18

Can Generalization Differentiate Whether Learning or Facilitation of a Process Occurred?

Michael P. Sullivan
Robert H. Brookshire

In dealing with aphasia, as in dealing with any other communication disorder, clinicians often attempt to reestablish some level of functional communication. There are two general methods of treatment available for this purpose.

The first method involves teaching compensatory strategies (Hillis and Caramazza, 1987; Royall and Horner, 1983; Tonkovich and Loverso, 1982). Clinicians using this method attempt to "adjust the patient's level of response to one commensurate with his or her abilities" (LaPointe, 1978, p. 137).

The second method involves either stimulating language processing in an attempt to facilitate the patient's access to linguistic elements and rules, the stimulation approach (Schuell, Jenkins, and Jimenez-Pabon, 1964; Taylor and Sands, 1966) or reteaching linguistic elements or rules, the learning approach.

The stimulation approach is implicitly based on the assumption that basic linguistic competence is preserved, but that access to language is impaired because of some sort of interference (Schuell et al., 1964). According to Schuell and colleagues (1964), a key component of stimulation-oriented treatment is that tasks are developed so that the stimuli used "get into the brain" (p. 339) and "that the stimulus presented should elicit an [adequate] response" (p. 341). Davis (1983, p. 244) suggested that, "An important reason for creating a task at a level of moderate success is that accurate responding ensures that a targeted normal process is being exercised. When many errors are produced, the patient is engaged in unproductive processing of a kind that cannot be identified." Unlike the learning approach, stimulation-oriented treatment allows for greater numbers of acceptable responses because specific responses are not forced and error responses are not corrected. If an error response occurs, more stimulation is provided under the assumption that it is some process supporting language that is impaired, rather than a loss of language. The logical outcome of any treatment task designed to ensure that a process is being exercised should facilitate generalized improvement of the linguistic behavior supported by that process. Schuell and colleagues (1964, p. 338) stated that the "clinician is not a teacher or words or rules, rather the clinician should try to communicate and stimulate disrupted processes."

The learning approach is implicitly based on the assumption that linguistic elements or rules are lost (Whitaker, 1970). Learning-oriented treatment targets specific responses that are forced. Because the "target response" may or may not be initially available to the subject, techniques such as shaping and chaining of responses often are required. If an error response occurs, it is corrected because it is assumed that the linguistic element or rule targeted for treatment needs to be relearned. However, there is no strong theoretical support for the loss view of aphasia. McNeil

(personal communication, 1987), a proponent of the interference view, suggested that loss "may in most instances, be characterized as a more severe degree of the performance deficit, but probably not different in quality or mechanism." As Davis (1983, p. 76) states, It is difficult to find a clinical aphasiologist who has believed in the loss theory."

Thompson and McReynolds (1986, p. 194) have suggested that generalization may allow one to differentiate between learning and stimulation approaches to treatment.

> According to the stimulation model, generalization is a given outcome of successful treatment. The emergence of untrained language behavior or general language improvement should be evident as general language proceses and access mechanisms are improved. Such generalization is not expected to occur when behavioral treatment is implemented, although generalization within response classes may be seen.

We have concluded, based on a review of the treatment literature, that generalization at this time cannot prove whether learning has taken place or stimulation of an impaired process has occurred. The presence or absence of generalization does not unequivocally support either the loss view or the interference view of aphasia as currently defined. Therefore, an investigator adhering to the interference view could interpret generalization of treatment effects as improvement in an impaired process, whereas an investigator adhering to the loss view could interpret the same generalization of treatment effects as discrimination failure of stimuli or responses.

It is difficult or impossible to use generalization to decide between an inteference view or a loss view of aphasia unless there has been sufficient pretreatment assessment of the underlying cause of the impaired language to be treated. Generalization has been obtained within both stimulation-oriented treatment (Burger, Wertz, and Woods, 1983; Linebaugh and Lehner, 1977; Peach, 1987) and learning-oriented treatment (Doyle, Goldstein, and Bourgeois, 1987; Kearns and Salmon, 1984; Thompson and McReynolds, 1986).

In stimulation-oriented treatment, the interpretation of generalization is complicated because (1) investigators usually do not explicitly say that their treatment is based on an interference view of aphasia and (2) the processes subjected to treatment are not defined a priori. For example, Linebaugh and Lehner (1977) developed a cuing hierarchy to improve word-finding. The hierarchy was based on two principles: (1) "the generally accepted concept that the essence of aphasia rehabilitation is the elicition of a response" (p. 19) and (2) stimulus fading — the "repeated elicitation of the appropriate response with successively less powerful cues [which would] not only provide a highly salient positive reinforce-

ment, but would also optimally stimulate the processes underlying the recovery of the word retrieval process" (p. 20). Although their treatment was based on the assumption that processes are impaired, no mention was made of what those processes were.

With regard to learning-oriented treatment, investigators have attempted to teach specific linguistic rules or elements. Consequently, it seems that they are based implicitly on a loss view of aphasia. However, interpretation of generalization is complicated because these investigators usually do not explicitly say that their treatment is based on a loss view of aphasia, and more importantly, it is not always clear that the linguistic elements or rules being taught are actually lost.

Doyle, Goldstein, and Bourgeois (1987) examined the effect of syntax training on the sentence production of patients with chronic Broca's aphasia. Doyle and colleagues did not report whether the five syntactic constructions selected for treatment were present in pretreatment language samples. However, before beginning treatment, the authors did assess the "accuracy" and "grammaticality" of responses targeted for treatment.

A second problem related to the question of whether treatment effects can be attributed to learning or facilitation of a process is that often generalization does not occur in spite of positive treatment effects.

If investigators hold an interference view of aphasia and obtain treatment effects, but not generalization, then they are likely to conclude that no processes were affected because only specific behaviors were acquired.

If one holds a loss view of aphasia, absence of generalization would be expected because behavioralists believe that generalization must be trained using methods such as training sufficient exemplars or loose training (Stokes and Baer, 1977). If learning a behavior is a function of forming associations between stimuli and responses, then one would not expect the behavior to occur unless the original conditions existed. In fact, Stokes and Baer (1977) consider generalization to be a result of discrimination failure.

If we accept an interference view of aphasia, and if treatment of impaired language is found to be effective, then we must conclude that the treatment improved the process(es) underlying language behavior. This is true regardless of whether an impaired process or processes that account for the improvement have been identified. Consider the following study from an interference view perspective.

Thompson and Kearns (1981) provided treatment to improve naming. In a pretreatment test, their patient could repeat and comprehend all spoken words targeted for treatment but could not name pictorial representations of the targeted words. This suggested that the underlying cause of the patient's word-finding difficulty was an impaired process rather than a loss of the words. Treatment was based on a cuing hierarchy in

which modeling and response-contingent feedback were provided. A multiple baseline design was used to assess generalization of treatment across semantically related words. Treatment proved effective. At the end of treatment the patient correctly named 90 percent of the picture stimuli. However, no generalization to the semantically related words was observed.

That generalization did not occur in this study is problematic for an interference view of aphasia. It is logical to assume that if the words were not lost, but accessible by some other route, as demonstrated by generally intact comprehension, then some type of interference must have been operating during production. Given an interference explanation of aphasia, we must conclude from this study that a process underlying the subject's production of the treated words improved as a result of treatment. However, one would expect other nontreated stimuli, which are presumably supported by the same process, would be similarly affected by the treatment. If one believes that the patient's naming problems were, in fact, caused by interference, then failure to obtain generalization can be explained in two ways. First, it may be that no "general" process underlying word retrieval exists. If this is true, generalization would not be expected, and Schuell's rationale for treatment of aphasia, as originally defined, would have to be reconsidered. Second, it may be that a general process exists, but at a level that applies to individual words (Rumelhart, McClelland, and the PDP Research Group, 1986). Thus, difficulties with word retrieval could be word specific depending on whether the process underlying the representation of a given word was impaired. This is in contrast to an impairment to a general process that implies a separate retrieval mechanism upon which retrieval of all words is dependent. With regard to Thompson and Kearn's (1981) results, individual processes underlying each targeted response may have been impaired and subsequently reestablished as a result of treatment. (Also note that this interpretation is not completely inconsistent with the loss view of aphasia.)

Similar logic can be applied to the results of studies treating production of syntax. Within-class, across-class, and stimulus generalization have been used to argue for the effectiveness of treatment. Within-class generalization occurs when the production of a trained sentence type generalizes to new examples of the same sentence type. Across-class generalization occurs when the production of a specific sentence type generalizes to a different sentence type. Stimulus generalization occurs when the production of a sentence type that has been trained as a response to a specific stimulus generalizes to new stimuli. Limited within-class and stimulus generalization with virtually no across-class generalization has been observed at the sentence level (Doyle, Goldstein, and Bourgeois, 1987; Thompson and McReynolds, 1986).

The virtual absence of across-class generalization suggests, first, that there may be no "general process" that supports the formulation of syntactic forms. This, again, raises questions regarding Schuell's original rationale for treatment of aphasia. Second, this absense of across-class generalization suggests that distinct and individual processes may underlie the production of different syntactic forms. In other words, there may be no separate general mechanism that functions to compute all syntactic forms. This explanation is similar to the explanation applied to word retrieval. Evidence for this possibility is provided by successful within-class generalization and successful though limited across-stimulus generalization. It is logical to assume that if a process underlying a specific syntactic form is treated and improves, then production of new, but similar syntactic forms would be possible.

To summarize, we have argued that generalization, which has been suggested as a measure of treatment effectiveness, cannot provide an explanation of treatment effects with regard to the interference or loss view of aphasia. We concluded from a review of the treatment studies that this lack of explanation is a result of most investigators' failing to provide evidence of the underlying cause of the impairment. To explain treatment effects, investigators will have to take greater care identifying the underlying cause or causes of the language impairment to be treated. The last 10 years of published research on treatment efficacy has shown that treatment can be effective. Therefore, the focus of treatment should not be on whether treatment is effective, but on why treatment is effective. Answering the question "Why is treatment effective?" will not only increase our knowledge of the nature of aphasia and its treatment, but also help define the limits of treatment. No clinical aphasiologist can deny that some patients get better and others do not. It may become possible to better predict which patients will benefit from what type of treatment, and it also may become possible to predict better which patients will not benefit from treatment.

ACKNOWLEDGMENTS

REFERENCES

Burger, L. H., Wertz, R. T., and Woods, D. (1983). A response to treatment in a case of cortical deafness. In R. H. Brookshire (Ed.), Clinical aphasiology (Vol. 13, pp. 127–136). Minneapolis: BRK.

Davis, A. (1983). *A survey of adult aphasia.* Englewood Cliffs, NJ: Prentice-Hall.

Doyle, P., Goldstein, H., and Bourgeois, M. S. (1987). Experimental analysis of syntax training in Broca's aphasia: A generalization and social validation study. *Journal of Speech and Hearing Disorders, 52,* 143–154.

Hillis, A.E., and Caramazza, A. (1987). Model-driven remediation of dysgraphia. In R. H. Brookshire (Ed.), *Clinical aphasiology* (Vol. 17). Minneapolis: BRK.

Kearns, K., and Salmon, S. (1984). An experimental analysis of auxiliary and copula verb generalizations. *Journal of Speech and Hearing Disorders, 49,* 153–163.

LaPointe, L. L. (1978). Aphasia therapy: Some principles and strategies for treatment. In D. F. Johns (Ed.), *Clinical management of neurogenic communicative disorders* (pp. 129–190). Boston: Little, Brown.

Linebaugh, C. W., and Lehner, L. H. (1977). Cueing hierarchies and word retrieval: A therapy program. In R. H. Brookshire (Ed.), *Clinical aphasiology* (Vol. 7, pp. 19–31). Minneapolis: BRK.

Peach, R. K. (1987). A short-term memory treatment approach to the repetition deficit in conduction aphasia. In R. H. Brookshire (Ed.), *Clinical aphasiology* (Vol. 17). Minneapolis: BRK.

Royall, J. B., and Horner, J. (1983). Acquisition and generalization of cued speech by a chronically aphasic adult. In R. H. Brookshire (Ed.), *Clinical aphasiology* (Vol. 13, pp. 85–95). Minneapolis: BRK.

Rumelhart, D. E., McClelland, J. L., and the PDP Research Group (1986). *Parallel distributed processing explorations in the microstructure of cognition. Vol. 1: Foundations.* London: MIT Press.

Schuell, H., Jenkins, J. J., and Jimenez-Pabon, E. (1964). *Aphasia in adults: Diagnosis, prognosis, and treatment.* New York: Hoeber Medical Division, Harper.

Stokes, T. F., and Baer, T. F. (1977). An impliant technology of generalization. *Journal of Applied Behavioral Analysis, 10,* 349–367.

Taylor, M., and Sands, E. (1966). Application of programmed instruction to the language training of severely impaired aphasic patients. *NSPI Journal, 5,* 10–11.

Thompson, C. K., and Kearns, K. P. (1981). An experimental analysis of acquisition, generalization, and maintenance of naming behavior in a patient with anomia. In R. H. Brookshire (Ed.), *Clinical aphasiology* (Vol. 11, pp. 35–45). Minneapolis: BRK.

Thompson, C. K., and McReynolds, L. V. (1986). Wh interrogative production in agrammatic aphasia: An experimental analysis of auditory-visual stimulation and direct-production treatment. *Journal of Speech and Hearing Research, 29,* 193–205.

Tonkovich, J. D., and Loverso, F. (1982). A training matrix approach for gestural acquisition by the agrammatic patient. In R. H. Brookshire (Ed.), *Clinical aphasiology* (Vol. 12, pp. 283–288). Minneapolis: BRK.

Whitaker, H. A. (1970). Linguistic competence: Evidence from aphasia. *Glossa, 4,* 46–54.

DISCUSSION

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

C.   I agree with your conclusions, but I have a problem with some of the
     things that you said in the introduction. Let me offer an alternative
     explanation of at least some of the naming treatment studies. You
     seem to be assuming that if there was an interference effect, and you
     do stimulation of a particular process, that you would expect to see
     generalization across items.

A.   Schuell says that. I don't think that I necessarily do.

C.   OK, you seem to be agreeing with it. But one of the things that I
     might offer is that take the naming studies in which the patients were
     impaired at word retrieval and then they were given a cuing hier-
     archy to name the words, and you assume that the words were there,
     in a sense, or not lost, but then there was no generalization to other
     items. That seems to be contradictory to you.

A.   No.

C.   OK, well that's what happened anyway.

C.   One possibility . . . one way of looking at it would be that the general
     process involved is that there are phonological representations
     stored for these patients, that those are not lost, but that each one has
     a separate threshold of activation, and when you treat with a cuing
     hierarchy you're stimulating, in a sense, but you may be changing the
     threshold of activation for that particular representation so that
     higher frequency words have lower thresholds of activation. If you
     treat that word every single day, you're changing the frequency of
     that word for that patient. You may be lowering the threshold of
     activation so that the person produces the word more successfully on
     other occasions. That would seem to be an interference. There is an
     interference effect in a sense that caused the word retrieval problem
     and there was a stimulation approach to therapy, but you wouldn't
     expect generalization.

A.   I don't think that's an alternative explanation. I think that's exactly
     what I said in my second possibility for failure of generalization, that
     there are individual processes that underlie the representation of
     single words. And I didn't go into that specifically because of time,
     but I agree with you wholeheartedly.

C.   I think it's interesting and possible to pursue or to have a process
     explanation for generalization. But I sense that you tried to establish
     some kind of necessary relationship between having such an expla-
     nation and measuring and determining whether or not generaliza-
     tion has occurred in the first place. And I'm not sure we can't mea-

sure and look for generalization and not necessarily have an explanation for it.

A. I think that Thompson and McReynolds were the folks that suggested that relationship. And I think in this paper what I did was try to investigate that and find out whether or not it was plausible and whether or not it would hold up given the current treatment literature, as small as it is, and I don't think that it does.

C. The other comment that I wanted to make was that, in looking for sources of explanation, I think the loss versus interference idea was a good one in its day, but I think it's a little oversimplistic now. I think we have many more options given the development of a cognitive science of language comprehension and production. One being the most basic distinction, that being mental representation or knowledge of something, versus process similar to the competence/performance idea awhile back. It seems like there are possibilities at least of loss of knowledge and loss of process, maybe interference with attaining knowledge and interference with processing, and there are possibilities of disorganization; there are all sorts of possibilities now in terms of establishing an explanation, so I think just simply loss versus interference is kind of a fuzzy way of going about it.

A. Right, I agree with you completely. As I said, I think the distinction was drawn by Thompson and McReynolds, and I saw the distinction implicitly within the treatment studies. In other words, there were people who were trying to reteach certain syntactic structures or certain forms, which to me is very different than coming from an interference view perspective. Therefore, what I was trying to do is look at the apposition between loss versus interference relative to what it looked like people were doing in their treatment. The problem is, people don't really tell you up front when they do a treatment study what kind of a theory of aphasia they hold, or what they believe about the nature of aphasia. I think if people would say up front, "I think aphasia is this, I think the language system is impaired in such and such a way, therefore I have developed this treatment that is consistent with that disruption," that we would get better explanations of treatment effects when they do occur, but it is a rare thing in the treatment literature as we have reviewed it.

C. I really think your logic is good, and that what you're implying is the way we have to go, and that we have to use our applied procedures and treatment methodologies to explore underlying processes and test our models of aphasia and language, and I applaud that. I think that needs to be said. A couple of things though, in reaction. One is that I think we sometimes confuse our procedures with our view of the world. Certainly a number of us, myself included, have been guilty of overemphasizing procedures at times, and so I think other in-

vestigators like yourself would say, "Gee this person must believe that something's missing," but that's not necessarily true. I don't know too many behavioral people these days that would ascribe to purely a loss point of view. I think more often than not people have adopted over time a reference point of view couched in perhaps what Albyn was talking about, more recent linguistic theorizing, but use behavioral methodologies, and so I think there has been an unhappy marriage, but a marriage at least. I'd also like to point out that the results in terms of generalization have to be looked at carefully, and you can't assume too much from the outside looking in either. Specifically, let me give you one example. A recent article by Pigget and colleagues in the *Journal of Applied Behavioral Analysis* (1987) provides a methodology — the use of scatter-plot diagrams and underlying correlations to look at relationships between trained behaviors and generalization behaviors before and during treatment. Depending on what the strength of the relationships are before treatment, during treatment, and after treatment, you can make some assumptions about whether or not the treated behavior is related to the generalization behavior. As a member of a response class, that is there a simple facilitation effect, or alternately whether or not those behaviors — and it has been convincingly demonstrated that you can do this — those behaviors are not inherently related, or within the same response class, but rather the procedure itself is powerful enough to facilitate generative responding. That, I think, is an example of the fact that we can't confuse our procedures with our underlying methodologies or our underlying thoughts of the disorder. I think you can indeed hold to a behavioral point of view and feel that perhaps you are training certain things and facilitating a process. And that's not incompatible. So I just think that the boundary is fuzzy, and we have to be real careful about where we go with it.

A. Are you saying that a response class can't be defined a priori?

C. Well what you do is attempt to make your best guess at what a response class is and test it out empirically.

A. Are you saying that, based on this study, you are forcing a response class that may not necessarily occur naturally?

C. No, I'm saying you can empirically test whether or not you have a response class versus whether or not your treatment is powerful enough to facilitate generalization over and above any type of naturally occurring class. Consequently, it's difficult to say, "This is a process and this is not a process." So I think you have to be real careful. To me, generalization is an operational definition of the occurrence of a process that has been facilitated through treatment. So, by my definition, these two positions that you're contrasting aren't compatible.