

*SUSTAINED BEHAVIORAL CONTRAST IN CHILDREN*<sup>1</sup>

WENDEN W. WAITE AND J. GRAYSON OSBORNE

UTAH STATE UNIVERSITY

Children were exposed to a multiple schedule involving equal variable-interval schedules in each of two components and a multiple schedule involving a variable-interval schedule in one component and an extinction schedule in the other. Response rates were equal in both components when each involved a variable-interval schedule. Response rates differed in the two components of the multiple variable-interval extinction schedule. Response rates were higher in the variable-interval schedule when the accompanying schedule was extinction than when it was variable interval. The increase in response rate in the variable-interval component, simultaneous with the decrease in response rate in the extinction component, illustrated sustained behavioral contrast, and was the first evidence of this phenomenon in children.

A multiple schedule of reinforcement is comprised of at least two schedules of reinforcement presented according to some sequence, the component schedules of which are indicated by correlated stimuli (Ferster and Skinner, 1957). Control by the stimuli of a multiple schedule is indicated by the repeated production of distinctive response rates and response patterns in the presence of the stimulus correlated with a given component schedule. Responding in multiple schedules is typically characteristic of the simple schedules that comprise them; however, if the schedule in one of the components is manipulated, the response rate may change in the unmanipulated (constant) component. This interaction between response rates in successive components of a multiple schedule is called contrast if the change in rate in one component of the schedule is away from the direction of change in rate in the other component (Reynolds, 1961).

Nevin and Shettleworth (1966) described

two types of contrast. The first, called transient contrast, refers to rate changes within the constant component. In a given presentation of that component, the magnitude of contrast is greatest when the component first appears. Contrast then declines to a stable level. Sustained contrast, the second type, refers to the mean rate over entire components. Averaged over sessions or over procedures, the rate in the constant component is changed away from the direction of change in the other component.

Given these definitions, it is possible for transient contrast to occur without sustained contrast if the transient changes within constant components are not sufficient to produce overall rate changes across sessions or procedures. Conversely, it is possible for sustained contrast to occur without transient contrast if there are response rate changes across sessions and procedures and no response rate changes within constant schedule components.

The only published study of contrast with humans found the transient contrast effect. O'Brien (1968) presented retarded adolescent girls with a multiple variable-interval 1-min extinction (mult VI 1-min EXT) schedule in which components were 5-min long and randomly sequenced. Response rates were higher in VI components immediately following EXT components than in VI components following VI components. Rate decreased across succeeding VI components until another ex-

<sup>1</sup>This research was partially supported under Utah State University, Division of Research, Grant No. U-536, and constitutes a portion of a Ph.D. dissertation submitted by the senior author as partial fulfillment of the requirements for the Ph.D. degree in psychology at Utah State University. Reprints may be obtained from Wenden W. Waite, Bingham County Multi-District Program for Handicapped Children, Route 2, Box 249A, Wilson Building, Blackfoot, Idaho 83221, or from J. Grayson Osborne, Department of Psychology, Utah State University, Logan, Utah 84322.

inction component occurred. These results are evidence of transient contrast as they take place within the cycles of a multiple schedule. Although response rates in the VI components were higher in each session than in EXT components, sustained contrast was not demonstrated as the overall response rates in the two components failed to diverge across succeeding sessions.

At present, sustained contrast has not been found with children. The present experiment was conducted to investigate sustained behavioral contrast in children.

## METHOD

### Subjects

Eight school children, four males and four females, ages 5 through 8 yr participated.

### Apparatus

A metal console 21 by 24 by 28 in. (53 by 61 by 69 cm) containing a universal feeder (Davis 310) and a Gerbrands rat lever was located in a small dimly lit room. A red and a blue pilot light, separated by 2 in. (5 cm), were arrayed 1.5 in. (3.7 cm) above the lever. The lever required a force of 34 g (0.33 N) through a distance of 2 mm for operation. Tokens were dispensed into an opening 3.25 by 3.25 in. (8 by 8 cm) in the face of the console, 1.75 in. (4.4 cm) to the right of the lever. A yellow pilot light that flashed for 3 sec upon feeder operation was located 0.5 in. (1.3 cm) above the feeder opening.

Mexican five-centavo pieces were dispensed as reinforcers. They were exchangeable for a variety of candies, games, and toys or could be used to operate a number of food and soft-drink vending machines, all displayed in an adjoining room. Electromechanical scheduling and recording equipment specified the experimental events and recorded the data.

### Procedure

Before the first session, subjects were shown the centavo pieces and the dispensing devices and told they could earn centavos to operate the devices and purchase what they wished from the toy displays. Subjects were allowed to save centavos for items that cost more than a single day's earnings. The exchange ratio was approximately two centavos to 1 cent. To start the first session, the subject was seated be-

fore the console on which the red light was lit and the experimenter said: "Watch what I do." At this time, the experimenter pressed the lever at the rate of approximately one response per second until a centavo was dispensed. He then indicated that the subject would receive centavos for lever pressing if he wished to remain and that a centavo would not be received for every response. The experimenter left the room at this point.

Subjects were divided into two groups according to the order in which they experienced the schedules. Five subjects were exposed to *mult* VI 20-sec VI 20-sec, *mult* VI 20-sec EXT, and *mult* VI 20-sec VI 20-sec again. The other three subjects were exposed to *mult* VI 20-sec EXT, *mult* VI 20-sec VI 20-sec, and *mult* VI 20-sec EXT. Schedule components were 2 min long and alternated. For all subjects, the red light was paired with the unchanging VI 20-sec component while the blue light was paired with the other component, which changed between VI 20-sec and EXT.

Any response emitted during the last 3 sec of the EXT components delayed the onset of the following VI component for 3 sec. During sessions in which the *mult* VI 20-sec EXT schedule was in effect, there were five 2-min presentations of each component. This effectively specified an average of 30 centavos per session. When *mult* VI 20-sec VI 20-sec was scheduled, the session was terminated upon delivery of the thirtieth centavo.

Subjects were shifted from the *mult* VI 20-sec VI 20-sec schedule to the *mult* VI 20-sec EXT schedule when response rates in both components of the *mult* VI 20-sec VI 20-sec schedule deviated from one another by less than 10% within sessions for a minimum of two consecutive days. Extra days were given to maintain the different subjects at similar phases of the experimental procedure. Subjects were shifted from the *mult* VI 20-sec EXT schedule to the *mult* VI 20-sec VI 20-sec schedule when the average number of responses occurring in the EXT component over a minimum of three consecutive sessions was less than 10% of total responding for the same period. Again, some subjects were maintained for more sessions so that all would be in similar phases of the experiment.

Sessions were conducted Mondays through Fridays at the same time each day with subjects being transported from and returned

to their homes or schools by laboratory personnel.

The results of two subjects are not included. One female, 5 yr of age, and one male, age six, were dropped from the study after refusing further participation. They had completed 12 and 21 sessions respectively, at which time they had not met the experimental criteria.

RESULTS AND DISCUSSION

Figure 1 depicts response rate changes for the six subjects who completed the experi-

ment. The increased response rate in the unchanged component of a two-component multiple schedule and decreased response rate in the changed component defines positive contrast, while a decrease in the unchanged component and an increase in the changed component defines negative contrast (Reynolds, 1961). Both positive and negative contrast occurred. Positive contrast was evident in the increase in VI response rate with corresponding decrease in responding during extinction. Negative contrast was revealed by the decrease in rate in the constant VI component with the change from *mult* VI EXT to *mult* VI VI.

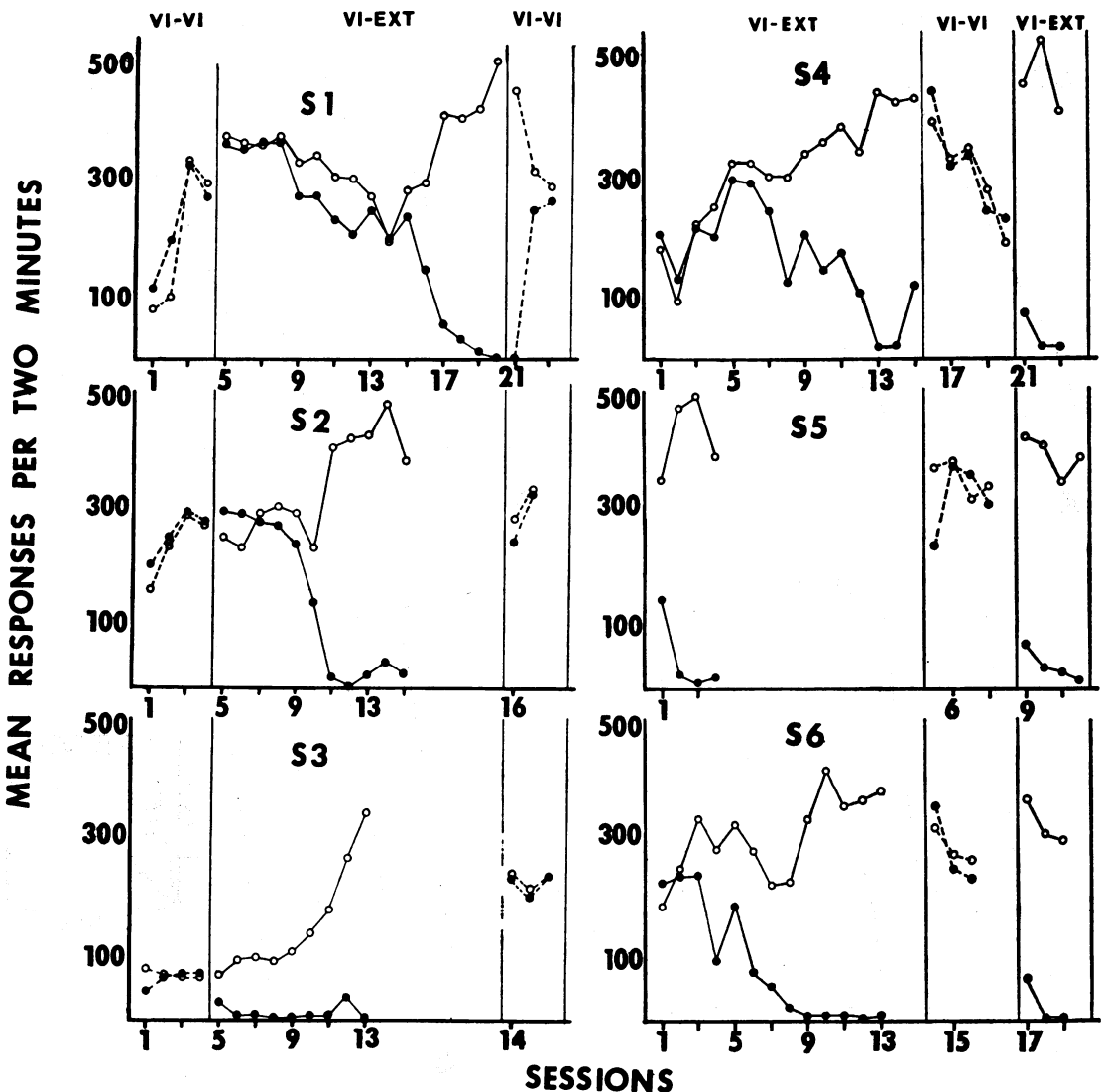


Fig. 1. The number of responses emitted in each component of the multiple schedule by the six subjects in the experiment. Nonfilled circles denote responding in the unchanged VI component, while filled circles denote responding in the second component, which was either VI 20-sec or EXT.

The present data provide the first demonstration of sustained contrast, both positive and negative, by children. O'Brien (1968) presented evidence of transient contrast, but not sustained contrast by humans. Overall response rates produced by his subjects in VI and EXT components failed to change relative to one another.

The independence of transient and sustained contrast is of some experimental interest (Nevin and Shettleworth, 1966). Transient contrasts may have been included in the sustained contrasts depicted in this study's data,

but inspection of Figure 2 allows the inference they were not. This figure portrays complete sessions for Subject 3 during each condition of the experiment. Sustained contrast is evident in the overall slope differences between VI VI (panel A) and VI EXT conditions, both early in VI EXT (panel B) and late (panel C). Positive transients would be evidenced by higher rates at the beginning of constant VI components (event line lowered) during VI EXT than at the end of these components. Visual inspection suggests that transient contrasts were not present in these data,

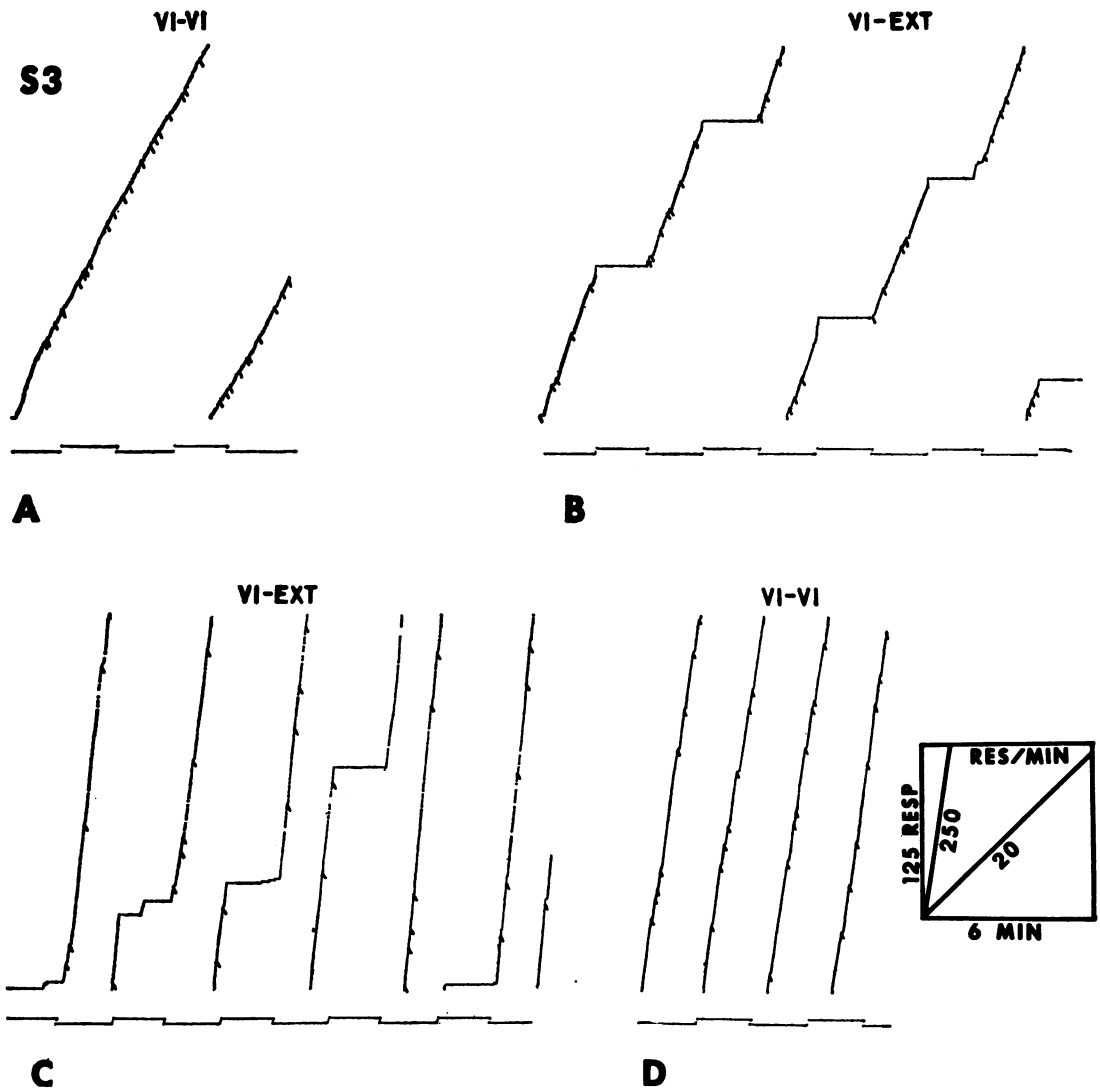


Fig. 2. Cumulative records of responding during the three phases of the study for S3. Panel A is Session 2, panel B is Session 7, panel C is Session 13, and panel D is Session 15. When raised, the event line denotes the changing component (VI or EXT) and when lowered, the unchanging component (VI).

as VI rates during VI EXT were fairly constant throughout each component. A similar conclusion regarding the presence of sustained contrast and the absence of transient contrast results from inspection of the cumulative records of the remaining five subjects (Waite, 1971).

#### REFERENCES

- Ferster, C. and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Nevin, J. A. and Shettleworth, S. J. An analysis of contrast effects in multiple schedules. *Journal of the Experimental Analysis of Behavior*, 1966, **9**, 305-315.
- O'Brien, F. Sequential contrast effects with human subjects. *Journal of the Experimental Analysis of Behavior*, 1968, **11**, 537-542.
- Reynolds, G. S. Behavioral contrast. *Journal of the Experimental Analysis of Behavior*, 1961, **4**, 57-71.
- Waite, W. W. *Behavioral contrast in children*. Unpublished doctoral dissertation, Utah State University, 1971.

Received 3 June 1971.

(Final Acceptance 13 March 1972.)