Trained spouse to decrease interruptions and use of covergent questions	Recognition training using video-taped dyads between aphasic patient and spouse	Multiple baseline across behaviors	To untrained spouse behavior: negative teaching	Yes
Thompson and Warner (1967)	6	7+	Broca's	Production of food request responses	Modeling, forward chaining, and feedback	Multiple baseline across subjects	No	
Cannito and Vogel (1967)	1	2	Agrammatic	Production of regular plural nouns	Closure procedure and clinican feedback	AB	Probes to untrained regular and irregular plurals	To regular but not irregular plurals

Stimulus generalization		Maintenance				
Measured	*Observed*	*Measured*	*Observed*	*Trained to generalize*	*Reliability data reported*	*Continuous measurement*
Probes in novel social dyads	Yes	Yes; within-session, 1 follow-up probe, 6 weeks posttreatment	Yes	No; but treatment was designed to facilitate generalization	Yes	Yes
Probes in three conditions: prompted interview, novel social dyad, and mealtime conversation	In prompted interview only	Yes; within-session, 2 follow-up probes, 1 to 4 weeks posttreatment	Yes	Yes; sequential modification resulted in generalization to novel social dyad	Yes	Yes
Probes of trained signs with nontraining pictures	Yes	No	No	No	No	No
No		Yes; within-session, 2 follow-up probes (time posttreatment unspecified)	Yes	No	Not on dependent measure	Yes
No	No	No		No	Yes	Yes
Probes in nontreatment conditions for each sentence type	For some sentence types but not others	Yes; within-session; no follow-up probes	Yes	No	Yes	Yes
In three untrained conditions: spouse/patient discussion, TV sports show conversations, and TV talk show conversations	In all conditions	Yes; within-session; 1 month follow-up	Yes	No; but treatment method was designed to facilitate maintenance	Yes	Yes
Probed trained response in simulated restaurant and real restaurant	To both conditions for 3 to 6 subjects	No		Yes; programming a common stimulus and training sufficient stimulus exemplars	Yes	Yes
No		Yes; 1 follow-up probe, time posttreatment not specified	Yes	No	Yes	Yes

(continued)

Table 16-1. (continued)

	Subject data						Response generalization	
Author	*No.*	*MPO*	*Type*	*Behavior trained*	*Treatment method*	*Design*	*Measure*	*Observed*
Steel, Weinrich, Kleczewska, Carlson, and Wertz (1987)	1	48+	Global	Name of gestures using computer	Computer-aided visual communication system (C-VIC)	Multiple baseline across behaviors	To untrained sets of objects	Yes
Hillis and Caramazza (1987)	1	3	Anomic, with dysgraphia and dyslexia	Spelling of single words	Teaching correct spelling and search strategies	Multiple baseline	To untrained set of spelling words	Yes
Thompson and McReynolds (1986)	4	15+	Broca's	Production of *What, Where, Who,* and *Why* questions	Two treatments: auditory-visual stimulation and direct-production treatment	Combined alternating treatments design, multiple baseline across behaviors and subjects	Probes of untrained exemplars of trained and untrained question types	To untrained exemplars of trained question types, but not to untrained question types
Thompson, Hall, and Sisson (1986)	3	12+	Broca's	Object naming	Imagery and hypnosis	Multiple baseline across subjects	Probes to untrained items	For 1 of 3 subjects
Kearns (1985)	1	36	Broca's	Increased content units in picture description	Response Elaboration Treatment (RET)	Multiple baseline across behaviors	To untrained pictures	Increased content units with untrained pictures
Salvatore (1985)	3	3+	2 nonfluent 1 fluent	Production of sentences	HELPSS program	Multiple baseline across behaviors	To untrained exemplars of trained and untrained sentence types	Little to untrained exemplars of trained or untrained sentences
Johannsen-Horbach, Cegia, Mager, and Schempp (1985)	4	6+	Global	Comprehension and production of Bliss Symbols	Nonspecific comprehension and production training	Case study	No	
Howard, Patterson, Franklin, Orchard-Lisle, and Morton (1985)	12	6+	5 Broca's 4 conduction 2 anomic	Naming pictures	Two methods: semantic treatment and phonologic treatment	Group study (ABC)	Probes to untrained items	Yes
Kearns and Salmon (1984)	2	24	Broca's	Production of third person auxilliary *is* in sentences	Imitation followed by spontaneous production	ABAB	Probes of copula *is* + predicate adjective, locative, nominative, and plural auxiliary *are*	To copula *is* + predicate adjective; variability across subjects on other structures

Stimulus generalization		Maintenance				
Measured	*Observed*	*Measured*	*Observed*	*Trained to generalize*	*Reliability data reported*	*Continuous measurement*
No		Yes; within session; no follow-up	Yes	No	No	Yes
No		Yes; within session; no follow-up	Yes	No	No	Yes
Probes in picture description task	No	Yes; within session; no follow-up	Yes	No	Yes	Yes
No		No		No	Yes	Yes
No		Yes; within session; no follow-up probes	Yes	No	Yes	Yes
No		Yes; within session; no follow-up probes	1 of 3 subjects	No	Yes	Yes
Observation in home environment	For 2 of 4 subjects	No		No	No	No
Probes in untrained pictures of trained words	Yes	Yes; within session; follow-up at 1 and 6 weeks	No	No	No	Yes
Probes in spontaneous speech	Yes	Yes; follow-up probes 2 and 6 weeks	Yes	No	Yes	Yes

(continued)

Table 16-1. (continued)

	Subject data						Response generalization	
Author	*No.*	*MPO*	*Type*	*Behavior trained*	*Treatment method*	*Design*	*Measure*	*Observed*
Thompson and Byrne (1984)	3	14+	Broca's	Production of social conventions: greetings, self-disclosures, and questions	Loose training: 4 training steps in which stimuli and feedback progressively loosened	Multiple baseline across subjects	No	
Hoodin and Thompson (1983)	3	NR	Broca's	Verbal, gestural, and verbal + gestural production of nouns	Three treatments: verbal, gestural, and verbal + gestural training	Alternating-treatments design	Probes to verbal labels (cross modal)	With verbal + gestural training only
Royall and Horner (1983)	1	60	Fluent	Reading comprehension with cued speech	Cued speech practice and clinical feedback	AB	Probes to untrained word list using cued speech	Yes
Thompson, McReynolds, and Vance (1982)	2	19+	Broca's	Production of NP + is + PP sentences containing locatives behind and beside	Modeling, forward chaining, and feedback	Multiple baseline across behaviors	Probes to untrained sentences within and across locatives	To sentences containing trained locatives only
Tonkovich and Loverso (1982)	4	26+	Broca's	Verb + noun gestural combinations	Matrix training	AB	Probes to untrained intramatrix and extramatrix combinations	To intramatrix and extramatrix combinations
Prescott, Selinger, and Loverso (1982)	1	48	NR	Verbal and graphic productions of subject + action utterances	Verbal center treatment: auditory + visual verbal prompt, *wh* question cues and clinician feedback	Multiple baseline across behaviors	Probes to untrained verbs	Yes
Kearns, Simmons, and Sisterhen (1982)	2	6	NR	Gestural production verbal + gestural production	Two treatments: gestural training, verbal + gestural training	Multiple baseline across behaviors	Probes of verbal production of items trained gesturally (cross modal)	No
Thompson and Kearns (1981)	1	48	Anomic	Naming pictured nouns	Cuing hierarchy	Multiple baseline across behaviors	Probes to untrained semantically paired nouns	No
Linebaugh and Lehner (1979)	5	12	Broca's	Naming nouns	Cuing hierarchy	Case study	Probes to untrained word lists of low and high frequency nouns using cuing hierarchy	Yes

Stimulus generalization		*Maintenance*				
Measured	***Observed***	***Measured***	***Observed***	***Trained to generalize***	***Reliability data reported***	***Continuous measurement***
Probes in novel social dyads	For greetings and self-disclosures but not questions	Yes; follow-up probes 3 months following treatment	Yes	No; but treatment designed to facilitate generalization	Yes	Yes
No		No		No	Yes	Yes
Probes with auditory stimulus only and auditory + lip posture stimulus	No	No		No	No	Yes
Spontaneous speech probes using picture description	For 1 of 2 subjects	Yes; within-sessions; follow-up at 4 and 6 months	Yes	No	Yes	Yes
No		Yes; follow-up probes at 2 and 3 months	Yes	No; but treatment was designed to facilitate generalization	Yes	Yes
No		Yes; follow-up probes at 2 and 3 months	Yes	No	No	Yes
No		Yes; within session; no follow-up probes	Yes	No	Yes	Yes
No		Yes; within session; no follow-up probes	Yes	No	Yes	Yes
No		No		No	No	Yes

(continued)

Table 16-1. (continued)

	Subject data						Response generalization	
Author	*No.*	*MPO*	*Type*	*Behavior trained*	*Treatment method*	*Design*	*Measure*	*Observed*
Seron, Deloche, Bastard, Chassin, and Hermand (1979)	8		5 Anomic 2 Wernicke's 1 Broca's	Naming pictured objects and actions belonging in four categories	Two methods: unspecified "traditional language therapy" and nonspecific stimulation of access mechanisms	Group; control group received traditional treatment; experimental group received stimulation	To untrained items within trained and untrained categories	Yes, for 3 of 4 experimental subjects
Salvatore (1976)	1	112	NR	Auditory comprehensions of part III level items of Token Test (TT)	Gradual reduction of interstimulus pause duration in auditory commands	Case Study	Probes of untrained items on parts III and V of TT	Yes to part III but not to part V items
Weigel-Crump (1976)	6	3	Broca's	Production of three sentence types: noun phrase + to be predicate, noun phrase + present progressive verb + object, noun phrase + intransitive verb + prepositional modifier	Two methods: programmed treatment and nonspecific stimulation	Group; three subjects per group; no control group	Probes to untrained exemplars of each sentence type	Yes, with programmed instruction
Shewan (1976)	1	21	Broca's	Production of two sentence types: subject + verb + object, and subject + verb + prepositional phrase	Two treatments: sequencing of all components of sentences and modeling of verb phrase only	Case study	Probes to untrained sentences of trained form	No
Helmick and Wipplinger (1975)	2	2	Anomic	Naming of nouns and verbs	Two treatments: maximum and minimum stimulations	Alternating-treatments design	Probes of untrained items	Yes
Kushner (1975)	1	1	NR	Auditory comprehension of nouns	Repetition and modeling	ABAB	Probes to production of trained nouns (cross modal)	Yes
Weigel-Crump and Koenigs-knecht (1973)	4	3	Anomic	Naming items in four categories: household items, clothing, living things, action words	Nonspecific stimulation	Case study	Probes to untrained items in trained and untrained categories	Yes

Stimulus generalization		Maintenance				
Measured	*Observed*	*Measured*	*Observed*	*Trained to generalize*	*Reliability data reported*	*Continuous measurement*
No		No		No	No	No
No		Yes; follow-up probes on part III of TT at 12 weeks	Yes	No	Yes	Not on all measures
No		No		No	No	No
No		No		No	No	No
No		No		No	No	No
No		Yes; 2 follow-up probes at 1 and 2 months	Yes	No	No	Yes
No		No		No	No	No

(continued)

Table 16-1. (continued)

	Subject data						Response generalization	
Author	No.	MPO	Type	Behavior trained	Treatment method	Design	Measure	Observed
Holland and Levy (1971)	7	NR	NR	Production of an active sentence (The man opened the door)	Reading, repetition, writing, and verbal production focused on one of two words in a sentence at a time	Case study	Probes to reading, writing, repetition and production of trained sentence (cross modal); to interrogative, negative, and passive forms of trained sentence; to untrained active sentences	To writing only (cross modal); to interrogative form; no change in negative or passive forms; to untrained active sentences

research. These include (1) the behaviors selected for training, (2) measurement variables, (3) treatment variables, and (4) subject (organism) variables.

Behaviors Selected for Training

Two major considerations in selecting treatment targets concern the relationship between responses trained and (1) responses tested for generalization and (2) contexts or conditions in which trained responses are tested for generalization. Research has shown that generalization often occurs across responses that are topographically or structurally related to each other. Generalization to responses similar in surface form is common, but generalization across forms is rare. For example, generalization occurring to novel exemplars of trained morphosyntactic structures, but not to untrained structures, has been demonstrated in a number of studies (Cannito and Vogel, 1987; Doyle, Goldstein, and Bourgeois, 1987; Kearns and Salmon, 1984; Thompson and McReynolds, 1986; Wambaugh and Thompson, in press).

Generalization also appears to be enhanced when behaviors trained are tested in environments in which they are likely to be used naturally or functionally. That is, responses that are functionally significant to the stimulus generalization environment may generalize more readily than those that are not. A few aphasia treatment studies demonstrating the relevance of functional significance in treatment of aphasia have been reported (Doyle, Goldstein, Bourgeois, and Nakles, in press; Snyder, 1984; Thompson and Byrne, 1984; Tullos, 1985; Thompson and Warner, 1987). Thomp-

Stimulus generalization		Maintenance				
Measured	*Observed*	*Measured*	*Observed*	*Trained to generalize*	*Reliability data reported*	*Continuous measurement*
No		No		No	No	Yes

MPO = months post onset; NR = not reported.
Source: Reprinted with permission from C. K. Thompson (1988). *Generalization strategies in the treatment of communication disorders* (pp. 85–88). Philadelphia: B.C. Decker, Inc.

son and Warner (1987), for example, trained food request responses and measured generalization in stimulated and real restaurants, and Snyder (1984) trained and obtained generalization of gestures that could be used during social events in a nursing home.

Measurement Variables

Measurement variables appear also to influence generalization. These variables include the type of probe condition chosen, frequency of measurement, and criteria established for generalization. Many aphasia generalization studies have utilized stimulus-specific probes or tests designed to evaluate a specific set of responses using tasks such as picture naming, picture description, sentence completion, and so on (Coelho and Duffy, 1987; Howard, Patterson, Franklin, Orchard-Lisle, and Morton, 1985; Kearns and Salmon, 1984; Thompson and Kearns, 1981). Simulated environmental probes have also been utilized in which certain aspects of the natural environment are introduced into the probe condition. These probes have included dyads, role playing, or the use of props (Prinz, 1980; Thompson and Byrne, 1984) and have been used primarily to evaluate generalization across settings. Finally, naturalistic sampling has been employed in which generalization is tested in the patient's communicative environment (Wambaugh and Thompson, in press). The problem here is that certain generalization probes may not provide obligatory contexts for the use of responses in the language repertoire of a particular subject. Therefore,

different generalization results may be seen when different types of generalization probes are employed.

Frequency of generalization probing and the criteria established for a generalized response are also important variables to consider. It has been demonstrated that generalization data differ in studies that use pre-/post-treatment probes versus studies in which probes are administered continuously throughout treatment (Doyle et al., 1987; Wambaugh and Thompson, in press). Further, generalization observed may vary depending on the criteria established. That is, strict generalization criteria may mask changes in patient behavior. Therefore, it is important to analyze error responses for partial or incomplete generalization (Wambaugh and Thompson, in press).

Treatment Variables

The treatment method employed is also an important consideration. Research in aphasia has focused on evaluating methods for facilitating generalization advanced by Stokes and Baer (1977) including loose training, programming common stimuli, training sufficient exemplars, sequential modification, and training mediational strategies.

Loose Training. Loose training approaches operate on the premise that generalization may occur when the treatment environment approximates stimulus conditions and response variations found in the environment to which generalization is desired. Therefore, in loose training procedures, the stimuli, responses, and/or feedback used in treatment are varied to approximate conditions occurring in the natural environemtn (Doyle et al., in press; Kearns, 1985; Thompson and Byrne, 1984).

Kearns (1985, p. 196) studied the effects of Response Elaboration Training (RET) designed to "loosen" responses trained by "reinforcing creative language use instead of demanding specific target responses." Figures 16-1 and 16-2, taken from Kearns (1985), depict results of this training for one aphasic subject, indicating an increase in the number of content units produced to two sets of training items (Fig. 16-1) and generalization to a third untrained set (Fig. 16-2).

In another loose training study, Thompson and Byrne (1984) trained two aphasic subjects to produce social conventions by progressively varying the stimuli and feedback dimensions of treatment while testing generalization in novel social dyads. Results (Fig. 16-3) indicated a gradual increase in the number of social conventions used in dyad probes taken throughout the study; as the stimuli and feedback were loosened to approximate the natural environment, subject responding in the natural environment improved.

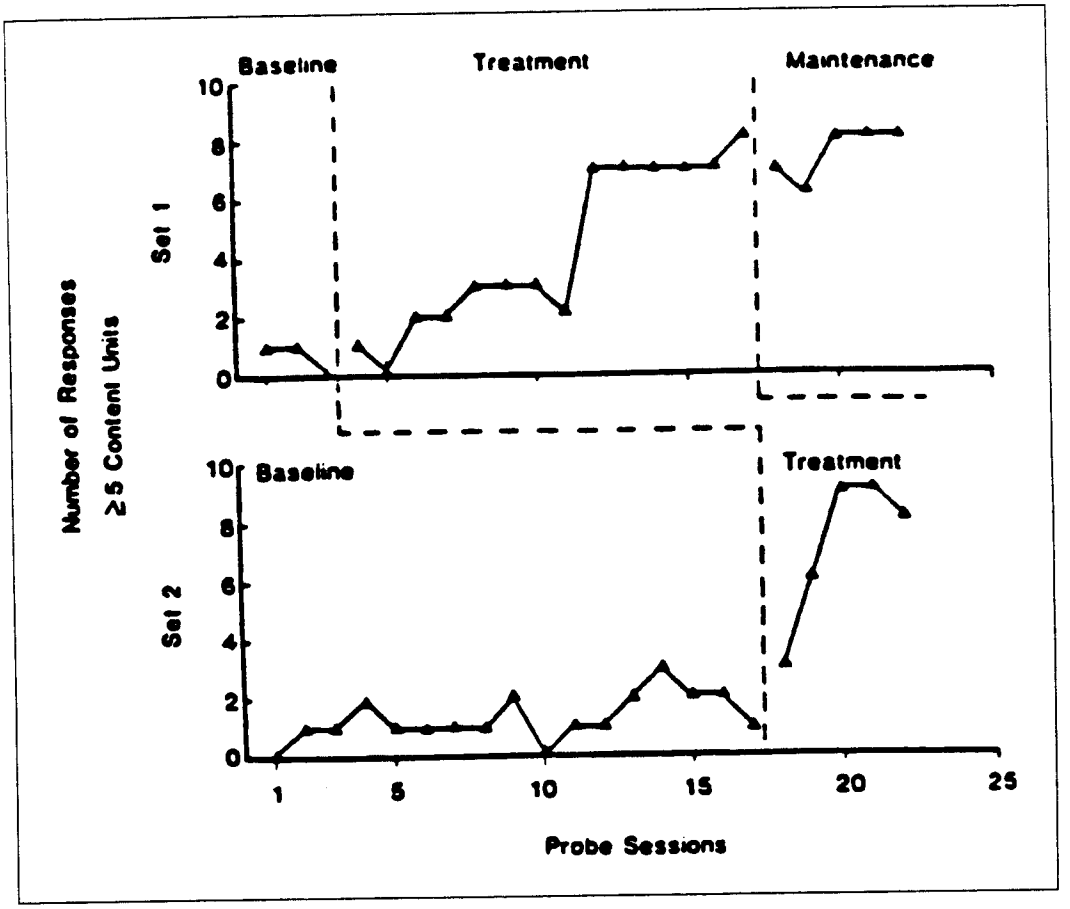

Figure 16-1. Number of responses containing five or more content units produced by a Broca's aphasic subject to sets of training pictures during baseline, treatment, and maintenance phases. Data indicate successful response acquisition using a loose training procedure (Response Elaboration Training, [RET]). (Reprinted with permission from K. P. Kearns, *Clinical aphasiology conference proceedings.* Minneapolis, MN: BRK, 1985. P. 199.)

The third loose training study (Doyle et al., in press) also indicated positive generalization results. In this study, the stimuli, responses, and feedback used in training were loosened to train aphasic subjects to request information about three topics: personal information, health, and leisure activities. Results indicated that treatment was successful in facilitating stimulus generalization in three of four subjects. (Data for one subject are shown in Fig. 16-4.)

Programming a Common Stimulus. Programming a common stimulus is another method that has been advanced to facilitate generalization. This method incorporates common components in the training and generalization environments.

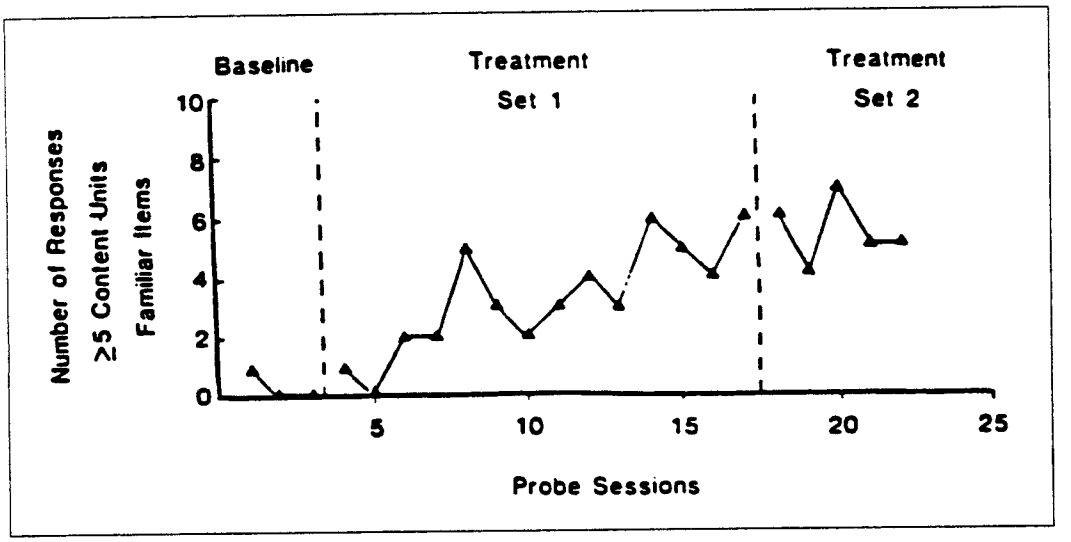

Figure 16-2. Response generalization (number of responses produced containing five or more content units to untrained picture stimuli), occurring during RET of picture sets 1 and 2 (see Fig. 16-1) for a Broca's aphasic subject. (Reprinted with permission from K. P. Kearns, *Clinical aphasiology conference proceedings.* Minneapolis, MN: BRK, 1985. P. 201.)

In the aphasia literature, only one study (Thompson and Warner, 1987) has attempted to program a common stimulus. In this study, food requests were trained by one examiner in a clinic treatment room, while generalization was tested in a simulated restaurant and in a real restaurant. When treatment did not result in complete generalization across conditions, a common stimulus was programmed that simply required the examiner to enter the simulated restaurant during probing and observe as responses were elicited. Data from the study indicated that this procedure did not improve generalization to either the simulated or the real restaurant. There are, however, numerous stimulus components that have not, but may be, programmed to facilitate generalization. These components may be selected from training and incorporated into the generalization environment or selected from the generalization environment and incorporated into training.

Training Sufficient Exemplars. Training sufficient exemplars may be used to promote generalization across settings or responses. Responses are trained across a sufficient number of settings or conditions (rather than across all conditions) until generalization occurs. Similarly, a sufficient number of responses of a given type are trained (as opposed to all responses) until generalization is observed.

The effects of training sufficient stimulus exemplars were demonstrated in the Thompson and Warner (1987) restaurant study. When program-

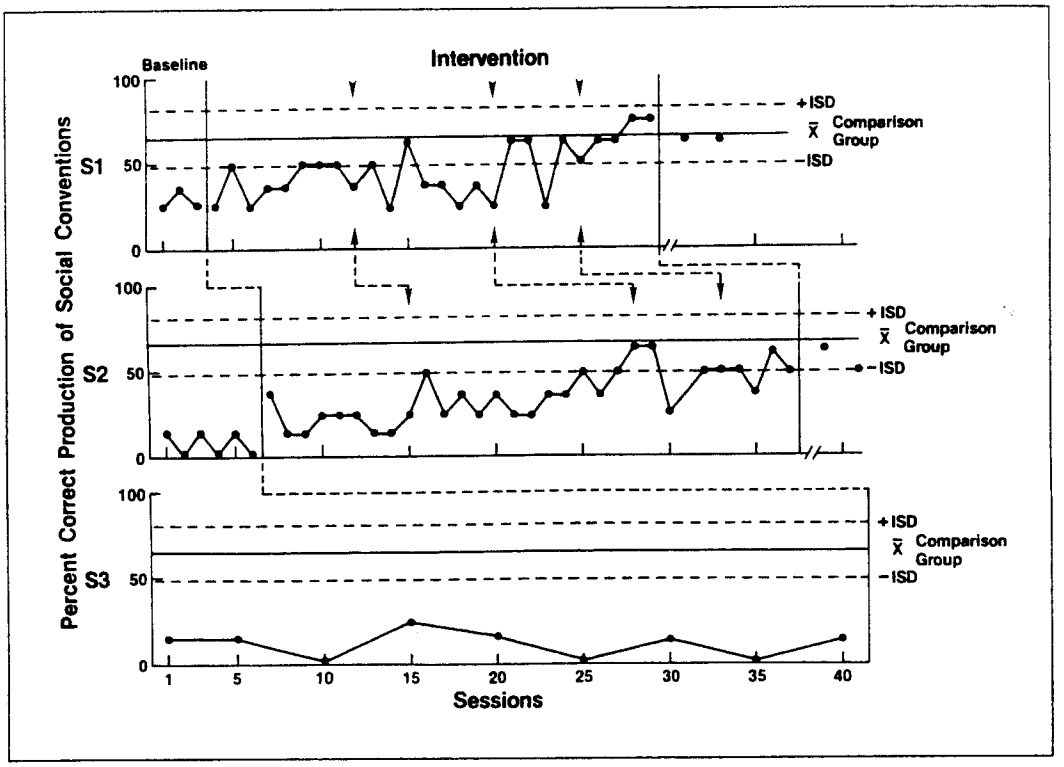

Figure 16-3. Percent correct production of social conventions (greetings, self-disclosures, and questions) during stimulus generalization probes (novel social dyads). S_1 and S_2 received "loose training"; S_3 received no treatment. Arrows indicate sessions in which new levels of the training procedure were introduced (stimuli and feedback were progressively loosened). Horizontal lines represent the mean and one standard deviation about the mean for a normal comparison group. (Reprinted with permission from C. K. Thompson and M. E. Byrne *Clinical aphasiology conference proceedings.* Minneapolis, MN: BRK, 1984. P. 137.)

ming a common stimulus was unsuccessful in promoting generalization, training was extended to the simulated restaurant, which resulted in generalization to a real restaurant. Data for one subject depicting the effects of programming a common stimulus and training across stimulus conditions are shown in Figure 16-5.

Intervention demonstrating the effects of training sufficient response exemplars has been accomplished using matrix training (Goldstein, 1985). That is, two studies in the literature have trained aphasic patients to produce selected word or gestural combinations and systematically measured generalization to untrained combinations (Tonkovich and Loverso, 1982; Thompson, McReynolds, and Vance, 1982). Using this approach, generalization to untrained responses has been noted. In only one study, however, has the effects of training sufficient response exemplars been

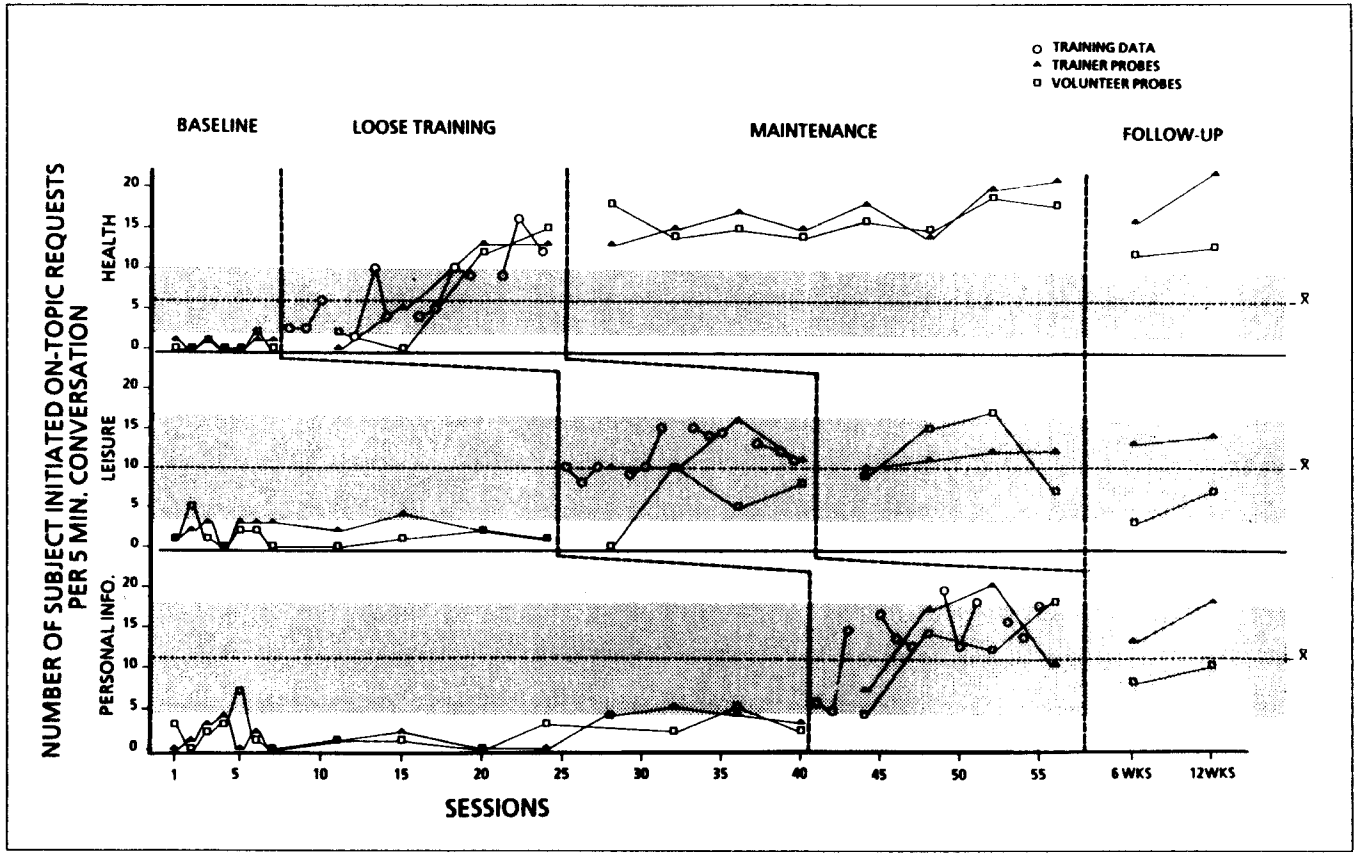

Figure 16-4. Number of requests produced during health, leisure, and personal information dyads with trainers and volunteers conducted during baseline, loose training, and maintenance phases for one of four subjects. Social validity data are depicted by shaded area, showing the mean and one standard deviation about the mean for a normal comparison group. (Reprinted with permission from P. Doyle, H. Goldstein, M. Bourgeois, and K. Nakles, *Journal of Applied Behavior Analysis,* in press.)

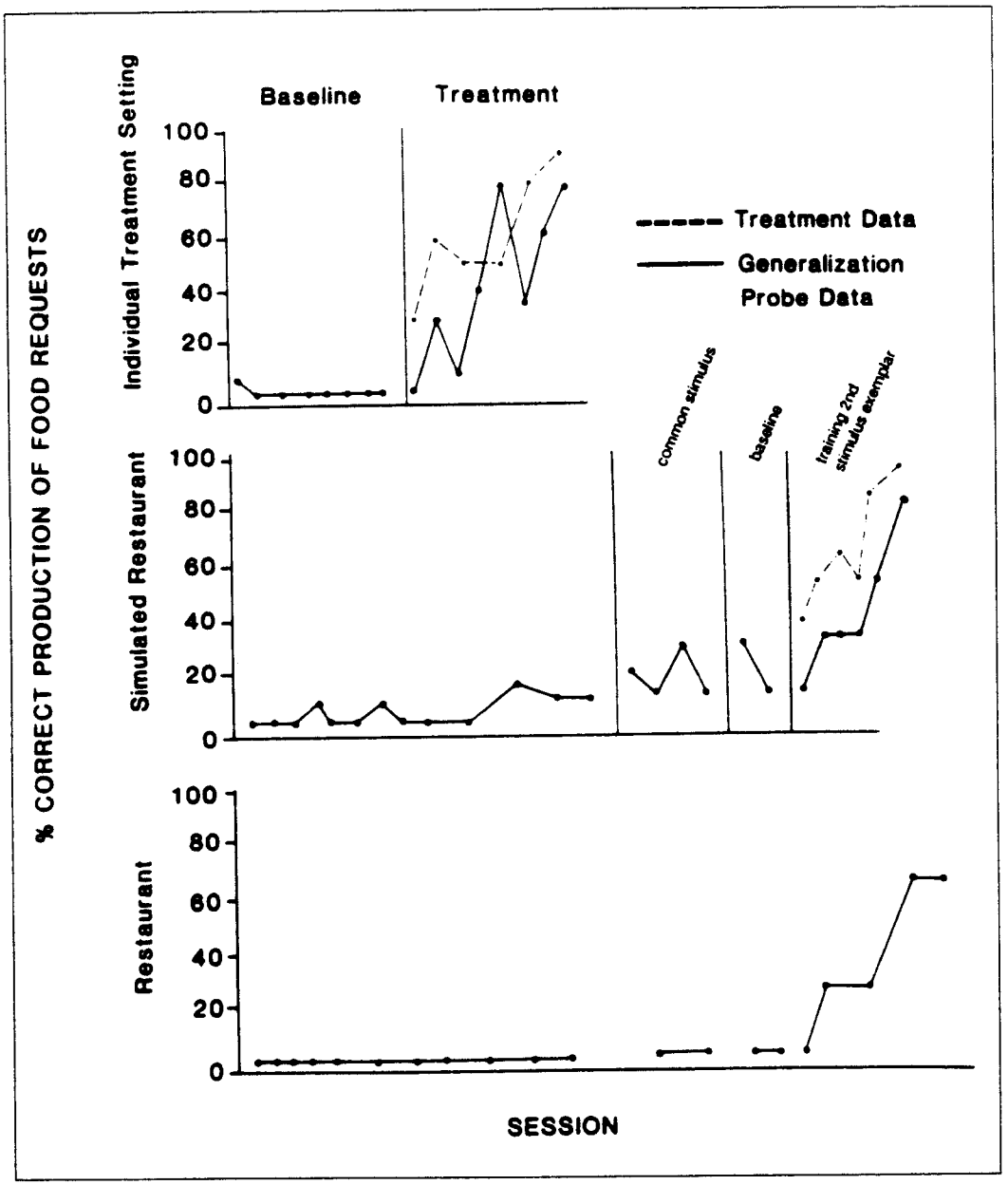

Figure 16-5. Effects of two generalization facilitation methods, programming a common stimulus and training sufficient stimulus exemplars, on production of food requests in two stimulus generalization environments (a stimulated restaurant and a real restaurant) in one of six Broca's aphasic subjects. (Reprinted with permission from C. K. Thompson and E. Warner. Paper presented at American Speech-Language-Hearing Association Convention, New Orleans, LA, 1987.)

studied when response generalization did not occur (Doyle et al., 1987). In that study, training additional responses was successful in facilitating generalization.

Sequential Modification. Sequential modification is another method involving extension of treatment across settings or conditions. The major difference between training sufficient stimulus exemplars and sequential modification is the number of conditions across which treatment is extended. Sequential modification requires training across all conditions, whereas training sufficient exemplars requires training in only a few.

Wambaugh and Thompson (in press) demonstrated the effects of sequential modification for facilitating generalization of question production. Question responses were trained in the clinic while generalization was tested across three conditions including (1) a prompted interview, (2) a dyad condition, and (3) a mealtime conversation condition. Results showed (Fig. 16-6) that generalization occurred to the prompted interview condition but not to others. Therefore, training was extended to the dyad condition that resulted in generalized use of questions in social dyads but not in mealtime conversation (Fig. 16-7) for some subjects.

Training Mediational Strategies. A final method for facilitating generalization in aphasia is to mediate generalization. In practice, training mediational strategies is similar to intersystemic reorganization as described by Rosenbek, Collins, and Wertz (1976), requiring pairing of an intact set of responses with an impaired one such that the intact responses mediate use or access to the impaired ones.

Studies in the aphasia literature utilizing this approach to facilitate generalization have included the use of gesture paired with verbal responding (Kearns, Simmons, and Sisterhen, 1982; Hoodin and Thompson, 1982), the use of cued speech to enhance auditory comprehension (Royall and Horner, 1983), and training an imagery strategy to improve word retrieval (Thompson, Hall, and Sisson, 1986).

Subject Variables

A final set of variables related to generalization pertain to subject (organism) variables. While these have not been experimentally studied, data by Coelho and Duffy (1987), Doyle and colleagues (in press), Thompson and Warner (1987), Tullos (1985), and others have suggested that variables such as severity of aphasia, severity of apraxia of speech, and motivation may be related to generalization. Further study of these and other subject variables such as pattern of language deficits, associated neurobehavioral disorders, site and extent of lesion, and personality factors may serve to

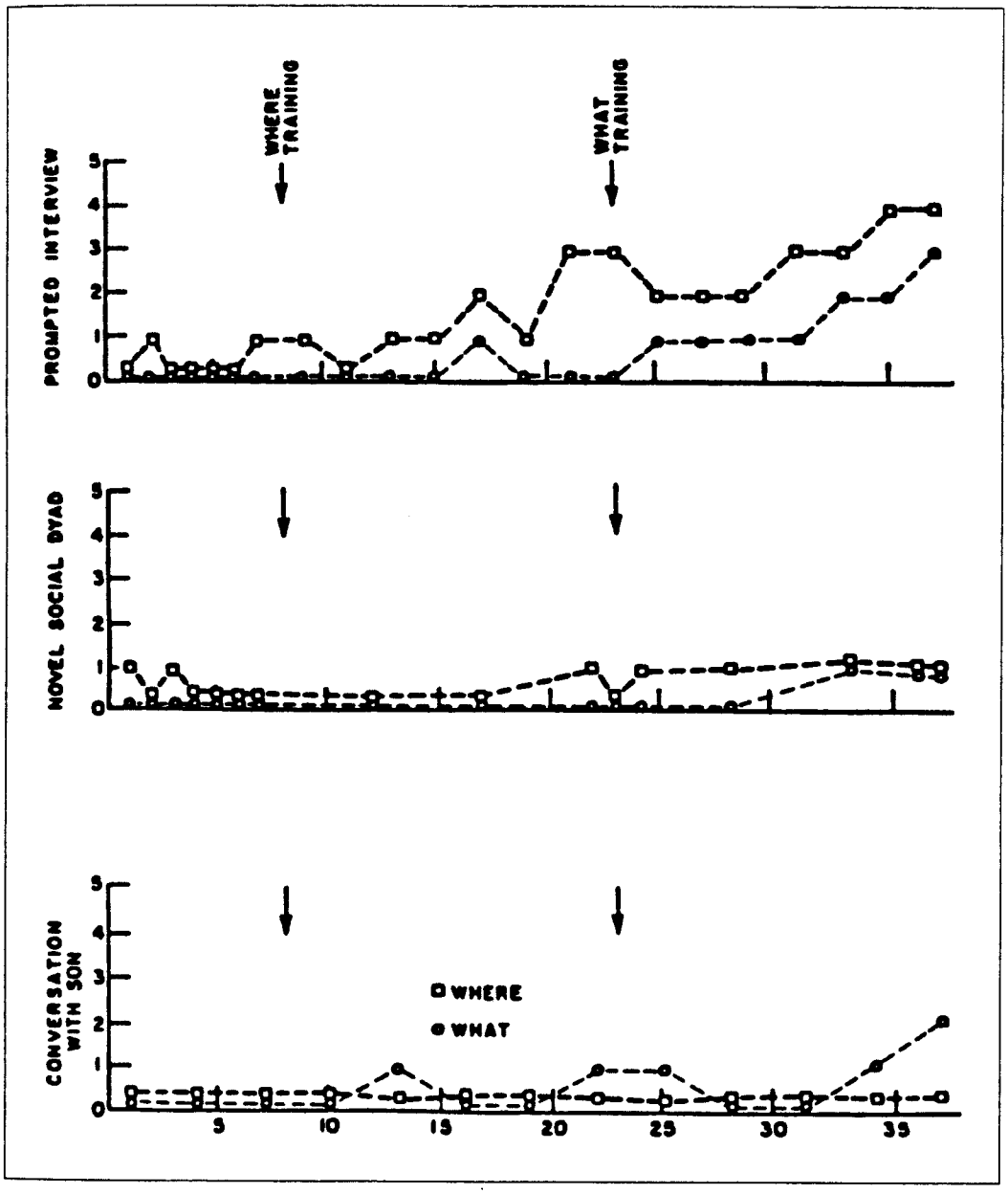

Figure 16-6. Number of *where* and *what* questions produced in stimulus generalization probes across three conditions for one of four agrammatic aphasic patients, indicating generalization to the prompted interview condition only. Arrows indicate sessions in which training of *where* and *what* questions, respectively, was begun. (Reprinted with permission from C. K. Thompson and J. L. Wambaugh, *Journal of Speech and Hearing Disorders,* in press.)

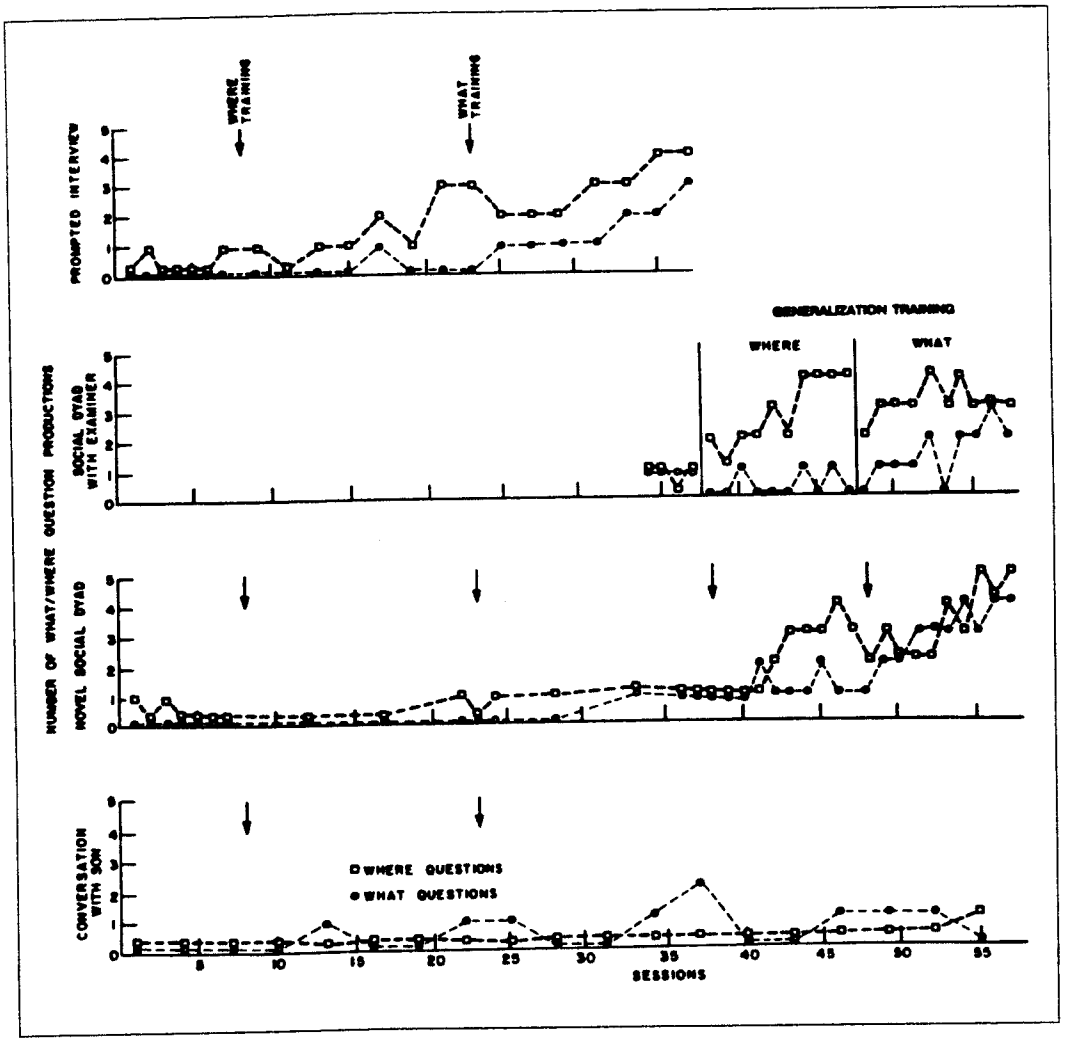

Figure 16-7. Number of *where* and *what* questions produced across stimulus conditions when a sequential modification procedure was implemented in one stimulus condition (social dyad), resulting in generalization to the dyad condition but not to mealtime conversation. (Reprinted with permission from J. L. Wambaugh and C. K. Thompson, *Journal of Speech and Hearing Disorders,* in press.)

explain some of the variability that has been noted in the literature and lead to new treatment strategies designed specifically to eliminate or circumvent problems precluding generalization.

SUMMARY AND CONCLUSIONS

In summary, findings from this review indicate that

1. Generalization may be limited to responses that are structurally similar to trained responses and to stimulus conditions in which responses trained are used functionally.

2. Conditions for measuring generalization have varied across studies and may, therefore, influence generalization results, as may generalization criteria and frequency of measurement employed.
3. Successful generalization facilitation procedures have
   a. Incorporated aspects of the generalization environment into treatment.
   b. Utilized a sufficient number of training responses.
   c. Trained in a sufficient number of conditions.
   d. Provided patients with strategies for mediating generalization.

Based on this review it is evident that a need for additional generalization research incorporating controlled research designs and increased numbers and types of aphasic subjects exists. Specifically, there is a need to study (1) the generalization effects of training language behaviors that have not been studied, (2) the effects of additional treatment variables, and (3) the relative effects of various treatments. In addition, efficient generalization testing or probe methods need to be designed, and language training programs incorporating procedures for measurement and facilitation of generalization need to be developed. Finally, the relationship between generalization and specific subject variables is in need of investigation.

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DISCUSSION

Q = question; A = answer; C = comments.

Q. This question pertains to the use of continuous generalization probes. As I have looked at generalization at varying distances away from the treatment, and in talking to people, I'm finding two areas in which continuous probing is problematic. One is in clinics, where clinicians need to accumulate and report data, there may not be enough time to do probing, something that is not directly involved in therapy. I think closely related to that is that information about probing is not filtering yet into clinical supervision in university settings where there is a tremondous emphasis on training clinicans to gather data during treatment and very little emphasis on probing prodcedures. It may be just too new yet for it to filter down. But I was wondering if you would comment on these two areas?

A. I agree that it can take a lot of time to do generalization probes, depending on the type of probe (i.e., response versus stimulus generalization probes), although I think that some of these probes could be incorporated into clinical practice rather easily and efficiently. For example, Warren (1986) suggested that some probing can be done in using single-subject research designs in a clinical setting (Braintree Hospital). In terms of training programs, I think that methods for generalization probing need to be made a part of clinical training. Supervisors, for the most part, aren't teaching generalization procedures, perhaps partly because clear guidelines for generalization probing have not been published. I don't think we have identified efficient methods for testing generalization even in our research. From my review of the literature, I found that a lot of different kinds of probes are being used and until we can identify which are the most efficient, we can't really tell students what they should be doing. Further research in this area is needed to identify and standardize proce-

dures for efficient probing. Until such procedures have been developed, students might be trained to (1) design stimulus specific probes for testing across particular responses, persons, and settings, (2) use simulated environmental probe procedures, perhaps something like *Easy Street,* and (3) routinely sample responding in natural environments that can be realistically sampled given the constraints of the work setting.

C. You named a number of factors that appear to be important with regard to whether we obtain generalization. One other factor that maybe we haven't looked at very much is what's wrong with the patient to begin with, what processes are involved. When looking at generalization, we make the assumption that if we don't see generalization as a result of treatment, then maybe treatment did not improve general processes. Maybe in a study in which generalization isn't obtained, treatment may improve different processes for different patients. That is, doing the same written naming treatment for 10 patients might improve written naming for different reasons for each patient. If verbal naming had been tested, for example, perhaps some patients would have shown improvement because the person's lexical semantic processes were improved for the training words. For another patient, it may be that easier access to a graphemic representation of trained words was accomplished, and therefore, you wouldn't expect to see generalization. In another patient, treatment may have improved typing skills, and you would expect generalization. That may be an important variable that we just haven't looked at.

A. I agree and I think that it goes along with the subject/organism variables that I was talking about. It makes intuitive sense to determine a patient's particular processing deficits, apply treatment based on these processes, and test for generalization across a number of different dimensions. What I perhaps do not agree with is the assumptions that are made when generalization does not occur. You're suggesting that if generalization doesn't occur, then we haven't discovered the right processing deficit, used the right or most appropriate treatment, or tested the right responses to see generalization. These assumptions suggest that generalization is a natural phenomenon, if we fix or test the right processes the right way. I'm not certain that we can validly determine specific patterns that are disrupted or the extent to which a patient's system is disrupted. Further, I'm not sure that we have the technology to test whether a process has been fixed. I do think that we certainly can and should use neurolinguistic theory when developing treatments and when developing tests for generalization, but I think that we are operating on false assumptions when we think that we are testing processes. During spontaneous recov-

ery, aphasic patients' systems or processes do improve to a point. But when that period is over, the system or processes may not recover further. Treating the processes at that point may be fruitless, because the neurological system has become static; therefore generalization due to improved processes would not be expected. I think that we should focus on training functional and salient responses, not expecting generalization to occur and not pretending to be training a process such that generalization will occur, and that we should program generalization when it doesn't occur.

C. I think that it's important that we look at generalization to a lot of different tasks, to other items within the same category if you're teaching naming. We're not looking enough at areas to decide exactly what processes we're seeing.

A. I agree and will say again that it may boil down to technology. In reality, the kind of generalization testing that you're describing takes a lot of time. That is, a large number of responses need to be tested on numbers of occasions in exactly the same manner. I do think that we need to develop efficient methods for systematically testing certain responses when certain responses are trained. But, I'm not certain that even with very extensive testing we will see different generalization (response generalization) patterns than those that have been reported in the published research. The data that have been collected so far have shown that generalization does not occur (at least response generalization) much of the time.

C. I do think though that if we just gather a little bit more information to come up with some assumptions about what's working with the patient before we even start to treat, maybe our treatment's not going to be different, but we'll be looking for generalization in different areas depending on what our assumptions are about why performance is impaired.

A. I'm not convinced that more generalization will be demonstrated even if we look harder, but it's worth a try and is certainly an area in need of research.