A HUMAN ANALOGUE OF INCENTIVE CONTRAST EFFECTS

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Abstract

This study represents a human analogue to the straight alley incentive contrast literature in which rats served as the primary research subject. Employing a motor task, incentive was bi-directionally manipulated from preshift to postshift training. The nine groups of subjects received 15 preshift trials of either large, medium, or no reward factorially combined with 5 postshift trials of the same incentive values. No evidence for positive or negative contrast effects was found.

In recent years, there has been growing interest with experimentation in the area of contrast effects. Contrast effects are found if the performance of a subject increases or decreases as a result of increased or decreased reward incentive when compared to control groups exposed consistently to a high or low reward. Positive contrast effects may be obtained when subjects who are exposed to an increase or decrease in reward magnitude respond at a higher rate than those control subjects exposed consistently to the postshift reward value. Negative contrast effects are observed when a subject is exposed to an increase or decrease in reward magnitude resulting in performance below that of a control group.

The original study researching positive and negative contrast effects was done by Crespi (1942). Running rats in a straight alley, Crespi demonstrated that animals exposed to either an upward or downward shift in amount of reinforcement following a specified number of preshift training trials, revealed sharp increases and decreases, respectively, in runway speed performance. However, the study lacked adequate control groups. In one experiment, three groups received a low reward during preshift training and two groups' reward magnitude was increased during postshift training. A comparison between the three groups' postshift speeds was made and an elation effect was found. The other experiment was similar except the three groups began on a large reward during preshift with a reduction in reward for two groups during postshift. Comparison between the three groups' postshift performance showed a depression effect. No comparisons were made to Ss receiving the post reward value throughout pre- and postshift training. Although Crespi referred to these results in terms of elation and depression effects, most recent investigators use the terms of positive contrast and negative contrast to describe the effects found when an upshift or downshift in reward magnitude occurs.

Since Crespi's investigation, animal studies have not been able to report substantial evidence for positive contrast effects when increasing or decreasing reward magnitude. However, animal literature has provided evidence for negative contrast effects, following a decrement in reward magnitude. This will be seen in the following discussion of the animal literature.

Schrier (1967) studied the effects of an increment in reward value with rats in a straight runway. Reward incentives were Noyes 45-mg food pellets and each S received 32 trials, one trial per day. A control group received four pellets each trial while an experimental group received one pellet for the first 16 trials and were shifted to four pellets for the remaining trials. Both the starting and running speeds of the control Ss were greater than those of the experimental Ss during the first 16 trials. Following the increase in reward magnitude of the experimental Ss, the level of their performance quickly reached and maintained that of the control Ss. There was no evidence for positive or negative incentive contrast effects.

Ashida and Birch (1964) also studied increasing reward magnitudes by running rats in a straight runway. Each S received a total of 40 trials. Ss were divided into the following five groups: 0-40;

10-30; 20-20; 30-10; and 40-0, in which the first number represents the number of trials the S received one Noyes food pellet and the second number represents the number of trials the S received 10 pellets. Start speeds were measured and the increase in speeds following incentive shifts was positively related to the number of preshift one pellet trials. In this case, the curves for the various groups make the finding of a positive contrast effect questionable as it appears that learning may still be taking place among all groups except, possibly, the 30-10 group.

Gonzalez, Gleitman, and Bitterman (1962) investigated the effect of reward decrement on runway performance. Three groups of rats ran 42 trials in a straight runway. During the first 27 trials, Group 2 received two food pellets, Group 8 received eight pellets, and Group 32 received 32 pellets per trial. On the 15 postshift trials, both Group 2 and Group 8 were rewarded two pellets per trial. Group 32 was subdivided into three groups receiving two pellets per trial, maintained on 32 pellets per trial, or the pellets were decreased by two per trial until the final level of two pellets was reached. The authors found three major results. First, the magnitude of the response decrement increased with decreases in the amount of reward. Second, no depression effect was found when the reward incentive was gradually decreased. Finally, although a response decrement was found, it was relatively transient even when the reward decrement was great.

Some studies have explored different variables that might affect contrast effects when the amount of reward is decreased. Di Lollo and Beez (1966) conducted a study with rats investigating the relationship between contrast effects and the amount of reward decrement. Five groups of rats were trained in a straight runway receiving five different levels of reward consisting of one, two, four, eight, or sixteen food pellets. After 20 trials, each group was shifted to one pellet. Although the changes in performance during the shift were gradual, a change which would not be expected, a positive relationship between the magnitude of reward decrement and the magnitude of negative contrast effects was found.

Vogel, Nikulka, and Spear (1966) investigated the effects of preshift training and decreasing reward magnitude. In the second of two reported experiments, eight groups of rats were trained in a straight runway. Each received 125 preshift training trials during which each group received a different number of rewarded trials as well as differential amounts of reward (one to 10 food pellets), and 45 postshift trials in which all groups received the same reward (one pellet). It was found that the resulting negative contrast effects were positively related to the amount of preshift training.

A few studies have investigated the effects of both an increasing and decreasing amount of reward incentive. Ehrenfreund and Badia (1962) ran 20 rats in a straight runway. Rats were divided into the following four groups: (1) high drive-high reward, (2) high drive-low reward, (3) low drive-low reward, and (4) low drive-high reward. High drive was measured by 85% ad lib. weight and low drive was 95% ad lib. weight. High reward was one 260-mg. Noyes food tablet and low reward was one 45-mg. Noyes food tablet. There were 90 preshift trials under the original drive-reward conditions. During the next 25 postshift trials, all Ss receiving high reward shifted to low reward and all Ss receiving low reward shifted to high reward. Performance comparisons of running speeds revealed a positive contrast effect for the high drive group shifted from a low to high reward, but not for the low drive-low reward group. Negative contrast effects were found for the high drive group shifted from a high to a low reward, but not for the low drive-high reward group. However, such evidence for the contrast effects found is not convincing for two reasons. First, the learning curve presented for the high drive group shows a steep slope for the acquisition trials. Second, the control groups were inadequate in that the postshift performance of each group was compared to their own preshift performance.

Roberts (1966) investigated the effects of age and reward magnitude on contrast effects in rats. Three groups of 25-day-old immature rats and three groups of 180-day-old mature rats were trained in a straight runway. Reward for 20 preshift trials was .1, .5, or 2.5 grams of wet mash and each group was shifted to .5 grams of wet mash on 25 postshift trials. Negative contrast effects were found when adult rats were shifted from 2.5 to .5 grams of wet mash, but no other effects were demonstrated in mature or immature rats.

Both positive and negative contrast effects have been found with human subjects. However, the positive contrast effects were found only with an increment in reward value and the negative contrast effects were found only when the reward magnitude was decreased. The only research with human subjects has been done by Weinstein (1970, 1972). In the first study, Weinstein (1970) studied the effects of decreasing the amount of reward from pre- to postshift training. Each subject worked the same 20 mental multiplication problems in a different sequence and was allowed one answer in 60 seconds for each problem. Preshift trails consisted of the first 15 problems and postshift trials consisted of the last five problems. A no reward (N) group received no reinforcement for all trials and the control (C) group received five points for every other trial. For the preshift trials, a low (L) group received ten points, a medium (M) group received 20 points, and a high (H) group received 40 points for all trials. The L, M, and H groups shifted to five points during the postshift trials. Postshift latency means (i.e. the time between slide onset and first response) were examined and a negative incentive contrast effect was found for all experimental groups when compared to a control group. In the same study, a second experiment was conducted to study the effects of reward increment. The procedure in this experiment was identical to the procedure in the first experiment. On the preshift trials, the C group received forty points, the L group received five points, the M group received 10 points, and the H group was rewarded 20 points. On the postshift trials, all groups experienced forty points. During all trials, an N group received no points. Postshift latency means were examined and a positive incentive contrast effect was demonstrated for all experimental groups when compared to a control group.

Weinstein (1972) also studied, in human subjects, the variables of subjects' age and the amount of preshift training and how such variables influence contrast effects. In this study, subjects worked the same sequence of the same 30 mental multiplication problems that were flashed on a screen. Each subject was allowed one answer, correct or incorrect, or 60 seconds for each problem. Weinstein conducted four different experiments. In the first experiment in which reward was decreased in postshift training, a positive relationship was obtained between the increased preshift training and the amount of negative contrast effects. The next study demonstrated that, with a decrease in reward value, the positive contrast effect found was a positive function of the amount of preshift training. In the last two experiments, both the negative and positive contrast effects found in older subjects (above the age of 35) were not obtained in younger subjects (between the ages of 16½ and 18½).

Although Weinstein found both positive and negative contrast effects in humans with increases and decreases in reward incentives, respectively, while only negative contrast effects have been found in animals, Weinstein's studies may be criticized on two points. First, subjects were shifted in only one direction, either from high or medium reward to low reward or low and medium reward to high reward. The use of a mental task, answering mental multiplication problems, cannot be compared to rats' motor task of running in a straight runway.

Calef, Calef, Bone, Thomas, and Fox (1971) conducted a human analogue of animal literature studying discrimination contrasts in which an environmental cue is paired with reward value. The relevance of their study to the present review is the use of a motor task more analogous to previous animal studies. Each subject was required to trace star patterns with his less-preferred hand. As in animal literature using runways, human subjects were placed in a situation employing a motor task which was not familiar to them (i.e. tracing with the less-preferred hand as compared to running in an alley). The number of segments completed within the time limit (speed) was the measure, similar to the speed of response measures with animals.

The present study was designed to investigate both negative and positive contrast effects in human subjects using bi-directional manipulations of incentive from preshift to postshift training. In addition, a motor task was employed to more closely approximate procedures used in the animal literature.

Method

Subjects. The Ss were 90 volunteer undergraduate students enrolled in developmental psychology classes (301) at Appalachian State University. Students were assigned randomly to nine groups of 10 Ss each.

Materials. Each S was provided a booklet containing 20 star patterns (see Figure 1). Each star pattern was divided into twenty scoring segments. The booklets differed only with respect to reward values (10, 5, or 0 points) printed on the back, lower left-hand corner of each star pattern. The first page of each booklet contained printed instructions of the procedure.

Procedure. The booklets were placed in randomized stacks with respect to reward value in the front of the classroom. Each S was told to pick up a booklet without looking through it. The following instructions (the first page of each booklet) were read to all Ss:

> "Do not open the booklet until instructed. Put your name and section number in the upper right-hand corner. The objective of this task is to find out how many points you can make on this star tracing task. You will receive extra credit, scaled according to your total number of points. The task will be to trace within the border of the stars on the next pages. Try to complete as many segments as you can without touching the borders. You must use the OPPOSITE of your dominant hand to do this task. You will have 10 seconds to begin at the 'start' and complete as much as you can. Do not skip any section of the star. You will not be allowed to turn the paper around while tracing the stars. When the buzzer sounds, put your pen down. Do not turn any pages until I ask you to. On the completion of the star, I will tell you to turn the page. On the back of the page you just completed, you will find printed the number of points that you will receive for each segment completed WITHOUT touching the borders. You will not receive any points for any segment in which you touch or cross a border. You will have 30 seconds to figure the total number of points you should receive for the star. Put the total on the front of the page under the star you just completed. Do not begin the next star until I tell you to begin (At this point, all Ss were shown the same sample star on the blackboard). Are there any questions? There will be no questions or talking during the entire task".

The design for the present study can be best conceptualized as a 3 X 3 (pre- by postshift reward magnitude) factorial design in which Ss received 15 pre- and 5 postshift trials. Reward was comprised of 10, 5, and 0 points per correctly completed segment. The groups were divided as follows:

		postshift reward magnitude		
		0	5	10
preshift reward magnitude	0	NN	NL	NH
	5	LN	LL	LH
	10	HN	HL	HH

N is no reward (0 points), L is low reward (5 points), and H is high reward (10 points). An analysis of variance was conducted over preshift and postshift data.

Results

Means of the number of correctly completed segments per star for each group were computed over two-trial blocks for acquisition data as well as postshift data. A 3 X 3 (pre- by postshift reward magnitude) analysis of variance was conducted over acquisition two-trial block data. Although Trial Blocks were statistically significant [$F(7, 567)=4390.88$, $p < .001$], indicating improvement in performance over trials; no other main effect or interaction was obtained.

A similar analysis of variance was conducted over postshift performance. The curves for the mean number of correctly completed segments for all groups over three postshift trial blocks are presented in Figure 2. As may be seen in Figure 2, the data from the present study does not support animal literature with decreasing reward incentives. Neither a positive nor negative contrast effect was obtained. However, further inspection of Figure 2 does support animal literature with respect to increasing reward values as no incentive contrast effects were obtained. Although Trial Blocks by Preshift Reward Value was statistically significant [$F(4, 162)=44.59$, $p < .05$], no other interaction was obtained.

Discussion

The present data does not provide evidence for any positive or negative incentive contrast effects and cannot support results of previous human studies (e.g. Weinstein, 1970; 1972). With the use of a motor task (star tracing) to more closely replicate animal literature procedures, the findings of this study raise the question of whether incentive contrast effects, either positive or negative, actually occur with human subjects. However, before such a conclusion can be justified, future research must investigate this area more extensively and consider certain differences between animal and human subjects.

The first consideration is the difference between the type of incentives given to animals and humans. In the animal literature, rats were differentially deprived and ran into different amounts of food incentives. Human subjects received points for their performance which cannot be compared to food, a necessary element for survival.

Another difference between animal and human studies is the number of trials given per day. Rats received spaced trials, one trial per day. Human subjects received massed trials, all trials being given in one session. It has been shown that learning is more stable under spaced trials than under massed practice.

Another area to investigate is the effects of testing subjects individually, as in all animal studies and previous human studies, or in a group, as in the present study. Problems were encountered in this study with testing subjects in groups, due to spontaneous verbal responses by individuals and brief discussions between other subjects, although the procedure attempted to control for this. Therefore, it seems that individual testing would be preferable. However, the experimental task should be selected carefully to ensure the subject's performance is in response to the incentive and not a performance to fulfill the experimenter's expectations.

Magnitude of reward change, ages of subjects, and the amount of preshift trials are still necessary to consider, as both animal studies (e.g. Di Lollo & Beez, 1966; Vogel, Mikulka, & Speer, 1966; Roberts, 1966) and human studies (Weinstein, 1970; 1972) have found these to be significant variables. Incentive contrast effects should also be studied in children.

Future research investigating human incentive contrast effects will be more complex than past studies have been. However, because many questions arise about human incentive contrast effects, such complexity with research in this area is justified.

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APPENDIX

Appendix A

Summary table for analysis of variance for Postshift Data over Two-trial Blocks.

Source	DF	SS	MS	F
Between-S	89	5652.88		
Pre-Shift	2	116.65	58.33	.91
Post-Shift	2	77.43	38.72	.61
A X B	4	284.80	71.20	1.11
error (b)	81	5174.00	63.88	
Within-S	180	799.33		
Trial Blocks (c)	2	.90	.45	.10
A X C	4	44.59	11.15	2.53*
B X C	4	8.68	2.17	.49
A X B X C	8	30.76	3.85	.87
error (w)	162	714.40	4.41	
Total	269	6452.21		

*p $<$ .05

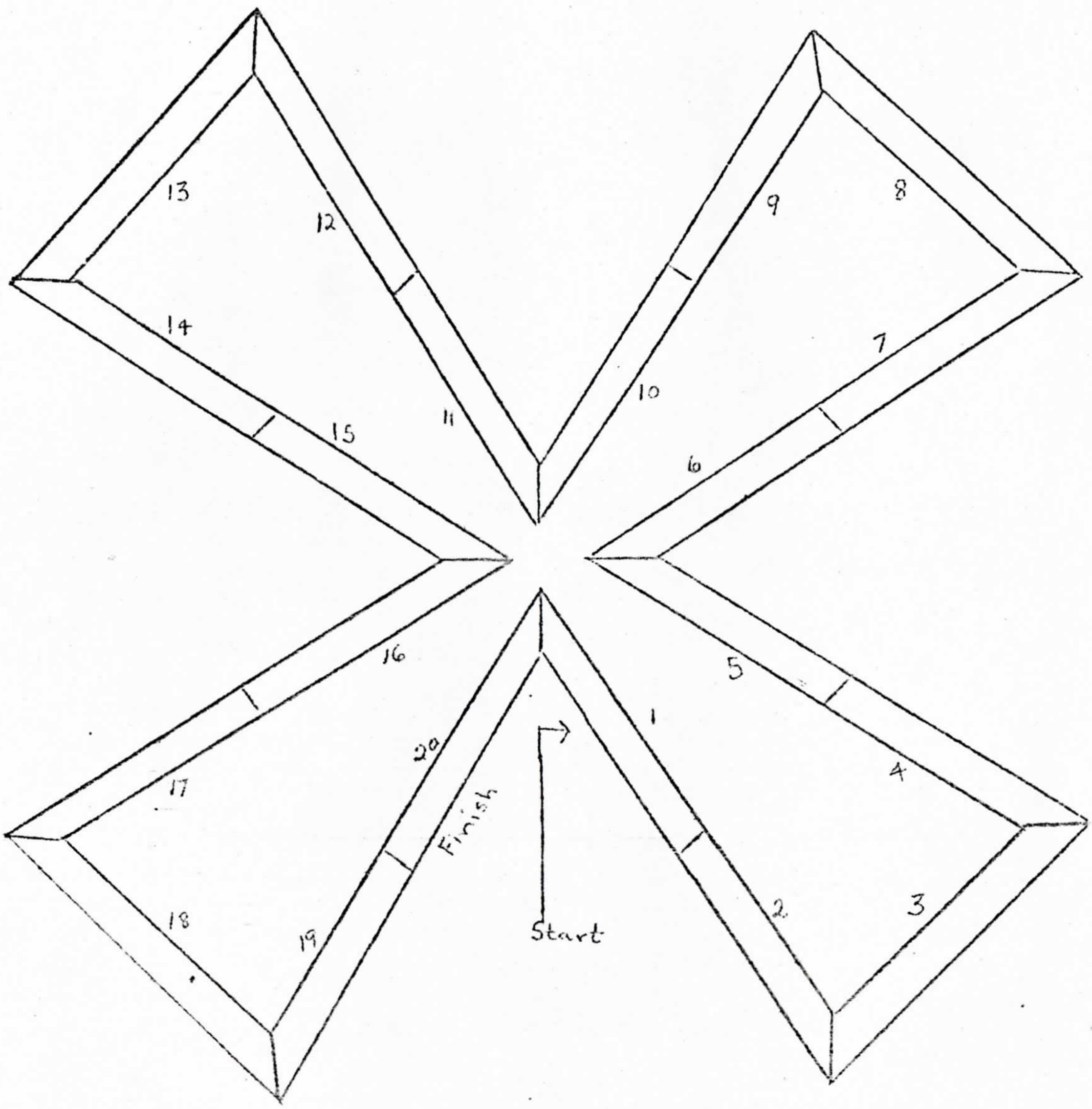

Figure 1: Star Trace

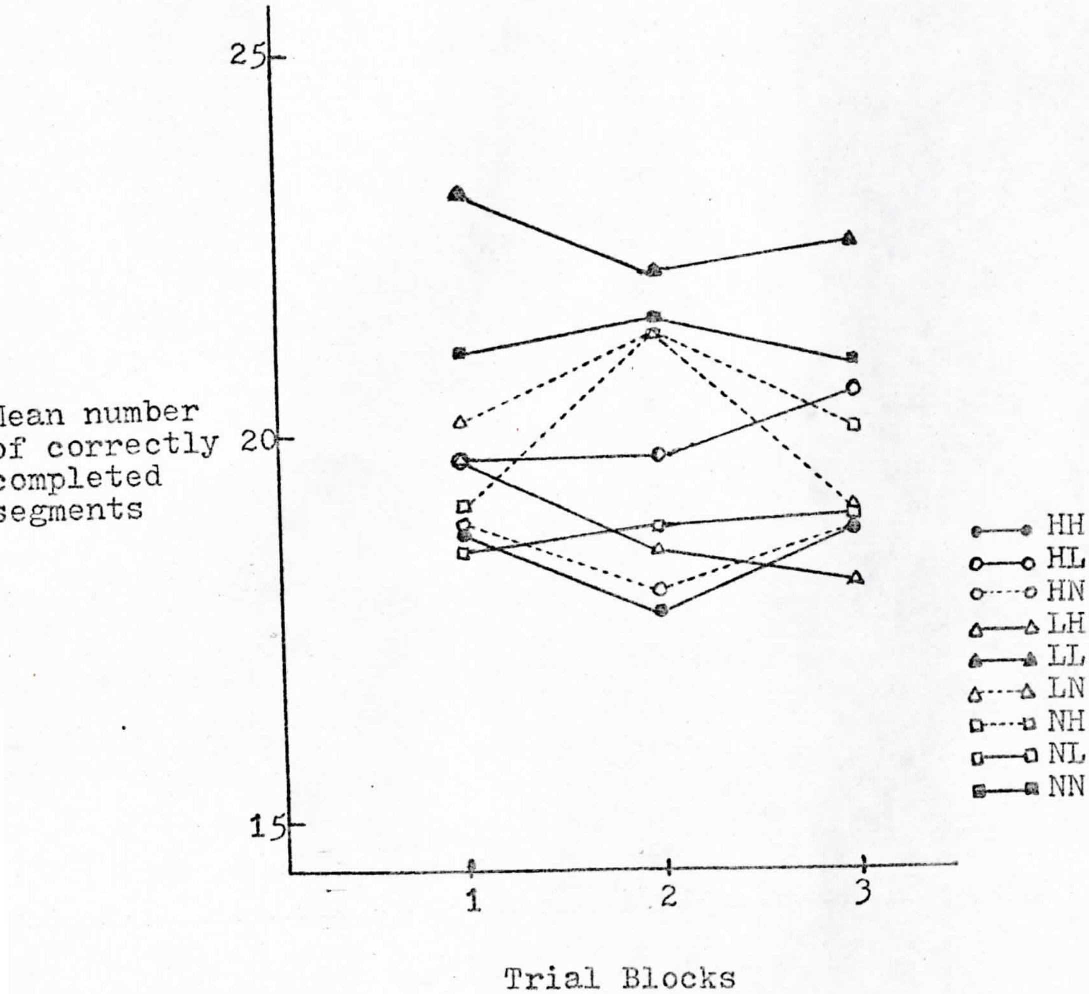

Figure 2: Mean number of correctly completed segments for all groups over trial blocks of postshift data.