ONLINE: A general-purpose BASIC microcomputer program to control and record events for operant conditioning experiments

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This paper describes a general-purpose on-line microcomputer program to control and record events for a variety of simple reinforcement schedules in up to six operant chambers simultaneously. Since the program is written in BASIC, it should have wide applicability regardless of the computer manufacturer.

Description. ONLINE is a compiled BASIC language program designed to service from one to six operant chambers, each running under an independent simple reinforcement schedule. The program works by sampling a parallel input port at a rate of 100 times/sec and testing the input ports' bit pattern against a stored table of bit patterns. Events are flagged when any prescheduled bit of an input port (for example, reflecting a response in an operant chamber) is "on." The program then measures the event duration in .01-sec units and increments the response counter by one. When the event ends, the program tests the interresponse time (IRT) counter and/or the response counter to determine if reinforcement delivery is scheduled. If reinforcement is scheduled, the appropriate bit on the output port is turned on for the scheduled reinforcement duration. Following either the end of each response or the end of each reinforcement, the program tests to see if the accumulated session time or reinforcement delivery count limits have been reached. If so, the session for that operant chamber is terminated by turning off the prevailing stimulus conditions bit on the parallel output port. In addition, no further events for that operant chamber are recorded. When the session criteria for all operant chambers are met, the program displays the elapsed session time, the total number of responses emitted, and the number of reinforcements delivered to each operant chamber. The operator is then given the option of storing on disk or tape the summary data, as well as the response duration and IRT distributions for each operant chamber. Control then returns to the resident disk operating system.

Hardware Requirements. The system was developed on a SWTP 6800¹ microcomputer using ABASIC, a BASIC language compiler supplied by Microware Systems Corporation.² The development system had 32K of RAM, with dual-floppy disks, a single 8-bit parallel input/output (I/O) port, and an interrupt timer, all supplied by SWTP.

By modifying the size of the values in the dimension statement, the program can be made to occupy less memory or to accommodate a greater number of operant chambers. In addition, since all I/O occurs in

subroutines, the program can easily be modified or adapted to other machine manufactures with unique I/O requirements.

In addition, simple modification of the print statements following Line 9000 (see program listing in the Appendix) permits the user with no disk system to display the frequency distributions of IRT and response duration on a printing terminal or cassette tape.

Availability. Requests for additional information or for a copy of the BASIC source code and the compiled machine language code on SWTP diskette should be addressed to the author in care of the Psychology Department, Fayetteville State University, Fayetteville, North Carolina 28301. (If a copy of the program on SWTP diskette is desired, please send a check, payable to the author, for \$15 to cover the cost of the diskette and postage.)

NOTES

1. Southwest Technical Products Corporation, 219 West Rhapsody, San Antonio, Texas 78216.
2. Microware Systems Corporation, 5835 Grand Avenue, P.O. Box 4865, Des Moines, Iowa 50304.

APPENDIX

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REM      ONLINE: OPERANT CHAMBER EVENT CONTROL AND RECORDING.
REM
REM      V1.0      6-3-79
REM
REM
OPT N
IRQ OFF
STACK=4042
ON IRQ GOTO 1000
ON ERROR GOTO 9999
DIM E2(6),C(6),R1(6),S4(6),S8(6),S1(6),S2(6),S3(6),L1(6),L2(6)
DIM E1(6),T1(8),T2(6),R2(6),E4(6),S5(6,20),S6(6),S7(6),S9(20)
DIM D1(6,50),D2(6,50),D3(6,50),D4(6,50),T4(6),T5(6),E5(6)
DIM R3(6),R4(6,20),R5(6)
FOR K=1 TO 6
  FOR N1=1 TO 50
    D1(K,N1)=0
    D2(K,N1)=0
    D3(K,N1)=0
    D4(K,N1)=0
  NEXT N1
NEXT K
T1(1)=1:T1(2)=2:T1(3)=4:T1(4)=8
T1(5)=16:T1(6)=32:T1(7)=64:T1(8)=128
S9(1)=10:S9(2)=55:S9(3)=110:S9(4)=465:S9(5)=40:S9(6)=30:S9(7)=70
S9(8)=80:S9(9)=20:S9(10)=40:S9(11)=50:S9(12)=100:S9(13)=60
S9(14)=90:S9(15)=45:S9(16)=75:S9(17)=35:S9(18)=85
S9(19)=60:S9(20)=60
Z=0
E3=0
PRINT
PRINT "HOW MANY BOXES WILL BE USED ";
INPUT N3
FOR I=1 TO N3
  E1(I)=0 : E2(I)=0 : E4(I)=0 : E5(I)=0
  S1(I)=0 : S2(I)=0 : S3(I)=0 : S4(I)=0 : S6(I)=0 : S7(I)=1
  L1(I)=0 : L2(I)=0
  R1(I)=0 : R2(I)=0 : R3(I)=0
  S8(I)=0 : T2(I)=0 : T4(I)=0 : T5(I)=0
NEXT I
PRINT
PRINT "CONTINGENCIES FOR BOX ";I
PRINT "INPUT CHANNEL ";
INPUT J
C(I)=T1(J)
PRINT "REINFORCEMENT CHANNEL ";
INPUT J
R1(I)=T1(J)
PRINT "REINFORCEMENT DURATION IN .01 SEC UNITS ";
INPUT T4(I)
PRINT "STIMULUS CHANNEL ";
INPUT J
S3(I)=T1(J)
Z=Z+S3(I)
PRINT "TIME LIMIT IN SECONDS ";
INPUT S1(I)
PRINT "REINFORCEMENT LIMIT COUNT ";
INPUT L1(I)
REM AT THIS POINT WE SET THE REIN SCHEDULE PARAMETERS.
PRINT "WHAT IS THE REINFORCEMENT SCHEDULE ";
INPUT R#
L3=LEN(R#)-2
R5(I)=VAL(MID$(R#,3,L3))
IF MID$(R#,2,1)="R" THEN 70
60 IF MID$(R#,1,1)="V" THEN 65
FOR J=1 TO 20 : REM SCHEDULE IS F1.
  S5(I,J)=R5(I)
NEXT J
GOTO 80
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63 FOR J=1 TO 20 : REM SCHEDULE IS VI.
SS(I,J)=S9(J)*RS(I)/60
NEXT J
GOTO 80
70 IF MID$(R6,2,1)="U" THEN 75
FOR J=1 TO 20 : REM SCHEDULE IS FR.
R4(I,J)=RS(I)
NEXT J
GOTO 85
75 FOR J=1 TO 20
R4(I,J)=S9(J)*RS(I)/60
NEXT J
GOTO 85
80 FOR J=1 TO 20 : REM ZERO RATIO COUNTERS IF SCHEDULE IS FI OR VI.
R4(I,J)=0
NEXT J
GOTO 90
85 FOR J=1 TO 20 : REM ZERO INTERVAL COUNTER IF SCHEDULE IS FR OR VR.
SS(I,J)=0
NEXT J
90 REM END OF SCHEDULE DETERMINATION SUBROUTINE.
NEXT I
POKE(8014)=Z
T=4 : REM SIGNAL AN INTERRUPT EVERY .01 SECONDS.
POKE(86113)=T
CALL #6103 : REM INITIALIZE THE TIMER.
IRD ON
100 INPUT A$
IF A$<>"S" THEN 100
POKE(8014)=0
GOTO 9000
1000 GEN #CE,8010,8A602
GOSUB 5000
FOR K=1 TO N3
IF E1(K)=1 THEN 4900
IF X&C(K)=C(K) THEN 1100 : REM WHEN EQUAL CH IS OFF.
GOTO 1500 : REM CHANNEL MUST BE ON.
1100 IF E2(K)=1 THEN 1300 : REM IF E=1 CH WAS ON.
GOSUB 6000
IF S4(K)=32767 THEN 4900 : REM CH IS OFF WAS OFF.
S4(K)=S4(K)+1
GOTO 4900
1300 GOSUB 6000 : REM CH IS OFF, WAS ON.
E2(K)=0
S8(K)=S8(K)/2
IF S8(K)>0 THEN 1390
S8(K)=1
1390 IF S8(K)>= 50 THEN 1400
D1(K,S8(K))=D1(K,S8(K))+1
GOTO 1450
1400 D1(K,50)=D1(K,50)+1
1450 S8(K)=0
R3(K)=R3(K)+1
IF E4(K)<>1 THEN 1475
E5(K)=1
1475 GOTO 4900
1500 IF E2(K)=1 THEN 1700 : REM IF E=1 THEN CH WAS ON.
GOSUB 6000
E2(K)=1 : REM CH IS ON, WAS OFF.
R2(K)=R2(K)+1
IF S4(K)=50 THEN 1600
IF S4(K)>0 THEN 1590
S4(K)=1
1590 D2(K,S4(K))=D2(K,S4(K))+1
GOTO 1650
1600 D2(K,50)=D2(K,50)+1
1650 S4(K)=0
S8(K)=S8(K)+1
GOTO 4900
1700 GOSUB 6000 : REM CH IS ON, WAS ON.
IF S8(K)=32767 THEN 4900
S8(K)=S8(K)+1
4900 GOSUB 7000
NEXT K
IF E3=N3 THEN 9000
4999 RETI
5000 POKE(8011)=#3C
X=PEEK(8010)
RETURN

5100 POKE(8017)=#3C
X=PEEK(8016)
RETURN
6000 T2(K)=T2(K)+1 : REM TEST FOR INTERVAL REQUIREMENTS, SET REIN FLAG.
IF S6(K)<S5(K,S7(K)) THEN 6050
E4(K)=1
6050 IF T2(K)<100 THEN 6100
S2(K)=S2(K)+1
S6(K)=S6(K)+1
T2(K)=0
IF E4(K)=1 THEN 6060
TS(K)=0
6060 IF S2(K)<>S1(K) THEN 6100 : REM END OF SESSION ? TURN OFF BOX.
E1(K)=1
E3=E3+1
Z=Z-S3(K)
POKE(8014)=Z
6100 RETURN
7000 IF E4(K)<>1 THEN 7200
IF E5(K)<>1 THEN 7200
IF R3(K)<R4(K,S7(K)) THEN 7200
Z=Z+R1(K)
POKE(8014)=Z
TS(K)=TS(K)+1
IF TS(K)<T4(K) THEN 7200
Z=Z-R1(K)
POKE(8014)=Z
L2(K)=L2(K)+1
S6(K)=0
E4(K)=0
E5(K)=0
R3(K)=0
TS(K)=0
IF S7(K)<20 THEN 7100
S7(K)=1
7100 S7(K)=S7(K)+1
IF L2(K)<>L1(K) THEN 7200
E1(K)=1
E3=E3+1
Z=Z-S3(K)
POKE(8014)=Z
7200 RETURN
9000 IRD OFF
POKE(86113)=800
CALL #6103
POKE(8010)=0:POKE(8011)=0:POKE(8012)=0:POKE(8013)=0
FOR I=1 TO N3
PRINT
PRINT "BOX 'I:' RESULTS."
PRINT "ELAPSED SESSION TIME IS 'S2(I):' SECONDS"
PRINT "NUMBER OF RESPONSES IS 'R2(I)"
PRINT "NUMBER OF REINFORCEMENTS IS 'L2(I)"
NEXT I
PRINT "WANT TO STORE THE SESSION DATA ?"
INPUT A$
IF A$="NO" THEN 9999
PRINT "WHAT IS THE DATA FILE NAME ?"
INPUT F$
PRINT "WHAT IS THE SESSION DATA LABEL ?"
INPUT A$
OPEN #1,"1."*F$
WRITE #1,A$
FOR I=1 TO N3
WRITE #1, "BOX 'I,' RESULTS."
WRITE #1, "ELAPSED SESSION TIME IS 'S2(I),' SECONDS"
WRITE #1, "NUMBER OF RESPONSES IS 'R2(I)"
WRITE #1, "NUMBER OF REINFORCEMENTS IS 'L2(I)"
NEXT I
FOR K=1 TO N3
WRITE #1, "DATA FOR BOX 'K"
WRITE #1, "DURATION (.01 SEC BINS) INTERRESPONSE TIMES (.05 SEC BINS) "
FOR N1=1 TO 50
WRITE #1, D1(K,N1),D2(K,N1)
NEXT N1
NEXT K
9999 STOP : END

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