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BRIEF COMMUNICATION

A Microcomputer Method for Behavioural Data Acquisition and Subsequent Analysis

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DEPAULIS, A. *A microcomputer method for behavioural data acquisition and subsequent analysis.* PHARMACOL BIOCHEM BEHAV 19(4) 729–732, 1983.—Using a microcomputer (TRS80, Model III), a modular procedure is described which allows rapid manual encoding of visually-observed behavioural units (module 1); processing of the data (e.g., calculation of frequency, duration, latency, sequence analysis) (module 2) and statistical analysis (module 3). This method can be used in several behavioural tasks and provides the possibility of various subsequent analysis without reencoding or transcribing the initial data.

Microcomputer Behaviour Data acquisition

ANIMAL behaviour may be considered to consist of a succession of definite units (i.e., acts or items) and the quantitative assessment of these units (e.g., frequency, duration, latency, sequence) provides essential data for behavioural analysis. The collection of such data is especially required for the study of social interaction in laboratory animals [3, 6, 8], but their subsequent analysis often becomes rather tedious.

When behavioural analyses are carried out in the laboratory, microcomputers can be used for both encoding and analysis of the data and "software" methods have been recently proposed. However, these methods are limited in the number of items which can be coded [5] or require transcription of the data for statistical analysis [4].

A procedure, developed for use with a microcomputer (e.g., TRS80 Model III; Radio Shack) is described in this paper. It is composed of programs, organised in three modules, which allow respectively: the manual encoding of visually-observed behavioural items (module 1); processing of the data—e.g., total summation, periodical summation, sequence analysis—(module 2); statistical analysis (module 3).

DESCRIPTION

Hardware

The procedure was developed for use with a TRS80 Model III (Radio Shack) microcomputer, including a keyboard and a video monitor, with 48 K of random access memory (RAM) and two 5¼ inch floppy-disk drives of 256 K memory.

Software

The procedure is structured in 3 modules: module 1 is a program for behavioural data acquisition; module 2 includes programs for data processing; module 3 includes programs for statistical analysis and printing of the results. These programs, written in BASIC language, can be used with BASIC-interpreter of the standard disk operating system (TRSDOS) and will be obtained on request.

Module 1: data acquisition. The acquisition of the data is made possible by a single program called "DATACQ." This program allows the encoding of visually-observed behavioural items using the keyboard of the computer: any press on a letter of the keyboard being simultaneously detected. The time elapsed between two presses is generated by an incrementation loop. The codes and their respective duration are then stored in a sequential access file (=data file) (Fig. 1).

Module 2: data processing. Different types of analysis (e.g., total summation, periodical summation, sequence analysis) can be undertaken for the data which has been stored by "DATACQ." For instance, the total number of occurrence (frequency), total duration and latency of every item during a given period of observation is calculated by a program called "TOTSUM."

According to the codes of the different behavioural items and the names of the individual animals, the data files are scanned and a tabulation of the frequency and duration is performed for each different code. When a code is read for the first time, the time elapsed from the beginning of the observation period is taken as the latency. The data are then stored in table form (Fig. 2) (rows=items; columns =variables) in a direct-access file (=processed data file).

Module 3: statistical analysis. Processed data as stored in module 2 are available for statistical analyses. For instance "TOTSTAT/U" is a program which compares the data as processed by "TOTSUM" between two independent groups of animals using the Mann-Whitney test [7]. The mean ±S.E.M. of the different variable are calculated for every

BEHAVIOURAL DATA ACQUISITION

Data File

Animal: P8

Codes	Duration (sec)
I	5.74
F	0.74
I	14.45
E	0.56
I	1.09
E	2.60
I	6.54
U	1.33
I	3.22
E	1.49
I	8.29
E	0.90
F	0.31
I	1.95
E	1.40
I	2.51
E	1.40
I	2.45
E	4.50
I	0.71
F	0.40
I	0.53
E	0.59
I	6.54
E	10.51
G	0.43
I	7.13
E	3.57
I	0.62
E	3.35
I	1.12
E	5.21
F	0.59

FIG. 1. Sample of the data as stored by "DATACQ" (module 1). The name of the animal observed is taken as the file label. The data (codes and durations) are stored according to their sequence of occurrence in a sequential file.

BEHAVIOURAL DATA ACQUISITION

Processed Data File

Observation/Experiment: BM1

Animal	No.	Codes	Frequency	Duration (sec)	Latency (sec)
P8	5				
		E	43	150.69	20.93
		T	1	14.14	135.32
		C	2	2.73	109.34
		I	56	286.44	0.00
		U	7	29.57	31.71
		S	2	2.83	119.23
		A	7	10.91	171.28
		R	8	17.34	121.27
		P	22	59.33	172.95
		L	0	0.00	600.00
		O	0	0.00	600.00
		G	2	3.89	78.74
		F	9	15.62	5.74
P19	6				
		E	73	212.78	0.00
		T	15	32.95	78.06
		C	8	7.47	82.00
		I	86	220.26	1.05
		U	11	25.51	7.56
		S	17	70.46	51.93
		A	0	0.00	600.00
		R	2	3.36	337.36
		P	3	0.87	335.87
		L	0	0.00	600.00
		O	0	0.00	600.00
		G	0	0.00	600.00
		F	2	12.12	551.83

FIG. 2. Sample of the processed data file as generated by "TOTSUM" (module 2). The name of the experiment/observation is taken as the file label. The data (frequency, duration, latency) are located in a random-access file.

item and for the two groups of animals. In each case the value of "U" is calculated (Fig. 3).

Operating Procedure

Data acquisition. Each selected behavioural item is assigned to a "one-letter" code from the keyboard of the computer. When run, "DATACQ" program requires the name of the animal to be observed for file specification. The encoding consists of pressing the corresponding key once when the behavioural item occurs; the code letter is then displayed on the screen. Pressing another key (i.e., when the following item occurs) determines the duration of the item. The timing of the observation period begins with the first press at any letter key. Pressing on key "@" stops the encoding and closes the data file. Pressing on key "Z" creates a pause in the observation and the time elapsed until the next press would not be taken into account in the further analysis.

Data processing. When run, "TOTSUM" requires the user to type the list of the codes of selected items and the name of the animals in the experimental groups. For each animal a number is also requested in order to locate the data within the file. The experimenter must also indicate the time alloted for the observation period and a file label for the series of animals. It is possible to store additonal data in the same processed data file.

Statistical analysis. "TOTSTAT/U" requires the name and the code of the different items used in the observation or experiment and, for the two groups to be compared, the location number of the animals. The results are then displayed on the screen or printed.

DISCUSSION

The procedure described in this paper provides a simple and flexible single system that can be used for both acquisition and subsequent processing/analysis of the data. The use of "one-letter" codes provides a convenient and rapid encoding—i.e., the observer can then use the keyboard as a typewriter, concentrating all his attention on the behaviour of the animals. The display of what is being coded and the possibility of checking/correcting the data files afterwards ensure the reliability of the system. Although the number of items which can be coded is limited to 26 upper case letters, it may be doubled by the use of lower case letters.

Interpreted-BASIC language provides a speed of execu-

BEHAVIOURAL DATA ACQUISITION

Statistical Analysis

Experiment: Simulation

Behaviours		Frequency		Duration		Latency	
Exploration	A	50.56	5.72	222.07	20.36	8.64	2.90
	B	44.14	5.65	303.08	23.49	2.31	1.39
U Values	(9/7)	22.5		12		18	
Autogroom	A	7.89	1.93	57.30	28.02	114.41	25.09
	B	5.14	2.30	32.78	10.33	272.73	91.83
U Values	(9/7)	23		30		22	
Crawl	A	5.44	1.56	6.88	1.98	144.28	58.21
	B	1.00	0.38	1.09	0.40	401.81	86.33
U Values	(9/7)	7		5.5		10.5	
Approach	A	55.22	7.38	181.07	27.08	0.25	0.17
	B	39.00	4.03	122.20	20.52	0.89	0.39
U Values	(9/7)	14.5		18		18.5	
Anogen	A	9.44	2.45	23.28	5.24	122.97	71.09
	B	1.43	1.13	2.65	1.81	429.77	109.88
U Values	(9/7)	9		6.5		20.5	
Allogroom	A	7.78	3.03	21.73	8.13	267.45	79.84
	B	1.86	0.86	8.95	4.37	533.04	32.16
U Values	(9/7)	18.5		19.5		11.5	

FIG. 3. Statistical analysis (module 3). For each item and for the different variables, the data of two groups of animals (A and B) are compared using the Mann-Whitney test. The results are expressed in Mean ± S.E.M.

tion of the program in module 1 which allows a time resolution quite sufficient for behavioural encoding [1]. It should be noted that the execution of the program is interrupted for 0.25 sec each time the buffer content is transcribed on the disk file. However, this interruption occurs only once every 20 presses and the delay is thus negligible.

This system can be used in any situation where quantitative measurement of behavioural items is required. In our laboratory it is currently used for the recording of data in social interaction studies [2]. The size of the apparatus allows it to be easily transported into the experimental rooms, however, transcription from video recording is generally preferred.

Several limitations should be noted. First, this procedure assumes that only one behavioural item occurs at a given time and this limitation must be taken into account in determining the list of behaviours to be encoded. Such an assumption has, however, been widely adopted in many behavioural studies [3, 6, 8]. Second, the present method allows for the behavioural encoding of only one animal at a time. For this reason videotape recording, including the display of a "real-time" timer, is necessary when interactions between animals are studied. Nevertheless, a particular advantage with this method is the possibility to analyse the data in various ways, without having to reencode the behavioural observation. This is made possible by the modular procedure of this method: in module 1, the data are stored in their initial sequence of occurrence thus allowing, in module 2, a great flexibility in the possibilities of analysis. Finally, blind studies can be easily conducted since group conditions are to be known only the module 3.

In conclusion, the currently-presented method allows the acquisition of behavioural data and their further analysis by the same microcomputer. It can be used for a large variety of behavioural tasks in the laboratory and provides for the possibilitiy of various kinds of subsequent data processing.

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