

Interteaching: A Strategy for Enhancing the User-Friendliness of Behavioral Arrangements in the College Classroom

Thomas E. Boyce
University of Nevada, Reno

Philip N. Hinline
Temple University

“Interteaching” is an arrangement for college classroom instruction that departs from the standard lecture format and offers an answer to criticisms commonly directed at behavioral teaching techniques. This approach evolved from exploratory use of small-group arrangements and Ferster and Perrott’s (1968) “interview technique,” leading ultimately to a format that is organized around focused dyadic discussion. Specific suggestions are offered that might enable both seasoned and novice instructors to incorporate this or similar arrangements into their classrooms. This approach retains some key characteristics of Keller’s personalized system of instruction and precision teaching, but offers greater flexibility for strategies that are based on behavioral principles.

Key words: applied behavior analysis, education, instruction, interviewing, PSI, precision teaching, reciprocal peer tutoring

This article describes a strategy for applying, in flexible and innovative ways, a technology of classroom instruction based on the principles of behavior analysis. The techniques described have been informally evaluated in the classroom instruction of the authors, and several features of this approach are shared with various alternative forms used by other behavioral scientists committed to using the principles of behavior in their own classroom arrangements. Because it is important to empirically validate the claims made, including their effectiveness at producing behavior change in criterion environments, we offer this paper as a starting point for research and as a guide for instructors who seek alternative classroom arrangements to enhance their own teaching repertoires.

To introduce the reader to the techniques of interteaching, we first offer some background rationale and de-

scribe how previous attempts to apply the principles of behavior in the classroom (i.e., personalized systems of instruction and precision teaching) have attempted to facilitate learning. Next, we identify sources of resistance to these more traditional behavioral approaches and introduce interteaching as a strategy for overcoming this resistance. Then, we describe in detail the key components of interteaching in hopes of encouraging readers to try some or all of these techniques in their own classrooms, perhaps using them as bases for their own innovations or for research comparing this to other approaches.

USING PRINCIPLES OF BEHAVIOR ANALYSIS IN THE CLASSROOM

For a behavior analyst, learning is something a person *does*, not something that happens to him or her. More specifically, no matter what arrangement or experience is said to produce learning, what students have learned is what they can do afterward that they could not do before. Thus, Catania (1998) characterizes learning as “the

Correspondence concerning this article should be addressed to Thomas E. Boyce, Department of Psychology/296, University of Nevada–Reno, Reno, Nevada 89557 (e-mail: teboyce@unr.edu) or Philip N. Hinline, Department of Psychology, Temple University, Philadelphia, Pennsylvania 19122 (e-mail: hinline@astro.temple.edu).

process by which behavior is added to an organism's repertoire; a relatively permanent change in behavior" (p. 395). It follows that a behavior analyst will view teaching as the facilitating of such changes, not as merely the dispensing of information.

From this viewpoint, the standard university format of lectures and mid-term and final exams is recognized as a design that will generate inferior performance or even failure among many students. Because they rely heavily on students' self-management skills that are maintained weakly, if at all, by long-term contingencies, traditional arrangements ensure that most studying will be concentrated within two or three 48-hr periods of a 3- or 4-month academic term. Furthermore, the standard format places most students in the role of spectators, for even if a skilled teacher encourages student participation in a lecture-discussion format, time constraints and social contingencies will result in active participation by only a small proportion of students. Moreover, lectures imply that the students in a class can progress in unison. However, no matter how a teacher paces a lecture, it will always be moving too fast for some and not quickly enough for others. It follows that for both students who cannot keep up and those who work ahead, coming to class is minimally reinforced or even punished. Basic principles of behavior predict that attendance will be problematic unless additional, typically punitive arrangements favor it. Adding frequent quizzes, perhaps without advance warning, will improve the performance and attendance of some students, but this can detract from the teacher-student relationship while making the instructional setting aversive.

Behavior analysts should be able to do better than that. As Keller (1968) proposed, we can generate improved changes in students' performances by arranging "a reinforcing state of affairs for everyone involved [students and instructor alike]" through a "sober analysis of the critical contingencies in op-

eration" (p 86). Such arrangements can produce durable enhancements of repertoires—which is to say, robust learning—without the aversiveness of unpredictable evaluations or other punitive arrangements. With his personalized system of instruction (PSI), Keller demonstrated that a behavior-analytic approach to teaching could be incorporated into a classroom environment and used with success.

Keller's PSI format emphasizes student participation and does not rely on lectures. It arranges for students' self-pacing as they master small selections of material specified on worksheets or lists of "study objectives." Students must demonstrate their readiness to progress to new material by taking frequent tests that also provide access to "motivational" lectures (thus positioned as reinforcers rather than as antecedent events). If a test indicates that the student has not yet mastered the current material, no penalty results other than the necessity of retaking the test until mastery has been achieved. Furthermore, instead of a focus on rote memorization of definitions and facts, students are encouraged to integrate definitions when describing examples that illustrate behavioral principles in action. Proctors and tutors supply ample feedback during in-class time, which often functions as a study session. After having taken the course, thus having mastered the material, students can in turn receive additional course credit and strengthen and fine-tune their repertoires by serving as proctors or tutors.

There have been a few systematic demonstrations of the effectiveness of the PSI format (for a review and meta-analysis of such studies, see Kulik, Kulik, & Cohen, 1979). Notable among these is Born, Gledhill, and Davis' (1972) direct comparison of PSI with traditional formats. Born et al. assessed student performance in a traditional lecture course, a PSI course, a modified PSI course (in which students selected the size of units for successive mastery), and a course that alternated be-

tween PSI and the lecture format. All courses were based on the same text materials. So as not to be biased against the traditional alternative, performances were measured by midterm and final examinations. It was found that students in the PSI and modified PSI courses scored higher on all types of test items, and in particular, on items requiring written responses.

In contrast, if one teaches mainly by lecturing and emphasizes stand-alone definitions, students will learn to take notes and recite definitions, assisted only by an arrangement in which there is little to do but read and listen. It is not surprising that a Keller course that emphasizes flexible repertoires of writing produces more adequate written responses than those that commonly result from a lecture course. These findings demonstrate the importance of developing repertoires foundational to effective behavior in later courses, in graduate school, and ultimately in careers. Although the method is unconventional, its effects are consistent with traditionally stated goals. For example, the student who is able to understand concepts, define and appropriately apply terms, speak a second language, play a musical instrument or a new piece of music after instruction, has learned. Thus, by any standard, in registering for a class a student is contracting with the teacher to facilitate these changes. PSI is a method of instruction by which the instructor's end of the contract seems more likely to be fulfilled.

Nevertheless, despite its reported effectiveness, PSI has not been widely adopted, possibly because it requires fairly elaborate administrative arrangements (Pear & Crone-Todd, 1999). In addition, it is difficult for administrators in that PSI courses often produce grade lists with high numbers of both As and incomplete. The resulting bimodal distribution, unlike the traditional bell curve expected in large-enrollment courses, leads administrators and colleagues to suspect both grade inflation and inefficient course administra-

tion, even though the actual conduct of the course ensures quality control that exceeds the usual norms. Even taking only the instructor's personal concerns into account, a properly run PSI course requires extensive advance preparation of instructional materials, coaching of proctors, and other administrative arrangements. Thus, despite evidence indicating the success of methods such as PSI, the lecture format combined with midterm and final exams remains the typical pattern of instruction in college undergraduate courses (Machado & Silva, 1998).

Another cluster of behavior-analytic educational techniques has evolved under the label of "precision teaching" (PT) (Lindsley, 1964). PT emphasizes direct measurement of rate of responding, which enables a specification of "fluency," which is said to be the fluid combination of accuracy and speed that defines competent performance, or "true mastery" (Binder, 1996). Thus defined, fluent performance entails more than mere accuracy. It also involves practice leading to high rates of responding that enable a student (a) to remember a skill, (b) to respond in the face of distractions and over long periods of time, and (c) to apply the skill to more complex problems.

A key component of PT is timed practice, whereby complex behaviors are broken down into simpler component skills. As applied to college instruction, these skills include defining and applying new terms appropriately. Each of these is practiced until it occurs rapidly as well as accurately; only then is the next component introduced. Students' progress is carefully monitored on standard celeration charts (Pennypacker, Koenig, & Lindsley, 1972), which allow a teacher to make data-based decisions regarding methods of instruction and adjustments of curriculum. Finally, each student progresses at his or her own pace. The objective is stability and reliability of performance that should be a desired outcome for any learning arrangement, including those of the college class-

room. PT shares several features with PSI, and its effectiveness for adult literacy training has been demonstrated among college students at Malcolm X College and for teaching basic skills to younger individuals at the Morningside Academy (Johnson & Layng, 1992). Also like PSI, however, PT methods have not been widely adopted.

Sources of Resistance to Alternative Approaches

Although few people openly dispute the effectiveness of PSI and PT, these techniques have been ignored by most educators. It appears to be assumed that, at any educational level, the success of "alternative education programs" is attributable mainly to enhanced personal attention, implying smaller classrooms and smaller teacher-student ratios whose economic inefficiency detracts from their pedagogical effectiveness. At the college or university level, both teachers and administrators seem to assume that techniques for individualized instruction are unsuited for large classrooms full of students, and perhaps are applicable only for narrowly defined topics of study. Thus, as McMichael and Corey (1969) asserted, if behavior-analytic techniques of teaching are to be widely adopted, it will be necessary to demonstrate more than their superior results compared to lecture methods. It will also be necessary to show them to be applicable to general subject matter—that is, not just to psychology courses, and especially, not limited to courses in learning or behavior analysis. In this context, it is worth noting that in McMichael and Corey's study, students not only performed better on conventional examinations when learning via PSI than via lecture; they also rated the course more favorably. This indicates that, from the students' perspective, contingency-management methods are readily acceptable. Nevertheless, it is the instructors' choices that determine and configure a teaching arrangement.

Most teachers at the college level have long histories of constructing courses that emphasize lectures and of evaluating students' work via midterm and final examinations. Most likely this is how they themselves learned and how their peers arrange their own courses. There is little reason to do otherwise if one persists in the tradition of viewing education as the imparting of knowledge rather than as the teaching of skills. However, a consideration of the principles of behavior analysis suggests that we examine the relations between instructors' and students' behavior that occur within the course and the repertoires or skills that the course is supposed to generate. If one takes seriously the acquisition of new skills and repertoires as the primary agenda of a college course, then the shortcomings of conventional formats become obvious and more compelling.

But many behavior analysts also conform to the tradition of teaching as lecturing. Perhaps the prospect of adopting a new format appears unpleasant simply by virtue of requiring more work. Perhaps, in addition to being at odds with the traditions of academe, the behaviorally based alternatives seem not to be very user-friendly. We shall attempt to show that one can retain several of the key features of PSI and PT in arrangements that are less at odds with the customs and administrative arrangements of a typical college or university. In the formats that we advocate here, much of class time is spent in active, well-focused discussion among students. Brief lectures still occur, but they address topics that students have identified as needing clarification. Guided by the student's requests, lecture preparation is targeted and efficient.

ACCOMMODATING BEHAVIOR ANALYSIS TO EDUCATIONAL INSTITUTIONS: STRATEGIES FOR BREAKING OUT OF THE BOX

We believe an effective way to learn something is to teach it. This basic phi-

losophy is shared with proponents of reciprocal peer tutoring (RPT), a process in which students develop a series of test questions and use these questions to quiz each other before exams (Griffin & Griffin, 1998). Students change roles from teacher to student during the day and may receive points for performing their roles competently (Greenwood, 1997). When compared to a control group, RPT has been shown to produce somewhat greater improvements in academic achievement (Ginsberg-Block & Fantuzzo, 1997; Harper, Mallette, Maheady, Bentley, & Moore, 1995). In fact, Greenwood (1997) reported on 12 years of data indicating that at-risk students with mild disabilities acquired skills faster, retained more, and increased social competency to a greater degree with RPT than without it. On the other hand, RPT has produced only modest improvements (when compared with a control group) in the reduction of academic anxiety and student self-efficacy (Griffin & Griffin, 1998; Rittschof & Griffin, 2001). Still, even in studies in which only modest improvements were made, the students reported that RPT was helpful (e.g., Griffin & Griffin, 1997; Rittschof & Griffin, 2001).

The characteristics that interteaching has in common with RPT suggest a promising strategy for building appropriate repertoires, because teaching typically entails precisely the repertoires that we are trying to facilitate. One feature of our strategy is to involve students in teaching in an unobtrusive way that incidentally requires the skills of defining, interrelating, and applying the terms and principles of concern in a college course. A second feature of our strategy is that consequences are contingent on each student's arriving, at each class meeting, prepared to participate actively. Through normal social interaction, the person or people being taught will supply the consequences of the teacher's preparation. One of the present authors (Hineline, 1974a, 1974b) initially attempted to arrange for students to teach

each other by assigning them to small discussion groups. This proved to be only partially successful, for in groups of five, two or three students do most of the talking; in groups of three, two do most of the talking. Thus, successive approximations led inexorably to groups of two, where "total involvement" is maintained by natural contingencies of social interaction that are minimally aversive while leaving no place to hide. Interteaching differs from RPT in that the instructor develops the questions, and sessions occur as a regular part of the classroom arrangement. Recall that in RPT, students develop the questions and typically quiz each other only before exams.

In the initial attempts with groups of two, the core activity was characterized as "interviewing," patterned after Ferster and Perrott (1968), in which students took turns evaluating each other's answers to previously supplied study questions. After a few iterations, however, it became "interteaching," which is more collaborative than evaluative, more cooperative than competitive. The dyadic discussions, whether interviewing or interteaching, were conducted with the aid of a preparation guide that was supplied in advance—a list of questions based upon the reading assignment for the day. In the interviewing format, the questions tended to be fairly straightforward, much like the "study objectives" that are commonly supplied with textbooks. With the shift to the interteaching format, these were supplemented with more problem-oriented questions that required the student to interrelate concepts that the text had treated as distinct, or to attempt novel inferences and applications. During the sessions of dyadic discussion, the interviewer (or the interteachers working collaboratively) used a record sheet to indicate topics that gave trouble. Turned in at the end of class, these record sheets became the bases for the instructor's record keeping and preparation for the next day's brief lecture.

Other features were varied during

the exploratory years of working within this framework. For example, if the instructor had anticipated that a given topic would prove difficult for the students (having found that these topics tend to be the same from semester to semester in the same course), potentially difficult topics were sometimes handled in advance by preceding the interviews with "troubleshooting sessions." In these, the class was initially divided into clusters of six or eight for guided problem solving before students paired up for interteaching. If interviewing, rather than interteaching, was to be the activity, each student had an equal probability of being an interviewer or interviewee; roles were decided at the beginning of a session by flipping a coin. Various joint contingencies were tried, whereby students' grades were determined in part by the quiz performance of the other students with whom they had worked.

Although either interviewing or interteaching works most effectively as an integral part of a coherent package such as will be described below, either one can be used initially to supplement traditional lectures, thus easing into the alternative format. If (or as in our experience, *when*) the instructor becomes comfortable with more and more of class time focused on what the students, rather than what the professor, is doing, lectures naturally evolve toward a role of supplementing the students' one-on-one interactions. That is, the natural contingencies of the new classroom arrangement should shape the instructor's as well as the students' behavior.

In the second author's history, an increasing proportion of class time was given over to the students' dyadic work, because it became clear that this dyadic work contributed most to the quality of their improving competency. This trend reached a limit, however, as indicated by student evaluations and by the instructor's informal assessments of classroom ambience. The best balance appears to place the instructor at the front of the room about one third of the

time. As an alternative to changing from a lecture format gradually, one could try an arrangement such as that presented below, which evolved through many iterations.

AN INTEGRATED COURSE PACKAGE BASED ON INTERTEACHING

An *interteach* is a mutually probing, mutually informing conversation between two people. It lasts 30 to 40 min, and deals with the main points in a specified selection of material (textbook or articles). A preparation guide is provided, often in advance (although the first author has started providing the preparation guide in class on the day of the scheduled interteach), indicating the source material, the due date, and what should be stressed. The guides may be ultimately used as aids for studying, and often provide the outline for supplementary notes. During interteaching, however, students are explicitly told not to use supplementary notes. It is emphasized that time should be used for discussing the questions, not reading, and that the guide should be used as a prompt for conversation. (See Appendix A for an example of a preparation guide.)

Although the reader might question the accuracy and quality of feedback that students provide to each other about their answers, the instructor can often catch inappropriate responses in his or her facilitation of the interteaching sessions. In addition, lecture is designed to clarify such issues. The second author has tried using only experienced tutors and has considered using a "pyramid system," but he has found such arrangements to be cumbersome. Although we have not experienced troubling effects related to quality of interteaching (at least as measured by quiz performance and overall grades), we would welcome potential solutions from readers of this paper.

For a basic strategy, the students are advised to begin each session by clearly defining key concepts involved in

the study questions, even if the questions do not specifically ask for definitions. Defining terms in this manner helps prevent misinterpretation of the questions. If students are unsure, or disagree about an answer, they are encouraged to discuss it with the instructor (or, if available, with a teaching assistant). The instructor's job during interteaching is to provide individual help and clarification for those who request it and otherwise facilitate discussions. When done appropriately, the classroom environment is much like that of a dynamic workshop.

During or immediately after an interteach session, participants complete a record form that is provided. The record forms request information that includes (a) identification of the student and his or her partner, (b) topics that gave difficulty, and (c) topics that the students would like reviewed in lecture. One might also use the record sheet to ask students ancillary questions such as which questions from the study guide should be eliminated or to rate the quality of their interteach session on a scale of 1 = *poor* to 10 = *outstanding*. (See Appendix B for a copy of the interteach record.)

Because it has been found that self-pacing induces an inefficient pattern of responding that approximates the classic fixed-interval scallop (Ferster & Skinner, 1957), interteaches have due dates. Credit for interteaching in class and on time has become the standard. Interteaching after the due date or outside of class may result in reduced credit, and if it becomes a student's common pattern, no credit at all. Students are required to work with many different people over the weeks and should not work with the same person on consecutive occasions or more than a few times in a semester. Repeated interteaching with the same person for a given unit of material results in no credit for those sessions. (It has proven to be important to ensure that each student works with a variety of other people; indeed, the best 1st-day instruction is "Work with someone you didn't

know before you came in here." One might have thought that the main problem here would be that the best prepared students prefer to work together. However, in our experience, the greater and more frequent risk is that the weaker students choose to work together.)

The authors have found 10% of a final grade based simply on participation in interteaching to be an effective contingency to maintain competent interteaching. Although credit allocation for interteaching is small relative to that based on evaluated performance, it is enough to benefit students whose performance places them near the border between two letter grades. An additional 10% may be based on the quality of interteaching, as explained below.

An Improved Role for Lectures

As we have noted, a common activity among university instructors is preparing course lectures. Instructors often struggle with what to include in lecture, trying to find a balance of providing information consistent with a textbook (or other reading materials) without being redundant. Interteaching provides an alternative to this struggle. With lectures deemphasized, students' participation in interteach sessions yields a wealth of information regarding course material that gave them difficulty, that they found interesting and would like supplemented, and that was easily learned from the text and interteaching sessions, and thus did not require lecturing. The instructor's job is to analyze the content of the interteach records and develop a lecture around the themes that appeared most frequently across interteach records. We have found that a simple frequency count is effective for this, noting how often a question or topic was recorded as difficult or as especially interesting. This simple technique makes abundantly clear what one needs to address in lectures to maintain the students' interest and facilitate their learning the

key concepts. Lecture preparation is eased also because, having listened in during interteaching, one already has a tentative set of topics to be covered; review of the interteach records typically prompts minor adjustments. At this point, one is ready to generate the lecture notes.

Recall that as conceived in PSI, lectures were described as “motivational,” and were used as consequences contingent on student mastery. In this context, it is noteworthy that there are data to indicate that attendance at optional lectures is highest when the lecture promises to discuss material that will be on future quizzes (rather than just providing information) or when quizzes are given on lecture days (Lloyd et al., 1972). This makes sense simply because of the contingencies placed on student behavior. Why should a busy student attend a lecture on material he or she already knows if it will not affect his or her course grades? In contrast, lectures developed from interteach records are explicit consequences of the students’ manding specific information. Thus, if the lecture is properly developed, its potency as a reinforcer is virtually assured. It has been our experience that once the students contact this contingency, attendance at lectures remains high.

Probes

The student’s developing repertoires should be evaluated frequently, and the evaluations should be keyed closely to the study questions that provided the basis for interteaching. We characterize our evaluations as “probes”; a probe is like a quiz, except that students know the possible questions in advance. Directed toward effective interteaching, the probe may include a written paragraph answer to one or two questions drawn directly from the preparation guides covered since the preceding probe. The probe may also include a few simple questions (define and comment, true–false, multiple choice, or matching among multiple al-

ternatives) that are based on other questions in those preparation guides. (Questions evoking greater synthesis or creativity should have been incorporated into the preparation guides, rather than introduced by surprise.)

Regardless of format, probes should occur regularly and frequently. We recommend a minimum of five probes during a semester, and have given them as frequently as every third class meeting. The trade-off, of course, concerns the amount of time taken up by the probes themselves. A probe should contain items explicitly emphasized in class activities and offer students the opportunity to improve interteaching skills, if necessary. For this reason we recommend allowing students to drop their lowest probe score. A missed probe, however, should constitute the lowest score. An effective contingency to ensure that all probes are at least attempted is *not* to allow missed probes to be dropped. Given these contingencies, students are made aware that grades will not be curved.

Quality Points for Interteaching

A common concern of instructors regarding the interteaching process is related to the quality of the activity during those sessions. That is, how can one be sure that the students behave during interteaching in the way that we had planned? There are a few ways. First, the instructor is present in the classroom to stimulate discussions with appropriately placed prompts, correct technical language as necessary, provide examples, and otherwise facilitate the conversations. In addition, the first author has placed a social contingency on interteaching in which students are asked to rate the quality of their session on a scale of 1 to 10. Specifically, the pair must agree on a score and provide justification for the score they agreed upon. As evidenced by comments regarding the difficulty of certain topics, and statements such as “we could have spent more time preparing this chapter,” requiring that students

justify their score appears to prevent them from "inflating" their quality ratings. Finally, there is a formal classroom contingency based on quality. Specifically, students are told that if on a given paragraph question appearing on a probe, both the student and the person with whom he or she intertaught on *that* question scores a grade of A or B, points will be added to each student's probe score. Thus, it becomes worthwhile to interteach effectively, because quality interteaching can supplement all students' probe scores and ultimately their grades in the course. The challenge for the instructor (a minor chore, once it becomes routine) is to maintain records that allow him or her to easily identify who taught with whom on the particular interteach question selected for inclusion on the probe.

THE RELATION OF INTERTEACHING TO OTHER BEHAVIOR-ANALYTIC INSTRUCTIONAL TECHNIQUES

As we mentioned earlier, it has been demonstrated that the PSI method of instruction is superior to traditional lecture courses as measured by student grades (Born et al., 1972). In addition, it has been suggested that each component of a PSI course is essential to producing the improvements in learning. Indeed, Calhoun (1976) demonstrated the superior effects of PSI courses that included all elements of Keller's (1968) model compared to those in which at least one component was missing. Thus, it becomes informative to discuss the characteristics of interteaching in comparison with the essential components of PSI.

As established by Keller (1968), "true PSI" includes self-pacing, mastery requirements, little emphasis on lectures, an emphasis on the written word, and the use of proctors to produce "enhancement of the personal-social aspect of the educational process" (p. 83). Interteaching certainly capitalizes on the latter component. Specifi-

cally, interteaching requires that students assist each other in understanding key course topics. With the addition of the more contrived contingency related to quality points, it has been our experience that students spend time with the course material outside of class so as not to disappoint their interteaching partner in class. With the addition of having students rate the quality of their interteach sessions, the social contingencies become even more salient. With appropriate contingencies in place, Diamond (1972) found that student-led discussions were perceived to be an asset to large lecture courses.

Interteaching does not necessarily allow self-pacing. However, because students complete interteach records, they do influence which material gets more attention in lecture. Enabling students to select the material to be covered in lecture, while leaving time management to the instructor, places a greater emphasis on material that has not been mastered without the necessity of spending more class time on a given unit of material. This seems to be an acceptable alternative to the self-paced aspect of PSI that is one major source of resistance to Keller's model. That is, some students do not finish PSI courses in a reasonable amount of time, and PSI tends to produce higher dropout rates than traditional lecture courses. Born et al. (1972) found that when compared to traditional lecture courses, withdrawal rates were higher for PSI and that students who rotated between PSI and traditional lecture courses were more likely to withdraw during the PSI format. This problem appears to have been eliminated with the use of interteaching without sacrificing the benefits.

Although lectures have a reduced role in courses using the interteach format, they appear to have a reinforcing effect, because students mand information from the instructor. A mand, by definition, specifies its own reinforcer. If hearing the lecture is contingent on student attendance at the next meeting,

student attendance at that meeting should be maintained. This is precisely what the authors have found. Additional contingencies, as described previously, maintain attendance at classes during which interteaching is the focus. The more seasoned instructor will likely use a course format in which a lecture based on the interteach of the previous class day occurs at the beginning of each new class, and is then followed by an interteach that yields information for the next class lecture, and so on. Once on schedule, student attendance and performance are maintained, and the instructor's work in setting up the arrangements described here is reinforced in turn by what goes on during class.

Interteaching does not stress the written word per se as emphasized in PSI. However, the spoken word is valued. And, transfer of training from the spoken word to the written word is assessed by means of the paragraph question on each probe. Regardless, emphasis is placed on applying concepts to solve problems and on integrating information. This is consistent with the call of Machado and Silva (1998) who documented the perils of teaching definitions and probing with multiple-choice exams.

Finally, mastery is not explicitly required in interteaching. However, the elaborate yet easily maintained contingencies, including probes at least five times per semester, appear to shape "mastery-like" repertoires. Although the authors have not yet systematically collected data on performance in interteach versus traditional lecture formats of the same course, anecdotal evidence indicates that students perform better than average when involved in interteaching. In addition, student evaluations of the courses taught in this manner have proved to be outstanding. In fact, since adopting the interteaching format, the second author has received several teaching awards, and the first author's annual merit evaluations of teaching have all been "excellent." Thus, interteaching appears to be ped-

agogically useful to both instructors and students.

CUSTOMIZING INTERTEACHING FOR VARIOUS CLASS SCHEDULES

We have found that interteaching is more conducive to some schedules than to others. Three 50-min sessions per week work better than longer, less frequent meetings. Still there is much room for variation. For example, the first author has used interteaching in 8-hr seminars for students in a master's level course that meets off campus on weekends. By simply scheduling breaks after interteaching sessions, the instructor is able to prepare a lecture from slide templates of course material prepared in advance on computer graphics. The 8-hr day is thus broken down into sections of interteach, followed by brief lecture, interteach, lecture, and so on. Using these formats, even on such a schedule, we sometimes find that students complain that class sessions are too short or fail to notice when the class time ended. We believe these reactions are related to the variety of activities scheduled for students during class time. These same activities constitute the repertoires we desire to teach.

If, as we have asserted, the best way to learn something is to teach it, interteaching develops this repertoire early in the academic careers of our students. Its utility in courses outside psychology still needs to be documented, and systematic research on the performance improvements produced by interteaching even within our field is warranted. We would be delighted to see such work accomplished. Our agenda here is somewhat different, however. One can function as scientist in some contexts and as scientifically informed artisan in others. In that manner it should be legitimate to apply previously validated principles in behaviorally informed but new and flexible ways. Thus, whatever their research

specialties, we wish to encourage young instructors and seasoned instructors alike to implement in their own classrooms some of the user-friendly behavioral arrangements described here, perhaps using them as a starting point for innovations of their own.

REFERENCES

- Binder, C. (1996). Behavioral fluency: Evolution of a new paradigm. *The Behavior Analyst, 19*, 163–197.
- Born, D. G., Gledhill, S. M., & Davis, M. L. (1972). Examination performance in lecture-discussion and personalized instruction courses. *Journal of Applied Behavior Analysis, 5*, 33–43.
- Calhoun, J. F. (1976). The combination of elements in the personalized system of instruction. *Teaching of Psychology, 3*, 73–75.
- Catania, A. C. (1998). *Learning* (4th ed.). Upper Saddle River, NJ: Prentice Hall.
- Diamond, M. J. (1972). Improving the undergraduate lecture class by use of student-led discussion groups. *American Psychologist, 27*, 978–981.
- Ferster, C. B., & Perrott, M. C. (1968). *Behavior principles*. New York: Appleton-Century-Crofts.
- Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement*. New York: Appleton-Century-Crofts.
- Ginsberg-Block, M., & Fantuzzo, J. (1997). Reciprocal peer tutoring: An analysis of “teacher” and “student” interactions as a function of training and experience. *School Psychology Quarterly, 12*, 134–149.
- Greenwood, C. (1997). Classwide peer tutoring. *Behavior and Social Issues, 7*, 53–57.
- Griffin, M. M., & Griffin, B. W. (1998). An investigation of the effects of reciprocal peer tutoring on achievement, self-efficacy, and test anxiety. *Contemporary Educational Psychology, 23*, 298–311.
- Harper, G. F., Mallette, B., Maheady, L., Bentley, A. E., & Moore, J. (1995). Retention and treatment failure in classwide peer tutoring: Implications for further research. *Journal of Behavioral Education, 5*, 399–414.
- Hineline, P. N. (1974a). An experimental approach to learning: Introduction for students. In R. Ulrich, T. Stachnik, & J. Mabry (Eds.), *Control of human behavior: Vol. 3. Behavior modification in education* (pp. 153–160). Scott Foresman.
- Hineline, P. N. (1974b). An experimental approach to learning: Introduction for teachers. In R. Ulrich, T. Stachnik, & J. Mabry (Eds.), *Control of human behavior: Vol. 3. Behavior modification in education*. Scott Foresman.
- Johnson, K. R., & Layng, T. V. J. (1992). Breaking the structuralist barrier literacy and numeracy with fluency. *American Psychologist, 47*, 1475–1489.
- Keller, F. S. (1968). Good-bye teacher . . . *Journal of Applied Behavior Analysis, 1*, 79–89.
- Kulik, J. A., Kulik, C. C., & Cohen, P. A. (1979). A meta-analysis of outcome studies of Keller’s personalized system of instruction. *American Psychologist, 34*, 307–318.
- Lindsley, O. R. (1964). Direct measurement and prosthesis of retarded behavior. *Journal of Education, 147*, 62–81.
- Lloyd, K. E., Garlington, W. K., Lowry, D., Burgess, H., Euler, H. A., & Knowlton, W. R. (1972). A note on some reinforcing properties of university lectures. *Journal of Applied Behavior Analysis, 5*, 151–155.
- Machado, A., & Silva, F. J. (1998). Greatness and misery in the teaching of the psychology of learning. *Journal of the Experimental Analysis of Behavior, 70*, 215–234.
- McMichael, J. S., & Corey, J. R. (1969). Contingency management in an introductory psychology course produces better learning. *Journal of Applied Behavior Analysis, 2*, 79–83.
- Pear, J. J., & Crone-Todd, D. E. (1999). Personalized system of instruction in cyberspace. *Journal of Applied Behavior Analysis, 32*, 205–209.
- Pennypacker, H. S., Koenig, C. H., & Lindsley, O. R. (1972). *Handbook of the standard behavior chart*. Kansas City, KS: Precision Media.
- Rittschof, K. A., & Griffin, B. W. (2001). Reciprocal peer tutoring: Re-examining the value of a co-operative learning technique to college students and instructors. *Educational Psychology, 21*, 313–331.

APPENDIX A

Sample Preparation Guide from an Undergraduate Course

PREPARATION GUIDE 6

Based upon Malott, Whaley, and Malott (4th ed., p. 94–120), for interteaching on Wednesday, September 20.

**Identifies questions that are not directly answered in the book.

- Describe how it is that the “law of effect” characterizes both reinforcement effects and punishment effects.
- Regarding pp. 97–99:
 - Describe a reversal design, and explain the role of its baseline conditions.
 - Often, in applied research, ABAB designs are preferred over ABA designs. Why is this so?

3. (a) Describe an extinction procedure, as applied to Lucille's office visits, and describe the effects of that procedure.
 - (b) How does the extinction procedure differ from a penalty procedure? (cf. pp. 94-95)
4. (a) Describe the traditional way parents attempt to reduce bedtime crying. What is wrong with this technique?
 - (b) Describe the use of extinction to reduce bedtime crying. Include the reinforcer withheld and the results.
 - (c) Draw a hypothetical graph [because the authors did not supply actual data] that illustrates the pattern of behavior that occurred during the extinction of bedtime crying. What parts of your graph illustrate spontaneous recovery? How so?
5. Compare and contrast extinction, response cost, and time-out (a) with the example of Uncle Sid and his swearing niece and nephew, (b) with an example of your own devising. (c) What are the advantages and disadvantages of each?
6. Describe the two distinct contingencies that were discontinued in the extinction of Laura's vomiting. (pp. 109-110)
7. Why was a punishment procedure preferable to an extinction procedure for reducing Judy's self-injurious behavior, as described on pp. 111-112?
8. Explain: "Recovery after punishment is discontinued and extinction after reinforcement is discontinued are closely analogous, but opposite

in direction" (pp. 113-114). Identify the features of the two graphs in Figure 6.10 that illustrate this statement.

9. What are the differences between extinction and forgetting? Describe some common examples that illustrate the difference.

APPENDIX B

Record of Interteaching

Date: _____

Guide number and topic _____

Participants: _____

Duration of interteach: _____

Sufficient time provided? _____

Quality of session (on a scale of 1 = *poor* to 10 = *excellent*): _____

Topics that gave difficulty, and the nature of the difficulty (e.g., text was unclear, question was ambiguous):

Topics you would like covered in class:

What parts did you find most interesting?

If a question were to be omitted, which should it be?

Other comments or suggestions?
Please give me feedback.