

COMPUTERIZED SYSTEMS FOR COLLECTING  
REAL-TIME OBSERVATIONAL DATA

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Advances in computer technology have led to the development of a number of semiautomated systems for collecting real-time observational data. We conducted a survey of 15 developers of computerized systems and summarized the features of each system. Many of these systems have incorporated laptop or handheld computers as well as bar-code scanners. Most systems used IBM-compatible (DOS or Windows) software, although a few were designed for either the MacOS or some other operating system. The range in prices started from free to more complete systems costing over \$1,500. Data analysis programs were included with most programs; however, only about a third of the systems included a program to compute interobserver agreement.

DESCRIPTORS: computerized observation, data collection, data analysis, observation systems

Recent technological advances have led to a proliferation of computer applications in behavioral research (see Farrell, 1991, for a review). One area of particular interest to applied behavior analysts has been the development of semiautomated systems for collecting real-time observational data. These systems have the potential to facilitate the task of observation by improving the reliability and accuracy of recording relative to traditional but cumbersome methods based on paper and pencil, and to improve the efficiency of data calculation and graphing (Donát, 1991; Eiler, Nelson, Jensen, & Johnson, 1989). Thus, the use of computers for both recording and analyzing data has become increasingly important in clinical work as well as in research.

As the technology continues to improve, these systems have incorporated more advanced features while becoming increasingly user friendly. Unfortunately, information about available options is not widely accessible and is shared primarily through informal networks. Therefore, we conducted a

survey of developers of computerized real-time observation systems. Fifteen developers responded to an initial request for information published in the *Journal of Applied Behavior Analysis* and subsequently completed more detailed surveys, the results of which are summarized in this report. A critical review of the systems, which would require comparisons under a number of different but standardized situations, was beyond the scope of this report. Therefore, our intent was merely to describe the key characteristics of each system, as reported by its developer. All summaries are presented in alphabetical order. A table listing the major features of each system, along with information for obtaining additional information, is presented in the Appendix. We recommend that potential users compare features and costs for systems having similar capabilities, contact several developers for more complete descriptions of their current systems, and query colleagues who use these specific systems or similar ones.

*Behavioral Evaluation Strategy and  
Taxonomy (BEST)*

BEST allows the user to record up to 36 different responses during a session. It has

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the capability to record response frequency, duration, intervals (variable duration), time samples, latency, interresponse time (IRT), and discrete trials. A text feature allows the recording of notes for unique or atypical event occurrences. In addition, a pause feature permits the interruption of observation sessions if the need arises, and entry errors made while recording can be edited.

The data analysis program gives the user the option of calculating response frequency (total number and rate), duration, latency, IRT, percentage of intervals, percentage of trials, and conditional probabilities. The user can also define subgroups that contain various combinations of responses (A or B, A and B). BEST has the option to calculate central tendencies (mean and median), variability (range and frequency distribution), and statistical significance ( $z$  score transformations). A reliability program allows the comparison of interobserver agreement (overall agreement and kappa). BEST also has the option to create frequency, duration, rate, and percentage charts; percentage pie charts; and multiple behavior temporal graphs. In addition, the data and graphs can be exported to commercial graphics applications (e.g., Windows Paint, Delta Graph, etc.).

BEST requires an IBM-compatible personal computer (PC) with a minimum 386 processor running DOS or Windows. It has minimal RAM and hard disk requirements. Demonstration copies are available upon request for 90 to 120 days. Individual purchase of the software costs \$750. Institutional purchases (i.e., site license), which include multiple copies of the software and a guarantee of free upgrades, are available for \$1,250. Included with the package are instruction manuals and technical support.

#### *Behavior Observer System (BOS)*

BOS uses handheld computers (Apple Newton or US Robotic Pilot) to record be-

havioral data by touching "buttons" created on the screens. The user can access templates (i.e., code sets) already created for a number of observational contexts. Furthermore, the user can customize the templates or create new templates by choosing from a list of behaviors provided by the system or by writing directly on the buttons. These templates allow the recording of up to 24 different responses during a session. With BOS, the user can record response frequency, duration, intervals (minimum 3 s), time samples, latency, IRT, and discrete trials.

The data analysis option of BOS has the capability to calculate response frequency (total number and rate), duration, latency, IRT, percentage of intervals, and percentage of trials, using the handheld computer. The user can also define subgroups that contain various combinations of responses (A or B, A and B) for further analysis. Interobserver agreement (overall, occurrence, and nonoccurrence agreement) can be calculated when using Apple Newton handheld computers by linking them via their infrared data transfer systems. The raw data, as well as session and reliability statistics, can be downloaded to a MacOS or Windows-based PC for storage or further manipulation by spreadsheets, graphing programs, data bases, or statistical software.

BOS requires an Apple Newton or US Robotic Pilot handheld computer with at least 2 megabytes (MB) of RAM. The cost of the software alone is \$199. However, Psychsoft offers grants of free software to students and faculty who wish to use the system at their academic institutions. Included with the purchase price are an instruction manual and technical support.

#### *DATA CAP, HARCLAG, HARCREL*

DATA CAP is software for real-time recording of observational data on Psion Series 3 or Workabout handheld computers. It allows recording of up to 40 different re-

sponses using frequency or duration measures. The data are saved as ASCII files for uploading to IBM-compatible PCs for storage or further analysis.

HARCLAG is a DOS-based program that can also run under Windows. It has the capability to calculate response frequency (total number and rate), duration, latency, IRT, and conditional probabilities. In addition, it has the capability to calculate cumulative frequency distributions as well as time-based lag sequential analyses. The user can also define subgroups that contain various combinations of responses (A or B, A and B) for further analysis. A Windows-based reliability program, HARCREL, permits the calculation of interobserver agreement (overall, occurrence, and nonoccurrence agreement as well as kappa).

Both HARCLAG and HARCREL have minimal memory requirements and require an IBM-compatible PC with a minimum 386 processor. All software is free and includes an instruction manual.

#### *Data Collection Assistant (DCA)*

DCA uses TimeWand I (TWI) or DuraTrax (DT) bar-code scanners to collect real-time data. Data can be recorded as frequency, duration, and discrete trials for an infinite number of different responses (over 2 million). In addition, the observer can use DCA to collect Likert scale data, prompt sequences, and yes-no entries. Customized templates can be created to facilitate data collection. Entry errors made while recording can be edited.

The data analysis option allows the user to calculate response frequency (total number and rate), duration, and percentage of trials. The user can also graph the data and identify central tendencies (mean and median) as well as determine the range and frequency distribution. The user can also annotate data collection and graphs with relevant comments.

DCA requires an IBM-compatible PC (Windows) with at least a 486/33 processor, 8 MB of RAM, and 8 to 10 MB of hard disk space. The costs of the TWI and DT scanners are \$348 per unit and \$625 per unit, respectively. An instruction manual and technical support are included with the package.

#### *Direct Observation Data System (DODS)*

Using separate programs, DODS has the capability of capturing frequency, duration, interval (variable duration), time sample, latency, and antecedent-behavior-consequences (ABC) data for three different responses. In addition, it can aid in the selection of data collection measures as well as interpreting student progress, refining an intervention, and confirming the mastery of an objective.

When the observation is complete, the program summarizes the data as response frequency (total number and rate), duration, latency, or percentage of intervals. The utilities program allows the user to retrieve files, graph data, and write and print reports or graphs. If the need arises to collect pencil-and-paper data, DODS has the option of constructing and printing data collection forms.

DODS requires a computer running MacOS (System 6.0.5 or later) and HyperCard. The user can also develop a remote recording device that consists of an adapted Macintosh mouse, radio transmitter, and radio receiver for use when a desktop computer is not available. The software is available free of charge.

#### *Ecobehavioral Assessment System Software (EBASS)*

EBASS is a series of three observational programs, each of which is designed specifically for a client's educational level. All allow the user to record interval data (10 to 20 s) for over 100 different responses.

The data analysis feature allows the user to calculate percentage of intervals, conditional probabilities, mean, range, and frequency distribution. In addition, responses can be combined (A and B) for further analysis. Interobserver agreement (overall and occurrence agreement) can also be calculated. The raw data, as well as session statistics, can be stored to disk or graphed.

EBASS requires an IBM-compatible PC (DOS or Windows) and has minimal memory requirements. The cost of the complete package is \$750 and includes an instruction manual and instructional videotapes as well as technical support. Site licenses are also available.

#### *EVENT-PC*

EVENT-PC is designed for use with multiple platforms (DOS, MacOS, Windows, Commodore 64, and Tandy 100/102). The observer can record frequency, duration, latency, and IRT for 40 different responses.

The data analysis feature has the capability of calculating total number and duration of responding. EVENT-PC can also calculate means, ranges, and standard deviations. With a supplemental program, SEQ, the user can perform additional statistical tests (e.g., chi-square). All results can be printed, viewed on screen, or saved to disk. Disk outputs are compatible with most spreadsheets and statistical packages. EVENT-PC has the ability to graph interval relations for visual inspection.

All platform versions have minimal memory requirements. The DOS, MacOS, and Windows version of EVENT-PC are available for \$50. The price includes an instruction manual and technical support.

#### *Multi-Option Observation System for Experimental Studies (MOOSES)*

MOOSES has the capability of capturing frequency, duration, interval (variable duration), and time-sampling data for 200 dif-

ferent responses. Code sets for individual projects are defined in a file by the user of the program. Entry errors can be edited at the end of the observation session.

The user can calculate response frequency (total number and rate), duration, percentage of intervals, percentage of trials, and conditional probabilities. The user can define subgroups that contain various combinations of responses (A and B, A or B). Furthermore, interobserver agreement (smaller-larger, overall, occurrence, and nonoccurrence agreement) can be calculated.

MOOSES requires an IBM-compatible PC (DOS) and has minimal memory requirements. The cost of the software system is \$450. The package includes an instruction manual and technical support through E-mail. A program for recording data from video (PROCORDER) is also available at an extra cost.

#### *Observational Data Acquisition Program (ODAP)*

ODAP allows simultaneous recording of up to 20 different responses in a given observation session. It permits the recording of response frequency, duration, intervals (variable duration), time samples, latency, and IRT. In addition, deletion of entry errors can be made while recording. Data output is provided in two formats: a raw data file and a summary file that is appended after each observation session with session identifiers as well as response frequency (total number and rate) and duration.

ODAP requires an IBM-compatible PC (DOS) and has minimal memory requirements. The software is free and includes an instruction manual.

#### *Observational Data Collection & Analysis for Windows (ObsWin)*

ObsWin is an integrated data collection and analysis software package. It has the capability to capture frequency and duration

data for up to 86 different behaviors. The user can create up to seven mutually exclusive code sets to facilitate data collection. Errors in data collection can be marked for future editing, and notes may be written during an observation session and saved with data files.

The data analysis option allows the user to calculate response frequency (total number and rate), duration, latency, IRT, and conditional probabilities. The user can also define various combinations of responses (A or B, A and B) for further analysis. ObsWin has the capability to compute central tendencies (mean and median), variability (range and frequency distribution), lag sequential analyses, and interobserver agreement (smaller-larger, overall, occurrence, nonoccurrence, and exact agreement). It also has the option to read in data collected using other existing data collection programs.

All data (raw, session statistics, and reliability statistics) can be saved to disk or printed. The user can create occurrence graphs, cumulative onset graphs, frequency per interval graphs, and summary statistic bar charts. All graphs may be saved as Windows metafiles or bitmaps.

The basic data collection program requires an IBM-compatible computer (DOS) and has minimal memory requirements. The analysis program, which also includes a program for data collection from video, requires Windows 3.1, 4 MB RAM, and a 386 processor. The cost of the system is £500. The package includes an instruction manual and technical support. The purchaser is permitted to use one copy of the Windows-based program on a single computer, but the DOS-based program can be freely distributed on any number of computers.

#### *The Observer*

The Observer's program tasks are divided into several subprograms. Observers can collect frequency, duration, interval (variable du-

ration), time sample, latency, and IRT data for a maximum of 999 different responses. Entry errors can be marked for later editing, and text notes for unique or atypical events can be written during an observation session. The user also has the option to pause the observation session if the need arises and to adjust the session timer during data collection. All observation sessions are stored to disk, and the user is notified when the threshold of disk space is about to be reached.

The data analysis feature has the capability to calculate the total number of responses, duration, latency, IRT, percentage of intervals, and conditional probabilities. The user can also define subgroups that contain various combinations of responses (A or B, A and B). The user also has the option of calculating other statistics such as interobserver agreement (overall and exact agreement, kappa), mean, range, standard deviation, and standard error as well as lag sequential analyses. In addition, the user can construct a graph of the observational data against elapsed time. All data can be saved to disk, printed, or exported to a number of spreadsheets, databases, or statistical packages.

The price of the base package, which includes the Observer software, is \$1,740 and can be used on any PC running DOS (minimal memory requirements), Windows (minimum 4 MB RAM, 10 MB hard disk, 386DX processor), or MacOS (minimum 4 MB RAM, 10 MB hard disk, system 6.0.7). Supplemental software packages that allow the user to collect data on a variety of different handheld computers (Observational Research Kit), such as the Psion Organizer and Workabout, or from video (Video Tape Analysis System) are available for an additional cost. All packages include an instruction manual and technical support.

#### *Portable Computer Systems (PCS)*

PCS consists of separate data collection and analysis programs. The data collection

program allows the observer to record response frequency, duration, latency, and IRT for up to 45 different events, and to capture discrete-trial data. Entry errors made while recording can be edited. The data collector has the option to temporarily disable the keys and timer if the need arises, as well as to enter text notes about the observation session.

The data analysis program can calculate response frequency (total number and rate), duration, latency, IRT, and conditional probabilities. In addition, PCS has the option to conduct lag sequential analyses. The user can define combinations of responses (A and B, A or B) for further analysis. A reliability program allows the comparison of data files using overall, occurrence, and non-occurrence agreement.

PCS requires an IBM-compatible PC (DOS) and has minimal memory requirements. PCS is available for \$400 and includes an instruction manual.

#### *Professional Behavior Evaluation System (ProBES)*

ProBES operates on a Psion Series 3a handheld computer. It enables the observer to collect frequency, duration, interval (1 s to 999 s), and time-sampling data for six different responses. The user can create templates for different types of observation sessions to facilitate data collection.

The data analysis option can calculate response frequency (total number and rate), duration, percentage of intervals, percentage of trials, conditional probabilities, and means. All of these can be viewed within ProBES immediately after completion of a session, downloaded to a desktop computer as a text file, or printed using any standard printer.

The cost of the system is \$695. Included with the system are a Psion Series 3a handheld computer, all software, an instruction manual, and technical support.

#### *Social Interaction Continuous Observation Program for Experimental Studies (SCOPE)*

SCOPE permits the recording of up to 21 different responses during a given observation session and can capture response frequency and duration. In addition, entry errors made during collection can be edited.

The data analysis feature allows the user to calculate response frequency (total number and rate), duration, conditional probabilities, and lag sequential analyses. Interobserver agreement (overall, occurrence, nonoccurrence, and exact agreement) can also be calculated.

SCOPE requires an IBM-compatible PC (DOS or Windows) and has minimal memory requirements. The program is available free of charge.

#### *Virtual Behavior Analyst (VBA)*

VBA is a template used in Microsoft Word 6.0 that allows the collection of up to 16 different responses. VBA captures response frequency, duration, interval (1 s to 60 min), time-sample, latency, and IRT data. Entry errors can be edited while recording. A separate program (The Enabler Series) can be used to record discrete-trial data.

The data analysis option allows the user to calculate response frequency (total number and rate), duration, latency, IRT, percentage of intervals, and conditional probabilities. In addition, the raw data and session statistics can be stored to disk or imported into Microsoft Excel for further analysis or graphing.

VBA requires an IBM-compatible PC with at least 8 MB RAM, a 386 processor, and Microsoft Office. A stand-alone version is currently under production. VBA retails for \$99 and includes an instruction manual and technical support. Interested users may download ScreenCam demos of the program from the Behavior Analysis Archive at the

University of Wisconsin–Madison (ftp://alpha1.csd.uwm.edu/pub/Psychology/BehaviorAnalysis/software/research).

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*Action Editor, David P. Wacker*

APPENDIX

Summary of Main Features of Computerized Observation Systems

Program	Behavioral Evaluation Strategy & Taxonomy	Behavior Observer System	DATACAP, HARCLAG, HARCREL
Address	Tom Sharpe Dept. of HKLS Lambert Fieldhouse Purdue University W. Lafayette, IN 47907	Sander Martin Psychsoft 1758 Timberidge Circle Corinth, TX 76205	Eric Emerson Hester Adrian Research Centre University of Manchester Manchester M13 9PL United Kingdom
Phone	(765)494-3178	(817)368-0345	0161 275 3335
FAX	(765)496-1239	(817)565-4682	0161 275 3333
Internet	tsharpe@sla.purdue.edu	smartin@terrill.unt.edu	eric.emerson@man.ac.uk
Data collection	user supplied (laptop computer)	user supplied (hand-held computer)	user supplied (hand-held computer)
Hardware operating system	DOS Windows	MacOS Windows	DOS Windows
Data collection <sup>a</sup>	F, D, I, S, L, IRT, T	F, D, I, S, L, IRT, T	F, D
Data analysis <sup>a</sup>	F, R, D, I, L, IRT, T, P	F, R, D, I, L, IRT, T	F, R, D, L, IRT, P
Reliability statistics <sup>b</sup>	OV, K	OV, OCC, NON	OV, OCC, NON, K
Price	\$750	\$199	free

<sup>a</sup> F = frequency, R = rate, D = duration, I = interval, S = time sample, L = latency, IRT = interresponse time, T = discrete trial, P = conditional probability.

<sup>b</sup> SL = smaller/larger, OV = overall, OCC = occurrence, NON = nonoccurrence, EX = exact, K = kappa.

## APPENDIX

*(Extended)*

Program	Data Collection Assistant	Direct Observation Data System	Ecobehavioral Assessment System Software
Address	Jay Saunders Bluestem Technologies 1104 E. 25 Terrace Lawrence, KS 66046	Happy Johnson College of New Jersey Hillwood Lakes, CN 4700 Trenton, NJ 08650	Charles Greenwood Juniper Gardens Children's Project 650 Minnesota Ave., 2nd Floor Kansas City, KS 66101 (913)321-3143 (913)371-8522 greenwood@kuhub.cc. ukans.edu <a href="http://www.lsi.ukans.edu/jg/ebass.htm">http://www.lsi.ukans.edu/jg/ebass.htm</a> user supplied (laptop computer)
Phone	(785)865-3804	(609)771-2998	
FAX	(785)865-0158	(609)771-3434	
Internet	bluestem@pchelponline.com	johnsha@tcnj.edu	
Data collection	TimeWand I DuraTrax by Videx	user supplied (laptop computer or remote controlled device)	
Hardware operating system	Windows	MacOS Windows	DOS Windows
Data collection <sup>a</sup>	F, D, T	F, D, I, S, L	I
Data analysis <sup>a</sup>	F, R, D, T	F, R, D, I, L, T	I, P
Reliability statistics <sup>b</sup>	none	none	OV, OCC
Price	\$348-\$625	free	\$750

## APPENDIX

*(Extended)*

Program	EVENT-PC	Multi-Option Observation System for Experimental Studies	Observational Data Acquisition Program
Address	James Ha University of Washington RPC Box 357330 Seattle, WA 98195	Jon Tapp Jon Tapp & Associates Box 43 Hampden-Sydney, VA 23943	William Hetrick Fairview Developmental Center 2501 Harbor Blvd., Box 5A Costa Mesa, CA 92626
Phone	(206)543-2420	(804)223-2928	
FAX			
Internet	jcha@u.washington.edu	jt@mail.hsc.edu <a href="http://panther.hsc.edu/mooses.html">http://panther.hsc.edu/mooses.html</a>	
Data collection	user supplied (laptop computer)	user supplied (laptop computer)	user supplied (laptop computer)
Hardware operating system	DOS MacOS Windows	DOS	DOS
Data collection <sup>a</sup>	F, D, L, IRT	F, D, I, S	F, D, I, S, L, IRT
Data analysis <sup>a</sup>	F, D	F, R, D, I, T, P	F, R, D
Reliability statistics <sup>b</sup>	none	SL, OV, OCC, NON	none
Price	\$50	\$450	free

## APPENDIX

*(Extended)*

Program	Observational Data Collection & Analysis for Windows	The Observer 3.0	Portable Computer Systems
Address	Chris Oliver School of Psychology University of Birmingham, Edgbaston Birmingham, B15 2TT United Kingdom	Noldus Information Technology 6 Pidgeon Hill Dr., Suite 180 Sterling, VA 20165	Peggy Williams Communitech P.O. Box 425 Dekalb, IL 60115
Phone	0121 414 4909	(800)355-9541	(815) 753-8436
FAX	0121 414 4897	(703)404-5507	(815) 753-9250
Internet	c.oliver@bham.ac.uk	info@noldus.com http://www.noldus.com	arepp@niu.edu
Data collection	user supplied (laptop computer)	user supplied (hand-held or laptop computer)	user supplied (laptop computer)
Hardware operating system	DOS Windows	DOS MacOS Windows	DOS
Data collection <sup>a</sup>	F, D	F, D, I, S, L, IRT	F, D, L, IRT, T
Data analysis <sup>a</sup>	F, R, D, L, IRT, P	F, D, L, IRT, I, P	F, R, D, L, IRT, P
Reliability statistics <sup>b</sup>	SL, OV, OCC, NON, EX	OV, EX, K	OV, OCC, NON
Price	£500	\$1,740	\$400

## APPENDIX

*(Extended)*

Program	Professional Behavior Evaluation System	Social Interaction Continuous Observation Program for Experimental Studies	Virtual Behavior Analyst
Address	Robert Ricketts 4150 Southwest Dr., Suite 250 Abilene, TX 79606	Richard Shores University of Kansas at Parsons 2601 Gabriel Parsons, KS 67357	Merrill Winston World Enabling Resources 5231 Pine Tree Rd. Coral Springs, FL 33067
Phone	(915) 692-3942	(316) 421-6550 x1859	(954) 341-2878
FAX	(915) 692-6433		(954) 977 0409
Internet	ricketts@abilene.com		drmrw@msn.com http://www.weru.com
Data collection	Psion Series 3a	user supplied (laptop computer)	user supplied (laptop computer)
Hardware operating system	OPL	DOS Windows	Windows (Microsoft Office)
Data collection <sup>a</sup>	F, D, I, S	F, D	F, D, I, S, L, IRT
Data analysis <sup>a</sup>	F, R, D, I, T, P	F, R, D, P	F, R, D, L, IRT, I, P
Reliability <sup>b</sup>	none	OV, OCC, NON, EX	none
Price	\$695	free	\$99