STUDIES OF THE "SPREAD OF EFFECT": V.

THE SPREAD OF THE EFFECT OF VERBAL PUNISHMENT
AND THE MEANINGFULNESS OF CUE-STIMULI*

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Waits (30) in 1947 suggested the possibility of a spread of verbal items in the multiple-choice situation. This is comparable in a reverse way to the spread of verbal reward effect to the immediately preceding and following "wrong" items first discovered by Thorndike (18) in 1933. Muenzinger and Dove (11) extended the Waits study using a typical Thorndikian design. Forty monosyllabic words were called out at a 2.5 sec. rate for 11 trials and their subjects were required to respond to each of the items with a number one through 10. The central part of the word series had one "wrong" followed by seven "rights" and then another "wrong" regardless of the subject's responses. The percentage of number repetitions was found to decrease with their proximity to the "wrong" response. The authors believed to obtain a bidirectional spread of response variability around a unsuccessful response.

However, Stone (14) has criticized the Muenzinger and Dove results on

the ground that serial effects were not ruled out in their study and consequently their main finding might be produced even though all the central items were rewarded.

Similar results to Muenzinger and Stone's were reported by Dove (2) using a circular "spoke-wheel" maze, in which a bidirectional gradient of variability appeared for "right" responses around a "wrong" response but the gradient was less clear than the previous results. Again several methodological criticisms have been raised against the Dove study by Stone (14).

Farber's attempt (3) to verify the bidirectional gradient of variability produced by punishment was not successful. A punch-board maze was designed in his study as a comparable motor-task to the Thorndikian situation. Percentages of repetitions of three rewarded items around a punished item showed no consistent gradient. Tilton (19) found a bidirectional variability gradient similar to Muenzinger and Dove's, using an "empirical base" in order to correct the data for serial

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effects. However, the same gradient was reversed, as was pointed out by Stone (14) for the longer reward series.

Stone has made the most systematic studies of the problem of gradients of variability around failure (13, 14, 15, 16, 17). In a Thorndikian design, stimulus word lists were presented with prearranged patterns of "right", "wrong", "light shock", "strong shock" or "no response" as after-effects. With respect to the spread of effect of negative incentives, Stone concluded that "the closer the rewarded item is to the punished item following it, the less it tends to be repeated," and "the closer the rewarded response is to the punished one preceding it, the greater the relative fixation" (14, p.210). In other words, the Muenzinger and Dove results were confirmed only for the fore-gradient and the opposite was true for the after-gradient. However no clear fore-gradient appeared for verbal punishment. Stone interpreted the fore-gradient or the pre-punishment gradient as due to the fact that "rewarded responses of the gradient series act as conditioned stimuli for the punishment to follow" (14, p.215) and thus the responses to the rewarded words closer to punishment were avoided more often than other responses preceding it. The post-punishment gradient was explained, on the contrary, in terms of a temporal spread of positive incentive due to the anxiety reduction resulting from the occurrence of punishment. This anxiety reduction hypothesis, however, was questioned by himself on the ground that although a state of anxiety is assumed to be built up only after considerable practice, the

data from the second trial in verbal punishment revealed an unambiguous after-gradient.

A second possible interpretation suggested by him was that more "available" responses would be made by the subject, following punishment as a regressive behavior and consequently less variability of responses or response fixation is expected immediately following an unsuccessful response. Stone, however, felt some hesitation in accepting this interpretation because "it is difficult to relate this hypothesis . . . to the gradient following shock" (14, p.216), although the present author cannot understand why it is.

In his footnote in page 215 of the same article (14), Stone referred to the similarity of the regression hypothesis to the "rehearsal-distraction" hypothesis of Jenkins and Sheffield (9) to account for the post-reward gradient of the Thorndike effect. It should be mentioned that the Jenkins and Sheffield hypothesis is based on the positive after-effect of reward, while Stone's regression hypothesis on the negative after-effect of punishment. Stone failed to illustrate how the two hypotheses were similar. It is hard to believe that the subject "regressed" because of the positive after-effect. What is common to the two principles, according to the present writer, would be a kind of distraction caused by the isolation of positive or negative incentives. Consequently the isolation-distraction hypothesis is a better term than either of them.

The purpose of the present study was to verify Stone's finding using verbal negative incentives and to test the isolation-distraction hypothesis of the variability gradient fol-

lowing punishment by the use of an experimental design similar to Stone's. Main differences were, however, that the present experiment utilized both meaningful and nonsense stimulus series and that the subject was required to recall the previous responses she made and at the same time whether the corresponding items were called "right" or "wrong". It was predicted that as the S-R connection is stronger for meaningful stimulus items, the effect of isolated incentives would be weaker for the same series than for the nonsense stimulus series. A similar experimental analysis was done by the present author (5) with respect to the spread of positive after-effects.

METHOD

Subjects.—A total of 98 undergraduate students at Nara Women's University served as subjects in the experiment. Forty-eight out of these subjects formed Group M and were presented meaningful stimulus series. The rest 50 subjects were called Group N and were given nonsense stimulus series.

Procedure.—Group M was given three trials of each of two stimulus lists in succession. For a half of the group, the subject was required to respond to each of first stimulus list with a number one through 10 at a three second rate for three times. The same instruction was read to the subject for the second list except that on the third trial the subject was asked to recall the number she last named in response to each of the stimulus item presented and at the same time to recall whether or not the item was called "wrong". For the other half of the

group the order of the two stimulus lists was reversed.

Exactly the same procedure was used for Group N with the exception that two lists of nonsense items were presented in place of the meaningful words.

Each of the lists consisted of 24 two-syllabled Japanese *kana* (syllabaries), being clearly written with ink on a 13cm×7.5cm card. The subject was told that each stimulus item had one or more "right" numbers arbitrary assigned to it by the experimenter before the experiment began but the incentive responses of "right" or "wrong" were actually chosen by the experimenter in a pre-arranged order regardless of the subject's responses and of course this was not known to her. That is, the seventh and 18th items of the first list and either the sixth and 17th or the eighth and 19th items of the second stimulus list were called "wrong" and all other items were called "right". The serial position of the stimulus items was changed randomly from subject to subject to eliminate the possibility that some particular S-R connections were easier than others.

RESULTS

Per cent repetition of numbers.—The obtained data were first analysed in terms of the number of times responses were repeated. As there were two isolated punished items for each of the two lists and each of these items was punished three times in one list and twice in another, the maximum number of repetition of responses for an item per subject was six. The minimum was of course zero.

Table 1 presents the data, in per cent repetitions, of the serial position analysis around the punishment. Fig. 1* was derived from Table 1. A falling gradient of response re-

petition was apparent following the "wrong" item for both groups but no clear trend was indicated preceding it for either of the groups. These results agreed with Stone's (14).

Table 1

PERCENTAGE OF RESPONSE REPETITIONS AROUND THE "WRONG" ITEM

after-effect		“right”			“wrong”		“right”	
step-position		-3	-2	-1	0	1	2	3
group	M	37.4	36.1	37.7	29.5	34.7	32.6	30.9
group	N	25.6	25.0	27.0	21.6	29.6	27.3	21.3

Fig. 1 Percentage of response repetitions around the "wrong" item

Analysis of variance was used for testing the significance of each of the obtained gradients as shown in Table 2.

Although the distribution of number of response repetitions was highly skewed, no transformation of the scores was made because of fairly large samples and for the sake of brevity. Only a significant gradient was obtained after punishment for Group N. The same gradient for Group M failed to reach the significance level.

Table 2

ANALYSES OF VARIANCE OF THE GRADIENTS OF RESPONSE REPETITIONS AROUND THE "WRONG" ITEM

Group M

fore-gradient				after-gradient			
source	df	MS	F	source	df	MS	F
gradient	2	.15	.13	gradient	2	.63	.53
subjects	47	3.81	3.28**	subjects	47	3.69	3.15**
residual	94	2.16		residual	94	1.17	

* The same trend, although in a reverse fashion, was obtained when the data were

analysed in terms of variability of responses.

Group N							
fore-gradient				after-gradient			
source	df	MS	F	source	df	MS	F
gradient	2	.19	.22	gradient	2	3.33	3.46*
subjects	49	3.81	4.59**	subjects	49	2.69	2.80**
residual	98	.83		residual	98	.96	

Beside these main findings, the percentage of response repetition for each of the punished item was considerably greater than the chance level of 10%, again confirming the previous results, although only a few trials were given in the present study. Interesting enough was the higher per cent repetition of the meaningful "wrong" response than that of the nonsense "wrong" response. This was contrary to ordinary expectation but the difference was not statistically significant ($t=1.843$, for df of 96).

As the stimulus items were crowded and the inter-trial interval was short, the "wrong" items might not always be punished from the standpoint of the subject. In order to eliminate the possibility, the data were dichotomized according to whether or not the "wrong" response was correctly varied on the next trial. This analysis seems to be necessary because of the fairly high per cent repetitions of the "wrong" responses already described. Table 3 and Fig. 2 indicate the results together with those in case the "wrong" response was incorrectly repeated.

Table 3

PERCENTAGE OF RESPONSE REPETITIONS AROUND THE NON-REPEATED "WRONG" RESPONSE
AND AROUND THE REPEATED "WRONG" RESPONSE

(a) around the non-repeated "wrong" response							
after-effect		"right"		"wrong"		"right"	
step	position	-3	-2	-1	0	1	2 3
group	M	31.6	33.0	32.6		33.4	28.5 27.3
group	N	22.0	24.4	23.4		25.0	24.4 17.6

(b) around the repeated "wrong" response							
after-effect		"right"		"wrong"		"right"	
step	position	-3	-2	-1	0	1	2 3
group	M	49.2	45.5	60.7		45.3	42.7 38.3
group	N	38.5	29.9	41.2		34.3	31.3 27.2

Fig. 2 Percentage of response repetitions (a) around the non-repeated "wrong" response and (b) around the repeated "wrong" response.

A falling after-gradient of repetition was found for all cases. However, no unambiguous trend appeared preceding the punishment. Analysis of variance was used for each of the gradients and the statistical significance was attained only for the gradient after the non-repeated "wrong" item of Group N ($F=3.518$, and two and 98 *df.*). In addition, the per cent repetition of the rewarded item immediately after that "wrong" item was relatively high for Group N. However, the difference in percentages between the first-after item and the first-before item (i.e. 25.0% vs. 23.4%) failed to meet the statistical significance by the *t*-test ($t=0.35$ for *df* of 34). It was also found that percentages of response repetition around the incorrectly repeated "wrong" response were about 10% higher than those around the correctly varied "wrong" response for both groups. The per cent repetition of the rewarded item just

preceding the repeated "wrong" was greater than that of the item immediately following the punishment for each of the two groups. This difference for Group M was found significant at the five per cent level of confidence ($t=2.070$ for 39 *df.*). But the same difference did not reach the significance level for Group N ($t=\text{less than } 1$ for 34 *df.*).

Recall.—Number of recalls of the responses made, on the preceding trial, to the stimulus items was computed and the per cent recalls for the seven items concerned are plotted in Fig. 3. As was expected the subject recalled previous responses more often when stimulus items were meaningful than when they were meaningless. The highest value was obtained for the punished item of Group M but the same was not true for Group N. A rising gradient appeared after the punished item for group M but it failed to be statistically significant ($F=\text{less than } 1$ for

2 and 94 *df.*). A similar gradient was obtained before the "punished" item for Group N but it was again insignificant ($F=1.287$ for 2 and 98 *df.*).

Fig. 3 Percent recall of responses made on the previous trial

Per cent recall of being called "wrong" was computed for each stimulus item and the main data are shown in Fig. 4. No consistent trend was observed for either group except for a fairly high percentage of recall of punishment for the item immediately following the "wrong" response for Group M.

Fig. 4 Percentage of being called "wrong" around the actual "wrong" item

The results disagreed with Nuttin's (12) in which a bidirectional

gradient of recalling "failure" was obtained. On the other hand, they were in accordance with Iwahara's previous results (5) so far as Group M was concerned. It should be noted that in the latter study a gradient of recalling "success" was measured while in the present experiment a gradient of recalling "failure" was observed.

DISCUSSION

The present results agreed with Stone's only in that an after-gradient of increasing variability was found following the verbal punishment. For a further analysis the data were analysed according to whether the punished response was correctly varied or incorrectly repeated. This was done on the basis of the fact that if the punishment was really punishment on the subject's side, the "wrong" response was expected to be changed on the next trial. Again a similar trend appeared around the isolated "wrong" item whether the response to it was varied or not. Although the obtained after-gradient of increasing variability or decreasing uniformity following the repeated "wrong" response may be explained by guessing habits (6,9), it is obvious that the same gradient after the non-repeated "wrong" item can not be attributed to the same principle. However, the isolation-distractor hypothesis which was proposed by the present writer at the beginning of this article, can be applied to the data with little difficulty. The fact that a statistically significant spread of punishment was obtained only following the "wrong" item of Group N is important because the principle of isolation and distrac-

tion is assumed to work more effectively when S-R connections are weak, i.e. when cue-stimuli are meaningless than when they are relatively strong, i.e. when cue-stimuli are meaningful. Moreover, the same principle predicts a relatively high per cent repetition for the rewarded item immediately following the punishment. This was proved to be true for Group N but the difference in per cent repetition between this item and the one just preceding the punishment failed to be significant.

If the falling after-gradient obtained was really due to the effect of isolation and distraction, a rising gradient of recalling previous responses would be predicted because distraction caused by the isolated "wrong" response should be greater on "right" items closer to that item. This prediction was confirmed by the recall data shown in Fig. 3, although the statistical significance of the gradient was not obtained for either of them.

Several points may be raised against the isolation-distraction hypothesis. If the "wrong" item was isolated, responses to that item should have been recalled more often than those to the crowded items. However, this was not the case for Group N as indicated in Fig. 3. This objection, although very plausible, may not be correct because *responses* to the isolated item need not be recalled well. The present finding that the isolated *item* was remembered as being "punished" more often than crowded items (Fig. 4) will serve a sound empirical proof of the psychological isolation.

A second possible objection is that the post-punishment gradient of decreasing uniformity could be an arti-

fact caused by serial effects. The same criticism, as was recalled, had been directed against Muenzinger and Dove's in a slightly different situation. A control experiment was thus conducted to see whether the same post-punishment gradient would appear without the "wrong" items. The procedure used for the experiment was the same as for the main experiment except that (a) the "wrong" items were placed on the extreme serial positions of the lists, i.e. the third and 21st or the fourth and 22nd serial positions and (b) different cue-stimuli were used because some subjects were duplicated on the two experiments.

Per cent repetition of response to each of the items on the same serial positions as those discussed in the main experiment was computed. In order to rule out any effect of the punishment on the following or preceding rewarded items, a gradient of response repetition was computed after the key-item corresponding in serial position to the first "wrong" item of the list in the main experiment and another gradient before the item corresponding in serial position to the second "wrong" item of the list in the previous experiment. The maximum number of repetition for each item was thus three per subject. Table 4 was constructed from the obtained data. As different key-items were used for fore- and after-gradients, percentages of response repetition for these items are both shown as the zero step position.

Fairly irregular trends were observed around the zero-position rewarded items as shown in Table 4 partly because the number of the subjects was small (19 for Group M and 18 for Group N) and the maxi-

Table 4

PERCENTAGE OF RESPONSE REPETITIONS AROUND THE KEY
REWARDED ITEM AS CONTROL FOR TABLE 1

after-effect		"right"			"right"			"right"	
step	position	-3	-2	-1	0*	1	2	3	
group	M	36.8	40.3	43.9	35.0, 31.6	45.5	31.6	35.0	
group	N	33.3	31.5	40.7	31.5, 35.1	37.0	35.1	35.1	

* The zero-position item corresponds to the "wrong" item in serial position in the main experiment.

num number of repetitions per item was only one half of that in the main experiment, i.e. three vs. six. Analysis of variance was used for testing the significance of the gradients but none of them reached the significance level. The most important control gradient is the after-gradient for Group N because the same gradient in the main experiment was found statistically significant. As no clear gradient of repetition was suggested by the obtained control data following the key rewarded item, our main finding may be assumed to be unaffected by serial effects.

Incidentally the insignificant differences in per cent repetitions between the two control groups with respect to after-gradients as shown in Table 4, seem to be due to an inadequate selection of the cue-stimuli. However this would not ruin the control results because we are interested in gradients rather than per cent repetitions themselves.

Beside the main results of the present study it was noticed that percentage of repetitions was higher for the items when responses to the "wrong" item was incorrectly repeated than when they were correctly varied. A possible interpretation of this would be that as the serial position of items was not changed from

trial to trial and most of the items were rewarded, fairly strong serial connections of responses would be built up during learning and this serial response-to-response learning would help increase repetition of responses not only for rewarded items but also incorrectly for punished items. Conversely, when a response to the "wrong" item was incorrectly repeated, it would suggest occurrence of the serial response-to-response connection and consequently higher response repetitions for rewarded items around punishment. This interpretation may also explain the superiority in per cent repetitions of response to the item immediately preceding the punished item to that just following the punishment if the response to the punished item was repeated because the response would be strongly connected to the preceding rewarded item.

A FURTHER CONFIRMATION OF THE ISOLATION-DISTRACTION HYPOTHESIS

If the isolation-distracton hypothesis be valid, it should be verified in a more general situation. In one (6) of the series of the present studies a number of experiments were conducted on number-guessings without any learning, in testing the guessing-sequence hypothesis of the

"spread of effect." The subject in Experiment III of the study was required to write down a number from one to 10 on a sheet of paper in response to a signal every three seconds, without given any rational except that it was an experiment in psychology. No systematic responses were allowed as was usual the case in any Thorndikian experiments. Two series of 240 such numbers (24 rows and 10 columns) were thus obtained.

The critical point was that an extra-three second pause was inserted after a response, twice in every column. This extra pause was assumed to isolate the response last made. Per cent repetition of numbers around repeated isolated numbers was computed. A significant gradient of decreasing uniformity was obtained with lack of a foreground. The results indicated that pre-learned number-guessing habits may be strengthened merely by the isolation of responses. That is, if the number response is isolated in some way or other, the subject tends to take on an easier, more primitive, pre-learned number-guessing habit rather than to call numbers randomly. Consequently the after-gradient is expected to occur more distinctly following the isolated chance repeat than following the

crowded (i.e. not isolated) chance repeat.

Now it should be remembered that the isolation-distraction hypothesis is more general than the guessing-sequence hypothesis in that the former assumes regression to easier, more basic, more "available" numbers principally in the same situation and no R-R sequences are required as in the latter hypothesis. If the isolation-distraction hypothesis is true, a gradient of decreasing uniformity in terms of percentages of repetition should be expected after the isolated response, repeated or not.

In order to test this prediction, number of repetitions of responses around isolated but *not* repeated responses was tabulated for each of two consecutive columns. No duplication of columns was allowed except when an isolated response was repeated on the next column, so that the maximum number of repetitions per subject was always 20. The results obtained are shown in Table 5. The same table also includes the gradient around the isolated chance-repeated number from Table 5 of Iwahara's previous study (6).

Table 5

Gradients of number repetition in percentages around non-repeated "isolated" numbers and around chance-repeated "isolated" numbers in a non-learning situation. Numbers were isolated by an extra three second pause after they were given by the subject.

step position	-3	-2	-1	0	1	2	3
around non-repeats	8.2	9.2	8.9		14.4	11.8	10.6
around repeats*	11.3	8.9	9.2		18.4	11.0	9.3

* from Table 5 of Iwahara's study (6).

Lack of the gradient effect was shown preceding the non-repeated isolated response but a significant after-gradient was obtained with an F of 4.045 for 2 and 152 df . ($P < 0.5$) (by the use of the analysis of variance. Thus our prediction was confirmed. Moreover, it was revealed that the gradient after repeats had a sharper slope than that after non-repeats. This difference can be explained by guessing-habits.

In conclusion, it is indicated that the mere isolation of response helps the subject regress to or take on a easier, more basic or more "available" response, in two ways: one is to such a number irrespective of the previous number given and another to such a number which is anchored to the previous number. The guessing-sequence hypothesis refers only to the second case.

It will be obvious that the isolation-distraction hypothesis may be derived from the frustration-regression hypothesis of Lewin and others (1) and the frustration-fixation hypothesis of Maier (10). Iwahara and Soeda (8) recently found fixation of responses in shocked cockroaches in the spontaneous-alternation situation. Iwahara (7) contended that less than 50% alternation found by Fujita (4) and the decay of alternation as a function of trials in rats may be explained by the same principle. All these facts are closely related.

SUMMARY AND CONCLUSIONS

Two groups of subjects were presented two lists of cue stimuli to which the subject was required to respond with a number one through 10. She was told that each stimulus

had one or more "right" numbers but, unknown to her, whether the response was called "right" or "wrong" was fixed, before the experiment began, in a pre-arranged pattern irrespective of the subject's response. Two lists of 24 two-syllabled meaningful Japanese *kana* (syllabaries) were used as cue-stimuli for Group M and the same but nonsense stimulus items were given for Group N.

The obtained per cent repetitions of responses around the "wrong" item indicated no fore-gradient but a falling gradient was shown for both groups. However the statistical significance was met only for Group N. The results confirmed part of Stone's previous findings.

The same analysis of the data was made according to whether a response to the "wrong" item was correctly varied or incorrectly repeated. This was on an assumption that negative after-effects caused by being called "wrong" would be really effective only when a response to the punished item was correctly varied. A falling gradient appeared following the "wrong" response whether it was repeated or not. However only a gradient after the non-repeated "wrong" response for Group N was statistically significant. Obviously the guessing-sequence hypothesis cannot be applied to the data.

The author agreed with Stone in accepting his theory of regression caused by punishment. According to the theory, the after-gradient effect was explained by the subject's regression to more basic or more available responses by punishment. As the effect would be stronger when S-R connections are weaker, a stronger after-gradient effect is expected for Group N than for Group

M and this was what we obtained.

However there is some doubt whether regression was really caused by punishment *per se*. As verbal punishment would not be very strong, what is more important would be the *isolation* of a critical item by being called "wrong", together with the massed and relatively difficult learning. All these factors would be related to regression, or distraction.

In order to test this isolation-distraction hypothesis, the author's previous data in the same series of the studies of the "spread of effect" were re-analyzed. The subject in this previous experiment was required to write down a number from one to 10 at a rate of three seconds in a non-learning situation. An extra three second pause was inserted twice in the same column. A significant falling gradient of number repetition appeared after the non-repeated response which was isolated by the extra pause.

The results showed the generality of the isolation-distraction hypothesis because the isolation in this experiment was caused by the insertion of a pause and not by punishment. It is concluded that mere isolation plus massed trials would cause the subject to be distracted and to regress to more basic and more available responses in two ways: one irrespective of the preceding isolated response and two, anchoring to that response. After-gradient effects of decreasing uniformity by punishment would be due to the first type of regression and the same gradient effects by reward to both types of regression. Relation of the isolation-distraction hypothesis to the frustration-regression hypothesis and the frustration-fixation

hypothesis were mentioned. The author's recent findings in spontaneous alternation were also discussed in this connection.

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