Magnitude of human incentive contrast as a function of amount of training and age

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In Experiment 1, increased amounts of preshift training produced larger negative contrast effects in human Ss; in Experiment 2, positive contrast was a monotonic function of amount of preshift training with humans. Experiment 3 demonstrated that negative contrast which occurs subsequent to a reduction in incentive size with older individuals, is eliminated in younger people; and, finally, Experiment 4 showed that upward contrast effects found with older individuals do not occur with younger Ss. It appears that magnitude of incentive contrast effects in humans is a positive function of amount and length of preshift training. It also seems that age of the S is a variable which controls the occurrence of human incentive contrast effects.

Negative incentive contrast effects are obtained when a reduction in incentive magnitude results in a reliably lower level of behavior than the level of performance in a control group exposed to only the single, lower, reward magnitude, while positive contrast effects are defined when an increase in amount of reward results in performance that rises significantly above the level of a high-reward control group. While it is not readily apparent which variables control the occurrence of incentive contrast effects, age of the Ss and amount of preshift training are two variables which have been demonstrated to affect the magnitude or occurrence of negative contrast effects in animals. Vogel, Mikulka, & Spear (1966, 1968) have reported that larger downward contrast effects in rats accompany increased preshift training. Roberts (1966) has demonstrated that negative contrast effects which result from a reduction in incentive magnitude in 180-day-old mature rats are eliminated in 25-day-old immature animals. Little information is available concerning how humans respond to the variables of age and length of preshift training in an incentive shift paradigm.

Experiment 1 investigated the magnitude of downward contrast effects with human Ss as a function of the amount of preshift training. Experiment 2 examined the effects of amount of training on the magnitude of positive incentive contrast effects. Experiment 3 attempted to determine how older and younger people respond to a reduction in incentive size. And, finally, Experiment 4 examined the effects of age on positive incentive contrast effects in humans.

EXPERIMENT 1

Subjects

The Ss were 20 male and 20 female undergraduate students enrolled in an introductory psychology course at the University of Melbourne. The Ss, 18 to 21 years of age, were assigned randomly to each of four groups so that 5 males and 5 females were in each group.

Materials

The materials consisted of a Kodak Carousel 750 slide projector 139.0 mm from a 152.4-mm square piece of cardboard that served as a screen, 50.8 x 42.6 mm slides with digits printed on them (i.e., 126 x 4), and a stopwatch.

Procedure

Each S worked the same sequence of the same 30 mental multiplication problems. One answer, correct or incorrect, or 60 sec, whichever came first, was allowed for each problem, and there were 4 sec between problems.

The problems were worked in four situations. Ss received no reinforcement after their answers (N). Other individuals, in the control condition (C), received 5 points after answering the 1st, 3rd, 4th, 6th, 9th, 10th, 12th, 14th, 17th, 19th, 24th, 25th, 27th, and 28th problems. Another group received 50 points through Problem 9 and then received 5 points from Problem 10 to the end of the session (10). Finally, some individuals received 50 points for 24 problems followed by a reduction in incentive size to 5 points on the 25th problem and thereafter (25). Reinforcement was delivered for all groups on the same, previously designated, problems.

The 10, 25, or C Ss were read the following instructions: "This is an experiment in abstract problem solving, the ability to rapidly work problems involving abstract reasoning.

You will be given some problems to work. Each one consists of a three-digit number multiplied by a one-digit number. You are, without pencil and paper, in your head, to multiply the numbers as quickly as you can and tell me your answer. You will receive from 1-55 points after some answers; the speed, and accuracy, with which you answer relative to other Ss will earn you more points. In other words, you are being rated against the other Ss."

In the instructions to the N individuals, reference to receiving points was omitted.

The E, seated beside the S in the same room, manually operated the slide projector and recorded latencies with the stopwatch. Between problems, as little as possible was said to the Ss.

Results

Latency means (the time between slide onset and the first correct or incorrect response) were examined in the analysis of the results.

Figure 1 indicates that for Problems 1-9 the N individuals took more time to respond than any other group and that the C group reacted more slowly than the 25 or 10 Ss.

The mean latency for Problems 1-9 differed significantly among the four groups by an analysis of variance, $F(3,36) = 2.94$, $p < .05$. By Newman-Keuls comparisons, Group N was different from each other group ($p < .05$), and the C Ss reacted more slowly than the 25 or 10 individuals ($p < .05$).

Figure 1 further indicates that on Problem 11 the 10 group rapidly increased their mean latency to a level above that of the C individuals (negative incentive contrast effects) while on Problem 26 the 25 Ss suddenly increased their mean latency to a level above that of the C (negative contrast effects) and the 10 Ss on Problem 11.

The mean latency for Problems 10-24 differed significantly between the 10 and C groups by an analysis of variance, $F(1,18) = 4.61$, $p < .05$. The mean latency for Problems 26-30 differed reliably between the 25 and C Ss by an analysis of variance, $F(1,18) = 4.92$, $p < .05$.

Since the control group levels of performance for the first four problems in each postshift phase, Problems 10-13 and 25-28, were comparable, it was possible to directly compare the shift groups. The mean latency over the first four problems in each postshift period differed significantly between the 10 and 25 groups by analysis of variance, $F(1,18) = 5.26$, $p < .05$.

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Fig. 1. Mean latency in seconds for decrement in reward. Arrows denote postshifts.

EXPERIMENT 2

Experiment 1 indicated that saying "5" and "50" after an answer is sufficient reward to produce negative incentive contrast effects in humans, and is a positive function of the amount of preshift training. In Experiment 2, these amounts of incentive were selected to examine the influence of magnitude of reward change on magnitude of positive incentive contrast.

Subjects, Apparatus, and Procedure

The Ss were 25 male and 25 female undergraduate students. The details of the Ss (i.e., age), apparatus, and procedure were the same as in Experiment 1 except that 5 males and 5 females were assigned randomly to each of five groups. The C individuals received 50 points, and the 10, 25, and 35 groups each received 5 points through Sessions 9, 24, and 34, respectively. Incentive magnitude was increased to 50 points for the 10, 25, and 35 Ss on Sessions 10, 25, and 35, respectively. A total of 40 problems were presented.

Results

The same measure of Experiment 1 was examined in Experiment 2.

Figure 2 shows that for Problems 1-9 the N group responded more slowly than all other groups and that the C Ss reacted faster than all other groups. The mean latency for Problems 1-9 differed significantly among the five groups by analysis of variance, $F(4,45) = 3.11$, $p < .05$. By Newman-Keuls comparisons, the difference between N and each other

group, and C and each group was statistically reliable ($p < .05$).

Figure 2 indicates that on Problem 11 the 10 group reduced the mean latency to a level above that of the C individuals, while on Problem 26 the 25 Ss performed faster than the C Ss (positive contrast effects), on Problem 36 the 35 individuals reacted more quickly than the control Ss (positive contrast) and faster than the 25 group reacted on Problem 26.

The mean latency for Problems 25-30 differed significantly between the 25 and C Ss by an analysis of variance, $F(1,18) = 5.83$, $p < .05$.

The mean reaction time for Problems 35-40 differed significantly between the 35 and C groups by an analysis of variance, $F(1,18) = 6.22$, $p < .05$.

The mean latency over the first three postshift problems differed significantly between the 25 and 35 groups by analysis of variance, $F(1,18) = 4.96$, $p < .05$.

EXPERIMENT 3

Experiment 2 indicated that positive incentive contrast effects in human Ss are a monotonic function of the amount of preshift training. Experiment 3 attempted to determine if age is a variable which determines the size or occurrence of negative contrast effects in humans.

Subjects, Apparatus, and Procedure

The Ss were 16 males and 16 females between 16½ and 18½ years of age (young) and 16 males and 16 females above the age of 35 (older). Younger Ss were randomly assigned to each of two groups so that 8 males and 8 females appeared in each group; the older individuals were assigned randomly to each of the two remaining groups, with the restriction that 8 males and 8 females be in each group. All Ss were enrolled in an introductory psychology course at the University of Maine, Portland. The details of the apparatus were the same as in Experiment 1.

The problems were worked in four situations. Younger Ss received 5 points after answering the 1st, 2nd, 4th, 6th, 8th, 10th, 11th, 12th, 16th, and 18th problems (5-5Y); the remaining younger Ss received 50 points through Problem 10 and then received a reduction in amount of reward to 5 points on Problem 11 and thereafter (50-5Y); a group of older

Fig. 2. Mean latency in seconds for increment in incentive. Arrows denote postshifts.

Fig. 3. Mean latency in seconds for reduction in incentive size with older and younger Ss.

individuals received 5 points throughout the 20 problems on the designated trials (5-5 OLD); and, finally, the other older group received 50 points through Problem 10 and then received a reduction in quantity of incentive to 5 points on Problem 11 for the remainder of the session (5-5 OLD). The remaining details of the procedure were the same as in Experiment 1.

Results

The same measure of Experiment 1 was examined in Experiment 3.

Figure 3 demonstrates that for Problems 1-10, 5-5 Y reacted more slowly than 50-5 Y, and 5-5 OLD responded more slowly than 50-5 OLD. The mean latency for Problems 1-9 differed reliably among the four groups by analysis of variance, $F(3,60) = 2.84$, $p < .05$. By Newman-Keuls comparisons the difference between 5-5 Y and 50-5 Y, and 5-5 OLD and 50-5 OLD was each statistically significant ($p < .05$).

Figure 3 indicates that on Problem 12 the 5-5 OLD Ss reduced their mean latency to a level above their control group (negative incentive contrast effects), while the 50-5 Y Ss decreased their mean latency to a level below the 5-5 Y group.

The mean latency for Problems 12-20 differed significantly between the four groups by analysis of variance, $F(3,60) = 4.22$, $p < .01$. By Newman-Keuls comparisons, the difference between 50-5 OLD and 5-5 OLD was significant ($p < .05$) while the difference between 50-5 Y and 5-5 Y was not reliable ($p > .05$).

EXPERIMENT 4

Experiment 3 demonstrated that negative incentive contrast effects obtained with older Ss are eliminated in younger Ss. Experiment 4 examined the effects of the variable of age on positive incentive contrast effects.

Subjects, Apparatus, and Procedure

Different Ss from Experiment 3 were used in Experiment 4. The remaining details of the Ss (i.e., age) and apparatus were the same as in the previous study. A younger group received 50 points throughout the 20 problems (50-50 Y); other, older, Ss were also kept on 50 points throughout the session (50-50 OLD); a third group, of younger individuals, received 5 points through Problem 10 and was then exposed to an increase in quantity of reward to 50 points from Problem 11 to the end of the session (5-50 Y); and, finally, older Ss received 5 points through the 10th problem and then 50 points from Problem 11 and thereafter (5-50 OLD).

Results

The same measure of Experiment 3 was examined in Experiment 4.

From Figure 4 it is clear that for Problems 1-10, 5-50 OLD took more time to respond than did 50-50 OLD and that 5-50 Y responded more slowly than 50-50 Y. The mean latency for Problems 1-10 differed reliably between the four groups by an analysis of variance, $F(3,60) = 3.14$, $p < .05$. By Newman-Keuls comparisons, the difference between 5-50 OLD and 50-50 OLD and between 5-50 Y and 50-50 Y was each statistically significant ($p < .05$).

Figure 4 indicates that on the 12th problem, the 5-50 OLD Ss abruptly decreased their mean latency to a level below that of their control groups, 50-50 OLD (positive contrast effects), and the 5-50 Y Ss decreased their mean latency to a level somewhat above that of the 50-50 Y group. The mean latency for Problems 12-20 was significantly different among the four groups by an analysis of variance, $F(3,60) = 2.85$, $p < .05$. By Newman-Keuls comparisons, the difference between 50-50 OLD and 5-50 OLD was reliable ($p < .05$) while the difference between 50-50 Y and 5-50 Y was not statistically significant ($p > .05$).

DISCUSSION

The findings in Experiment 1 that for Problems 1-9 the N group took longer to answer than any other group and response latency was a negative function of the amount of reward indicate that: (1) saying "5" and "50" after answers served as reinforcing events, and (2) two discriminably different levels of reward were employed, where different levels of incentive are defined by the significantly different levels of performance they produce rather than by different values on the stimulus scale.

Experiment 1 demonstrated negative contrast effects in humans

Fig. 4. Mean latency in seconds for increment in quantity of reward with older and younger Ss.

with a reduction in amount of reward. This result is consistent with most studies with infrahuman organisms (Black, 1968) and is in agreement with the few available human investigations (e.g., Weinstein, 1970; Weinstein & Colucci, 1970).

Experiment 1 clearly indicated that negative incentive contrast effects are a positive function of the amount of preshift training in human Ss. This result is in accord with most studies with infrahuman organisms (e.g., Vogel, Mikulka, & Spear, 1966, 1968).

In Experiment 2, for Problems 1-9, the same relationship was obtained between incentive magnitude and response latency as in the preshift phase in Experiment 1. In other words, saying "5" and "50" after an answer served as reinforcing agents which were discriminably different.

Experiment 2 clearly demonstrated that positive contrast effects are a monotonic function of the amount of preshift training in humans.

It would appear that the size of upward and downward contrast effects in human Ss is a direct function of the amount and length of preshift experience.

In Experiment 3, in the preshift phase for both older and younger Ss, two discriminably different levels of reward were employed. The postshift results clearly show that the older Ss displayed downward contrast while the younger individuals did not exhibit the effect. These postshift results are in agreement with the few available studies with animals (e.g., Roberts, 1966).

In Experiment 4, for Problems 1-10 for older and younger Ss, the same negative relationship was obtained between response latency and incentive magnitude as in the previous experiments. The data from Problems 12-20 plainly indicate that

older Ss displayed positive contrast consequent to an increase in incentive size while younger individuals did not exhibit upward contrast effects.

In Experiments 3 and 4, while Ss could not be randomly assigned between age groups individuals were randomly allocated within each age group. That is to say, the young Ss may perhaps be a bit brighter than the older individuals. This is a difficulty that seems to arise in nearly all studies that compare different age groups.

It seems that positive and negative human incentive contrast effects found with adults do not occur with younger individuals. That is to say, age appears to be a controlling factor in the occurrence of incentive contrast effects in humans.

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clustering and words recalled. Hudson & Davis (1970) also included a third group [information-between (IBe)] which was given the category names prior to whole-list learning only. Any difference between this group and the NI group should reflect effects of information per se, and any difference between the IB group and IBe group should reflect effects due to either differences in transfer of organization or, possibly, differences in retention. The trend of the results of their data was as predicted, but was generally nonsignificant.

The study which follows was a modification of the Hudson & Davis (1970) design in an attempt to demonstrate that in free recall studies of categorizable word lists, increased recall will be a concomitant of increased E-defined organization when such organization is more efficient than other systems. The present study utilized taxonomic word lists with four words from each of 10 categories. In addition to the three groups previously mentioned (IB, IBe, and NI), two other groups were added. The no-information/irrelevant (NI/I) and information-between/irrelevant (IBe/I) groups were treated like the NI and IBe groups, respectively, except that the Task 1 words learned by these groups were not present in the Task 2 list and shared no categories in common with the Task 2 list. The NI/I group, then, would be the appropriate baseline group from which to judge negative or positive transfer in the other groups. In addition, the NI and NI/I groups should provide a replication of Tulving's (1966) original part-to-whole transfer study as the NI group would be expected to exceed the NI/I group on the first trial or two of whole-list learning, but the NI group should be inferior over the remaining trials because, presumably, the organization this group imposed on part-list learning would generally not be appropriate for whole-list learning.

Thus, the hypothesis of the study was that on at least the first trial or two, the IB group would exceed the other groups, but on later trials would not exceed the IBe group. We expected that the IBe/I group would have an initial depression compared to the IB and IBe groups but would later catch up. In accordance with Tulving's previous findings, we expected the NI group to exceed the NI/I group on the first trial or two and to be depressed from that point on.

SUBJECTS

The Ss were 75 male and female introductory psychology students who served in order to fulfill a course requirement.

MATERIALS

Forty words were chosen from the

Part-whole transfer of a taxonomic word list*

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Three groups of Ss were given a part-whole transfer task where the words were members of taxonomic categories. Information regarding the taxonomic nature of the words was varied. The information-before (IB) group was given this information prior to the part list, the information-between (IBe) group received it prior to the whole list, and the no-information (NI) group was never given any information. Two control groups were included which were given taxonomic words in part-list learning which were not included in the whole list, i.e., category content was irrelevant. The information-between/irrelevant (IBe/I) group was given information regarding the whole list prior to the whole list, and the no-information/irrelevant (NI/I) group was given no information at all. Basically, the results indicated that both the IB and IBe groups exceeded the NI/I and NI groups in word recall. They did not, however, differ between themselves, except on Trial 1 of the whole list when only "old" words recalled were considered. Implications of these results were discussed.

In studies of free recall using categorizable word lists, several investigators have demonstrated that many variables will affect the extent or organization, where organization is defined as consecutive recall of words from the same category, i.e., clustering. One thing conspicuous about these studies, however, is that increased recall is not necessarily concomitant with increased organization (Cofer, 1967). In many studies, there is a paradox in that there is a tendency for Ss who cluster more to recall more words; yet, "artificially" increasing the tendency to organize into E-defined units does

not increase the actual number of words recalled.

Hudson & Davis (1970) attempted to demonstrate positive transfer of both clustering and number of words recalled in a part-whole transfer paradigm using words from the Underwood & Richardson (1956) norms. They hypothesized that when the whole list consists of the part list plus additional words from each category, the part-list organization would be effective for organizing the whole list. This should be true for a group [information-before (IB)] told prior to part-list learning that the words can be categorized along with the category names. The nature of the word lists is such, however, that a group never given this information [no-information (NI) group] should essentially be equivalent to a group learning unrelated words. Hence, in whole-list learning, the IB group should exceed the NI group in both

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