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ASSESSING STIMULUS CONTROL IN NATURAL SETTINGS: AN ANALYSIS OF STIMULI THAT ACQUIRE CONTROL DURING TRAINING

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When a learner is taught a new response, the stimuli that influence its display are often unknown. The presence or absence of these stimuli alters the probability of occurrence of the response. By identifying the stimuli influencing the probability of newly acquired responses, interventionists may program for their generalization more effectively and efficiently. This investigation describes the application of an operant methodology to assess functional relationships between responses and specific stimulus variables. Four young adults with moderate mental retardation were taught to include "please" as part of requests they made in school. Four environmental stimuli, present during training, were assessed for the controlling properties they acquired. Each of the four was assessed prior to and after training by presenting it in isolation (i.e., the other three were varied). If the presence of a single stimulus associated with training did not occasion "please," then pairs of stimuli were probed. The results revealed that single-stimulus probing occasioned responding by only 1 learner; paired-stimulus probing set the occasion for including "please" by 2 others. Control of the 4th learner's responding was lost before training was introduced, because he began including "please" in his requests during baseline. The implications of these results are discussed in terms of analyzing stimulus control and promoting stimulus generalization.

DESCRIPTORS: stimulus control assessment, functional analysis, stimulus generalization, assessment methodology

Stimulus control is a principle that may facilitate an analysis of generalization. To achieve generalized performance, we need to focus on antecedents as well as on consequences. If a response is to occur under nontraining conditions, then some stimuli must be present in the nontraining environment to signal that the response is likely to produce reinforcement (Marholin & Touchette, 1979).

The present study explored the conditions influencing stimulus generalization via a systematic analysis of stimulus control. This analysis elaborates an operant methodology for assessing functional relationships acquired during training. It is a type of functional analysis not unlike those conducted by investigators working with learners who display severe behavior problems (e.g., the presentation of analogue conditions by Carr & Durand, 1985; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; Weeks & Gaylord-Ross, 1981). It differs, however, in at least one important respect: Those working with severe behavior problems typically focus on behavior with an unknown history of acquisition, with their purpose being to develop effective treatments related to the conditions that occasion and/or maintain the target behavior. In contrast, the present analysis focuses on a behavior for which we

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controlled specific stimulus conditions during its acquisition, our purpose being to assess the stimulus properties and their influence on generalization.

Rincover and Koegel (1975) conducted an analysis of stimulus control and setting generality that served as a model for the current study in terms of methodology and purpose. They demonstrated that in the process of acquiring simple responses, the performance of children with autism came under the control of unintended, often "bizarre" stimuli (e.g., trainer hand movements, arrangement of tables and chairs). Furthermore, they demonstrated functional relationships between the presence of these stimuli and the target response by introducing these stimuli one at a time in a nontraining context. Thus, a lack of generalization caused Rincover and Koegel to explore further the stimulus control that had been established, and the errors in generalization provided the impetus for conducting a stimulus control analysis.

Halle (1989) conducted a study that directly assessed stimulus control. Two children with mental retardation were taught coin labels under a stable set of conditions (e.g., trainer, setting, time of day, verbal instruction, and positioning of trainer, learner, and stimuli). When the acquisition criterion was met, probes were conducted to assess the stimuli that acquired control. Probes consisted of trials in which only one stimulus condition (of the eight specified) was changed at a time; the other seven remained intact. If the response repeatedly failed to occur during particular probes but not during others, then the stimulus controlling the response had been identified. None of the single-condition stimulus changes produced errors. When two conditions were changed simultaneously, however, responding was disrupted for one of the children.

As in the Halle (1989) study, the present investigation assessed stimulus control and generalized responding. The approach, however, was modified in accord with the previous findings: Changing one condition at a time did not disrupt coin-label responses, and hence it appears that changing only one stimulus at a time may not provide a discriminating test of stimulus control. Thus, we decided to use the inverse strategy: On probe trials, only one condition remained the same as in training; the remaining conditions were varied. Intuitively, this appeared to provide a rigorous test of each condition, uncontaminated by other conditions associated with training. Flawless responding on probe trials, like that reported by Halle (1989), was not expected.

METHOD

Participants and Setting

Four adolescents diagnosed as having moderate mental retardation participated. Their IQs as measured by the Stanford-Binet varied from 31 to 40 with a mean of 36. Peabody Picture Vocabulary Test scores, a measure of comprehension, varied from 3-6 (Mac) to 8-11 (Will), with a mean of 4-10. Mac spoke in one- to three-word sentences and had fair intelligibility; his vocal language was supplemented with a communication book, some signs, and natural gestures. Bart spoke in one- to five-word sentences; he had poor intelligibility and required a communication book as a supplement. Borg spoke in one- to seven-word sentences, had good intelligibility, and frequently engaged in echolalia and perseverative speech. Finally, Will spoke in one- to ten-word sentences, but his intelligibility was only fair. One student had Down Syndrome, another was diagnosed as having Fragile X Syndrome, and a third had cerebral palsy. At the onset of the study, three were 18 and one was 19 years old.

The study was conducted in a school for students with moderate handicaps. All 4 participants were selected from one class. Training occurred in the vocational training classroom, with probes conducted throughout the school (i.e., in the office, music room, language therapy room, other classrooms, gym, or custodian's office).

Target Response

The target response was the addition of the word "please" accompanying students' requests in a naturally occurring context: Teachers sent their stu-

Table 1
Examples of a Training Trial and Stimulus Probes

Requester	Item	Receiver	Setting
Training trial			
Kathy	**Tape recorder**	**Connie**	**Voc room**
Probe trials			
Kathy	tissues	Darcie	office
Mary	**Tape recorder**	Judy	gym
Ryan	game	**Connie**	speech room
Jan	key	Susie	**Voc room**

dents on errands. For example, the teacher might send a student to the office to pick up materials or to the language therapy room to get a language book from the communication specialist. It was in the context of these errands that we targeted the inclusion of "please" when making the request. "Please" could occur anywhere within the request: at the beginning, in the middle, or at the end.

Stimulus Parameters Assessed

Within an errand trial, four stimulus parameters were identified: Participants were sent by a *requester* to get an *item* from a *receiver* in a particular *setting*. Many more stimuli than those identified were associated with errands; however, we chose those that appeared to be most salient or those that had been found to be influential in related literature (e.g., trainer, setting). During training, the four stimulus parameters were held constant both within and across students with one exception. For each participant, only the item varied (e.g., tape recorder, key, a card game called Uno); the other three stimuli (i.e., requester, receiver, and setting) associated with training were constant across students. Table 1 lists the stimuli used in training and the variation of stimulus probes conducted. For example, on a training trial, Kathy, the teacher, would ask Mac to get the tape recorder from Connie in the vocational room.

Experimental Design and Procedures

The primary consideration in the present study was the analysis of stimulus control; thus, the primary data were the probe data, and the primary design that analyzed these data was a multielement probe design. A secondary consideration was the effect of training on students' use of "please" in the context of errand requests. To determine this effect, training was introduced in a staggered fashion across students, with each student receiving a varying number of baseline probes.

A multielement probe design was used to assess the functional relationship between the manipulated stimuli and the target response. That is, to assess the control acquired by any one stimulus used in training, each was presented in isolation (i.e., the other three stimulus parameters varied from their training status) on multiple and alternating errand occasions. The consistency with which any of the four stimuli evoked "please" contributed to the demonstration of a functional relationship between that stimulus and the target response. Reversals in responding were produced by rapidly alternating the stimuli.

The design has components of reversal designs in that "please" was emitted under specific stimulus conditions that were repeated and was not emitted under other repeated stimulus conditions. However, stimulus conditions were introduced in a rapidly alternating pattern and not by phase. The alternating nature of the probes was similar to an alternating treatments design, but the variables alternated were not "treatments" in the usual sense of the word. Typically, treatment conditions are administered across different stimulus conditions such as treatment agents or settings (to separate the effects of treatment from those of discriminative stimuli). In the present design, these stimulus conditions were equivalent to the treatment; thus, a multielement probe design seemed to capture most accurately the operations of the design.

Baseline probes. To assess the baseline level of the use of "please," more frequent errand occasions than the number occurring naturally were contrived. One to three errand-probe trials were conducted daily, with a mean of less than two per day. Baseline probes consisted of trials in which either one training-stimulus parameter (e.g., Rows 2 through 5 of Table 1) or all four stimuli that were to be used during training (e.g., Row 1 of Table 1) were present. During baseline probes, requests were supported by natural contingencies; no additional consequences were provided.

Training. As in baseline, one to three probe trials were conducted daily. All training trials included the same four stimuli; together these defined the training conditions. When a student was sent on an errand and made a request without "please," Connie (the receiver of the request) provided a rationale for including "please" with requests. The rationale was a variation of the statement, "When you ask for something, you need to be polite and say *please*!" Connie then waited for another request. If "please" still did not occur or no request was forthcoming, she said, "Ask again and say *please* this time." If again the target response did not occur, Connie modeled the request with an accompanying "please." The participants always imitated this direct model. Connie smiled and provided descriptive praise and the requested item contingent on correct responding (i.e., a request that included "please"), whether the request was student initiated or trainer prompted. The criterion for acquisition was four consecutive unprompted responses across 2 days.

An additional training protocol was required for Borg, because his posttraining-probe performance on training-condition probes was unstable. In this special training, when Borg made a request and omitted "please," rather than immediately providing a rationale, Connie pause and waited for Borg to self-correct (i.e., include "please" in his request). The pause functioned as a means of delaying the prompt (i.e., a model by Connie), thereby transferring stimulus control from the model to other aspects relevant to the request occasion (Halle & Touchette, 1987).

Posttraining probes. Again, one to three trials were conducted daily. Trials in which training conditions were operating were presented, on the average, every third trial. Correction or descriptive praise continued to be provided contingent on these trials. This was done to maintain a baseline against which stimulus probes could be compared. If responding in the presence of the four combined training stimuli (i.e., a training trial) was inconsistent, the control exerted by any single training stimulus or by any pair of the training stimuli could not be assessed accurately.

In each posttraining probe, one of the four stimuli was assessed, while the other three stimuli differed from those present during training. If none of the four single-stimulus probes demonstrated control, we selected pairs of stimuli to assess. The criteria used to determine the stimulus pairs to be assessed were informed by observation and experience. *Receiver* was selected because of the frequency in the literature (Redd, 1969, 1970) with which trainers acquire stimulus properties. Although *setting* has a similar distinction in the literature, we surmised that *item* may have acquired more potent stimulus properties. Thus, for the 2 participants who required paired-stimulus probes, *receiver* and *item* were paired and *requester* and *setting* were paired.

Maintenance probes. Two months after the completion of the study, maintenance probes were conducted. These probes were identical to the posttraining probes that had reliably occasioned requests with "please" (i.e., receiver for Will and item/receiver for Borg and Bart).

Recording Procedures and Reliability

On every training and probe trial, the receiver recorded what the student said on a card containing the following information: date, time, student's name, trial number, and the four target conditions that obtained (requester, item, receiver, setting). If the student included a "please" within the request, the response was considered correct. If "please" was not part of the request or if no request was made (which almost never occurred), the response was considered incorrect.

Reliability of recording was assessed by another observer (one of the experimenters) who gathered data independently of and simultaneously with the receiver on 24% of the trials conducted. Frequently, these interobserver agreement checks were conducted without the knowledge of the receiver. For example, when an errand occurred in the office with the secretary, other people (including the reliability observer) were often present in the office for various reasons, allowing unobtrusive assessment. Other settings, however, did not permit unobtrusive reliability checks. Data were recorded in the same manner by the reliability observer as by the receiver. To determine agreement, two cards representing the same trial were compared to assess whether the recorders agreed that a "please" had occurred as part of the request. Agreement was assessed at least once in every condition for each of the 4 participants. The percentage of trials on which agreement was assessed and the mean level of agreement for each student were 19% and 100% for Will, 26% and 89% for Borg, 28% and 100% for Bart, and 15% and 100% for Mac, respectively.

RESULTS

The probe data are presented in Figures 1 and 2. Figure 1 constitutes a trial-by-trial analysis of potential discriminative stimuli for "please." Probe trials and trials in which all four training conditions were present are indicated in the sequence in which they occurred. In Figure 2, a summary of the data that appear in Figure 1 (the percentage of requests that included "please") is provided by the bars of the histogram.

The baseline probe data revealed that 3 of 4 students rarely said "please" (the exception was Mac, who will be reviewed later) when they made requests as part of an errand. Only Bart said "please," and he said it only once, on a requester probe. The 3 learners who received training required seven (Bart) and nine (Will and Borg) trials distributed across 4 days to meet the established criterion of four consecutive correct responses across 2 days. With only one exception (Bart's first baseline probe), the learners began saying "please" when, and only when, training was introduced. In addition to the initial training, Borg received special training during the posttraining-probe phase (i.e., he received 10 "pause" training trials over 6 days).

Will's posttraining probe data are clear. After training, he continued to say "please" on 100% (six of six) of the interspersed trials in which all of the training conditions were present. When single-condition probes were presented, his performance was stable; he said "please" every time (four of four) the trainer-receiver was present and never responded when the other three conditions were present individually.

Borg's performance was more variable. He responded correctly on 71% (15 of 21) of the training-condition probes. Interspersed with this probing, each of the four single-stimulus probes was administered five times, but Borg never responded correctly in the presence of individual conditions. Because individual conditions did not control correct responding, paired-stimulus probing was begun. Item/receiver probes resulted in 20% (one of five) correct responding; requester/setting probes produced no (zero of four) correct responses.

Two problems make the interpretation of these data difficult. First, 20% represents only one correct response, indicating incomplete or weak stimulus control. Second, Borg's correct responding to training-condition trials was unstable; he said "please" on only two of six trials. A clear test of stimulus control cannot be performed if the stimulus–response relationship under training conditions is not intact. Therefore, a pause phase was initiated for Borg, followed by the reinstatement of posttraining probes. The objective of "pause" training was to strengthen correct responding under training conditions. In the first data set (Set 1) after pause training, Borg's responding to training-condition probes increased to 100% (seven of seven). This allowed a more accurate assessment of his paired-stimulus probe performance. He responded cor-

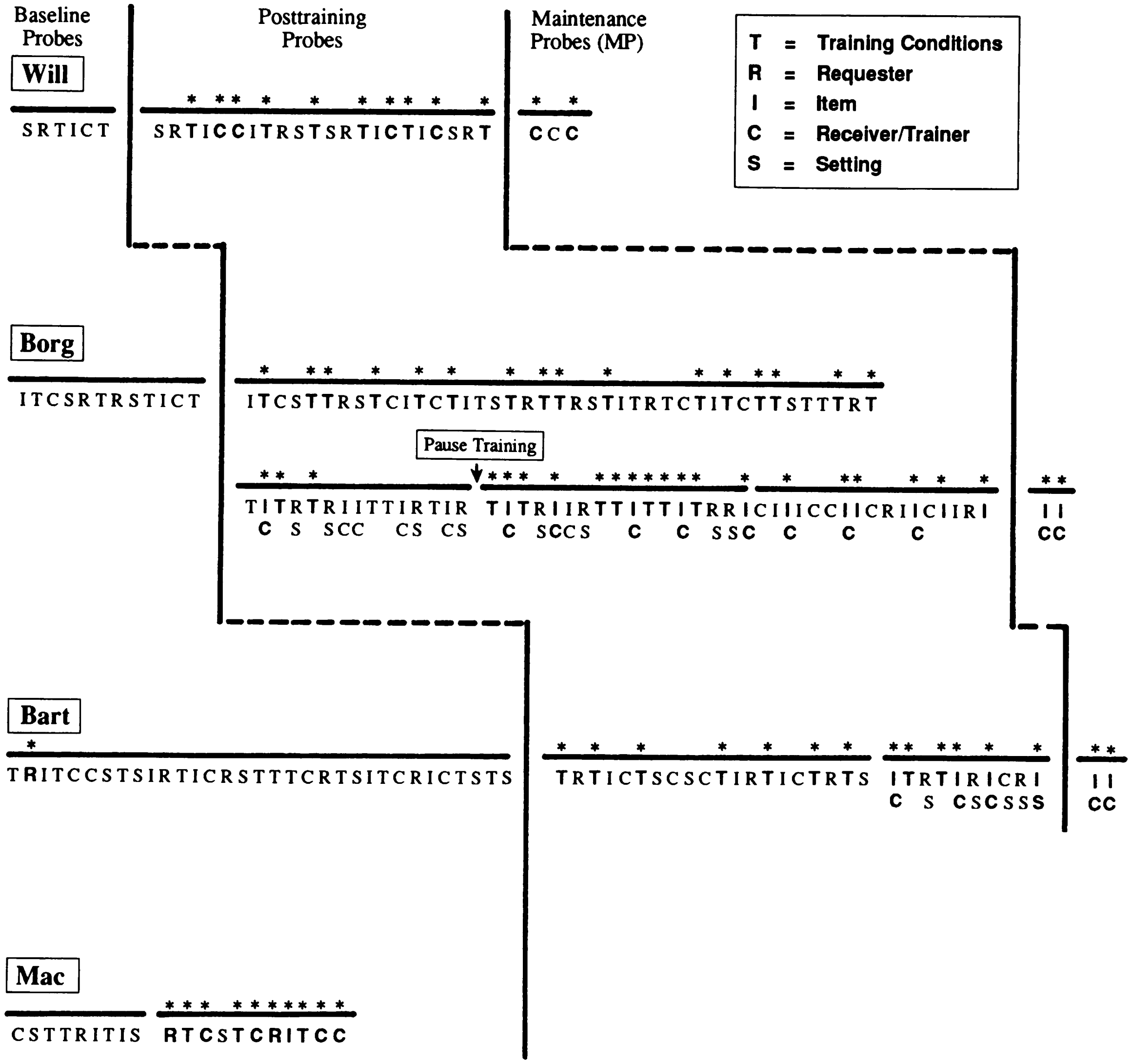

Figure 1. Sequence of probe trials across phases for each participant. The darker letters with asterisks above represent probes that occasioned correct responses (i.e., "please" was part of the request); the lighter letters reflect probes that failed to occasion "please." The solid vertical lines indicate changes in phases. The breaks in the horizontal lines represent changes in probing within a phase. To accommodate Borg's large number of posttraining probes within the format of the multiple baseline design, two horizontal lines were required.

rectly on 83% (five of six) of the item/receiver probes and on 0% (zero of four) of the requester/setting probes.

Given that item/receiver probes were now setting the occasion for "please" with consistency, we wanted to examine the stimulus control of each. To do so, in Data Set 2 we interspersed single-stimulus item, receiver, and requester probes with paired-stimulus item/receiver probes. Borg responded correctly to all three of the paired-stimulus probes; he never responded correctly to the single-stimulus receiver (zero of five) or requester (zero of two) probes. When the item was presented in isolation, however, it set the occasion for correct responses on three of seven trials.

Bart's performance replicated that of Borg, with the exception that Bart did not require "pause" training. He responded consistently and accurately

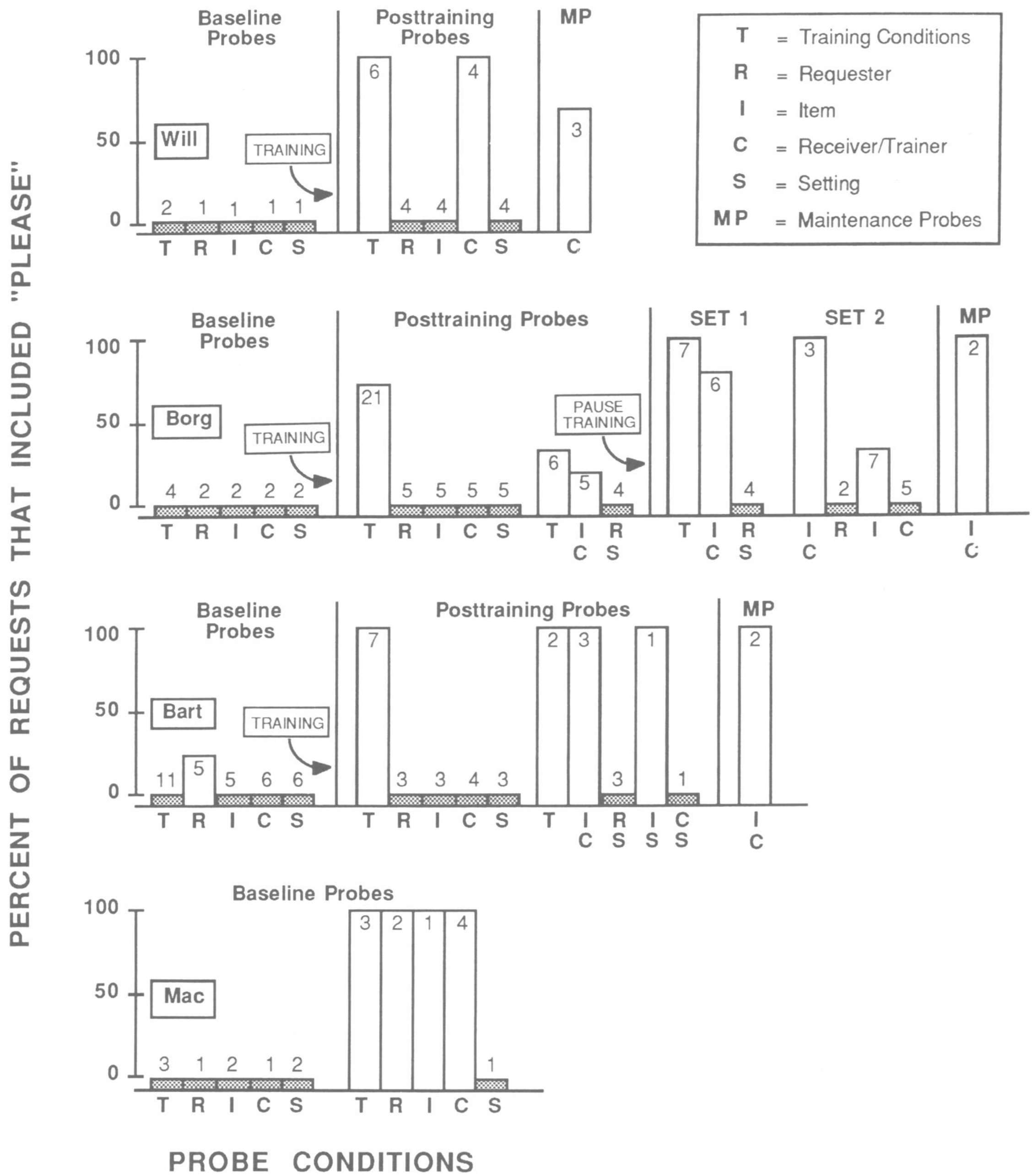

Figure 2. Percentage of requests that included "please" across phases for each participant. The different types of probes appear beneath the abscissa; the numbers above or inside the bars reveal the number of trials of the type indicated on the abscissa. Bars representing 0% responding are shaded. For Borg, Sets 1 and 2 constitute a continuation of posttraining probes. Mac's entire data set consists of baseline probes; his data are presented chronologically to highlight his uncontrolled acquisition.

to training-condition trials throughout the posttraining probe phase (nine of nine). Single-stimulus probes were interspersed with these trials; each was administered three times with the exception of receiver. Bart never responded correctly in the presence of individual conditions; thus we introduced paired-stimulus probes. Item/receiver probes resulted in 100% (three of three) correct responding;

requester/setting probes resulted in no correct responding (zero of three). At the end of this evaluation, we presented novel combinations of conditions to assess their control. He responded correctly on the one item/setting probe and incorrectly (omitted "please") on the one receiver/setting probe.

Mac did not receive a consistent number of pre- or posttraining probes because he acquired the response without training. Inexplicably, after nine incorrect baseline probes across all stimulus conditions, he said "please" on 10 of the next 11 probes (two occurred 3 months after he acquired the response).

Will received three receiver probes 2 months after posttraining probing was terminated. The second probe was conducted in the school office at a time when it was crowded and noisy; Will omitted "please" from his request. This probe was repeated in the office the next day (no crowd and no noise), and this time he responded correctly. Borg and Bart each received two item/receiver probes 2 months after the study, and both responded correctly.

DISCUSSION

Although the data generated in this study do not represent a complete analysis of the stimuli controlling the use of "please" with requests, the methodology used offers a novel alternative in the field of behavioral assessment. In the last 5 years, the elaboration of functional analysis methodology has been pervasive (cf. Iwata et al., 1982; Mace, Lalli, & Pinter, in press; O'Neill, Horner, Albin, Storey, & Sprague, 1989). As this technology has been elaborated, components once combined under the term functional analysis are currently separated. For example, Mace et al. (in press) discussed descriptive analysis as a procedure prerequisite to the more formal functional analysis, because a descriptive analysis can permit identification of variables correlated with the response of interest.

Most previous investigations, in addition to evaluating severe behavior problems, have focused on response consequences. Not only is the analysis of antecedent variables rare, but such analyses rarely occur in more natural contexts (Mace et al., in press). Mace et al. warned that any assumptions about the controlling conditions being the same under experimental (i.e., analogue) conditions as they are under natural conditions are precarious at best.

This investigation offers a methodology responsive to the two neglected areas delineated above by providing a means of analyzing (a) antecedent stimulus variables in (b) natural contexts. In this investigation, the stimulus control influencing the probability of including "please" as part of requests was assessed. For each student, the presence of a single stimulus or pair of stimuli increased the probability of the "please" response, whereas the presence of other stimuli associated with training did not enhance the probability of responding. It is noteworthy that the stimulus conditions ought not to have been discriminative for the target response. That is, regardless of who makes or receives the request, what is requested, or the physical context of the request, "please" ought to accompany requests. Such conditions have been referred to as background stimuli (Goldiamond, 1962; Spradlin, 1989); they are irrelevant to the criterion discrimination, and if they acquire controlling properties (as they did here), they may prevent desired stimulus generalization.

That "please" was controlled by irrelevant stimuli can be easily understood by examining the conditions of training. We purposely used an invariant training protocol, and then assessed the stimulus properties acquired by the four preestablished conditions. In contrast to our procedure, investigators who promote generalization have recommended that training protocols include planned systematic (e.g., general-case programming by Horner, Sprague, & Wilcox, 1982) and unsystematic (e.g., loose training by Stokes & Baer, 1977) variation of stimulus conditions.

The assessment of stimulus control for Will yielded a clear and consistent finding: The receiver or trainer was the only stimulus to acquire control. Borg's data are not as clear, but do suggest that prior to paired-stimulus probing, none of the four stimuli in isolation had acquired control. However, after paired-stimulus probing in which item/receiver occasioned "please," a return to single-stimulus probes revealed that the item alone occasionally controlled correct responses. Other combinations of single- and paired-stimulus probes never acquired control of Borg's use of "please." Bart's data are similar to Borg's in that he did not respond with "please" to any of the single-stimulus probes, but did respond discriminatively when stimuli were presented in pairs (i.e., item/receiver and item/setting). These results are tentative because only one item/setting trial was conducted; thus, demonstration of its control was inconclusive. Future investigators should attempt to obtain a larger number of probe trials to better evaluate the stimulus control relationships. In spite of this weakness, we believe the major objective of this investigation, elaborating an operant methodology for assessing stimulus control in natural settings, was accomplished. Additional assessments of stimulus control would have provided a more complete analysis.

The results of the present study appear to have direct implications for the analysis of stimulus control and the promotion of stimulus generalization. First, the behavior analysis literature is rife with examples of generalization failures attributable to the control of target responses by irrelevant background stimuli (e.g., trainer, physical setting) redundant with the relevant stimuli during training. In response to this problem, the loose training and train multiple exemplars strategies were developed. Until an analysis of stimulus control is conducted, it may be impossible to identify the background stimuli that have acquired control and therefore require loose or multiple exemplar training to produce the desired generalized responding.

To produce this generalized outcome, however, guidelines must be available to identify the stimuli requiring variation. Instead of varying every conceivable stimulus, perhaps only a restricted set of stimuli (i.e., those controlling responding during acquisition) need to be varied to achieve generalized performance. Baer (1982) discussed this dilemma in terms of the "trade-off of efficiency in learning for efficiency in generalization" (p. 198). If we identify the stimuli that control responding for an individual, then perhaps we can be at once efficient in programming acquisition and generalization by varying only the potentially controlling stimuli (and not having to vary noncontrolling stimuli constantly and unpredictably) in ways that represent a generalized solution to the problem.

A question requiring further evaluation pertains to the constancy versus the flexibility of the stimulus control across responses for learners with disabilities. That is, if brief assessments of stimulus control reveal that a learner's behavior comes under the control of similar stimulus dimensions across varying training situations (e.g., they respond consistently to trainers or to physical properties of settings), then we can program more selectively by varying specific stimulus dimensions instead of all "salient" dimensions. Conversely, if the brief assessments of stimulus control reveal that a learner's behavior comes under the control of varying stimulus dimensions across different training situations (i.e., each situation has its own stimulus controls), then the efficiency of stimulus control assessments will be limited to the one context in which training occurred. If this case holds, the contribution of stimulus control analysis is reduced and may not constitute an expedient method of promoting stimulus generalization.

A second implication pertains to the variability of the findings across participants. Although, as far as we know, the students received the same training history, differential responding to the stimuli associated with training was the rule. That is, their responding came under differential control in the environment. Because of this lack of subject generality, the applied implications of this study are limited. To program generalization of the use of "please" in the context studied, we now have data to suggest which conditions need to be varied and which do not for individual students.

Third, if an analysis of generalization is to occur, it must extend beyond a simple assessment of the presence of newly acquired responding in one (or even many) untrained contexts. Rather, the assessment must identify the controlling stimuli to insure that the appropriate stimulus configurations will occasion the response. An exception to this contention is the case in which a response is appropriate only in a very limited set of circumstances, each of which could be assessed practically (e.g., use of vending machines).

Fourth, for any naturally occurring behavior, the stimulus control of the behavior is probably complex and, depending on the learning history of the individual *in that context,* one, a few, or many stimuli may determine the response. Although this implication is not new (see Halle, 1987; Horner et al., 1982; Horner, Bellamy, & Colvin, 1984; Kaiser & Warren, 1987; Skinner, 1953, 1957), it is frequently overlooked. Too often, applied behavioral researchers and clinicians refer to *the* discriminative stimulus as though only one exists. This implication also points indirectly to an inherent weakness of the study. The stimulus conditions under investigation in no way exhaust those representing the universe of potential controlling stimuli. For example, although it appeared that Will's "please" was controlled by a single stimulus (i.e., the receiver), a number of other unidentified stimuli may have been present coincidentally and may have assumed controlling properties.

Stimuli potentially influencing a response are multiple and thereby challenge exhaustive identification. Kaiser and Warren (1987) provided a sampling of the complexity of stimuli potentially influencing a language response: language directed to the learner and language by the learner that precedes an utterance; eye contact and body orientation of the listener; past history (including reinforcement) shared by the learner and listener; objects and other physical stimuli comprising the environment. Important, but omitted from this sampling, are states of deprivation acting as establishing operations (Michael, 1982) that may develop or abolish the functions of particular sets of impinging external variables. These stimuli probably act in combination with one another to influence the probability of a response and thus greatly complicate the analysis of stimulus control of behavior displayed in natural contexts. Such complexity should not, however, discourage efforts to understand the role of stimulus control in determining generalized performance. Hains and Baer (1989) have presented an elegant discussion of design options (e.g., multielement designs combined with reversal designs) that may have the potential to accommodate the complexity noted above. Their discussion of our failure "to learn the contextual conditions that maximize and minimize" (p. 64) the effects of powerful independent variables is exemplary and supports the need for follow-up research to the present study.

REFERENCES

Baer, D. M. (1982). The role of current pragmatics in the future analysis of generalization technology. In R. B. Stuart (Ed.), *Adherence, compliance, and generalization in behavioral medicine* (pp. 192–212). New York: Brunner/Mazel.

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis,* **18,** 111–126.

Goldiamond, I. (1962). Perception. In A. J. Bachrach (Ed.), *Experimental foundations of clinical psychology* (pp. 280–340). New York: Basic Books.

Hains, A. H., & Baer, D. M. (1989). Interaction effects in multielement designs: Inevitable, desirable, and ignorable. *Journal of Applied Behavior Analysis,* **22,** 57–69.

Halle, J. W. (1987). Teaching language in the natural environment to individuals with severe handicaps: An analysis of spontaneity. *Journal of the Association for Persons with Severe Handicaps,* **12,** 28–37.

Halle, J. (1989). Identifying stimuli in the natural environment that control verbal responses. *Journal of Speech and Hearing Disorders,* **54,** 500–504.

Halle, J. W., & Touchette, P. E. (1987). Delayed prompting: A method for instructing children with severe language handicaps. In J. Hogg & P. Mittler (Eds.), *Issues in staff training in mental handicaps* (pp. 125–167). Cambridge, MA: Croom-Helm Publishers.

Horner, R. H., Bellamy, G. T., & Colvin, G. T. (1984). Responding in the presence of nontrained stimuli: Implications of generalization error patterns. *Journal of the Association for Persons with Severe Handicaps,* **9,** 287–295.

Horner, R. H., Sprague, J., & Wilcox, B. (1982). General case programming for community activity. In B. Wilcox & G. Bellamy (Eds.), *Design of high school programs for severely handicapped students* (pp. 61–98). Baltimore: Paul H. Brookes.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1982). Toward a functional analysis of self-injury. *Analysis and Intervention in Developmental Disabilities,* **2,** 3–20.

Kaiser, A. P., & Warren, S. F. (1987). Pragmatics and generalization. In R. L. Schiefelbusch & L. L. Lloyd (Eds.), *Language perspectives: Acquisition, retardation,* *and intervention* (2nd ed., pp. 393–442). Austin, TX: Pro-Ed.

Mace, F. E., Lalli, J. S., & Pinter, E. (in press). Functional analysis and treatment of aberrant behavior. In J. Matson & R. Barrett (Eds.), *Advances in developmental disability*. Greenwich, CT: JAI Press.

Marholin, D., II, & Touchette, P. (1979). The role of stimulus control and response consequences. In A. P. Goldstein & F. H. Kanfer (Eds.), *Maximizing treatment gains: Transfer enhancement in psychotherapy* (pp. 303–351). New York: Academic Press.

Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior,* **37,** 149–155.

O'Neill, R. E., Horner, R. H., Albin, R. W., Storey, K., & Sprague, J. (1989). *Functional analysis: A practical assessment guide*. Sycamore, IL: Sycamore Publishing.

Redd, W. H. (1969). Effects of mixed reinforcement contingencies on adults' control of children's behavior. *Journal of Applied Behavior Analysis,* **2,** 249–254.

Redd, W. H. (1970). Generalization of adult's stimulus control of children's behavior. *Journal of Experimental Child Psychology,* **9,** 286–296.

Rincover, A., & Koegel, R. (1975). Setting generality and stimulus control in autistic children. *Journal of Applied Behavior Analysis,* **8,** 235–246.

Skinner, B. F. (1953). *Science and human behavior*. New York: Macmillan.

Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.

Spradlin, J. E. (1989). Model of generalization. In L. V. McReynolds & J. E. Spradlin (Eds.), *Generalization strategies in the treatment of communication disorders* (pp. 132–146). Toronto: B. C. Decker, Inc.

Stokes, T. F., & Baer, D. M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis,* **10,** 349–367.

Weeks, M., & Gaylord-Ross, R. (1981). Task difficulty and aberrant behavior in severely handicapped students. *Journal of Applied Behavior Analysis,* **14,** 449–463.

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