Exceptional Children, Vol. 61, No. 2, pp. 197-210.

Development and Validation of Standard Classroom Observation Systems for School Practitioners: Ecobehavioral Assessment Systems Software (EBASS)

CHARLES R. GREENWOOD
JUDITH J. CARTA
DEBRA KAMPS
BARBARA TERRY
JOSEPH DELQUADRI
University of Kansas

ABSTRACT: This article describes the development and validation of Ecobehavioral Assessment Systems Software (EBASS), a computer-assisted observational system for school practitioners. EBASS contains three instruments widely used in special education research—CISSAR, ESCAPE, and MS-CISSAR. The theoretical and empirical bases for these systems are presented in the context of the need for quality information on student behavior and the teaching environment in special education. Portable computers, used to support observational assessment, vastly improve the quality of data entry, case management, data analysis, and observer training. The article describes the background, instruments, supporting technology, validation research, and barriers to the use of computer-assisted observational assessment.

□ In the past 2 decades, we have made major progress in understanding the relationship between classroom instructional processes and learning outcomes in both general (Brophy & Good, 1986) and special education (see the special issue, "Enhancing the Education of Difficult to Teach Students in the Mainstream: Federally Sponsored Research," of *Exceptional Children*, 1990, Vol. 57, Issue 2). Improved observational methods for assessing classroom instructional processes and the use of this information to guide teaching practice have contributed to this knowledge. Observational assessment, like other direct assessment methods (e.g., curriculum-based measurement), shares the principle of measurement within the context of the classroom environment, the curriculum, and the ongoing effort to teach (Deno, 1984). Unlike much of traditional assessment that is sensitive to individual differences between students but not the effects of teaching (e.g., norm-referenced tests), measurement with implications for improving teaching and learning must be sensitive to changes in teaching (Deno, Mirkin, & Chiang, 1982; Hayes, Nelson, & Jarrett, 1987). Classroom observation protocols honor this assumption by recording one or more classroom processes, such as (a) the behavior of the student, (b) the behavior of the teacher, (c) the materials in use, and (d) the interactions between and among these variables.

One of these approaches, the "ecobehavioral framework" (Greenwood, Carta, Kamps, & Arreaga-Mayer, 1990; Rogers-Warren & Warren, 1977), combines ecological and behavioral process information in ways that provide a system for studying the covariation and relationship between these constructs in time (Morris & Midgley, 1990). For example, instruments based on this approach are capable of generating the displays of individual behaviors expected in a typical behavioral assessment. However, because ecobehavioral taxonomies include ecological variables, they provide similar analyses of environmental variables (e.g., settings, subject matter, or materials) and teacher behaviors, as well. Further, because ecobehavioral taxonomies lead to identification of classroom situational factors that either promote or reduce the occurrence of specific behaviors (Greenwood, Carta, & Atwater, 1991; Repp & Dietz, 1990), a sophisticated range of analyses may be obtained for use in changing instruction.

The ecobehavioral approach has been enhanced by the availability of ecobehavioral classroom observation instruments for use by school practitioners. We describe a 13-year program of research that has led to three specific classroom observational instruments, now available together in *Ecobehavioral Assessment Systems Software (EBASS)*, a computerized observational assessment system for local education agency (LEA) practitioners (Greenwood, Carta, Kamps, & Delquadri, 1992).

A PROGRAM OF ECOBEHAVIORAL RESEARCH TO IMPROVE STUDENT BEHAVIOR AND ACADEMIC OUTCOMES

Code for Instructional Structure and Student Academic Response: CISSAR

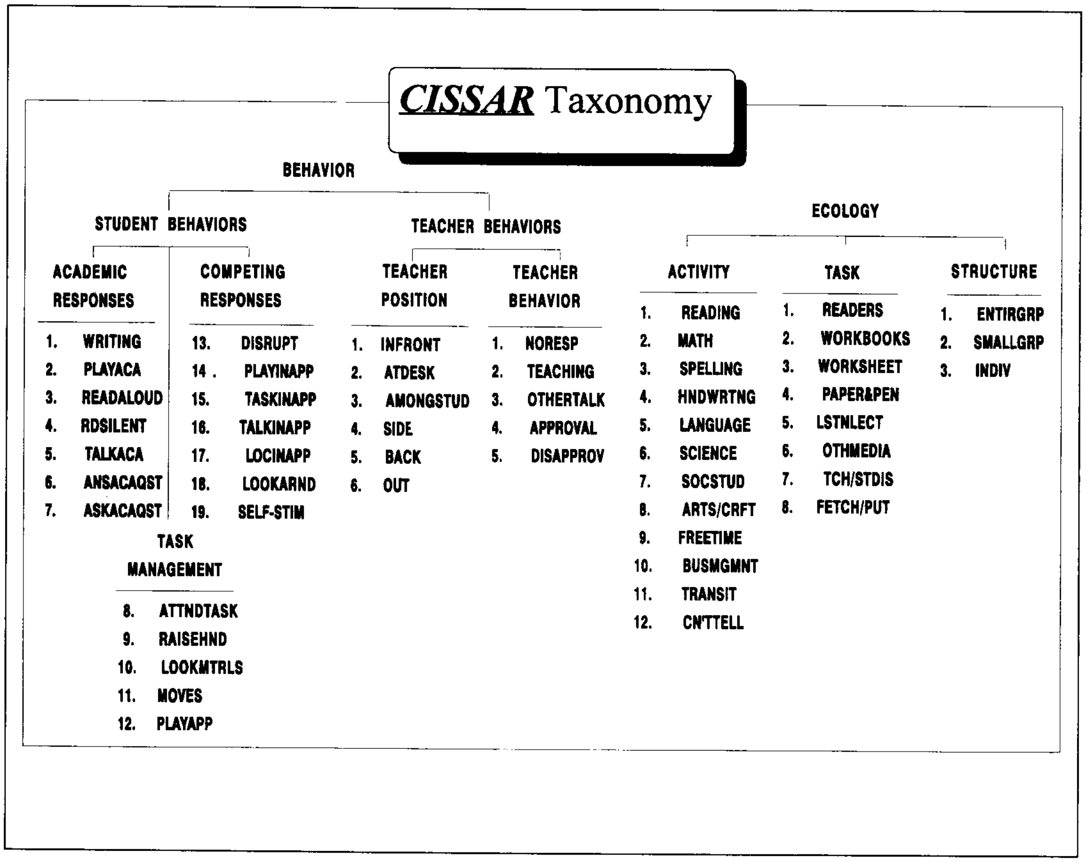
Compared to earlier pioneering lines of observational research in special education that assessed primarily student behavior (e.g., Hall, Lund, & Jackson, 1968; Walker & Buckley, 1968), or teacher-student interaction (e.g., Flanders, 1970; Semmel, 1975), the ecobehavioral approach represents an expansion in concept, scope, and function. In the *Code for Instructional Structure and Student Academic Response (CISSAR)* (Stanley & Greenwood, 1981), we sought to combine (a) classroom ecology, (b) teacher behavior, and (c) student behavior events within a single taxonomy. CISSAR became a taxonomy of 53 individual events recorded in relatively equal priority during an observation (see Figure 1). A momentary time-sampling procedure was used to prompt observers' recording of events every 10 s, because it provided a reliable framework for recording so many variables. Moreover, second to real-time recording, it provided the most reliable and accurate means of estimating frequency and duration (Ary, 1984; Powell, 1984; Powell, Martindale, & Kulp, 1975).

CISSAR was validated in a preliminary study of the instruction and achievement of disadvantaged students attending Title 1 (now Chapter 1) schools versus students attending non-Title 1 schools (Greenwood, Delquadri, & Hall, 1984; Stanley & Greenwood, 1983). The instrument was shown to be sensitive to ecological differences in instruction and student behavior. A primary finding, supported in this and subsequent research (e.g., Cooper & Speece, 1990a, 1990b; Greenwood, 1991), was the significantly lower engagement in academic responding of at-risk students compared to nondisadvantaged students (Greenwood, Delquadri, Stanley, Terry, & Hall, 1985; Stanley & Greenwood, 1983).

CISSAR was also used in an extensive program of research designed to describe and compare differences in the instruction of students with and without disabilities (e.g., Thurlow, Ysseldyke, Graden, & Algozzine, 1984; Ysseldyke, Thurlow, Christenson, & Weiss, 1987). Taken as a whole, this research reported few differences between instructional features in special and general education settings, relative to the CISSAR taxonomy. Thus, the unique aspect of special education instruction was called into question.

Other researchers have adapted the CISSAR taxonomy for use in other similar instruments (Friedman, Cancelli, & Yoshida, 1988). Researchers have used the system in the training of school psychologists (Skiba, Commings, & Lin, 1992); as a measure in studies of young students at risk for special education placement (Cooper & Speece, 1990a, 1990b); in school district evaluation studies (Nelson, 1986); and in providing feedback to teachers in training (Otis-Wilborn, 1986).

FIGURE 1
CISSAR Taxonomy of Ecobehavioral Events by Category (3), Subcategory (8), and Individual Events Within Each (53)



Note: CISSAR=Code for Instructional Structure and Student Academic Response (Stanley & Greenwood, 1981). The three major categories are student behaviors, teacher behaviors, and ecology.

Ecobehavioral System for Complex Analyses of Preschool Environments: ESCAPE

The *Ecobehavioral System for Complex Analyses of Preschool Environments: ESCAPE* (Carta, Greenwood, & Atwater, 1985) was developed and validated in several studies of preschool instruction. We developed the instrument in response to the need for improved systems for generating information concerning the effectiveness of preschool instruction (Carta & Greenwood, 1985). The ESCAPE taxonomy modeled CISSAR in that classroom ecology, teacher, and student behavior events were included. ESCAPE also employed a momentary time-sampling recording procedure based on 15-s intervals. The ESCAPE taxonomy was designed to reflect the unique preschool program ecology, teacher events, and the behaviors of children 3-5 years of age, with and without disabilities. The full ESCAPE taxonomy included a total of 101 individual events organized within 12 subcategories (6 ecology, 3 teacher, and 3 student categories).

Studies using ESCAPE have provided important empirical descriptions of preschool programs and of preschoolers' behavior. For example, Carta, Greenwood, & Robinson (1987) reported that the most frequently occurring student behavior was *looking* at (a) a teacher, (b) a peer interacting with the child, or (c) some material. For only 36% of the day were children engaged in active behaviors (i.e., manipulate, self-care, gross-motor, pretend, preacademic work, and sing/recite); and in only 2% of the typical day were students engaged in preacademic work. In other studies (e.g., Carta, Atwater, Schwartz, & Miller, 1990), researchers made comparisons between children's current special preschool classrooms and their next environment—regular kindergarten programs. The findings led to intervention studies designed to better prepare preschoolers for the transition to kindergarten by exposing them to similar activities and teaching them specific survival skills (Atwater, Carta, Connell, et al., 1989). Other researchers used the ESCAPE taxonomy to study teacher-child interactions (Hundert, Mahoney, & Hopkins, 1993), the effects of supervisor training on teacher-student interactions (Hundert, 1994), and as a basis for developing taxonomies for practitioner-oriented observation instruments (Bramlett & Barnett, 1993).

Mainstream Version of CISSAR: MS-CISSAR

The advent of mainstreaming and inclusion prompted the need for assessment that could account for differences in students' educational settings, teachers, and novel instructional practices (Kamps, Greenwood, & Leonard, 1991). In response to this need, we extended the CISSAR taxonomy in several dimensions to improve its sensitivity to both regular and special education ecologies, teacher behaviors, and student behaviors for children 6 to 15 years (elementary and middle school). From the 53-event CISSAR taxonomy, we developed a 99-event taxonomy (5 ecology, 4 teacher, and 4 student subcategories). In brief, the *Mainstream CISSAR* or the MS-CISSAR (Carta, Greenwood, Schulte, Arreaga-Mayer, & Terry, 1987) added a *Settings* ecological category to record factors such as resource room, regular class, and self-contained class and added subject-matter activities experienced by students with disabilities (e.g., self-care, prevocational, etc.). MS-CISSAR also increased the number of teacher categories (i.e., aide, peer tutor) and their behavior (e.g., commands, questions, and talk) for greater sensitivity.

In studies of the instruction provided students with learning disabilities, who are experiencing some degree of mainstreaming, MS-CISSAR produced descriptions of their daily programs (Greenwood, Arreaga-Mayer, & Carta, 1994; Greenwood, Carta, Arreaga-Mayer, & Rager, 1991). As in prior research, findings suggested relatively low levels of student engagement in academic responding that covaried with instruction in which students had no materials, had to wait for long periods for teacher interaction, or were otherwise involved in noninstructional activities and tasks (Kamps, Leonard, Dugan, Boland, & Greenwood, 1991).

CONTRIBUTION OF TECHNOLOGY

Computer technology has played an important role in the development of observational instruments such as CISSAR and EBASS (Rep, Harman, Felce, Van Acker, & Karsh, 1989; Rieth, Haus, & Bahr, 1989; Saudargas & Bunn, 1989; Semmel, 1976). Initially, electronic technology replaced the mechanical stopwatches and counters previously used to record the durations and frequencies of behavior. Currently, portable computers provide these and other functions, including observer training, calibration, data collection, case and database management, numerical analysis, and graphic displays.

Management of Data Collected Using Paper-and-Pencil Methods

Before computer-assisted instruments were available, observers typically collected data by using paper-and-pencil protocols (Stanley & Greenwood, 1981). When needed, dubbed audiocassette tapes or electronic interval timers, provided the intervals that often paced observers' recording of data. Researchers completed data analyses by using electronic calculators and drawing graphs by hand.

Researchers initially used computers to perform numerical analysis of observational data collected by hand. In the 1970s, the preliminary step of data entry involved typing the data into a university mainframe computer for purposes of storage and processing. In the early 1980s, hand entry of data was replaced partially by optical scanning technology that vastly reduced the time required (e.g., Greenwood, Hops, et al., 1979). However, both hand entry and optical scanning required a verification step, in which data-entry errors (as opposed to observer recording errors) were checked against the original documents and errors corrected. Estimates varied, but verification often required as much time as the initial entry of the data.

Next, researchers numerically analyzed the verified and corrected data, using software with the computational routines necessary to produce the summary scores, analyses, and displays needed. In the case of CISSAR, computer analyses were essential to the development of two useful data displays: (a) environment-behavior description in terms of percentage occurrence and (b) environment-behavior covariation in the form of conditional probabilities (Greenwood & Carta, 1987). With the computer, analyses of the 53 CISSAR variables became routine; by hand, they were time consuming, tedious, and inaccurate.

Computerizing Data Collection

A major improvement was direct data entry into the computer. This was first achieved in the mid-1970s: Observers used a key pad with either a cable or a telephone connection to the mainframe computer. The major advantage of direct entry, of course, was elimination of the verification step. Yet this technology was severely restricted to settings such as university lab schools with connections to campus computers.

Practical classroom applications of computer-assisted data collection arrived with the first generation of truly portable microcomputers (e.g., Rieth et al., 1989; Saudargas & Bunn, 1989). ESCAPE was the first instrument that we designed for use on a hand-held computer (Carta, 1988). These first-generation, affordable, programmable computers (e.g., Tandy Model 100, NEC Model 8201) were battery powered, had 32 to 96 KB random access memories, and lacked disk drives. As with ESCAPE, MS-CISSAR was written directly for use on this generation of laptop computer (the NEC 8300); and thereafter, the original CISSAR instrument was converted for use on this computer.

In contrast, the present generation of portable computers provides nearly full office capabilities to professionals who are on the road. Today's portable computer includes a hard drive, a floppy drive, and memory enough to rival most desktop computers—and many now have color screens. The average portable computer is powered by a 486 MHz processor; has a monochrome screen, weighs 3.4 kg; has a battery life of 2 hr, 25 min (e.g., Howard, 1993); and costs about $2,000. Portable computers appropriate for classroom observations currently on the market, in descending order of size, include the notebook (3.2-6.8 kg), subnotebook (1.8-2.7 kg), and palmtop (0.5-1.4 kg).

Researchers have developed observational instrument software for use with portable computers and for assessing educational and parenting applications (e.g., Barton & Johnson, 1990; Horner & Storey, 1989; Repp et al., 1989). Other researchers have developed instruments for assessing bilingual special education (ESCRIBE: Arreaga-Mayer, Tapia, & Carta, 1993); the interactions between teachers and preschool students (ACCESS: Atwater, Carta, & Schwartz, 1989); social interaction among peers and students and teachers (MOOSES: Tapp & Wehby, 1992); event and duration information in the classroom, clinic, or community (PCS: Communitech International, 1993; EMPIRICIST: Ironwood Development Systems, 1993), caregivers and infants in the hospital and home (CIRCLE 1: Baggett et al., 1993) and toddlers/preschoolers in the home and at preschool (CIRCLE 2: Atwater, Montagna, Creighton, Williams, & Hou, 1993).

Numerical Analyses

Percentage Occurrence. Percentage occurrence data allowed us to answer questions about the relative frequency and distribution of events within the ecobehavioral taxonomy of variables. Thus, one could display the profile of all student behaviors. In addition, it was possible to form composite scores (i.e., academic responding) based on the sum of occurrences of seven individual academic responses. As noted earlier, the academic-response composite has become of particular interest because it had been shown to be a correlate of achievement (Greenwood, 1991).

Change Over Time. Graphical capability enabled us to examine individual change in percentage occurrence over time as a function of intervention. We were able to graph baseline-to-treatment changes in events such as students' academic talk; composites such as academic responding; and the amounts of time students were exposed to subject matter, materials, and grouping. In addition, the new technology enabled us to graph teachers' behavior as they implemented the instructional intervention (classwide peer tutoring = CWPT) (Greenwood, Dinwiddie, et al., 1984) or as they made efforts to integrate students in the regular classroom (Keefe, 1994; Lowe, 1993).

Normative Peer Comparisons. Normative peer comparisons of the behavior profiles of a target student versus those of an index peer were useful in forming decisions about the severity of a behavior problem and its appropriateness or inappropriateness (e.g., Walker & Hops, 1976). Researchers have been able to compute the differences between target and normative peers, compute statistics on the similarity of their behavior profiles (Nunnally, 1967), and display the profiles for visual analysis.

Current Versus Next-Placement Setting Comparisons. We found that profile analyses could be extended to the environmental variables; and these analyses were helpful in assessing differences between present and next placement settings (Cone & Hoier, 1986; Hoier, McConnell, & Palley, 1987). The analyses were helpful in planning transitions, establishing and assessing progress towards transition goals, and guiding transenvironmental programming (Anderson-Inman, Walker, & Purcell, 1984).

Behavior-Environment Relations. Computer-assisted analyses also enabled researchers to assess how a student's behavior changed relative to changes in the classroom ecology and teacher behavior. Analyses produce indexes of environment-behavior covariation as reflected in the conditional probability of responding, given specific environmental conditions (see Figure 2). These analyses identified which materials and teacher behaviors during subject-matter instruction promoted specific student behaviors (Greenwood, Delquadri, et al., 1985); and the results were useful in planning changes in instruction in specific ways. Similar analyses identified types of teachers (e.g., aides) and teacher behaviors (e.g., talk management) that appeared to trigger or promote inappropriate behaviors. Computer software enabled rapid calculation and displays of these probabilities and their statistical significance, when compared to base-level probabilities (the unconditional probability) of a response occurring. These analyses of environment-behavior relations led to hypotheses about how instruction appeared to regulate student responding, and they suggested ways to increase academic responding and decrease inappropriate behavior.

Advances in Practitioner-Oriented, Computerized-Assisted Observation Software

Unlike research instruments, practitioner-oriented software was needed that worked successfully and reliably when implemented by persons who were not sophisticated computer users and in settings where extensive help would not be available. Practitioners also needed user-friendly, flexible software, capable of providing a range of functions, in addition to data collection. For example, practitioners needed the option to modify an instrument to suit specific needs (Greenwood & Carta, 1987). They also needed inservice training opportunities for learning to use these instruments.

ECOBEHAVIORAL ASSESSMENT SYSTEMS SOFTWARE (EBASS)

Features

EBASS is a practitioner-oriented software instrument package (Greenwood, Carta, Kamps, & Delquadri, 1992) that can be used to observe, assess, and modify classroom instruction. Table 1 illustrates that EBASS contains the ESCAPE, CISSAR, and MS-CISSAR instruments.

EBASS is designed to run on any portable computer with at least one floppy drive. As can be seen in Figure 3, EBASS contains *Tutorial* and *Data* software features and tools. Tutorial features include computer-assisted training exercises for each instrument and calibration checks for establishing reliability standards. Data features include data collection, including instrument selection; instrument modification (downsizing); and control of data entry, data analysis, database capabilities, and file management, among others. Augmenting the computerized tutorial system, instructional manuals and videotapes provide technical information, examples, and simulations. In combination, these materials support a self-instructional, mastery-based approach to learning how to use each EBASS instrument.

Learning an Instrument

The EBASS tutorial module provides the means of learning *event definitions* on the computer, with immediate correction and feedback on performance. These skills were previously taught using a combination of text information and drill-and-practice methods.

FIGURE 2
The Probability of Writing Behavior Given a Two-Level Ecological Model Defined by Activities and Task Materials

Probability Analysis of Ecobehavioral Relations

---------------<ECOLOGICAL MODEL>--------------------|----------<OUTCOME Behavior>---------

ACTIVITY AND TASK — **ACADEMIC RESPONDING**

OUTCOME BEHAVIORS: ***Writing***

---------<ECOLOGICAL MODEL>---|---<VALUES> (at least 10% of data)	FREQ	PCT	FREQ	CONDITIONAL PROB	Z-SCORE	SIGNIFI-CANCE
Reading+Readers	75	30	1	0.01	-2.664	.01
Reading+Paper/Pen	71	29	19	0.27	2.295	.05
Reading+Discussn	56	22	2	0.04	-1.980	.05
Spelling+Paper/Pen	47	19	15	0.32	2.782	.01
				UNCONDITIONAL PROBABILITY		
TOTAL SEQUENCES USED	249	80	37	0.15		
TOTAL SEQUENCES RECORDED	310					

Press ENTER to continue.

```
                        Conditional Probability of Outcome Behaviors
ECOLOGICAL MODEL        0       0.1      0.2      0.3      0.4
     Values             |--------|--------|--------|--------|----

Reading+Readers      0.01XXXXXXX|
Reading+Paper/Pen               |XXXXXXX0.27
Reading+Discussn       0.04XXXXX|
Spelling+Paper/Pen              |XXXXXXXXXX0.32
                                |
                              0.15
                      (base probability level)
Press ENTER to continue.
```

Note: Screens display CISSAR frequencies of each observed ecological value, the conditional probability of its occurrence with writing behavior, the statistical significance of each (upper panel), and a graphic display of these probabilities as compared to the base level or unconditional probability (lower panel).

TABLE 1
Comparison of CISSAR, MS-CISSAR, and ESCAPE Taxonomies Across Ecological, Teacher, and Student Behavior Event Categories

Attribute	*Description*	*CISSAR*	*MS-CISSAR*	*ESCAPE*
	Ecology			
Setting	Service delivery settings	0	11	0
Activity	Subject of instruction	12	20	13
Activity structure	Degree of teacher direction	0	0	5
Task/material	Curriculum situation	8	9	13
Location	Classroom location	0	0	9
Physical location	Seating arrangement	3	3	5
Instructional grouping	Instructional pattern	0	5	0
Disability composition	Degree of integration	0	0	7
	Teacher			
Definition	Person teaching student	0	9	8
Location	Position relative to student	6	5	0
Focus	Recipient of teacher behavior	0	4	5
Behavior	Teacher response	5	11	15
	Student			
Academic response	Engagement	7	6	10
Task management	Enabling behavior	5	7	0
Inappropriate response	Competing behavior	7	8	6
Talk	Verbalizations	0	0	5
	Summary			
Total events		53	99	101
Subcategories		9	13	12
Categories		3	3	3

Note: CISSAR = Code for Instructional Structure and Student Academic Response (Stanley & Greenwood, 1981); MS-CISSAR = Mainstream version of the CISSAR (Kamps, Greenwood, & Leonard, 1991); ESCAPE = Ecobehavioral System for Complex Analyses of Preschool Environments (Carta, Greenwood, & Atwater, 1985).

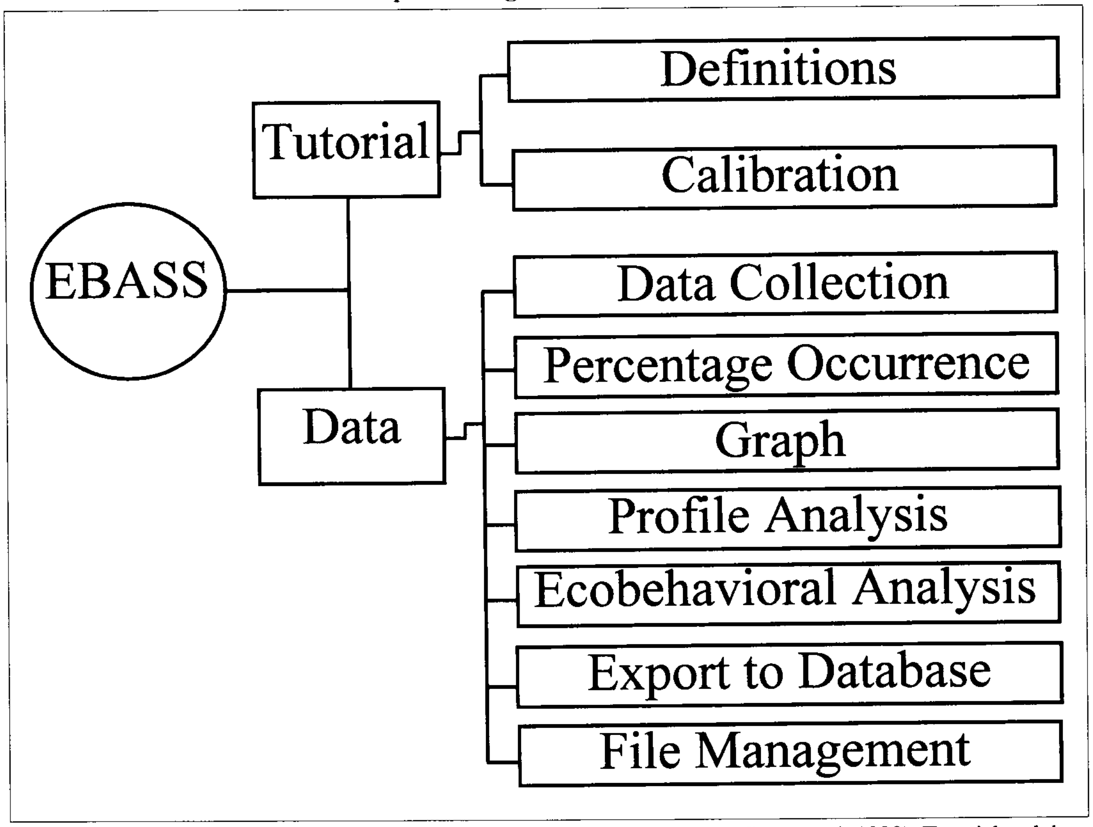
In the tutorial, after selecting the instrument, the learner works through three progressive levels of difficulty: (1) *student behavior;* (2) student behavior and *teacher behavior*; and (3) student behavior, teacher behavior, and *ecology*. This strategy requires the learner to work on new material while reviewing previously learned material.

The learner is presented a written classroom scenario to read, followed by an opportunity to enter the appropriate event codes using the format used in actual data entry. Thus, data entry and event definitions are taught. Each entry is evaluated by the computer; and, if correct, a new scenario is presented. Otherwise, a correction screen is presented, allowing the trainee to compare the definition entered against the correct entry. After each tutorial session, the computer provides a detailed summary of the trainee's performance at that level of learning and provides advice for future study. Thus, computer support of training makes a self-instructional format a reality.

Development and Validation

EBASS was developed during a 3-year project that used a standard software-development design, supplemented by several key studies designed to guide its development and validation. The studies included a survey of school psychologists' preferences, the comparability of adapted versions of the instruments, and trials by school psychologists.

FIGURE 3
Top-Level Organization of EBASS



Note: EBASS = Ecobehavioral Assessment Systems Software (Greenwood, Carta, et al.,1992). Tutorial and data functions are broken down by their major components (e.g., instrument definitions, calibration, data collection, graphing, profile analysis, ecobehavioral analysis, export, and file management).

Study I. We conducted a national survey of members of the National Association of School Psychologists to assess features of observation instruments that were important to school psychologists. Included in the survey were items related to demographic information, professional orientation and activities, assessment practices, and use of computer technology.

From a list of 400 randomly selected school psychologists representing the 50 states and the District of Columbia, 260 (65%) returned questionnaires (Greenwood, Delquadri, Terry, & Schick, 1992). Eighty-two percent reported that they regularly conducted classroom observations, as did other educational professionals in their districts, including special education teachers, resource room teachers, and others. Factors they reported that would influence their use of observational assessment included greater availability of published instruments (76%); availability of instruments with normative standards (83%); systems-supporting collection, analysis, and interpretation of observational data (65%); and more frequent opportunities for instrument training (76%). Respondents reported the following drawbacks to the use of observational assessment, in rank order: time required to conduct observations, necessity of interobserver agreement checks, limited use of most instruments in the literature, informal design of most instruments, limited training opportunities, limited norms/technical standardization data available, and limited training materials.

We addressed these concerns in the development of EBASS. For example, we addressed the issues of instrument quality by including instruments with histories of use in special education research (i.e., ESCAPE, CISSAR, and MS-

CISSAR) and with established technical information. To address the concern over interobserver agreement that required observations with partners, we developed videotapes for purposes of calibration. Thus, instead of checking against a partner, trainees could privately view a video to evaluate percentage agreement against standards. To address the concern about limited training opportunities, we developed a self-instructional package that includes software, video, and text materials in a sequence of steps from orientation to calibration.

Study II. A feature desired by practitioners was the ability to modify the instrument taxonomy, but preserve integrity and standardization. We had first addressed this issue by providing a downsized, paper-and-pencil version of CISSAR for school practitioners (Greenwood & Carta, 1987). Other software systems have addressed this issue by supporting the full or partial authoring of customized instruments (e.g., S + K Products, n.d.; Tapp & Wehby, 1992).

However, because we intended to provide standardized instruments in EBASS, we decided to provide downsizing rather than authoring. *Downsizing* refers to the option of leaving out categories and subcategories of a taxonomy, but not changing definitions or adding new events to be recorded. Downsizing in EBASS retains only those original variables that a practitioner needs for a specific application. For example, instead of using all 12 subcategories of ESCAPE, a practitioner can decide to select and record only (a) the size of the instructional group, (b) the teacher's behavior, and (c) the student's behavior—and ignore the other 9 subcategories.

Although providing downsizing was relatively easy, doing so potentially affected the comparability of the scores obtained in a downsized instrument versus a full-sized instrument, because of differences in complexity and changes in time-sampling patterns. The workload on the observer (complexity) is a factor known to affect accuracy (Dorsey, Nelson, & Hayes, 1986). In a downsized taxonomy, observers are handling fewer events and recording these events more frequently, as compared to the original instrument. We addressed these issues by (a) taking steps to preserve the original time-sampling pattern and (b) conducting a comparison of the three instruments under variations in complexity to investigate discrepancies in obtained scores.

The general research question addressed the issue of differences in accuracy arising under three levels of recording complexity: *high* (all subcategories), *intermediate* (teacher and student events), and *low* (student events only). Under high complexity, the observers recorded all events (53, 99, and 101 for CISSAR, MS-CISSAR, and ESCAPE, respectively). Under intermediate complexity, observers recorded 31, 51, and 49 events, eliminating all ecological events. Under low complexity, observers recorded only student behavior (19, 21, and 21 for CISSAR, MS-CISSAR, and ESCAPE, respectively). Results were relatively uniform across instruments. Overall, the effects of complexity on accuracy were small and insignificant, ranging from between 0 to 1% across individual behaviors for CISSAR; 0 to 2% for MS-CISSAR; and −1 to 2% for ESCAPE. Thus, based on these comparisons of data collected between full-sized and downsized versions of the same instrument, we concluded that downsizing did not adversely affect comparability of data and that it was an appropriate procedure to offer assessors.

Study III. EBASS was validated in several stages, and its development is ongoing. In the first stage, we formed an advisory group of school psychologists from six local school districts to support planning and feedback on assessment functions and preferences.From among this group, we trained three psychologists in a pilot test of the first prototype.

At this stage, we tested the data-entry screens used for each instrument and the satisfaction of the observers under conditions of actual observation. Similarly, we tested the EBASS tutorials for each of the three instruments, for accuracy, function, and satisfaction. Last, we evaluated and improved the analytic tools and their interpretation, based on feedback from school psychologists using the program.

With improvements made and incorporated into the software, manuals, and videos, we began the second stage of field testing EBASS. This stage involved school psychologists and other educational professionals (i.e., school principals, paraprofessionals, special educators, counselors, and teachers) in two districts (*n*s = 20 and 13, respectively). These two groups were led by two of the school psychologists who had previously used the EBASS materials. In both sites, school psychologists used EBASS on Macintosh PowerBook computers (160s, with PC emulation software) that had been acquired by the districts specifically for the purpose of observational assessment. Funds in both sites were obtained from grants from the State Department of Education as part of LEA plans for improving the quality of the special education program and its evaluation. Across both sites, approximately 340 individual observations were collected; and the information was used to inform a range of questions, including case referrals, inclusion effectiveness issues, prereferral interventions, and behavior-disorders programming. During the third phase of field testing, we disseminated EBASS to five sites across the United States to explore the instrument's viability off site. At one site, EBASS was used as the basis for doctoral dissertation research that focused on the effects of integration (Keefe, 1994). At other sites, the instrument has been used in other research projects. Results in each site indicated that (a) trainees were able to learn one or more of the EBASS instruments, (b) they conducted systematic observations using EBASS for a range of purposes, (c) these data were incorporated into the individualized education programs (IEPs) and prereferral interventions of specific children, and (d) teachers and school psychologists found the results useful.

BARRIERS TO IMPLEMENTATION

The two most obvious barriers to the wide-scale use of this assessment technology are the availability of high-quality instrument software and portable computers within the LEA. Our experience has been that both software and computers become increasingly available if school psychologists and special education assessors are aware of the possibilities and develop this need within their own settings. In all the districts with whom we have worked, some means existed for acquiring the technology, although acquisitions have taken time, planning, and creativity.

Perhaps the greater barrier to future use of classroom observational assessment in general, is its perceived and actual contribution to the mission of special education. Based on trends in policies and initiatives, the need for classroom behavioral and environmental data in special education is increasing. As one cogent example, recent federal efforts are encouraging LEAs to incorporate *the opportunity to learn a subject matter at school* into Chapter 1 evaluations of student achievement (Stevens & Grimes, 1993). Ecobehavioral observational measurement is one established measure of this construct.

Training in the use of computer-assisted observational assessment is also an issue in reducing the gap between research and practice in this area. Graduate-level preservice training in the use of computer-assisted observational assessment is particularly needed. Similar training experiences are needed at the inservice level, directed at the role that observation plays in teaching decisions and how observational data may be incorporated into the broader scheme of educational assessment and data management systems employed in an LEA. All these considerations must be addressed before the use of computerized observation systems such as EBASS will translate into better decisions, better services, and better outcomes for children.

REFERENCES

Anderson-Inman, L., Walker, H. M., & Purcell, J. (1984). Promoting the transfer of skills across settings: Transenvironmental programming of handicapped students in the mainstream. In W. Heward, T. Heron, D. Hill, & J. Trap-Porter (Eds.), *Behavior analysis in education* (pp. 17-37). Columbus, OH: Charles E. Merrill.

Arreaga-Mayer, C., Tapia, Y. & Carta, J. J. (1993). *Ecobehavioral System for the Complex Recording of Interactional Bilingual Environments (ESCRIBE): Observers manual.* Kansas City: Juniper Gardens Children's Project, University of Kansas.

Ary, D. (1984). Mathematical explanation of error in duration recording using partial interval, whole interval, and momentary time sampling. *Behavioral Assessment, 6,* 221-228.

Atwater, J., Carta, J., Connell, M., Dougherty, J., Rinkle, P., Schwartz, I., & Trissel, D. (1989, October). *Ecobehavioral assessment of children's classroom survival skills: A multi-level approach.* Poster presented at the Division for Early Childhood Conference, Minneapolis.

Atwater, J. B., Carta, J. J., & Schwartz, I. S. (1989). *Assessment code/checklist for the evaluation of survival skills: ACCESS.* Kansas City: Juniper Gardens Children's Project, Bureau of Child Research, University of Kansas.

Atwater, J., Montagna, D., Creighton, M. A., Williams, R., & Hou, S. (1993). *CIRCLE-2: Code for Interactive Recording of Caregiving and Learning Environments* (Infancy through early childhood). Kansas City, KS: Early Childhood Research Institute on Substance Abuse.

Baggett, K., Atwater, J., Peterson, P., Montagna, D., Creighton, M. A., Williams, R., & Hou, S. (1993). *CIRCLE-1: Code for Interactive Recording of Car-*

egiving and Learning Environments (Early infancy). Kansas City, KS: Early Childhood Research Institute on Substance Abuse.

Barton, L. E., & Johnson, H. A. (1990). Observational technology: An update. In S. R. Schroeder (Ed.), *Ecobehavioral analysis and developmental disabilities: The twenty-first century* (pp. 201-227). New York: Springer-Verlag.

Bramlett, R. K., & Barnett, D. W. (1993). The development of a direct observation code for use in preschool settings. *School Psychology Review, 22*, 49-62.

Brophy, J. E., & Good, T. L. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 328-375). New York: Macmillan.

Carta, J. J. (1988, July). *Using laptop computers for observation data collection.* Presentation made at the annual meeting of Office of Special Education Programs project directors, Washington, DC.

Carta, J. J., Atwater, J. B., Schwartz, I. S., & Miller, P. A. (1990). Applications of ecobehavioral analysis to the study of transitions across early education. *Education and Treatment of Children, 13*, 298-315.

Carta, J. J., & Greenwood, C. R. (1985). Ecobehavioral assessment: A methodology for examining the evaluation of early intervention programs. *Topics in Early Childhood Special Education, 5*(1), 88-104.

Carta, J. J., Greenwood, C. R., & Atwater, J. (1985). *Ecobehavioral System for Complex Assessments of Preschool Environments: (ESCAPE).* Kansas City: Juniper Gardens Children's Project, Bureau of Child Research, University of Kansas.

Carta, J. J., Greenwood, C. R., & Robinson, S. (1987). Application of an eco-behavioral approach to the evaluation of early intervention programs. In R. Prinz (Ed.), *Advances in the behavioral assessment of children and families* (Vol. 3, pp. 123-155). Greenwich, CT: JAI Press. Also see ERIC (ED 276 217)(EC 190 983).

Carta, J. J., Greenwood, C. R., Schulte, D., Arreaga-Mayer, C., & Terry, B. (1987). *The Mainstream Code for Instructional Structure and Student Academic Response (MS-CISSAR): Observer training manual.* Kansas City: Juniper Gardens Children's Project, Bureau of Child Research, University of Kansas.

Communitech International. (1993). *PCS: Portable computer systems for direct observation.* DeKalb, IL: Author.

Cone, J. D., & Hoier, T. S. (1986). Assessing children: The radical behavioral perspective. In R. J. Prinz (Ed.)., *Advances in the behavioral assessment of children and families* (Vol. 2, pp. 1-27). Greenwich, CT: JAI Press.

Cooper, D. H., & Speece, D. L. (1990a). Maintaining at risk children in regular education settings: Initial effects of individual differences and classroom environments. *Exceptional Children, 57*, 117-127.

Cooper, D. H., & Speece, D. L. (1990b). Instructional correlates of students' academic responses: Comparisons between at-risk and control students. *Early Education and Development, 4*, 279-299.

Deno, S. L. (1984). Curriculum-based measurement: The emerging alternative. *Exceptional Children, 52*, 219-233.

Deno, S. L., Mirkin, P. K., & Chiang, B. (1982). Identifying valid measures of reading. *Exceptional Children, 49*, 36-45.

Dorsey, B. L., Nelson, R., & Hayes, S. C. (1986). The effects of code complexity and of behavioral frequency on observer accuracy and interobserver agreement. *Behavioral Assessment, 8*, 349-363.

Flanders, N. (1970). *Analyzing teacher behavior.* Reading, MA: Addison-Wesley.

Friedman, D. L., Cancelli, A. A., & Yoshida, R. K. (1988). Academic engagement of elementary school children with learning disabilities. *Journal of School Psychology, 26*, 327-340.

Greenwood, C. R. (1991). Longitudinal analysis of time, engagement, and academic achievement in at-risk and non-risk students. *Exceptional Children, 57*, 521-535.

Greenwood, C. R., Arreaga-Mayer, C., & Carta, J. J. (1994). Identification and translation of effective, teacher-developed instructional procedures for general practice. *Remedial and Special Education, 15*, 140-151.

Greenwood, C. R., & Carta, J. J. (1987). An ecobehavioral analysis of instruction within special education. *Focus on Exceptional Children, 19*, 1-12.

Greenwood, C. R., Carta, J. J., Arreaga-Mayer, C., & Rager, A. (1991). The behavior analyst consulting model: Identifying and validating naturally effective instructional models. *Journal of Behavioral Education, 1*, 165-191.

Greenwood, C. R., Carta, J. J., & Atwater, J. J. (1991). Ecobehavioral analysis in the classroom: Review and implications. *Journal of Behavioral Education, 1*, 59-77.

Greenwood, C. R., Carta, J. J., Kamps, D., & Arreaga-Mayer, C. (1990). Ecobehavioral analysis of classroom instruction. In S. R. Schroeder (Ed.), *Ecobehavioral analysis and developmental disabilities: The twenty-first century* (pp. 33-63). New York: Springer-Verlag.

Greenwood, C. R., Carta, J. J., Kamps, D., & Delquadri, J. (1992). *Ecobehavioral Assessment Systems Software (EBASS): Practitioner's manual.* Kansas City: Juniper Gardens Children's Project, University of Kansas.

Greenwood, C. R., Delquadri, J., & Hall, R. V. (1984). Opportunity to respond and student academic performance. In W. Heward, T. Heron, D. Hill, & J. Trap-Porter (Eds.), *Behavior analysis in education* (pp. 58-88). Columbus, OH: Charles E. Merrill.

Greenwood, C. R., Delquadri, J., Stanley, S. O., Terry, B., & Hall, R. V. (1985). Assessment of eco-behavioral interaction in school settings. *Behavioral Assessment, 7*, 331-347.

Greenwood, C. R., Delquadri, J., Terry, B., & Schick, C. (1992). *The 1990 assessment practices of school psychologists in America*. Kansas City: Juniper Gardens Children's Project, University of Kansas.

Greenwood, C. R., Dinwiddie, G., Terry, B., Wade, L., Thibadeau, S., & Delquadri, J. (1984). Teacher-vs. peer-mediated instruction. *Journal of Applied Behavior Analysis, 17*, 521-538.

Greenwood, C. R., Hops, H., Walker, H. M., Guild, J. J., Stokes, J., Young, K. R., Keleman, K. S., & Willardson, M. (1979). Standardized classroom behavior management program (PASS): Social validation and replication studies in Utah and Oregon. *Journal of Applied Behavior Analysis, 12*, 255-271.

Hall, R. V., Lund, D., & Jackson, D. (1968). Effects of teacher attention on study behavior. *Journal of Applied Behavior Analysis, 1*, 1-12.

Hayes, S. C., Nelson, R. O., & Jarrett, R. B. (1987). The treatment utility of assessment: A functional approach to evaluating assessment quality. *American Psychologist, 42*, 963-974.

Hoier, T. S., McConnell, S., & Palley, A. G. (1987). Observational assessment for planning and evaluating educational transitions: An initial analysis of template matching. *Behavioral Assessment, 9*, 5-19.

Horner, R. H., & Storey, K. (1989). Putting behavioral units back into the stream of behavior: A consumer report. *The Behavior Therapist, 12*, 249-251.

Howard, B. (1993). Which is right for you: The portable puzzle. *PC Magazine, 12*(14), 125-272.

Hundert, J. (1994). The ecobehavioral relationship between teachers' and disabled preschoolers' behaviors before and after supervisor training. *Journal of Behavioral Education, (4)*, 75-91.

Hundert, J., Mahoney, W. J., & Hopkins, B. (1993). The relationship between the peer interaction of children with disabilities in integrated preschools and resource and classroom teacher behaviors. *Topics in Early Childhood Special Education, 13*(3), 328-343.

Ironwood Development Systems. (1993). *The EMPIRICIST: Direct observation software for interval and sequential analysis*. Brookline, MA: Author.

Kamps, D., Greenwood, C. R., & Leonard, B. (1991). Ecobehavioral assessment in classrooms serving children with autism and developmental disabilities. In R. J. Prinz (Ed.), *Advances in behavioral assessment of children and families* (pp. 203-237). New York: Jessica Kingsley.

Kamps, D., Leonard, B. R., Dugan, E. P., Boland, B., & Greenwood, C.R. (1991). The use of ecobehavioral assessment to identify naturally occurring effective procedures in classrooms serving children with autism and developmental disabilities. *Journal of Behavioral Education, 4*(1), 367-397.

Keefe, E. (1994). *Integration of students with multiple disabilities: Ecobehavioral description*. Doctoral Dissertation. Albuquerque: Department of Special Education, University of New Mexico.

Lowe, A. (1993). *An ecobehavioral analysis of an inclusion effort*. Kansas City, KS: Juniper Gardens Children's Project, University of Kansas.

Morris, E. K., & Midgley, B. D. (1990). Some historical and conceptual foundations of ecobehavioral analysis. In S. Schroeder (Ed.), *Ecobehavioral analysis and developmental disabilities: The twenty-first century* (pp. 1-32). New York: Springer-Verlag.

Nelson, C. R. (1986, May). Using ecobehavioral data in formative evaluation in a public school setting. In C. R. Greenwood (Chair), *Applied uses of ecobehavioral data: Program evaluation, teacher training, and research in regular and special education settings*. Symposium presented at the 9th Annual Convention of the Association for Behavior Analysis, Milwaukee, WI.

Nunnally, J. (1967). *Psychometric theory*. New York: McGraw-Hill.

Otis-Wilborn, A. (1986, May). Using ecobehavioral data in the training of student teachers in instructional management. In C. R. Greenwood (Chair), *Applied uses of ecobehavioral data: Program evaluation, teacher training, and research in regular and special education settings*. Symposium presented at the 9th Annual Convention of the Association for Behavior Analysis, Milwaukee, WI.

Powell, J. (1984). On the misrepresentation of realities by a widely practiced direct observation procedure: Partial interval (one-zero) sampling. *Behavioral Assessment, 6*, 209-219.

Powell, J., Martindale, A., & Kulp, S. (1975). An evaluation of time-sampling measures of behavior. *Journal of Applied Behavior Analysis, 8*, 463-470.

Repp, A. C., & Dietz, E. D. (1990). Using an ecobehavioral analysis to determine a taxonomy of stereotyped responding. In S. Schroeder (Ed.), *Ecobehavioral analysis and developmental disabilities: The twenty-first century* (pp. 122-140). New York: Springer-Verlag.

Repp, A. C., Harman, M. L., Felce, D., Van Acker, R., & Karsh, K. G. (1989). Conducting behavioral assessments on computer-collected data. *Behavioral Assessment, 11*, 249-268.

Rieth, H. J., Haus, G. J., & Bahr, C. M. (1989). The use of portable microcomputers to collect student and teacher behavior data. *Journal of Special Education Technology, 9*, 190-199.

Rogers-Warren, A. (1984). Ecobehavioral analysis. *Education and Treatment of Children, 7*, 283-304.

Rogers-Warren, A., and Warren, S. (1977). *Ecological perspectives in behavior analysis*. Baltimore: University Park Press.

S + K Computer Products Ltd. (undated). *S+K Portable event recorder*. Buffalo, NY: Author.

Saudargas, R. A., & Bunn, R. D. (1989). A hand held computer system for classroom observations. *Journal of Special Education Technology, 9*, 200-206.

Semmel, M. I. (1975). Application of systematic classroom observation to the study and modification of pupil-teacher interaction in special education. In R. Weinberg & F. H. Wood (Eds.), *Observation of pupils and teachers in mainstream and special education settings: Alternative strategies.* Minneapolis: University of Minnesota Press.

Semmel, M. I. (1976). Assessing performance of teachers through direct observation and computer processing. *Behavior Disorders, 1,* 133-143.

Skiba, R., Commings, J., & Lin, C. (1992). *Interactive video training module: Code for Instructional Structure and Student Academic Response (CISSAR).* Bloomington: Indiana University.

Stanley, S. O., & Greenwood, C. R. (1981). *Code for Instructional Structure and Student Academic Response (CISSAR): Observer's manual.* Kansas City: Juniper Gardens Children's Project, Bureau of Child Research, University of Kansas.

Stanley, S. O., & Greenwood, C. R. (1983). Assessing opportunity to respond in classroom environments through direct observation: How much opportunity to respond does the minority, disadvantaged student receive in school? *Exceptional Children, 49,* 370-373.

Stevens, F. I., & Grimes, J. (1993). *Opportunity to learn: Issues of equity for poor and minority students.* Washington, DC: National Center for Education Statistics.

Tapp, J., & Wehby, J. (1992). *Multiple Option Observation System for Experimental Studies (MOOSES).* Nashville, TN: Jon Tapp & Associates.

Thurlow, M. L., Ysseldyke, J. E., Graden, J., & Algozzine, B. (1984). Opportunity to learn for LD students receiving different levels of special education services. *Learning Disabilities Quarterly, 7,* 55-67.

Walker, H. M., & Buckley, N. K. (1968). The use of positive reinforcement in conditioning attending behavior. *Journal of Applied Behavior Analysis, 1,* 245-250.

Walker, H. M., & Hops, H. (1976). Use of normative peer data as a standard for evaluating classroom treatment effects. *Journal of Applied Behavior Analysis, 9,* 159-168.

Ysseldyke, J. E., Thurlow, M. L., Christenson, S. L., & Weiss, J. (1987). Time allocated to instruction of mentally retarded, learning disabled, emotionally disturbed, and nonhandicapped elementary students. *Journal of Special Education, 21,* 43-55.

ABOUT THE AUTHORS

CHARLES R. GREENWOOD (CEC #436), Director; JUDITH J. CARTA (CEC #436), Associate Scientist; DEBRA KAMPS (CEC #93), Associate Scientist; BARBARA TERRY (CEC #436), Assistant Scientist; and JOSEPH DELQUADRI, Assistant Scientist, Juniper Gardens Children's Project, University of Kansas, Kansas City.

The preparation of this article was supported by Grant H180B00005 from the U.S. Department of Education, Office of Special Education Programs, Division of Innovation and Development, to the University of Kansas. Additional technical support was provided by the Kansas Mental Retardation Research Center, particularly by Davida Sears, Rebecca Finney, and Janet Marquis. The opinions expressed in this article are those of the authors and do not reflect those of the funding agency.

We acknowledge the special contributions made by Liang-Shye Hou and Carl Schick. We also appreciate the contributions of Ann Lowe and Dave Crawford in guiding testing of the EBASS. We thank Olivia Pinell, Gerry Robinson, and all other school psychologists and program assessment staff who participated in the development, validation, and improvement of the entire package. We are also grateful to the Kansas City, Kansas, School District; the Turner, Kansas, District; the Olathe, Kansas, District; and their respective directors of special education, Lowell Alexander, Joseph Meyers, and Larry Cryier for their efforts. We also wish to thank the National Association of School Psychologists for their help in identifying a random sample of psychologists for participation in Study I.

For reprints and information on the EBASS, write to Dr. Charles R. Greenwood, Director, Juniper Gardens Children's Project, 1614 Washington Blvd., Kansas City, KS 66102.

INDEX OF ADVERTISERS