

AN IMPLICIT TECHNOLOGY OF GENERALIZATION<sup>1</sup>

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Traditionally, discrimination has been understood as an active process, and a technology of its procedures has been developed and practiced extensively. Generalization, by contrast, has been considered the natural result of failing to practice a discrimination technology adequately, and thus has remained a passive concept almost devoid of a technology. But, generalization is equally deserving of an active conceptualization and technology. This review summarizes the structure of the generalization literature and its implicit embryonic technology, categorizing studies designed to assess or program generalization according to nine general headings: Train and Hope; Sequential Modification; Introduce to Natural Maintaining Contingencies; Train Sufficient Exemplars; Train Loosely; Use Indiscriminable Contingencies; Program Common Stimuli; Mediate Generalization; and Train "To Generalize".

DESCRIPTORS: generalization, treatment-gain durability, followup measures, maintenance, postcheck methodology

Traditionally, many theorists have considered generalization to be a *passive* phenomenon. Generalization was not seen as an operant response that could be programmed, but as a description of a "natural" outcome of any behavior-change process. That is, a teaching operation repeated over time and trials inevitably involves varying samples of stimuli, rather than the same set every time; in the same way, it inevitably evokes and reinforces varying samples of behavior, rather than the same set every time. As a consequence, it is predictable that newly taught responses would be controlled not only by the stimuli of the teaching program, but by others somewhat resembling those stimuli (Skinner, 1953, p. 107ff.). Similarly, responses resembling those established directly, yet not themselves actually touched by the teaching procedures, would appear as a result of the teaching (Keller and

Schoenfeld, 1950, p. 168ff.). Thus, generalization was something that happened, not something produced by procedures specific to it.

If generalization seemed absent or insignificant, it was simply to be assumed that the teaching process had managed to maintain unusually tight control of the stimuli and responses involved, allowing little sampling of their varieties. This assumption was strongly supported by the well-known techniques of discrimination: by differential reinforcement (in general, by *any* differential teaching) of certain stimuli relative to others, and/or certain responses relative to others, generalization could be programmatically restricted and diminished to a very small range. Thus, it was *discrimination* that was understood as an active process, and a technology of its procedures was developed and practiced extensively. But generalization was considered the natural result of failing to practice discrimination's technology adequately, and thus remained a passive concept almost devoid of a technology. Nevertheless, in educational practice, and in the development of theories aimed at serving both practice and a better understanding of human functioning, generalization is equally as important as dis-

<sup>1</sup>Preparation of this paper was supported in part by PHS Training Grant 00183, Program Project Grant HD 00870, and Research Grant MH 11739. Reprints may be obtained either from T. F. Stokes, Department of Psychology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2, or D. M. Baer, Department of Human Development, University of Kansas, Lawrence, Kansas 66045.

crimination, and equally deserving of an active conceptualization.

Generalization has been and doubtless will remain a fundamental concern of applied behavior analysis. A therapeutic behavioral change, to be effective, often (not always) must occur over time, persons, and settings, and the effects of the change sometimes should spread to a variety of related behaviors. Even though the literature shows many instances of generalization, it is still frequently observed that when a change in behavior has been accomplished through experimental contingencies, then that change is manifest where and when those contingencies operate, and is often seen in only transitory forms in other places and at other times.

The frequent need for generalization of therapeutic behavior change is widely accepted, but it is not always realized that generalization does not automatically occur simply because a behavior change is accomplished. Thus, the need actively to *program* generalization, rather than passively to expect it as an outcome of certain training procedures, is a point requiring both emphasis and effective techniques (Baer, Wolf, and Risley, 1968). That such exhortations have often been made has not always ensured that researchers in the field have taken serious note of and, therefore, proceeded to analyze adequately the generalization issues of vital concern to their programs. The emphasis, refinement, and elaboration of the principles and procedures that are meant to explain and produce generalization when it does not occur "naturally" is an important area of unfinished business for applied behavior analysis.

The notion of generalization developed here is an essentially pragmatic one; it does not closely follow the traditional conceptualizations (Keller and Schoenfeld, 1950; Skinner, 1953). In many ways, this discussion will sidestep much of the controversy concerning terminology. Generalization will be considered to be the occurrence of relevant behavior under different, non-training conditions (*i.e.*, across subjects, settings, people, behaviors, and/or time) without the

scheduling of the same events in those conditions as had been scheduled in the training conditions. Thus, generalization may be claimed when no extratraining manipulations are needed for extratraining changes; or may be claimed when some extra manipulations are necessary, but their cost or extent is clearly less than that of the direct intervention. Generalization will not be claimed when similar events are necessary for similar effects across conditions.

A technology of generalization programming is almost a reality, despite the fact that until recently, it had hardly been recognized as a problem in its own right. Within common teaching practice, there is an informal germ of a technology for generalization. Furthermore, within the practice of applied behavior analysis (especially within the past 5 yr or so), there has appeared a budding area of "generalization-promotion" techniques. The purpose of this review is to summarize the structure of that generalization literature and its implicit embryonic technology. Some 270 applied behavior analysis studies relevant to generalization in that discipline were reviewed.<sup>2</sup> A central core of that literature, consisting of some 120 studies, contributes directly to a technology of generalization. In general, techniques designed to assess or to program generalization can be loosely categorized according to nine general headings:

1. Train and Hope
2. Sequential Modification
3. Introduce to Natural Maintaining Contingencies
4. Train Sufficient Exemplars
5. Train Loosely
6. Use Indiscriminable Contingencies
7. Program Common Stimuli

<sup>2</sup>Ninety per cent of the literature reviewed was from five journals: *Behaviour Research and Therapy*; *Behavior Therapy*; *Journal of Applied Behavior Analysis*; *Journal of Behavior Therapy and Experimental Psychiatry*; and *Journal of Experimental Child Psychology*. Seventy-seven per cent of the literature reviewed has been published since 1970.

8. Mediate Generalization
9. Train "To Generalize".

This review characterizes each category, and describes some examples of research that illustrate the generalization analyses or programming involved in each category. Obviously, all the relevant references cannot be discussed in this review.<sup>3</sup> The nine categories listed above were induced from the literature; they are not *a priori* categories. Consequently, studies do not always fit neatly into these categories. It should also be noted that not all studies reviewed were thorough experimental analyses of generalization. Often inferences were necessary to categorize the research. However, the following discussion still may provide a useful organization and conceptualization of generalization and its programming.

### 1. *Train and Hope*

In applied behavior analysis research, the most frequent method of examining generalization, so far, may be labelled *Train and Hope*. After a behavior change is effected through manipulation of some response consequences, any existent generalization across responses, settings, experimenters, and time, is concurrently and/or subsequently documented or noted, but not actively pursued. It is usually hoped that some generalization may occur, which will be welcomed yet not explicitly programmed. These hopeful probes for stimulus and response generalization characterize almost half of the applied literature on generalization. The studies have considerable importance, for they begin to document the extent and limits of generalization of particular operant intervention techniques. While not being

examples of the programming of generalization, they are a sound first step in any serious analysis of generalization. When generalization is desired, but is shown to be absent or deficient, programming procedures can then be instituted.

For example, useful generalization across settings was documented by Kifer, Lewis, Green, and Phillips (1974). In an experimental classroom setting, parent-child pairs were taught to negotiate in conflict situations. During simulated role-playing, instructions, practice, and feedback were used to teach the negotiation behaviors of fully stating one's position, identifying the issues of conflict, and suggesting options to resolve the conflict. The data showed increased use of negotiation behaviors and the reaching of agreements in actual parent-child conflict situations at home.

An assessment of generalization across experimenters was described by Redd and Birnbrauer (1969), who demonstrated that control over the cooperative play of retarded children did not generalize from an adult who dispensed contingent edible reinforcement to five other adults who had not participated in training.

Studies that are examples of Train and Hope across time are those in which there was a change from the intervention procedures, either to a less intensive but procedurally different program, or to no program or no specifically defined program. Data or anecdotal observations were reported concerning the maintenance of the original behavior change over the specified time intervening between the termination of the formal program and the postchecks. An example of a followup evaluation was the study by Azrin, Sneed, and Foxx (1973). An intensive training program involving reinforcement of correct toileting and positive practice procedures promptly decreased bedwetting by 12 retarded persons. The reduced rate of accidents was maintained during a three-month followup assessment.

Perhaps there are many more studies in the Train and Hope category than would have been expected (about 135, of which 65% are across Time). However, despite its obvious value, this research is frequently characterized by a lack of

<sup>3</sup>Complete reference lists and detailed tables describing subjects, procedures, and generalization of all studies reviewed are deposited with the National Auxiliary Publications Service (NAPS). For copies, order NAPS Document #02873. Order from ASIS/NAPS Co., C/O Microfiche Publications, 305 East 46th Street, New York, New York 10017. Remit with order for each copy \$3.00 for microfiche or \$19.50 for photocopies. Make checks payable to Microfiche Publications.

comprehensiveness and depth of the generalization analysis. Even though generalized behavior change was frequently reported, extensive, wide-ranging, and practical generalization was not often noted or even sought. The continued development of behavior analysis almost surely will demand more extensive collection of generalization data than is presently the fashion. The extent and limits of applied behavioral interventions may be well documented and understood if measurement is extended over longer periods of time, over more than one circumscribed part of the day, with more than one related response, and with more than a restricted part of the social and physical environment. It is as important for the field to formalize the conditions of the non-occurrence of generalization as it is to document the conditions associated with the display of unprogrammed generalization.

Most of the Train-and-Hope research described successful generalization—approximately 90% of Train-and-Hope studies. By definition, there was no further need to program generalization in those studies where generalization had been exhibited within the Train-and-Hope paradigm—presuming, of course, that the generalization exhibited was considered sufficient to meet the therapeutic goals of the various modification programs (not necessarily a valid presumption in the Train-and-Hope research). This preponderance of positive data may simply reflect the tendency of some researchers not to report their generalization data if measurement procedures were instituted to probe for any generalized behavior changes, but generalization was shown to be absent. Some researchers may view nongeneralization as reflecting a deficiency or ineffectiveness of their procedures to develop a desirable generalized performance. Behavior analysts, nevertheless, should encourage their fellow researchers to document and to *analyze* experimentally their apparent failures, rather than allowing them to slide into oblivion. A detailed and systematic understanding of generalization and its programming could result. Alternatively, researchers might view their generalization base-

lines as being essentially independent of the modified baseline; thus, to report nongeneralization would serve no useful purpose, for its nonoccurrence would be expected. Again, any such documentation contributes to our understanding of the extent and limits of generalization, as well as serving as an indication of the frequent necessity of generalization-programming techniques.

There is another reason for the predominance of positive results in this section: if nongeneralization was clearly evident, and the modification of this state was important, then a form of limited programming was frequently instituted. Examples of this research will be discussed in the next category, "Sequential Modification".

## 2. *Sequential Modification*

These studies exemplify a more systematic approach to generalization than the Train-and-Hope research. Again, a particular behavior change is effected, and generalization is assessed. But then, if generalization is absent or deficient, procedures are initiated to accomplish the desired changes by systematic sequential modification in every nongeneralized condition, *i.e.*, across responses, subjects, settings, or experimenters. The possibility of unprogrammed generalization typically was not examined in these sequential modification studies, because after the initial demonstration of nongeneralization, all other baselines were exhausted. That is, after changes had been produced directly in all baselines, generalization to nonrecorded responses, subjects, settings, and experimenters may have occurred, but could not be examined.

For example, Meichenbaum, Bowers, and Ross (1968) reported an absence of generalization of behavior changes from an afternoon intervention period to the morning period in a classroom for institutionalized female adolescent offenders. Money dispensed contingent on on-task behaviors effected desired behavior changes during the afternoon, but generalization to the morning period required that the same manipulations be applied there as well (sequential modification across settings). Similarly, generalization across

settings of the disruptive and oppositional behavior of two children was investigated by Wahler (1969). He demonstrated control of these behaviors in the home by using differential attention and timeout operations. When generalization to the children's school behavior was not evidenced, similar contingency operations were employed to accomplish changes in that setting as well.

The category of Sequential Modification characterizes much of the actual practice of many behavior analysts. Sequential modification is merely a systematized experimental procedure that formalizes and allows evaluation of these typical therapeutic endeavors. The tactic of scheduling behavior-change programs in every condition to which generalization is desired is frequently employed. The rationale for these procedures is as follows. If a desired generalization is not likely to be exhibited after changing a behavior in a particular condition, or a number of conditions, *e.g.*, settings, then the researcher or practitioner works to effect changes across conditions as a matter of course, rather than as an outcome of the display or nondisplay of generalization. Thus, a behavior analyst is likely to advise the scheduling of consequences in every relevant condition in preference to the dispensing of consequences in only one or a few conditions, while hoping for generalization, but likely not seeing it.

### 3. *Introduce to Natural Maintaining Contingencies*

Perhaps the most dependable of all generalization programming mechanisms is one that hardly deserves the name: the transfer of behavioral control from the teacher-experimenter to stable, natural contingencies that can be trusted to operate in the environment to which the subject will return, or already occupies. To a considerable extent, this goal is accomplished by choosing behaviors to teach that normally will meet maintaining reinforcement after the teaching (Ayllon and Azrin, 1968).

Baer and Wolf (1970) reported a study by Ingram that illustrated the mechanism of "trap-

ping", where a preschool child was taught an entry response that exposed the child to the natural contingencies of peers in the preschool environment. Preschool teachers modified the low rate of skillful interaction of the child by priming others to interact with the subject and reinforcing appropriate interactions. The data showed that over time the teachers lost control of the interaction behavior, which remained high; it was assumed that the group's natural consequences for interaction had taken control of the subject's behavior. Thus, to program generalization, the child perhaps needed only to be introduced adequately to the natural reinforcers inherent in active preschool play and interaction. Some early analyses of preschool children's behavior have stressed that if the child can be so introduced (through the operation of differential attention from teachers) to a reinforcing preschool natural environment, then the behaviors eventually do not need to be maintained by continued contrived modification of the environment. For example, Hall and Broden (1967) modified the manipulative play, climbing, and social interaction of three subjects through social reinforcement operations. Behavior changes were shown to be durable and successful followup data at three months were described.

Buell, Stoddard, Harris, and Baer (1968) demonstrated the collateral development of appropriate social behavior (*e.g.*, touching, verbalizing, and playing with other children) accompanying the reinforcement of increased use of outdoor play equipment by a 3-yr-old girl. This entry response to the natural reinforcement community was tactically sound because the child's motor behavior was modified in a setting where the resulting behavior would tend automatically to increase social contact with other children, and this natural social environment could maintain the child's new skills, but indeed may also be expected to sharpen and refine them, and add entirely new ones as well.

Most of the research concerning natural maintaining contingencies has involved children, perhaps because such techniques seem particularly

suitable, especially to their social behavior. Research would profit by determining what natural reinforcement communities exist for various behaviors and subjects, and what economical means may be employed to ensure entry to these behavioral traps.

Unfortunately, in some instances there may be no natural reinforcement operating to develop and maintain skills. For example, in the case of retarded and institutionalized persons whose dependency has become a stable fact in the lives of their caretakers, some re-arrangement of the natural environment may be necessary. A few studies have introduced subjects to semicontrived or redesigned "natural" reinforcement communities. A simple but meaningful example was provided by Horner (1971), who taught a 5-yr-old institutionalized retarded boy to walk on crutches in an experimental setting. The child was then prompted to generalize the new walking skill to other settings and activities to which he previously had been taken in a wheelchair by solicitous caretakers, by enlisting those caretakers to refrain from offering this help. Within 15 days after treatment was concluded, the child walked on crutches to all those activities and settings, eventually extending his ambulation skills to any part of his world. Stolz and Wolf (1969) trained a 16-yr-old, "blind" retarded male to discriminate visual stimuli. Then, the environment was so structured that assistance was not given in situations where it had previously been given as a matter of course. When the boy was required to use visual cues to help himself in a cafeteria line, he soon emitted the necessary behaviors. However, these studies did not establish the functionality of their procedures in the maintenance of behavior changes.

Another significant example was provided by Seymour and Stokes (1976). In their study, institutionalized delinquent girls were taught to solicit reinforcement (*cf.* Graubard, Rosenberg, and Miller, 1971) from their natural community, the staff of their residential institution. In their case, the staff had rarely displayed any systematic attempts at reinforcing desirable behavior shown

by the girls, perhaps on the presumption that the girls were "bad" and not reinforcible in any case. However, the experimenters were able to teach the girls that when their work was objectively good, and when staff persons were nearby, a simple skill of calling these adults' attention to their good work would result in fairly consistent reinforcement. Thus, this was a case in which experimental reinforcement was used to develop a response in the subjects that would tap and cultivate the available but dormant natural community. In theory, this new skill should have obviated the need for further experimental reinforcement, for the praise evoked should have functioned to maintain both the girls' work and cueing, and the cueing, in turn, should have functioned to maintain staff praise. The Seymour and Stokes' study could not be continued long enough to establish whether this would happen, and so it remains a logically appealing but still unexplored method of enhancing generalization: teaching the subject a means of *recruiting* a natural community of reinforcement to maintain that generalization. Perhaps an even greater advantage of such procedures is a change in the locus of control: the subjects can become more prominent agents of their own behavior change, rather than being hapless pawns of more-or-less random environmental contingencies.

Restructuring the environment thus becomes a target of research aimed at extending the generalization of newly taught skills; even though, at a technical level, this operation may not be considered generalization, but rather transfer of control from one reinforcement contingency to another. In any event, it is a much neglected topic of experimental research, although widely recognized as a desirable, and even essential characteristic of any rehabilitative effort.

Some natural contingencies are inevitably at work contributing to the maintenance of inappropriate behavior. For example, peer-group control of inappropriate behavior has often been suspected and sometimes documented (Buehler, Patterson, and Furniss, 1966; Gelfand, Gelfand, and Dobson, 1967; Solomon and Wahler, 1973).

It would seem reasonable, then, that if the pattern of reinforcement of inappropriate behavior is modified, the observed outcome may erroneously, but happily be attributed to generalization. For example, Bolstad and Johnson (1972) presented data that showed that both experimental and control subjects in the same classroom were all affected (although not to the same extent) by experimental manipulation of the reinforcement contingency for the experimental subjects, whereas control subjects in a different classroom were not so affected. The authors presented data that may account for these differences. The control subjects in the experimental classroom, who were also disruptive students, had fewer disruptive interactions with the experimental subjects during the treatment phases than during baseline. This possible generalization effect may be due to the disruption of the natural contingencies operating in that environment. That is, other disruptive students previously supported some of the disruptive behavior of the control subjects, but during treatment these experimental subjects did not support the disruptive behavior of their peers and, thus, a "generalized" decrease in disruptive behavior by the control subjects resulted.

#### 4. Train Sufficient Exemplars

If the result of teaching one exemplar of a generalizable lesson is merely the mastery of the exemplar taught, with no generalization beyond it, then the obvious route to generalization is to teach another exemplar of the same generalization lesson, and then another, and then another, and so on until the induction is formed (*i.e.*, until generalization occurs sufficiently to satisfy the problem posed). Examples of such programming techniques will be described in this category of training sufficient exemplars, perhaps one of the most valuable areas of programming. Certainly it is the generalization-programming area most prominent and extensive in the present literature.

In the research discussed previously under the categories of Train and Hope and Sequential Modification, the typical analysis of generalization concerned the measurement of gener-

alization to only a few (and often only one) extraexperimental responses, subjects, settings, experimenters, or times. When the absence of generalization was noted, sometimes it was accomplished by further direct intervention in every nongeneralized condition (*i.e.*, Sequential Modification). Having completed such modifications, the possibility of more extensive generalized effects (*i.e.*, beyond the two or three modified baselines) was not examined. In the training of sufficient exemplars, generalization to untrained stimulus conditions and to untrained responses is programmed by the training of *sufficient* exemplars (rather than all) of these stimulus conditions or responses.

A systematic demonstration of programmed generalization and measurement of generalized effects beyond intervention conditions was reported by Stokes, Baer, and Jackson (1974). They established that training and maintenance of retarded children's greeting responses by one experimenter was not usually sufficient for the generalization of the response across experimenters. However, high levels of generalization to over 20 members of the institution staff (and newcomers as well) who had not participated in the training of the response were recorded, after a second experimenter trained and maintained the response in conjunction with the first experimenter. Thus, when generalization did not prevail after the training of one stimulus exemplar, it was programmed by training a greater diversity of stimulus (trainer) conditions. Similarly, Garcia (1974) taught a conversational speech form to two retarded children, and, upon discovering a lack of stable generalization across experimenters after one training input, programmed generalization across experimenters by having a second experimenter teach the same responses.

A sufficient-stimulus-exemplars demonstration of programmed generalization across settings has been described by Allen (1973). Allen modified the bizarre verbalizations of an 8-yr-old boy by differential attention procedures. Ignoring bizarre verbalizations and praise for appropriate

interaction reduced bizarre verbalizations during evening camp activities. However, there was no generalization to three other camp settings. After additional training in a second setting, some generalization to the unmanipulated settings was noted. This generalization was further enhanced by intervention in the third setting. Unfortunately, the experimental procedures did not allow sufficient time to document the full extent of generalization after training in two settings, but generalization after training in two settings was clearly evident. Griffiths and Craighead (1972) similarly programmed generalization across settings. A 30-yr-old retarded woman received praise and tokens for correct articulation in speech therapy. Generalization to a residential cottage was not observed until the same procedures were instituted there. Following training in these two stimulus exemplars, generalization to a third nontraining setting (a classroom) was observed.

Very little research concerned with generalization programming has dealt with the training of sufficient stimulus exemplars. The infrequent research that has been published is characterized largely by programming across experimenters. This work has been promising, for after a modest number of training inputs, generalization apparently will occur with persons not involved in training—unquestionably a valuable and inexpensive outcome. However, the present implication of these studies is limited because of the restricted nature of the type of subjects and responses analyzed. Further work is also needed to give direction to the optimal conditions whereby the most extensive generalization will be achieved with a minimal training expenditure. Nevertheless, it is optimistic to note how frequently a sufficient number of exemplars is a small number of exemplars. Frequently, it is no more than two. In particular, there may well be reason to suspect that the use of two trainers will yield excellent results in terms of generalization. This possibility, obviously an economical one, certainly merits systematic study of its potential and limits.

Although very little research has been reported, the analysis of generalization programming by training in a number of settings is a virtually untapped area of far-reaching value. However, consistent optimism should follow examination of the studies showing generalization after training in only a few settings. Unfortunately, behavior analysts seem too often satisfied with the modification of a single, well-defined behavior in one setting, *e.g.*, a laboratory preschool. Discriminated programs are often acceptable, and sometimes even desirable. When generalization is a valid concern, but researchers and practitioners do not act as if this were so, the discriminated behavior of researchers is most probably inhibitory to the development of an effective generalization technology.

Over the past 10 yr, there has developed an extensive literature discussing the programmed generalization of responses through the training of sufficient response exemplars. A response class has been operationally defined to describe the fact that some responses are organized such that operations applied to a subset of responses in the class affect the other members of that class in the same manner. For example, Baer, Peterson, and Sherman (1967) reinforced various motor imitations by retarded children. They found that as long as reinforcement followed some imitative responses, other imitations continued to be performed without training or reinforcement.

A topographical analysis of generalized imitation has been made by Garcia, Baer, and Firestone (1971). Four retarded children were trained to imitate three different topographical types of response: small motor, large motor, and short vocal. These subjects were also probed for their imitation of other unreinforced responses: short motor, long motor, short vocal, and long vocal. Generalized imitation was observed with each subject, but this generalization reflected the particular dimensions of the topographical response currently being trained or having previously received training. Thus, generalization may occur within well-defined classes and may not generalize to other classes unless some special training

(generalization programming) occurs within that class as well. These data depict one possible limitation of the generality of generalized imitation, as well as pointing to the need to train response exemplars that will adequately reflect the diversity of the generalization being programmed.

Children's grammatical development has been another prominent area of research dealing with generalized behavior. The concept of response class is again pivotal in these studies, which conceptualize the rules of morphological grammar as equivalent to response class phenomena. For example, Guess, Sailor, Rutherford, and Baer (1968) developed the generative correct use of plurals by a retarded girl. After teaching a number of exemplars of the correct plural response, the girl appropriately labelled new objects in the singular or plural without further direct training relevant to those objects. Plural usage had become a generalized response class; the morphological rule had been established. Schumaker and Sherman (1970) rewarded three retarded children for the correct production of past- and present-tense forms of verbs. As past- and present-tense forms of verbs within an inflectional class were modified, there occurred a generalized usage of untrained verbs to similar tense forms.

There has been considerable research to establish the importance of the training of sufficient response exemplars. A survey of these (approximately 60) studies shows that the number of exemplars found to be "sufficient" for a desirable level and durability of generalization varies widely, probably determined primarily by the nature of the task and the subject's prior skills relevant to it. Most of this research was concerned with the development of motor and vocal imitations, and the beginning development of grammar and syntax. The development of question-asking and instruction-following is also well represented.

In conclusion, examination of the sufficient exemplar research points to a significant (and long-familiar) generalization-programming procedure: a number of stimulus and/or response

exemplars should undergo training. That is, to program the generalized performance of certain responses across various setting conditions or persons, training should occur across a (sufficient) number of setting conditions and/or with various persons. In a similar manner, generalization across responses can be programmed reliably by the training of a number of responses. Diversity of exemplars seems to be the rule to follow in pursuit of the maximum generalization. Sufficient diversity to reflect the dimensions of the desired generalization is a useful tactic. However, diversity may also be our greatest enemy: too much diversity of exemplars and not enough (sufficient) exemplars of similar responses may make potential gains disproportional to the investment of training effort. The optimal combination of sufficient exemplars and sufficient diversity to yield the most valuable generalization is critically in need of analysis. Is the best procedure to train many exemplars with little diversity at the outset, and then expand the diversity to include dimensions of the desired generalization? Or is it a more productive endeavor to train fewer exemplars that represent a greater diversity, and persist in the training until generalization emerges?

##### 5. *Train Loosely*

One relatively simple technique can be conceptualized as merely the negation of discrimination technique. That is, teaching is conducted with relatively little control over the stimuli presented and the correct responses allowed, so as to maximize sampling of relevant dimensions for transfer to other situations and other forms of the behavior. A formal example of this most often informal technique was provided by Schroeder and Baer (1972), who taught vocal imitation skills to retarded children in both of two ways, one emphasizing tight restriction of the vocal skills being learned at the moment (serial training of vocal imitations), and the other allowing much greater range of stimuli within the current problem (concurrent training

of imitations). The latter method was characterized repeatedly by greater generalization to as-yet-untaught vocal imitation problems, thus affirming "loose" teaching techniques as a contributor to wider generalization.

It will be appreciated that the literature of the field contains very few examples of this type. Researchers always have attempted to maintain thorough control and careful restriction and standardization of their teaching procedures, primarily to allow easy subsequent interpretation of the nature of their (successful) teaching techniques. Yet the import of this technique is that careful management of teaching techniques to a precisely repetitive handful of stimuli or formats may, in fact, correspondingly restrict generalization of the lessons being learned. The ultimate force of this recommendation remains to be seen. What seems required is programmatic research aimed at assessing the generalization characteristics of lessons taught under careful, restricted conditions, relative to similar lessons taught under looser, more variable conditions.

#### 6. *Use Indiscriminable Contingencies*

Intermittent schedules of reinforcement have been shown repeatedly to be particularly resistant to extinction, relative to continuous schedules (Ferster and Skinner, 1957). Resistance to extinction may be regarded as a form of generalization—generalization across time subsequent to learning. The essential feature of intermittent schedules may be their unpredictability—the impossibility of discriminating reinforcement occasions from nonreinforcement occasions until after the fact. Thus, if contingencies of reinforcement or punishment, or the setting events that mark the presence or absence of those contingencies, are made indiscriminable, then generalization may well be observed.

In generalization, behavior occurs in settings in which it will not be reinforced, just as it does in settings in which it will be reinforced. Then, the analogue to an intermittent schedule, extended to settings, is a condition in which the subject

cannot discriminate in which settings a response will be reinforced or not reinforced. A potential approximation to such a condition was presented in a study by Schwarz and Hawkins (1970). In that experiment, the behavior of a sixth-grade child was videotaped during math and spelling classes. Later, after each school day had ended, the child was shown the tape of the math class and awarded reinforcers according to how often good posture, absence of face-touching, and appropriate voice-loudness were evident on that tape. Although reinforcers were awarded only on the basis of behaviors displayed during the math class, desirable improvements were observed during the spelling class as well. In that reinforcement was delayed, this technique must have made it difficult for the child to discriminate in which class the behaviors were critical for earning reinforcement. In other words, the generalized success of the study may well be attributable to the partly indiscriminable nature of the reinforcement contingency.

In general, it may be suspected that delayed reinforcement often will have the advantage of making the times and places in which the contingency actually operates indiscriminable to the subject. However, this advantage is an advantage, by hypothesis, primarily for the goal of generalization. Otherwise, delayed reinforcement would often be considered an inefficient technique, most especially so for the initial development of a new skill. Indeed, it may be exactly in the realm of disadvantaged persons such as retarded children that the usual inefficiency of delayed reinforcement may seem the most severe handicap to its use. However, its potential for fostering generalization suggests strongly that further research be invested in this procedure (and any others that make reinforcement contingencies properly indiscriminable), to develop methods of applying it perhaps only after the initial development of a new skill, in the interests of promoting generalization.

Less than a dozen studies of generalization interpretable as cases of indiscriminable reinforcement contingencies can be found in the

literature. Kazdin (1973), for example, showed that teacher attention to one retarded child was responded to by another child as if it were reinforcement for on-task behavior. Indeed, the onlooker reacted with increased on-task behavior, even when the teacher attended to the target child's off-task behavior. Possibly, prior experience with reinforcement contingent on the peers' on-task behavior was sufficient to make all future praise (contingent or not) discriminative for on-task behavior. In other words, with sufficient prior experience, the onlooker may have stopped observing the contingency in which the reinforcement operated and responded only to the reinforcing stimulus' presence, making the contingency functionally indiscriminable.

Generalization across subjects has similarly been reported by Broden, Bruce, Mitchell, Carter, and Hall (1970) in a classroom of culturally disadvantaged children. When positive teacher attention was given for one child's attention to academic work, the attending of a peer also increased. This generalization was also a probable function of the cueing properties of teacher reinforcement. However, the generalization observed may also have been due to the manipulation of natural social consequences received by the nontarget child through peer attention, or may have been caused by a slight increase in the amount of teacher attention to the nontarget child. These effects deserve further systematic evaluation because of their relevance to the classroom practices of many teachers who strive to instruct effectively but are unable to devote extensive time to individual children.

Pendergrass (1972) showed that timeout could be employed to decrease the destructive behavior of two retarded children. With one subject, decreased rates were also observed with another response (self-biting) which was sometimes chained to the destructive behavior, but not itself subjected to contingent timeout. However, with the second subject, generalization to a second response (autistic jerking movement) was not observed. Analysis of the data revealed that the two behaviors occurred simultaneously more

frequently with the subject with whom generalization was evidenced. Thus, with this subject, punishment of the generalization response occurred more frequently when destructive behavior was punished. Unfortunately, it was not determined how often the self-biting occurred at times not simultaneous with the destructive behavior. Therefore, the schedule of punishment for self-biting was not established, *i.e.*, whether biting occurred only when destructive behavior occurred and, therefore, always met the timeout contingency. In this example (which was not intended to be a careful analysis of the indiscriminable reinforcement concept), not only was the reinforcement contingency somewhat difficult to discriminate, but the two behaviors (destructive and self-destructive responses) also may well have been only somewhat differentiated by the subject.

Thus, preventing the ready discrimination of contingencies is a generalization-programming technique worthy of application and research. Perhaps a random or haphazard delivery of reinforcement will (if luck or good judgement prevails) function to modify targetted behavior as well as behavior occurring in proximal time or space. Even noncontingent reinforcement, delivered at the outset of an intervention program, may retard initial effects, but may work to later advantage in generalization outcomes.

Finally, Kazdin and Polster (1973) showed once again the usefulness of intermittent schedules to delay subsequent extinction, relative to continuous schedules of reinforcement. Social interaction by two retardates was reinforced with tokens. After establishing social interaction, one subject received continuous reinforcement and the other, intermittent reinforcement. During extinction, only the subject who received intermittent reinforcement continued to interact socially with peers. However, these results may simply reflect different extinction rates by two subjects. The research was essentially a group study where  $N = 1$ . Adequate single-subject experimental control was lacking. Therefore, replication of these procedures would be desirable.

### 7. *Program Common Stimuli*

The passive approach to generalization described earlier need not be a completely impractical one. If it is supposed that generalization will occur, if only there are sufficient stimulus components occurring in common in both the training and generalization settings, then a reasonably practical technique is to guarantee that common and salient stimuli will be present in both. One predictor of the salience of a stimulus to be chosen for this role is its already established function for other important behaviors of the subject.

Children's peers may represent peculiarly suitable candidates for a stimulus common to both training and generalization settings. An example has been provided by Stokes and Baer (1976). In their study, two children exhibiting serious learning disabilities were recruited to learn several word-recognition skills. One child was taught these skills and concurrently shown how to teach them to the other child, thus acting as a peer-tutor. It was found that both children reliably learned the skills, but that neither generalized them reliably or stably to somewhat different settings in which the other child usually was absent. However, when the peer-tutor was brought into those settings, then each child similarly showed greatly increased and stabilized generalization, even though there were never any consequences for generalization. Similar demonstrations have been provided by Johnston and Johnston (1972) for the skill of speech articulation. In that study, peers were rewarded for correct monitoring of the subjects' articulation. Generalization of correct articulation occurred only when the "monitoring" peer was present. Unfortunately, it was not determined clearly whether generalization was evidenced because of the discriminative properties of the peers' presence in both settings, or whether the peers actively continued their monitoring in the generalization setting.

Rincover and Koegel (1975) have also incorporated functional training stimuli into the gen-

eralization setting. Autistic children were rewarded for imitation and instruction-following in a training setting. Four of their 10 subjects then did not exhibit generalization to a different setting. Therefore, to program for this generalization, various aspects of the training procedures (*e.g.*, hand movement by therapist) or physical training environment (*e.g.*, table and chairs) were systematically introduced to the generalization setting to control generalization. Making the experimental setting more closely resemble the regular classroom (generalization setting) was the programming procedure employed by Koegel and Rincover (1974). They decreased the teacher-to-student ratio in the experimental setting from 1-to-1 to 1-to-8. After these special programming conditions were instituted, there was increased performance on previously learned and new behaviors learned in the classroom. Walker and Buckley (1972) programmed generalization of the effects of remedial training of social and academic classroom behavior by establishing common stimuli between the experimental remedial classroom and the childrens' regular classroom by using the same academic materials in both classrooms.

The literature of this field shows only a handful of studies deliberately making use of a common stimulus in both training and generalization settings. Obviously, this is a technological dimension urgently in need of thorough development. The use of peers as the common stimulus has much to recommend it as a practical and natural technique. To what extent peers need to participate in the training setting has not yet been determined, although the absence of generalization sometimes shown when peers are present in nontraining settings, suggests that peers not involved in a training setting will not likely acquire sufficient discriminative function to control generalized responding. The use of common physical stimuli is in even greater need of systematic research. A common stimulus approach to generalization would encourage the incorporation into training settings of (naturally occurring) physical stimuli that are frequently promi-

nent or functional in nontraining environments. If these stimuli are well chosen, and can be made functional and salient in the training procedures, then generalization may thereby be programmed.

#### 8. *Mediate Generalization*

Mediated generalization is well known as a theoretical mechanism explaining generalization of highly symbolic learnings (Cofer and Foley, 1942). In essence, it requires establishing a response as part of the new learning that is likely to be utilized in other problems as well, and will constitute sufficient commonality between the original learning and the new problem to result in generalization. The most commonly used mediator is language, apparently. However, the deliberate application of language to accomplish generalization is rare in the literature reviewed, and correspondingly little is known about what aspects of a language response make for best mediation.

A sophisticated analysis of mediated generalization was conducted by Risley and Hart (1968), who taught preschool children to report at the end of play on their play-material choices. Mention of a given choice was reinforced with snacks, which produced increased mentioning of that choice, but no change in the children's actual use of that play-material. When reinforcement was restricted to *true* reports of play-material choices, however, the children then changed their play behavior (the next day) so that when queried about that play, they could truthfully report on their use of the specified play material and earn reinforcement. Control over any choice of play materials proved possible with this technique, which placed teaching contingencies not on the play, but on a potential mediator (verbal report) of that play behavior. That the reports were only potential mediators was apparent in the early stages of the study, when the children readily reported (untruthfully) their use of play materials with no corresponding actual behavior with those materials; at that stage, they earned reinforcement even so. When the reinforcement

was restricted to true reports, the reports then became mediators of play behavior. The lesson generalized, such that after several sequential experiences with these procedures, the children then used reports about play as mediators, even without reinforcement being restricted to only true reports. Israel and O'Leary (1973) used essentially the same paradigm to compare the effects of having children report first what they would play with later, in contrast to having them report after play what they had done (the Risley and Hart method); they found that reinforcing postreports (when they were true) produced more actual behavior (the next day) than reinforcing the actual behavior when it agreed with the earlier promise to perform it. This technique has been extended subsequently to the case of social skills, specifically sharing and praising between young children (Rogers-Warren and Baer, 1976). In that case, modelling was added, such that the young children would have a thorough chance to learn the nature of the relatively complex responses at issue.

Obviously, verbal mediation can easily fail, most especially in those situations in which the verbal mediators have little meaning (*i.e.*, tightly restricted discriminative value) for the subjects. It is commonplace to find children agreeing to a query (*e.g.*, about whether they praised or shared) without any knowledge of what that must entail in actual behavior. In the case of retarded children, it might be particularly true that the ability to use verbal responses as mediators would lag behind that of normal children using the same language responses. It may be reasonable to suggest that in the development of language-training programs, systematic attention be given to the training of language skills sufficiently well elaborated to function as mediators of nonverbal behavior. Language is a response, of course; it is also, equally obviously, a stimulus to the speaker as well as to the listener. Thus, it meets perfectly the logic of a salient common stimulus, to be carried from any training setting to any generalization setting that the child may ever enter. It also perfectly exemplifies the essence of the

active generalization approach recommended earlier.

The mediation of generalization is also exemplified in the behavior analysis research of self-control and self-management procedures. That is, self-control procedures such as self-recording, taught as part of an intervention program, may function to promote generalization: such techniques are easy to transport and may be employed readily to facilitate responding under generalization conditions. Some research that has employed any or all of the various tactics of self-assessment, self-recording, self-determination of reinforcement, and/or self-administration of reinforcement (Glynn, Thomas, and Shee, 1973), has also displayed maintenance and generalization of behavior change; however, the correlation is not perfect.

Brodén, Hall, and Mitts (1971) reported that after an eighth-grade girl experienced self-recording of study behavior and teacher praise for improved study, her study behavior maintained at a high level for a recorded three weeks. Although the individual effects of the self-recording and praise were not determined, it is possible that the self-recording procedures contributed significantly to this generalization.

Drabman, Spitalnik, and O'Leary (1973) taught disruptive children to match their teacher's evaluations of their appropriate classroom behavior. Tokens were dispensed for appropriate classroom behavior and accurate matching. Disruptive classroom behavior decreased and was maintained at low levels during a 12-day phase when tokens were not dispensed for self-recording accuracy. Generalized behavior improvement was also evident during a 15-min no-token period within the experimental hour. These changes were possibly a function of the close temporal proximity of the token periods, which frequently immediately preceded or followed the generalization period.

The role of self-control procedures in mediating generalization has often been proposed. Research would do well to examine the contribution of self-control tactics in generalization

and maintenance, especially when formal intervention manipulations have ceased to operate. The effects of accompanying procedures should be experimentally separated from self-control effects, and the role of each of the various self-control tactics (Glynn *et al.*, 1973) should be individually analyzed. The potential of self-mediated generalization is apparent, but its implications and practical utility still remain to be assessed.

### 9. Train "To Generalize"

If generalization is considered as a response itself, then a reinforcement contingency may be placed on it, the same as with any other operant. Informally, teachers often do this when they urge a student who has been taught one example of a general principle to "see" another example as "the same thing". (In principle, they are also attempting to make use of language as a mediator of generalization, relying on the supposed characteristics of words like "same" to accomplish the generalization.) Common observation suggests that the method often fails, and that when it does succeed, little extrinsic reinforcement is offered as a consequence. A more formal example of the technique was seen in a study by Goetz and Baer (1973), in which three preschool children were taught to generalize the response of making block forms (in blockbuilding play). Descriptive social reinforcement was offered only for every different form the child made, *i.e.*, contingent on every first appearance of any blockbuilding form within a session, but not for any subsequent appearances of that form. Thus, the child was rewarded for moving along the generalization gradient underlying block-form inventions, and never for staying at any one point. In general, the technique succeeded, in that the children steadily invented new block forms while this contingency was in use. Thus, there exists the possibility of programming reinforcement specifically, perhaps *only*, for movement along the generalization gradient desired.

In largely unspecified ways, perhaps two other studies exemplify this logic. Herbert and Baer

(1972), for example, taught two mothers of deviant children to give social reinforcement only to their children's appropriate behaviors, but taught the mothers from the outset to judge all behavior according to criteria they helped to develop, rather than attack only a few specified child responses. These mothers learned a generalized skill because they applied correct social contingencies to categories that included virtually all appropriate child behavior likely to occur. Behavior changes were maintained at 20 and 24 weeks after completion of formal training. Similarly, Parsonson, Baer, and Baer (1974) taught two teachers of retarded children to apply generalized correct social contingencies to all likely appropriate and inappropriate behaviors of preschool retarded children. These effects were also durable over several months. Apparently generalized changes were produced in these studies by Herbert and Baer and Parsonson *et al.*, but the extent and quality of that generalization was not quantified as such.

Very few studies of this type are found in the literature of applied behavior analysis, probably because of the preference of behaviorists to consider generalization as an outcome of behavioral change, rather than as a behavior itself. Ultimately, this behavioristic stance may well prove durable and consistent. Meanwhile, it is worth hypothesizing that "to generalize" may be treated as if it were an operant response, and reinforced as such, simply to see what useful results occur.

Consequently, one other technique deserves discussion: the systematic use of instructions to facilitate generalization. Thus, if a behavior is taught and generalization is not displayed, the least expensive of all techniques is to tell the subject about the possibility of generalization and then ask for it. If that generalization then occurs, it may well be referred to as "instructed generalization". If the effects of that instruction are themselves to become generalized (yielding a "generalized generalizer"?), then reinforcement of the generalized behavior, on a suitable schedule, might well be prudent, at least at first. Perhaps it is simply a very elaborate version of this

technique that is being practiced when a client is taught to relax in a somewhat anxiety-arousing situation, and reinforced (socially) for doing so; and then is instructed to relax in a somewhat more powerful anxiety-arousing situation, *etc.* That is, systematic desensitization to a hierarchy of stimuli may be analyzed as reinforcing not just relaxation, but also generalization along an already constructed generalization gradient (*cf.* Yates, 1970, p. 64ff.).

### CONCLUSION

The structure of the generalization literature and its implicit embryonic technology has been summarized. The most frequent treatments of generalization are also the least analytical—those described as *Train and Hope* and *Sequential Modification*. Included in the category of *Train and Hope* were those studies where the potential for generalization had been recognized, its presence or absence noted, but no particular effort was expended to accomplish generalization. By contrast, some limited programming was implemented in the *Sequential Modification* research. In these studies, given an absence of reliable generalization, procedures to effect changes were instituted directly in every nongeneralized condition. Although contributing significantly to our understanding of the generalization of behavior-change programs, these studies are not examples of the programming of generalization.

Seven categories were discussed that directly relate to a technology of generalization. First, the potential role of *Natural Maintaining Contingencies* was discussed. According to this tactic, generalization may be programmed by suitable trapping manipulations, where responses are introduced to natural reinforcement communities that refine and maintain those skills without further therapeutic intervention. The *Training of Sufficient Exemplars* is numerically the most extensive area of programming: generalization to untrained stimulus conditions and to untrained responses is programmed by the training of sufficient exemplars of those stimulus condi-

tions or responses. *Train Loosely* is a programming technique in which training is conducted with relatively little control over the stimuli and responses involved, and generalization is thereby enhanced. To invoke the tactic of *Indiscriminable Contingencies*, the contingencies of reinforcement or punishment, or the setting events marking the presence or absence of those contingencies, are deliberately made less predictable, so that it becomes difficult to discriminate reinforcement occasions from nonreinforcement occasions. *Common Stimuli* may be employed in generalization programming by incorporating into training settings social and physical stimuli that are salient in generalization settings, and that can be made to assume functional or obvious roles in the training setting. *Mediated Generalization* requires establishing a response as part of new learning that is likely to be utilized in other problems as well, and thus result in generalization. The final technique, *Train "To Generalize"*, involves reinforcing generalization itself as if it were an explicit behavior. These programming techniques should be researched further and usefully applied in programs in which generalization is relevant.

This list of generalized tactics conceals within itself a much smaller list of specific tactics. These specific tactics can be presented as a small picture of the generalization technology in its present most pragmatic form, not only to offer a set of what-to-do possibilities, but also to emphasize how very small the current technology is and how much development it requires:

1. Look for a response that enters a natural community; in particular, teach subjects to cue their potential natural communities to reinforce their desirable behaviors.
2. Keep training more exemplars; in particular, diversify them.
3. Loosen experimental control over the stimuli and responses involved in training; in particular, train different examples concurrently, and vary instructions, S<sup>P</sup>s, social reinforcers, and backup reinforcers.
4. Make unclear the limits of training contingencies; in particular, conceal, when possible, the point at which those contingencies stop operating, possibly by delayed reinforcement.
5. Use stimuli that are likely to be found in generalization settings in training settings as well; in particular, use peers as tutors.
6. Reinforce accurate self-reports of desirable behavior; apply self-recording and self-reinforcement techniques whenever possible.
7. When generalizations occur, reinforce at least some of them at least sometimes, as if "to generalize" were an operant response class.

There are many examples of generalization and nongeneralization of behavior changes. The fact that apparently unprogrammed generalization has been demonstrated (particularly across time) is valuable. It heralds a practicality desirable in any technology of behavior: that every one of a subjects' responses, in every setting, with every experimenter, and at every conceivable time does not need to meet specific treatment consequences for that program to accomplish and maintain important behavior changes. Alternatively, the fact that generalization is not always observed and durability is not inevitable means that there is hope for behavior modification: behavior can always be modified and changes are not necessarily irreversible. That is, once behavior has been modified, there is still the possibility of reconditioning if changes are undesirable or inappropriate, or if new inappropriate behaviors develop. If both appropriate and inappropriate behavior changes were to persist and prove irreversible, it would presage the demise of any technology of behavioral intervention. This occurrence of nongeneralization also underlines the need to develop a technology of generalization, so that programming will be a fundamental component of any procedures when durability and generalization of behavior changes are desirable.

A most important question is prompted by an examination of the previous research: does generalization ever occur without programming? In the above research, generalization was not always evident. In fact, the highly discriminated effects of some operant programs were sometimes documented. We have seen that the behavior analysis literature describes various programs that have shown that generalization may be promoted or programmed by particular intervention techniques. It seems reasonable to suggest, then, that many of the successful Train-and-Hope examples cited above may be undiagnosed instances of informal or inadvertent programming techniques, rather than an absence of programming techniques. It cannot be discounted, and is indeed possible, that these generalization examples may simply depict successful programmed generalization, and neither the authors of those papers, nor the present authors have recognized or hypothesized the programming technique.

Perhaps the most pragmatic orientation for behavior analysts is to assume that generalization does not occur except through some form of programming. Thus, the best course of action seems to be that of systematic measurement and analysis of variables that may have been functional in any apparently unprogrammed generalization. These analyses should be included as part of all research where "unprogrammed" generalized behavior changes are evidenced, for discriminated behavior changes may well be the rule if generalization is not specifically programmed. Such analyses, if successful, will contribute to a technology of generalization by further developing the understanding of critical variables that function to produce generalization, and would further emphasize the need always to be concerned not only with generalization issues, but with the various techniques that accomplish generalization.

In other words, behavioral research and practice should act as if there were no such animal as "free" generalization—as if generalization never occurs "naturally", but always requires programming. Then, "programmed generalization" is essentially a redundant term, and should

be descriptive only of the active regard of researchers and practitioners.

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Received 22 December 1975.

(Final acceptance 3 June 1976.)