Three Nice Labs, No Real Rats:

A Review of Three Operant Laboratory Simulations

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Abstract

The operant laboratory, once a major foundation for a curriculum in behavior analysis, seems to have decelerated in frequency from 1960-1995 because of costs and other factors. Recently, several computer simulations of animal labs have been developed. This paper describes, compares, and contrasts 3 simulations and concludes that they are generally effective and offer an alternative to the real thing.

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Better teaching of behavior analysis as advocated by Heward and Malott (1995) should provide students more experience with operant laboratory phenomena than hearing about them from professors or reading about them in textbooks (Shimoff & Catania, in press). While Karp (1995) makes a case for the value of an operant animal laboratory, recent advances in computer graphics have jumped up the quality from those done several years ago (e.g., Acker & Goldwater, 1991) to the point where computer programs now provide a reasonable alternative to laboratory experiences.

Computer programs developed for teaching behavior analysis fall into three main categories—tutorials, fluency practice, and simulations. Tutorials rely mostly on text-based screens with a learner moving through the material at one's own pace by responding to choices or typing responses (e.g., Hardy, 1988). Practices shuffle and repeat a set of items as the learner attempts to become fluent with the material (McDade, Austin, & Olander, 1986). Simulations use graphics to reproduce a laboratory environment which requires nonverbal or less verbal responses. Some programs include both or all categories (Mulick, 1992).

Three current programs that simulate aspects of an operant laboratory environment include: "Behavior on a Disk", "Sniffy the Virtual Rat", and "The Box". Behavior on a Disk has tutorial features as well as simulations and attempts coverage of topics beyond the operant chamber. Sniffy and The Box each limit themselves to operant chamber behavior. Since a previous review covered Behavior

on a Disk in its entirety (Mulick, 1992), I'll focus mostly on that program's operant chamber simulation—"The Shaping Game". Figure 1 shows the basic setup information for these three programs.

The Simulations

Behavior on a Disk

The Shaping Game. You try to shape a rat to bar press with a target force of 100 gm. You see the rat on the screen and it presses a lever. How much force the rat exerted is displayed briefly after each bar press. You must quickly decide whether or not to reinforce that particular approximation of the target force because the rat will press the bar again in two or three seconds. The simulation ends when the rat emits a 100 gm barpress—or when satiation or extinction effects reduce responding to zero.

The Shaping Game gives a compressed time "feel" for shaping. Because the rat presses the bar at a frequency of 20-30 times per minute, you don't have to wait long for things to happen. One realizes that providing a reinforcer after every bar press won't work, that rewarding every small increment will take a long time to produce the target behavior, and that you sometimes have to drop your criterion band width for acceptable behavior back when the rat hasn't produced anything close to the current force for which you're waiting.

If you reinforce increments in force that are too small, the rat satiates and the game ends with the rat saying, "I'm full." Will the rat extinguish if you don't reinforce it occasionally? Yes. After eight to ten unreinforced responses the game will end with the rat saying "I quit". These effects seem to combine for an efficient program. If you "mess up", you can start over.

Other shaping simulations. Four other simulations in "Behavior on a Disk" provide slightly different situations and decisions involved in shaping behavior.

Fluency practice on cumulative records. "Matching Cumulative Records" constitutes one of three programs that aim to help students become proficient in understanding cumulative records. You use the space bar as a barpress trying to make a cumulative record similar to one generated by the program.

Sniffy the Virtual Rat

Your role—shape Sniffy the rat to press the lever. You see Sniffy in a operant chamber with three walls, a lever, a food receptacle, and a water tube. When you click the computer mouse with the screen pointer on the lever, the food magazine sounds a click and food appears in the food receptacle. Sniffy wanders around, occasionally scratching, sniffing, and stretching—and eventually finds and eats the food.

A real time cumulative record displayed at the bottom of the screen shows Sniffy's bar presses and reinforcements received from those bar presses. This record can be printed out.

Once Sniffy has been shaped to press the bar at a high enough frequency, you can work through the various simple fixed and variable interval and ratio schedules. You can save his learned behavior as a file and start from that point the next time. If you fail to save the performance of your virtual rat, you lose the behavioral effects which have occurred during a session. The disk provides five files with Sniffy already at a particular stage of learning. This can cut down on the time requirement that will occur if "starting from scratch". The cumulative record for these files shows the prior few minutes of data each time you access the file.

The creators of Sniffy have programmed a number of variables to operate in conjunction and produce Sniffy's behavior. Six such features can be manipulated on a five-point ordinal scale (e.g., low to high; slow to fast) through pull-down menus. These include variables such as the number of reinforcers required before a behavior's probability increases, the effectiveness of a single reinforcement, how often reinforcer is delivered in specific location before that sector of chamber becomes attractive, etc. Over twenty other parameters can be overriden or changed by entering the actual program and editing. The developers include technical information on how to do this, but caution that only experienced programmers will find the task to be easy.

The Box

Your role can be either as learner in an operant chamber or programmer of the operant chamber. As a learner, you see stimuli representing colored lights, levers, food, food receptacles, tokens and point counters arranged on the screen—the box. You can respond freely as an organism to these box stimuli by pointing, clicking, and dragging the mouse to operate on the environment. Pointing to and clicking on a lever produces a lever press with an accompanying click sound. The variety of stimuli allow a variety of consequences.

As programmer, you can set up the box and run an experiment using humans as subjects. You decide upon the stimuli previously mentioned and what the contingencies will be. You can program up to 25 different phases and data will be tabulated by the program. The program will also produce cumulative record graphs for viewing or printing which the program sizes to fill the screen or a single sheet of paper.

Designing an operant chamber and running human subjects through it become practical possibilities with The Box. Even though responses occur through use of a computer mouse, humans "trained" by video games for high frequency behaving will find the brief time segments and potential high frequency of mouse clicking behavior to their liking.

Available demonstrations quickly familiarize you with what options exist for stimuli. Upon completion, you can view either the cumulative record of your performance, the data you generated, or both. Phase changes show up in both data and cumulative records automatically. A 13 cm vertical line marks the latter.

Suggestions for Improvement

Behavior on a Disk

The graphics and screen fonts used in this program show their relative antiquity. Upgrading these features would keep the program in tune with the technology existing in other software.

The printer driver also appears to need updating. The program handles this problem well by having you respond to "no printer response". If your printer won't work with the system, at least the program doesn't crash because of it.

While you can choose four levels of The Shaping Game ranging from easy to very hard, the program doesn't monitor your performance in a way that provides any useful feedback as to your shaping skill. Either you shape the rat or you don't. Even world class animal shapers won't succeed every time in the "very hard" condition. Providing more precise information on frequency of the shaper's behavior would allow one to see one's own learning of shaping skill. This would also allow an "all-time best" type file that seems to keep individuals playing a game beyond several successful completions.

Sniffy the Virtual Rat

The "real time" feel of this program provides a realism that may stretch the endurance of some students, particularly those raised on a diet of video machines requiring high frequency of behaving with high density of consequences.

At some point, the cumulative record becomes much more interesting than watching Sniffy produce it. You can leave Sniffy working while you do something else, checking back periodically.

Adding the capability to print the data embedded in the cumulative record would seem to be a fairly straightforward enhancement of the current version.

The cumulative records shown do not make clear what the scale of responses up the left or the minutes across the bottom amount to. The documentation explains that the up and down lines mark five-minute intervals. All cumulative records drawn by the program represent a standard scale, but what the standards involve should be made clear, both up the left and across the bottom. A "fan"—showing slopes for .25 responses per second, .5 responses per second, 1 response per second, and 3 responses per second—formed a part of each cumulative record Skinner presented (e.g., Skinner, 1959). These fans would enhance reading of the cumulative records "Sniffy" generates.

Another helpful feature would be some signal on the cumulative record for phase changes.

As in many simulations, Sniffy's programers have constructed a model of how a rat behaves. How convincing is Sniffy's behavior to operant rat lab experts? The ease of changing the model parameters seems to indicate that the designers have retained their roots in behavior analysis rather than fallen into extensive cognitvie processing concerns.

The Box

The descriptions of the various system components produce some difficulty in determining what to do first and where to go next. Such problems may reflect the addition of new ideas and features as the software evolved. The new user can easily be overwhelmed by too many options and no clear sequence. The documentation

straightens these problems out to some extent, but ideally one could engage the program successfully without reliance on the documentation.

The "stretch-to-fill" graphics that the program currently produces for the cumulative records cloud the interpretation and make these charts harder to compare than if a standard set of axes occurred each time (Lindsley, 1994).

Usefulness

Each of the three programs reviewed contains nice features not found in the others. Figures 2 and 3 describe many of the program characteristics and behavioral features, respectively. The price of "Behavior on a Disk" makes it very affordable to all. "Sniffy the Virtual Rat" seems more suited to students working through a few lengthy laboratory exercises. "The Box" allows students to design and run their own experiments with human subjects. None of the three programs seem overpriced. Each of these programs represent valuable tools in the toolbox of anyone attempting effective teaching of operant chamber processes, procedures, and concepts.

Extensions

The main difference between the three programs seems to be that "The Shaping Game" and "Sniffy the Virtual Rat" produce simulations of what we know and have learned from the operant laboratory. These programs can help us teach others better what we already know.

By contrast "The Box" not only can help teach the known, but also extends simulations into the area of new research tools. Programs such as this can help us launch others very quickly into areas of discovery within the human operant realm. For example, one could adjust the incentive value by having the graphics used as

consequences represent actual monetary amounts and then explore what kinds of cumulative records non food-deprived college students generate on various schedules compared to published research with food-deprived organisms.

Research applications

Pioneering work in the fifties extending operant research from animals to humans involved intensive space, time, equipment and energy costs (Lindsley, 1956). Consequently, little of that research has carried forth to present day. Advancing simulations promise to make possible research tools of equal or greater power at far less cost.

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Crofts.

Feature	Behavior On a Disk	Sniffy the Virtual Rat	The Box
Computer platform	MS-DOS	Macintosh (MS-DOS in preparation)	MS-DOS
Version reviewed	2.0	v4.5	2.01
Requirements	MS-DOS; printer optional	System 7.x or higher; color monitor preferred; minimum 1.5 Meg of free RAM	MS Windows; standard font modes; 4 Meg of RAM; 4 Meg of free hard drive space; MS compatible mouse; 640x480 VGA mode
Designers	Eliot Shimoff, Charles Catania, Byron Matthews	Tom Alloway, Lester Krames, Jeff Graham, Greg Wilson	Wayne Bartlett, Elson Bihm
Price (single user)	$13.50	$43.95	$89.00

Publisher	CMS Academic Software P.O.Box 1514 Columbia, MD 21044 e-mail: Shimoff@UMBC.edu (developer) Catania@UMBC2.UMBC.edu (developer)	Brooks/Cole Publishing Co. 511 Forest Lodge Rd., Pacific Grove, CA 93950-5098 (408) 373-0728 (800) 487-3575 e-mail: Info@BrooksCole.com	Triad Soft P.O. Box 10162 Conway, AR 72033 e-mail: TriadSoft@AOL.com
ISBN	0-922077-20-7 (5.25" disk) 0-922077-21-5 (3.5" disk)	0-534-25836-0	

Figure 1. System requirements and availability.

	Behavior On A Disk	Sniffy the Virtual Rat	The Box
Interactive graphics	Yes	Yes	Yes
Quality of screen fonts & graphics	x1 (acceptable; not high quality)	x5 (five times better)	x5 (five times better)
Cumulative records	Not of shaping (cumulative records covered separately as tutorial and own set of simulations)	Yes (but shows only rat-produced reinforcements; doesn't show when shaper reinforced)	Yes (although both axes stretch to fill space rather than standard)
Print cumulative records	No (not of shaping)	Yes	Yes
Ease of use	x5 (five times easier)	x4 (four times easier)	x1 (acceptable)
Realism	/1.5 (1.5 times less)	x1	x4 (four times more)
Typical session	6-10 minutes	20-120 minutes	1-2 minutes
Programmable	No	Yes	Yes
Set time for phase or session	No	No	Yes

Save files in progress	No	Yes	No
Sample files to run	No	Yes (5 files of Sniffy "trained")	Yes (22 various programs)
Does user learn what program tries to teach?	Probably	Probably	Probably

Figure 2. Program characteristics.

	The Shaping Game	Sniffy the Virtual Rat	The Box
Baseline frequencies	No	Yes (but data not accessible independent of cumulative record)	Yes (all defined behaviors recorded and accessible on screen)
Shaping	Yes (time compressed)	Yes (real time)	No (lacks moment by moment decision feature)
Available consequences	Verbal feedback	Graphic of rat food	Graphic of cheese; graphic of seed (lasts 3 seconds); graphic of tokens; points on counter, lights, sound
Noncontingent reinforcement possible?	Yes	Yes	Yes
Establishing operation	No	Yes (water can be set on pull-down menu; food default=24 hrs.)	Yes (by telling behaver of food or water deprivation)

Discriminative stimuli available	No	No	Yes
Conditioned reinforcers or response definers	No	No	Yes
Aversive events	No	No	Yes (loss of points)
Extinction	Yes	Yes	Yes
Satiation	Yes	No (not in this version)	Yes (empirically possible)
Time out	No	Yes	No
VR,VI,FR,FI	No	Yes	Yes
Mixed schedules	No	No	Yes
Multiple scheds.	No	No	Yes
Concurrent scheds.	No	No	Yes

Figure 3. Program features.

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