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The Role of Decay and Interference in Short-Term Recognition Memory[1]

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This study investigated the roles of decay and interference in short-term recognition memory for visual stimuli. Three experiments, involving 300 subjects, are reported. The general procedure was to test six independent groups of subjects in each experiment. The different groups received different treatment conditions including decay, retroactive and proactive interference situations. The rate of presentation, the nature of the recognition test and the duration of the delay interval were varied in different experiments. The results do not show any decay effect in short-term recognition memory. The interference effect, however, seems to be ambigous. Apparently both retroactive and proactive interference effects seem to be significant. The analysis of recognition errors indicates that the discrimination of list-membership required by the presence of the interference items amog the recognition alternatives was confounded with an interference effect. The apparent interference effect in the results are thus an artifact of the recognition procedure used. The results seem to indicate a persistence of short-term recognition memory against both decay and interfeernce.

Decay and interference are suggested to be the two major causes of forgetting in both short-term and long-term memory. The relative importance of decay and interference in the explanation of forgetting has been a matter of debate in recent years (Melton, 1963). Results of experiments on long-term memory (LTM) suggest that interference by interpolated material produces greater loss of retention than by simple decay (Melton, 1963; Postman, 1961). But the role of decay as against interference in short-term memory (STM) is not clear (Broadbent, 1963 ; Corballis, 1965 ; Melton, 1963 ; Peterson, 1963).

The experiments reported in this paper were designed to compare the decay process with the interference process in short-term memory for visual stimuli under a recognition procedure. The loss of short-term retention produced by decay alone is compared with the loss brought about by decay

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and interference operating together. A decay situation was arranged by introducing a delay between the presentation and test of the items without any interpolated task. The interference condition used interpolated materials similar to the test items between their presentation and test. Dissimilar materials were interpolated with a view to preventing rehearsal during the intervening period between presentation and test as a control condition for both decay and interference by similar materials. Both similar and dissimilar materials were also proactively presented as interference.

The experimental paradigm was to test six independent groups of subjects for six different conditions. Group 1 was tested immediately after the presentation of the stimuli in order to assess the extent of short-term recognition memory without any decay or interference (decay resulting from the time taken by the presentation and test and inter-item interference were assumed to be common in all cases). This group also served as a control for both decay and interference. Group 2 took the recognition test after an unfilled delay interval following the stimulus presentation (a decay situation with rehearsal allowed). Group 3 was presented with a series of dissimilar items (apparently to be tested) in order to prevent rehearsal during the intervening period between presentation and test. This group also served as "dissimilarity control" for "similarity-interference" group. Group 4 received two series of similar item but was tested for the first series only. Ss were given the impression that all the materials would be tested. This group was assumed to be the retroactive interference (RI) group. Group 5 was the opposite of Group 4 : a proactive interference (PI) situation ; recognition test was taken for the second series of items. Group 6 was the "dissimilarity control" group for PI ; the first series was the dissimilar items, the second series being the test stimuli. It was hoped that the relative importance of decay and interference processes as cause of forgetting in short-term recognition memory (STRM) could be determined by a cross-comparison of performance of these different groups.

Experiment I

This was an exploratory experiment designed to develop a technique to study the operation of decay and interfernence processes in short-term recognition memory.

Method

Subjects

Sixty paid subjects (27 male and 33 female) participated in the experiment. They were divided into 6 groups of 10 Ss each. The Ss were college or high school students between 16 and 22 years old.

Apparatus and Materials

Ten low-association value (0 to 20%) nonsense syllables (Hilgard, 1951) constituted the stimulus items. Another set of similar (common initial letter) low-association value (0 to 20%) nonsense syllable was used as the interference items. Ten 3-digit numbers, selected from a table of random numbers, were the dissimilar rehearsal-preventing items. Thirty new (0 to 20%) nonsense syllables were randomly mixed up with the stimulus and interference items to form a sequence of fifty alternatives in the binary-choice recognition test. All items were sequentially presented by a slide projector onto a white screen. Each item occurred on a separate slide (black on white). The rate of presentation was controlled by a Lafayette electronic timer connected with the projector. The distance between S and the screen was 10 feet ; and the projected size of the letters or digits was $2\frac{1}{2} \times 2\frac{1}{2}$ inches.

Procedure

The test consisted of two parts, a presentation part and a recognition part. All Ss were individually tested. They were told that the experiment was a recognition-memory test. Ss were instructed to say the letters or digits of the items in the presentation part. The recognition part required them to respond "yes" or "no" to each of the alternatives indicating whether they saw the item in the presentation series. Subjects were instructed not to count the number of yeses or noes, and nothing was said about guessing. As a result, the number of yeses or noes for any subject was unrestricted (within the limit of fifty). E recorded S's responses on a sheet containing the alternatives arranged in the same order. Any missed item was considered as an error. The rate of presentation for all items was 3 seconds/item with an interval of 1 second between items.

Six groups of subjects received six different treatment conditions as outlined below :

Group 1 ; This group took the recognition test immediately after the presentation of the stimuli. The termination of the stimuli was marked by a blank flash on the screen. A question mark "?" appeared on the screen to signal the beginning of the recognition test.

Group 2 : The recognition test was taken after a delay of 40 seconds following the presentation of the stimuli. The projector was turned off during the delay interval and Ss rested. There was no specific instruction about the rest interval. S's rehearsal was therefore uncontrolled. After the delay, S was given a ready signal and the projector was turned on. The test signal "?" appeared and the recognition test followed in the same way.

Group 3 : Two sequences of stimuli were presented; the nonsense syllables were followed by a number series. The two series were separated by a blank flash on the screen. Ss were told that either the nonsense syllables or the numbers would be tested, depending on whether they saw the symbol "? L" or "? D" before the recognition test. The test was of course always on the nonsense syllable series.

Group 4 : Two series of similar nonsense syllables were presented with the instruction that either first or second series would be tested, depending on whether the test symbol "? I" or "? II" appared. The test was always on the first series.

The duration of the interpolated task in both Group 3 and Group 4 was 40 seconds.

Group 5 : This group was just the opposite of Group 4. Subjects received the same instructions as in Group 4, but the test stimuli occurred in the second series ; and the second series was always tested.

Group 6 : The number series was presented first followed by the nonsense syllable series. Ss were told that either of the series would be tested ; but the test was always on the second series (nonsense syllables).

Results

The number correct (out of ten) was taken to be the recognition score. Since the "yes-no" choice was out of 50 alternatives, individual differences in recognition-error was quite large. The following formula was derived for the correction for guessing in the recognition scores.

Assume that S actually recognizes x itemes and randomly guesses another y items.

He guesses then from a pool of 50 – x

$$\text{Expected number of } \textit{correct} \text{ guesses} = \frac{10 - x}{50 - x} \cdot y$$

$$\text{Expected number of } \textit{incorrect} \text{ guesses} = \frac{40}{50 - x} \cdot y$$

$$\therefore \quad x + \frac{10-x}{50-x} \cdot y = R \text{ (number right)}$$

and

$$\frac{40}{50-x} \cdot y = W \text{ (number wrong)}$$

Solving for x :

$$x + \frac{10-x}{50-x} \times \frac{50-x}{40} \cdot W = R$$

$$\therefore \quad x + \frac{10-x}{40} \cdot W = R$$

$$\therefore \quad x - \frac{Wx}{40} = R - \frac{W}{4}$$

$$\therefore \quad x = \frac{4R - W}{4} \times \frac{40}{40 - W}$$

$$\text{or} \quad x = \frac{40R - 10W}{40 - W} \text{ (formula used)}$$

The mean and standard deviation of the corrected scores for the different groups are presented in Table-I (a). A one-way analysis of variance

Table I(a)

Group Means and Standard Deviations of the Recognition Scores (Corrected for Guessing) : Experiment I

Group	Mean	Standard Deviation
1. Immediate	6.26	1.94
2. Delay	7.10	1.62
3. Dissimilar RI	7.72	1.52
4. Similar RI	4.82	2.21
5. Similar PI	3.10	1.89
6. Dissimilar PI	5.56	2.06

was carried out on the corrected scores. The F ratio (7.05 ; df : 5, 54) is highly significant ($P < \cdot 001$). Following the analysis of variance, Duncan's New Multiple Range Test (Edwards, 1960) was used for individual comparison of the group-means. Table I(b) summarizes the comparison. The comparison shows the performance in the similarity PI group (Group 5) is significantly poorer than all other groups, except similarity RI (Group 4). Recognition in the similarity RI group (Group 4) is significantly poorer than its "dissimilarity control" group (Group 3) and the delay group (Group 2). The difference between the dissimilarity PI group (Group 6) and the delay group (Group 2) also turns out to be significant. This

Table-I(b)

Multiple Comparison of Group Means by Duncan's New Multiple Range Test : Experiment I

Group	1 Immediate	2 Delay	3 Dissimilar RI	4 Similar RI	5 Similar PI	6 Dissimilar PI
1. Immediate						
2. Delay						$p<.05$
3. Dissimilar RI						$p<.05$
4. Similar RI		$p<.05$	$p<.01$			
5. Similar PI	$p<.01$	$p<.01$	$p<.01$			$p<.05$
6. Dissimilar PI						

shows a PI effect even with dissimilar items. The defference between the immediate test and delayed-test groups was not significant ; nor was the delayed (rehearsal allowed) group significantly different from the dissimilar interpolation (rehearsal prevented) group. This indicates that neither decay nor rehearsal seems to have any significant effect on short-term recognition memory (STRM). Only the similarity-interference (retroactive and proactive) factor seems to significantly decrease STRM.

As the items of the interference series were included among the recognition alternatives, a discrimination of the list-membership of each item was required for its correct recognition. An analysis of the recognition errors was, therefore, carried out in order to determine wheather the interference items were more frequently chosen than the new items. The mean number of items chosen from the interference and new series by different

Table I(c)

Mean Errors of Recognition from the Interference and New Items of the Recognition Alternatives : Experiment I

Group	Interference items	New Items
1. Immediate	6.30	6.30
2. Delay	3.30	3.80
3. Dissimilar RI	5.70	6.10
4. Similar RI	11.10	5.50
5. Similar PI	11.10	6.10
6. Dissimilar PI	5.70	5.90

groups is presented in Table-I(c). As the number of new items among the recognition alternatives was three times larger than interference items, the error-scores from the interference items were multiplied by three to equate the probability of choice of items from both categories (interference and new) of incorrect alternatives. A two-way analysis of variance for repeated measures (interference items and new items) was carried out on the error-scores. The main effect as well as the interaction between the groups and repeated measure (interference items and new items) is highly significant (P<·001). Following the analysis of variance, the t-test was applied for the individual comparison of the repeated measures in each group. The difference between the interference and new items chosen was highly significant (P<·01) in the two similarity-interference groups (Group 4 and 5). The difference between the interference and new items in all other groups was insignificant.

Discussion

The results do not show any decay effect of the delay interval used. The recognition performance in the delayed-test group is better than in the immediate-test group. This might have been due to a rehearsal factor counteracting the decay effect. But the recognition score for the rehearsal-prevented group (dissimilar interpolation) turns out to be still higher. Although the difference is not significant, this does not support the rehear-sal-strategy hypothesis. The better performance in the delayed-test groups (blank or dissimilar interpolation) is perhaps due to a consolidation process operating during the delay interval while no similar interfering material is presented. This consolidation factor counteracts both decay by the delay interval and interference by the dissimilar materials.

The results, however, show a significant interference effect by similar materials (retroactive and proactive). Groups 4 and 5 (similar interference, RI and PI) yielded the lowest scores. But proactive interference seems to be stronger than retroactive. The similarity PI group yielded consis-tently poorer recognition scores than all other groups. The RI effect is not consistant ; the similarity RI group (Group 4) is not significantly different from other non-interference groups except its dissimilarity control (Group 3). This inconsistency in the RI effect might have been due to associational factors resulting from the long exposure duration per item (3 seconds/item) used in this experiment. On the other hand, the PI effect even with dissimilar materials is significant. Performance in the dis-similar PI group (Group 6) is significantly poorer than all other non-interference groups except Group 1 (immediate),

The immediate-test group, for some reason, has a very low parfor-mance score. This is perhaps because of the absence of consolidation in this group. In the three test-conditions which prevent consolidation (Group 1, 5 and 6), performance is poor, the similar PI group being the poorest of all. Among the three groups permitting consolidation (Groups 2, 3 and 4), the similar RI group (Group 4) has the lowest score. The poorest performance in the similar RI group is due to similarity-inference counteracting consolidation. But poorer performance in Group 2 (delayed-test, rehearsal allowed) than in Group 3 (dissimilar interpolation, rehearsal prevented) cannot be explained by the consolidation hypothesis. It indicates that rehearsal impairs STRM rather than facilitating it. Thus in Group 2 rehearsal counteracts consolidation, and performance is poor. The dissimlar RI group (Group 3) has the most uninterrupted consolidation as neither rehearsal nor similarity-interference is counteracting it. Consequently, this group yields the highest recognition score.

The poor performance in the two similarity-interference groups (RI and PI) supports the interference hypothesis in STRM ; and the results are consistent with STM findings using recall.

On the other hand, the analysis of errors shows that interference items were significantly ($P < \cdot 00$) more often chosen that new items by the groups exposed to the interference items (similarity RI and PI), while other groups not exposed to the interference items chose both the interference and new items on a chance level. This means that recognition as such was not affected by the similarity-interference ; instead, the discrimination of list membership of the recognized items was impaired. The appearance of the interference items among the recognition alternatives requires a discrimination of the list-membership of each individual item in addition to judging its familiarity (recognition in the absolute sense) Thus the interference effect measured by the number of items correcty recognized appears to be an artifact of the recognition test used. Similarity interference may not decrease recognition performance in its absolute sense. This impairment of the discrimination of list-membership is similar to interlist intrusions observed in short-term recall studies.

But how much of the interference effect showed by the recognition scores could be explained away as an artifact could not be determined from the results. A simpler recognition task without discrimination of list-membership is necessary to determine the extent of interference effect produced by similar interference items in STRM.

Experiment II

Experiment I was mainly exploratory; and the exposure duration per item was perhaps too long for a short-term memory test. The decay effect (with or without rehearsal) was not significant. The interference effect, however, was significant, but the trend was not consistent enough to warrant any conclusion. Besides, long-term memory components were found to be prominent as Ss indicated that they were forming associations for the items. Accordingly, Experiment I was replicated as Experiment II with a faster rate of presentation.

Method

Subjects

Another six groups of 10 Ss each were drawn from the same source (23 male and 37 female).

Apparatus and Materials

The apparatus and materials used were the same as in Experiment I.

Procedure

The same procedure was followed as in Experiment I except that the rate of presentation was 1 second/item; and the delay interval as well as the duration of the interpolated task was 20 seconds.

Results

The same formula was used for the guessing correction of the recognition scores as in Experiment I. The mean number correct and the standard deviation of the recognition scores (corrected for guessing) for different groups are presented in Table 2 (a). Examination of Table 2 (a) shows that Groups 4 and 5 (similar RI and PI) have the lowest recognition

Table 2 (a)

Group Means and Standard Deviations of the Recognition Scores (Corrected for Guessing) : Experiment II

Group	Mean	Standard Deviation
1. Immediate	6.65	1.74
2. Delay	5.88	2.40
3. Dissimilar RI	6.68	1.79
4. Similar RI	2.81	2.20
5. Similar PI	2.58	1.52
6. Dissimilar PI	6.28	1.51

scores. All other groups look more or less alike in their mean recognition scores. A one-way analysis of variance was carried out on the corrected scores. The F ratio ($F=9.35$; $df=5,54$) is highly significant ($p<.001$). Duncan's New Multiple Range Test for the comparison of means following the analysis of variance shows that Groups 4 and 5 (similarity RI and PI) are significantly poorer ($p<.01$) than all other groups. There is no significant difference between the similarity RI and PI groups (Groups 4 and 5), however ; although the recognition scores in the similarity RI groups is slightly higher than in the similarity PI group. No other groups are significantly different from one another. The comparison of different groups appears in Table 2 (b).

Table 2 (b)

Multiple Comparison of Group Means by Duncan's New Multiple Range Test : Experiment II

Group	1 Immediate	2 Delay	3 Dissimilar RI	4 Similar RI	5 Similar PI	6 Dissimilar PI
1. Immediate						
2. Delay						
3. Dissimilar						
4. Similar RI	$p<.01$	$p<.01$	$p<.01$			$p<.01$
5. Similar PI	$p<.01$	$p<.01$	$p<.01$			$p<.01$
6. Dissimilar PI						

While the results apparently indicate a significant interference effect (RI and PI) by the similar materials, analysis of the recognition errors reveals a different picture, Table 2 (c) shows the mean error-scores from the interference and new items. As the number of new items among the

Table 2 (c)

Mean Errors of Recognition from the Interference and New Items of the Recognition Alternatives : Experiment II

Group	Interference Items	New Items
1. Immediate	4.50	5.20
2. Delay	5.70	5.60
3. Dissimilar RI	7.80	6.20
4. Similar RI	10.50	5.30
5. Similar PI	12.60	6.00
6. Dissimilar PI	7.20	5.40

recognition alternatives was three times larger than the interference items, the error-scores from the interference items were multiplied by three to equate the probability of choice of items from both categories (interference and new) of incorrect alternatives. A two-way analysis of variance for repeated measures was carried out on the error-scores to determine whether the interference items were significantly more often chosen than the new items. The main effect as well as the interaction between groups and repeated measures (interference items and new items) was highly significant ($p<.001$). The t-test following the analysis of variance shows that the two similarity-interference groups (Groups 4 and 5) chose the interference items (among the errors) significantly more often then the other groups ($p<.001$). The choice from either categories of incorrect alternatives (interference items and new items) in all other groups was on a chance level. The analysis of errors raises doubt about the interference interpretation of the results, and suggests that much of the interference effect could probably be attributed to the discrimination of list-member-ship of items rather than to the decreasing function of the similarity-interference (RI and PI) effect.

Discussion

As in Experiment I, the results do not show any decay effect by the delay interval used. Only the interference effect due to the presentation of similar materials (RI and PI) seems to produce significant decrement in the recognition scores. Both similarity RI and PI consistently show up in the results. Although there is no significant difference between the two similarity-interference groups, PI effect seems to be stronger than RI as in Experiment I. The STRM loss in the similarity PI group is greater than in the similarity RI group. This difference might have been due to lack of consolidation in the PI group, while consolidation facilitates performance in the RI group. But the consolidation hypothesis as such does not seem to be tenable as there is little difference between the non-interference groups enjoying consolidation (Groups 2 and 3) and the ones lacking consolidation (Groups 1 and 6).

The poorer performance in Group 2 (delayed- test, rehearsal allowed) than in Group 1 (immediate-test)—although the difference is not significant—might indicate a decay effect of the delay interval in spite of rehearsal counteraction decay ; and this suggests that if rehearsal were prevented, the decay effect would probably be significant. But the better performance by Group 3 which prevents rehearsal by interpolating dissimilar materials-rules out the decay suggestion. The poorer performance by Group 2 (delayed test, rehearsal allowed) than by Group 3 (dissimilar interpolation, rehearsal prevented) indicates, as in Experiment 1, that rehearsal probably impairs rather than facilitates short-term recognition memory.

While the recognition scores show a significant similarity-interference effect (RI and PI), the analysis of recognition errors suggests that the apparent decreasing function of both RI and PI by similarity might be an artifact of the recognition test. As in Experiment I, the discrimination of list-membership rather than absolute recognition seems to be impaired by similarity-interference. Thus, while both similarity RI and PI effect became consistent after elimination of the associational factors by using faster rate of presentation (1 sec./item), the similarity-inteference interpretation does not seem convincing because the groups exposed to interference chose the interference items (among the errors) significantly more often than new items, but the error-scores from both categories of incorrect alternatives (interference and new items) in all other groups not exposed to interference remained at a chance level. This shows, as in Experiment I, that much of the similarity R1 and PI effect obtained could be attributed to impairment of the discrimination of list-membership rather than loss of absolute recognition. Although it could not be determined from the results that how far of the similarity-interference effect is attributable to the discrimination of list-membership, the results seem to question both the decay and interference theory of short-term memory so far as short-term recognition memory is concerned.

Experiment III

The number of recognition responses was unrestricted and guessing was high in the first two experiments. The variance was quite large as a result. The task was difficult because Ss had to decide first whether they had seen a particular alternative before and then, in the similar interference condition, whether the syllable had been seen in the test or in the interference list. Thus guessing probability was high, and consequently, recognition-error was large. Experiment III was designed to use a multiple-choice recognition test with all the alternatives presented together. Guessing would be reduced because the maximum number of choices was limited by the number of correct responses.

Method

Subjects

The subjects were 71 males and 49 females (between 17 and 20 years old) volunterring from an introductory psychology course. They were divided into 6 groups of 20 Ss each.

Apparatus nad Materials

The apparatus and materials used were the same as in Experiments I and II, but all the alternatives of the recognition test were arranged together in a random order on a single slide. The distance between S and the screen was 15 feet : and the projected size of the letters or digits was 3/4 x 3/4 in.

Procedure

The procedure was the same as in Experiment II except in the recognition test part. The correct and incorrect alternatives appeared together for comparison in the recognition test. Ss were required to identify the 'correct' items from the list and write them down in any order. They were instructed to write down as many items as they could recognize (not exceeding ten) within a 2-minutes time limit.

Results

As the number of recognition responses for different subjects was still unequal, the same formula was for guessing correction as in Experiments I and II. The mean and standard deviation of the corrected scores for all the groups are presented in Table 3 (a). An analysis of

Table 3 (a)

Group Means and Standard Deviations of the Recognition Scores (Corrected for Guessing) : Experiment III

Group	Mean	Standard Deviation
1. Immediate	3.96	2.34
2. Delay	4.61	1.56
3. Dissimilar RI	3.89	1.81
4. Similar RI	2.02	1.80
5. Similar PI	2.10	1.59
6. Dissimilar PI	4.39	2.11

veriance (one-way classification) was carried out on the corrected recognition scores. The F ratio ($F=6.99$; $df=5,114$) is highly significant ($p<.001$). Following the analysis of variance, Duncan's Multiple Range Test was used for individual comparison of the different groups. The multiple comparison of the group means appears in Table 3 (b). Both the similarity-interference groups (RI and PI) are significantly poorer in

Table 3 (b)

Multiple Comparison of Group Means by Duncan's New Multiple Range Test : Experiment III.

Group	1 Immediate	2 Delay	3 Dissmilar RI	4 Similar RI	5 Similar PI	6 Dissimilar PI
1. Immediate						
2. Delay						
3. Dissimilar RI						
4. Similar RI	P <.01	P <.01	P <.01			P <.01
5. Similar PI	P <.01	P <.01	P <.01			P <.01
6. Dissimilar PI						

recognition performance than all other groups (p<.01). The difference between all other groups is insignificant. There is of course no significant difference between the two similarity-interference groups (RI and PI), although the similarity PI group (Group 5) has slighty higher score than similarity RI group (Group 4). Unlike the previous two experiments, the delayed-test group (Group 2) has the highest, and the dissimilar PI group (Group 6) the next highest scores. Among the non-interference groups, the immediate-test group (Group 1) is the poorest in performance.

Since the interference items were also included among the recognition alternatives, an analysis of the recognition-errors was made to determine whether the interference items were more often chosen (among the errors) than new items by the interference groups than by the non-interference groups. The mean error-scores from both categories of incorrect alternatives (interference items and new items) are presented in Table 3 (c). As the

Table 3 (c)

Mean Errors of Recognition from the Interference and New Items of the Recognition Alternatives : Experiment III

Group	Interference Items	New Items
1. Immediate	3.45	3.50
2. Delay	1.95	2.45
3. Dissimilar RI	4.20	2.00
4. Similar RI	6.75	3.05
5. Similar PI	7.20	3.30
6. Dissimilar PI	4.05	2.65

number of new items among the recognition alternativis was three times larger than the interference items, the error-scores from the interference items were multiplied by three to equate the probability of choice of items from both categories (interference and new) of incorrect alternatives. A two-way analysis of variance for repeated measures (interference items and new ilems) was carried out on the error-scores. Both the main effect and the interaction between the treatment groups and repeated measures are highly significant ($p<.001$). The t-test following the analysis of variance shows that the two similarity-interference groups (Groups 4 and 5) chose the interference items (among the errors) significantly ($P<.001$) more often than the new items. The non-interference groups, except Group 3 (dissimilar-interpolation), chose items from both categories (interference and new) on a chance level. The dissimilar interpolation group (Group 3), however, chose the interference items significantly ($p<.01$) more often than new items.

Discussion

The results do not show any decay effect of the interval on short-term recognition memory. The similarity-interference effect (RI and PI), on the other hand, is highly significant as the performance in both similarity RI (Group 4) and similarity PI (Group 5) groups is significantly poorer than all other groups (including their respective 'dissimilarity-eontrols'). This suggests that interference may play a significant role in STRM, while decay does not.

But the similarity-interference interpretation is questioned by the analysis of thc recognition errors as in Experiments I and II. The groups exposed to similarity-interference chose the interference items among the errors significantly ($p<.001$) more often than the new items, while the non-interference groups chose items from both categories (interference and new) on a chance level. This shows that discrimination of list-membership of the recognized items, as required by the presence of both stimulus and interference items among the recognition alternatives, was impaired by the similarity-inteference rather than absolute recognition being affected. But this impairment of the discrimination of list-membership, in spite of all the items being available for comparison at the same time, could perhaps be interpreted as a similarity-interference effect, and the results would support the interferenee theory of short-term memory in that sense.

Group 3 (dissimilar interpolation) also chose the interferece items among the errors significantly ($p<.01$) more often than new items. As this group was not exposed to the interference items, the preference for interference items to new items cannot be explained by the discrimination of list-membership hypothesis. The only explanation that could be offered for the greater frequency of interference items (among errors) than new items is the greater similarity of the interference items to the stimulus items. But this explanation even does not seem convincing because no other non-interference group shows this tendency. The explanation is rather unknown and further investigation is necessary to provide the explanation.

Unlike the previous two experiments, rehearsal seems to facilitate performance as the recognition score in Group 2 (delayed-test, rehearsal allowed) is higher than any other group, though the difference is significant only in case of the two similarity-interference groups (Groups 4 and 5). Performance becomes poorer when rehearsal is controlled by interpolating dissimilar materials (Gaoup 3), although the difference is not significant. This tendency of rehearsal to facilitate performance, while consistent with STM results using recall, seems to rule out the suggestion made by the first two experiments that rehearsal might impair rather than facilitate STRM. The conflicting results about the effect of rehearsal on short-term recognition memory might have been due to the difference in the recognition procedure used in this experiment.

Another insignificant but interesting difference is between Group 1 (immediate-test) and Group 6 (dissimilar PI). The recognition test in both the groups is taken immediately after the presentation of the stimulus items. In spite of the dissimilarity-interference of the proactively presested numbers, the performance in group 6 is higer than in Group 1 (immediate-test) which has no interference whatsoever (RI or PI). This difference might have been due to a contrast effect between the numbers and nonsense syllables, or due to a "novelty reaction" to the nonsense syllables after receiving the numbers. On this assumption, however, a similar facilitating effect would be expected in Group 3 (dissimilar-interinterpolation), even after eliminating the facilitating effect of rehearsal, and in the corresponding conditions of the previous two experiments. This is not the case; and the "contrst-effect" or "novelty-reaction" hypothesis, peculiar to this experiment, would seem convincing if it is assumed that numbers and nonsense syllables have differential facilitating effect on each other due to contrast effect or novelty reaction.

The consolidation effect does not show up in the results as there is little difference between the non-interference groups enjoying consolidation (Groups 2 and 3) and the ones lacking consolidation (Groups 1 and 6) when the facilitating effect of rehearsal and "novelty reaction" is eliminated.

General Discussion

The results of the present series of experiments do not support the decay theory of short-term recognition memory. The extent of persistence of STRM against decay was not determined in the present study. But within the range of intervals studied (up to 40 seconds), it may be concluded that short-term recognition memory is not subject to decay. On the contrary, short-term recall is often found to be subject to decay with much shorter intervals (Brown, 1958 ; Peterson and Peterson, 1959). Short-term recognition memory seems to be quite different from short-term recall so far as the decay theory in concerned. The effect of interference is ambiguous. Apparently in the results, the similarity-interference (RI and PI) seems to have produced a significant decrement in short-term recognition memory. But analysis of the recognition-errors showed that the interference effect was perhaps an artifact caused by the interference items among the recognition alternatives.

The results, however, could be interpreted as supporting an interference theory if the discrimination of list—membership of the stimulus and inter ference items is taken as the criterion of performance. Exposure to the similar interference items impairs the discrimination, and intrusions from the interference series are numerous. Wickelgren (1965C) found a similar tendency in recall. Intrusions tend to be similar to the presented items, and their frequency increases with the degree of similarity with the presented items. The same kind of intrusions are also reported with acoustic similarity of the interference items (Wickelgren, 1965d).

If, on the other hand, the absolute recognition performance (identification of the previously exposed items ; both stimulus and interference) is taken as the criterion, interference has no effect on short-term recognition memory. The impairment of recognition performance in the results was thus an artifact of the presence of the interference items among the recognition alternatives. This suggestion is confirmed by a subsequent study (Rahman, 1968) in whieh the recognition performance was found to be unaffected by interference when the interference items did not occur among the recognition alternatives. The recognition errors, or false positives, however, appear to be parallel to intrusion errors in short-term recall (Wickelgren, 1966a, 1966b). No definite conclusion is, however, warranted by the results about the decay or interference process in short term recognition memory. Further investigations with longer delay intervals and clear but inteference process are necessary in order to determine the relative roles of decay and interference in short-term recognition memory.

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Negative Recency Effect in Free-Recall

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The present paper is a review of research findings concerned with negative recency effect in free recall studies of memory. It has been found that in a free-recall experiment, the last few words in the serial position of a list are retrieved best (recency effect) in the initial test while retrieved least well in a second recall session (negative recency effect). Several theorists have forwarded different models of memory to explain the resutls of free-recall studies. Most of the studies reviewed in this paper support the two-store model of memory (STM and LTM). As far as 'rehearsal' is concerned a number of studies have supported 'quantity of rehearsal' point of view, as being responsible far negative recency effect. However, others have questioned this, and have suggested 'quality of rehearsal' interpretation Other variables discussed influencing recency in serial position learning are coding, modality and experimental paradigms. From the studies discussed in this paper it is evident that the present theories of memory are inadequate in explaining all the variations found in studies of memory. The two-store model, however, has played a very useful role in memory studies.

Considerable research evidences indicate that the last few words in a free recall list are retrieved best (recency effect) in initial test while retrieved least well in a second recall session. This phenomenon of "negative recency" in free recall was first described by Craik (1970). In the last few years several theorists have advocated various models of memory to describe the results of free-recall studies. The present paper is a review of the studies indicating recency effect in free recall. The first section of the paper discusses the theoretical frameworks forwarded by different theorists. The second section reviews the experiments designed to test specific theoretical models. The last section is a discussion of current data reexamined in the light of existing theoretical models of memory.

Theoretical Considerations

One process model of memory :

The better recall of terminal items (the recency effect) is handled by one process model of memory (Melton, 1963) by postulating that an item's strength or accessibility is very high immediately after presentation but falls off rapidly as further items are presented. The proponents of unitary theory of memory have argued that recall after a few seconds is affected in very similar weys by the variables that govern recall over much longer intervals and that therefore the distinction between a short-term memory mechanism, on the one hand, and a longer term mechanism, on the other, is purely arbitrary. They cite evidences that the short term retention improves just as does long term relation when the material to be recalled is repeated before a test of retention or when it is repeated between successive tests (Hebb, 1961 ; Hellyer, 1962). They also argue that retention after a brief delay is subject to proactive interference, as is retention after long delay (Keppel and Underwood, 1962). Unitary theorists do not distinguish short and long term retention as no quantitative and experimentally manipulatable differences could be found between them.

Two-storage mechanism in free recall

Waugh and Norman (1965) proposed that the last few words in a free recall list are retrieved from primary memory (PM) whereas earlier words are retrieved from secondary memory (SM) with greater difficulty. Every verbal item that is attended to enters PM, and the capacity of this system is sharply limited. New items displace old items, while displaced items are permanently lost. When an item is rehearsed, however, it remains in PM and it may enter SM. The recency effect is attributed to this highly accessible PM, while prerecency items are considered to be recalled from a more commodious and permanent SM, with a probability that depends on a wide variety of experimental variables. Broadbent (1958) had proposed a similar model earlier.

Glanzer and Cunitz (1966) proposed two distinct storage mechanisms of memory. In free-recall, the recency effect is held to reflect output from short-term store while previous items are retrieved from long term store.

Atkinson and Shiffrin (1968) divided memory into three structural components : the sensory register, the short-term store, and the long-term store. Incoming sensory information first enters the sensory register, where it resides for a brief period of time, then decays and is lost. The short-term store receives selected inputs from the sensory register and also from long-term store. Information in the short-term store decays completely and is lost within a period of about 30 second. However a control process called rehearsal could maintain a limited amount of information in this store as long as the subject desires. The long term store is a fairly permanent store for information, which is transferred from the short-term store. Atkinson and Shiffrin (1968) model is an explicit rehearsal mechanism. They assume that primary memory storage in itself, without rehearsal, plays a negligible role and show that rehearsal strategies may under certain conditions become the dominant features of the learning process, This follows from the notion that the short-term store contains a rehearsal buffer which can hold 4-5 words. Once the buffer is full, further incoming items knock out words already present. Thus the words at the end of the list will remain in the buffer for a shorter time on average as compared to earlier items since they are retrieved soon after presentation. The model further postulates that the strength of registration in LTM depends on the length of an item's stay in the buffer so it follows that the last words in a list, although better recalled than earlier words in immediate recall, should have the least strength in permanent memory.

Two retrieval process :

Tulving (1968) has proposed an alternative view, that the storage system of memory is unitary and that differential recall of items from different serial positions and the differential effects of various independent variables on such recall are to be attributed to different kinds of retrieval mechanisms. He argues that differences in recall of early, middle, and late input items reflect primary differences in the accessibility of these items. Late input items may be retrieved more easily because certain kinds of additional auxiliary information, stored with each item at the time of presentation, are available for these items and not available for items perceived earlier. The acoustic trace of an item the subject hears—or the acoustic trace of an item the subject sees and recodes acoustically (Sperling, 1963)—may be one kind of such auxiliary information that might serve as a retrieval cue for the items. Such an acoustic trace may rapidly decay. Serial position or temporal dating of items in the input phase may constitute another kind of auxiliary information which can serve as a retrieval cue. Such information may be greater for early and late input items than for the middle ones and may be initially more powerful and yet decay more rapidly than other retrieval cues.

Coding :

Conrad (1964) and Baddeley (1966) worked with verbal material and distinguished STS and LTS on the basis of coding. They concluded that information in STS was coded acoustically and that coding was predominantly semantic in LTS. However further research has shown that STS can accept variety of physical codes. Recent evidence by Shulman (1970, 1971) has show that STS can also hold semantic information.

Input and response :

Other variables are the modes of input and response. Murdock and Walker (1969) have shown that auditory presentation is superior to visual presentation in single trial free recall and that this superiority is cofined to the last few input positions. With regard to response mode, studies by Murray (1965) and Craik (1969) have shown a superiority of written over spoken response in free recall.

Neurological evidence of primary and secondary memory :

Milner (1967) reported an intriguing case of a specific memory deficit observed in brain-damaged patients. A patient with hippocampal lesions suffered from an inability to form new long-term memory traces. Patients with these lesions showed no loss of preoperatively acquired skills, and intelligence as measured by formal tests was unimpaired but they were largely incapable of adding new information to the long-term store. These observations of Milner strongly suggest that the neurological basis for immediate memory and long-term memory are quite distinct.

A related defect called Karsakoff's syndrome has been known for many years. Patients suffering from this abnormal condition are unable to retain new events for longer than a few seconds or minutes, but their memory for events and people perior to their illness remains largely unimpaired. Recent evidence suggests that Karsakoff's syndrome is related to damage of brain tissue, frequently as the result of chronic alcoholism in the hippocampal region and the mammillary body (Barbizet, 1963)

Review of Studies Concerned with Recency Effect in Free Recall

Negative recency effect in free recall :

The two-process view of short-term memory (Waugh and Norman, 1965 ; Atkinson and Shiffrin, 1968) was given considerable support by Craik's (1970) finding of a 'negative necency effect' in secondary memory. Craik presented to each of 20 subjects, 10 lists of 15 words each for immediate recall and then asked Ss to recall as many words as possible from all lists. It was found that the words in the terminal serial positions were retrieved best in immediate recall but least well in a second recall session. This pattern of results has been replicated in several studies and has usually been attributed to recency items gaining less rehearsal and therefore less registration in secondary memory than prerecency items. Subsidiary findings of this study were that auditory presentation was superior to visual presentation and written recall was superior to spoken recall in PM. Also words retrieved late in immediate recall had the highest probability of retrieval on the second recall session.

Craik, Gardiner and Watkins (1970) in two further experiments found that words retrieved in free recall were subsequently recognized less well if they had been presented late in their original input list. There was some evidence that a pattern of primacy and negative recency also held for recognition of words not retrieved in free recall. Craik *et al.* (1970) in their third experiment in the series, presented ten 20-words lists for IFR to 20 subjects. Immediately after the 'final recall trial subjects were given a recognition test. Words recalled in the final recall' session were recognized extremely well, while recognition of words previously recalled in IFR was poorer. It was concluded that terminal words in a free recall list, although best recalled immediately, are thereafter least available in LTS, though it is unlikely that they are simply less accessible. In another study, Darley, Tinklenberg, Hollister and Atkinson (1973) showed no difference in immediate and delayed recall between two groups who were administered placebo and marijuana respectively. The immediate recall curves for both the groups showed typical primacy and recency effects. However, the recency effect which was very prominent in immediate recall disappeared for delayed recall ; this result was consistent with Craik's (1970) finding, in spite of marijuana administration.

The results of these studies demonstrate that retrieval of a word in immediate recall does not by itself guarantee SM registration. For adequate registration to occur it is apparently necessary to process a word for some time. In the case of terminal words, which are typically output first, this processing time is shorter and registration is correspodingly poorer. The processing time in question is presumably occupied by rehearsal which after both Waugh and Norman (1965) and Atkinson and Shiffrin (1968) may be thought of performing two functions : maintaining information (or accustic retrieval cues) in PM and transferring information (or generating semantic cues) in SM.

Role of rehearsal in short-term memory :

The quantity-of-rehearsal interpretation of negative recency has been well supported by studies using the overt-rehearsal technique, in which subject is required to vocalize his rehearsal activity (Rundus and Atkinson, 1970). In Rundus' and Atkinson's (1970) study the subjects were given a series of word lists with each list followed by a free recall test on that list. During the study of these lists subjects were required to rehearse list items aloud. The subjects were instructed to study the list by filling the 5 second presentation interval for each word with overt repetitions of any words including the current one, from the list being presented. This overt rehearsal was tape recorded and analyzed. When the frequency of item rehearsal is plotted against serial position, the last few list items are found to be given progressively less rehearsal, so that the serial position function for rehearsal is very similar to that for the final recall phase of Craik's (1970) procedure.

Rundus, Loftus and Atkinson (1970) employed Rundus' and Atkinson's (1970) technique of overt rehearsal on twenty-five subjects using 10 lists of words followed by a free recall test. Three weeks later subjects retunred for a recognition test on these words. Initial recall and three week delayed recognition both showed a positive correlation between probability of recall and the amount of rehearsals accorded the item. The resuls also showed the probability of delayed recognition decreased as a function of the initial serial study position and appeared to increase as a function of its output position on initial recall. This fiinding is similar to the relation found by Craik (1970) between final recall and the item's list position during initial study. Rundus (1971) in another study, examined structural features of rehearsal, the relationship between rehearsall and recall, and output order as a function of item strength in lists of unrelated words. The results showed that the recall probability of an item, was a function of its serial position in the study list. The V-shaped function exhibited both primacy and recency effects. The mean number of rehearsals given an item as the function of its serial position indicated the number of rehearsals to be quite high for the early list items and to decrease steadily as a function of serial position.

These findings indicate that number of times an item is repeated correlates strongly with its registration in secondary memory. However the notion that secondary memory registration is a simple function of quantity of rehearsal has not gone unquestioned. Even if we accept that the pattern of rehearsal yielded by the overt repetition technique gives a reasonable indication of rehearsal in more conventional list presentation procedures, a high correlation between number of rehearsals and probability of recall from secondary memory does not prove that repetition is the agent of secondary memory registration. The 'quantity-of-rehearsal' approach has been challenged in a number of recent studies, and a 'quality-of-rehear sal' interpretation of the negative recency effect has been suggested (Craik and Lockhar, 1972):

Quality-of-rehearsal approach of recency effect :

Craik and Watkins (1973) in a study examined the notion that the adequacy of an item's registration in long-term storage is a positive function of its length of stay in the short-term store. In Experiment No. 1, a paradigm was designed in which subjects were induced to hold single words in short-term storage for varying lengths of time. The subjects were instructed to listen to a series of lists, and to 'report' after each list just the last word beginning with a particular letter. The subjects went on holding, dropping and replacing words starting with the critical letter till the list ended, when he wrote down the latest critical word. Three rates of presentation were used. Thus the time for which a critical word was held in short-term storage varied both as a function of presentation rate and of the number of non-critical words monitored between presentation and replacement (or report). After presentation of all the lists, the subjects were unexpectedly asked to recall as many words as possible from all lists. The results indicated that when short-term storage times were measured, these times did not predict long-term recall or recognition. This result was clearly contrary to the idea that recall probability necessarily increases in direct proportion to the total amount of time an item has been thought about or attended to (Waugh, 1970), a view which is implicit in most of the two-process models of short-term memory. In Experiment No. 2 an initial free recall test was given immediately after list presentation or after an interval of 20 seconds, during which the last 4 items were repeated continuously. In the immediate recall ths strong instruction regarding the last four words resulted in a boost in rehearsals for these words. But the final-recall test revealed that the last 4 items ln the rehearsal condition were no better recalled than those in the control condition. Results of the present study thus showed that neither the length of an item's stay in short-term storage nor the number of overt rehearsals it received was related to subsequent recall. The results of the present study seem inconsistent with evidence indicating that retention varies directly with amount of rehearsal (Rundus & Atkinson, 1970 ; Rundus, 1971). To reconcile this discrepancy to distinct modes of rehearsal have been postulated (Craik & Lockhart, 1972). An alternative explanation of negative recency is that it is the type of rehearsal, not the amount of rehearsal, which is critical for later recall. It is assumed that when the subject knows the end of the list is near, he relies on highly effective but transient 'phonemic' information for recall of terminal items, while earlier items the subject encodes in a more 'semantic-associative fashion.' It was concluded that "maintenance" and "elaborative" aspects of rehearsal can be clearly separated, and that the duration of rehearsal is related to long-term memory and learning only in the latter case. 'Maintenance rehearsal' does not however, lead to an improvement in memory performance.

Marshall and Werder (1972) investigated the role of rehearsal in free recall by varying the amount of rehearsal during learning. Subjects were presented with common English words under three conditions : full, reduced and eliminated rehearsal conditions. The full rehearsal condition produced both primacy and recency effects. The reduced rehearsal condition also produced the serial position effect. Lastly, the rehearsal eliminated condition which was developed in such a way which assured that the subjects would attend to the material but would not continue to rehearse the material—resulted in the presence of recency and the absence of primacy effect. The results of the present study thus questioned the necessity of a rehearsal buffer mechanism as an explanation of recency. Jacoby (1973) reported an experiment in which subjects recalled five word lists either immediately after presentation, or following 15 seconds of overt rehearsal. Despite their greater amount of rehearsal. final recall performance for the second group was no higher than that of the "immediate recall."

Watkins and Watkins (1974) in a study tested the quality-of-rehearsal interpretation of recency effect. The procedure involved presenting word lists of variable length under conditions in which half of the subjects were given information allowing them to anticipate the end of each list, while list length was unpredictable for the other half of the subjects. This was followed by an unexpected final recall test. The quality-of-rehearsal view predicts the final recall of prerecency items will remain unaffected by knowledge of list length, and the final recall of recency items will be lower when list length is known. If it is not possible to identify during presentation which are to be recency items, then these items will be afforded the same relatively 'elaborate processing' as prerecency items. On the other hand, when the end of the list can be anticipated, a simple 'maintenance rehearsal' will be adopted for recency items ; and therefore these items will be recalled with relatively low probability in the final recall test. In the present study this prediction was confirmed and hence the notion that 'negative recency effect' results from switching to a different mode of processing for recency items was supported. These findings thus indicate that the negative recency effect was due to recency items being given qualitatively different type of rehearsal rather than a reduced amount of rehearsal.

Such a view derives good support from the negative recency in those studies in which primary memory is eliminated by a distractor task given immediately following list presentation (Glanzer and Cunitz, 1966).

Elimination of primary memory by distractor task :

When subject konws that a distractor task is to follow list persentation, it is to be expected that he will encode the recency items in the same comparatively durable from in which he encodes prerecency items.

Glanzer and Cunitz (1966) varied the delay between end of list and recall with a minimal interpolated task of counting alound to find out its effect on the end section curve. In experiment I, Glanzer and Cunitz (1966) found that pure delay indicated no effect on short-term storage. In Experiment II subjects were shown 15-word lists and at the end of the list an interpolated task of counting was introduchd which varied from 10 to 30 seconds. After each list the subjects were asked to recall the words. Result showed 10-second delay with an interpolated task was sufficient to remove most of the end peak. With 30-second delay there was no trace at all of the end peak.

Baddeley (1968) in an experiment separated presentation and recall by rehearsal-preventing task. The results showed the curves for new and old items to be very similar in shape, with no recency effect.

In a recent study Jacoby and Bartz (1972) have reported an experiment which also favoured this interpretation. They found that relative to a silent delay, an interpolated arithmetic task filled delay of 15 seconds between presentation and initial free recall reduced recency in the initial recall test, but at the same, eliminated the negative recency effect in final recall. Results of the present study allowed two possible interpretations. Anticipation of a filled delay preceding recall influenced processing. Retrieval cues that can survive the filled delay may be generated and stored when delay is anticipated. If subject expects recall to be immediate or after an unfilled delay, items are merely maintained in STM and not processes further for storage in LTM. This supports Tulving's (1968) notion that items recalled immediately after presentation differ from those recalled after a delay in terms of type of retrieval cues employed.

Recency effect attributed to long-term retrieval process :

The notion that recency effect, either positive or negative, entails a STM process, has been recently challenged by several studies. By using the partial recall technique pronounced recency was obtained in a delayed recall (30 sec.) (Cofer & Tzeng, 1972 ; Dalesman, 1972). The most contradictory finding came from Bjork and Whitten (1972). In Experiment I, Bjork and Whitten (1972) employed a mixture of Brown-Petersen and free recall paradigm. Subjects were presented with eight lists of 13 pairs of to-be-recalled words. After each presentation of a word pair, there was a 12-second period filled with distraction activity, till the last word pair which was followed by 20 senonds of arithmetic. At the end of the list presantation subjects were asked to free recall the words. The results showed a striking effect of recency regardless of the experimental technique which attempted to reduce the probability of an item's stay in STM during recall. In Experiment II, after the recall of the last list, the subjects were given a final recall test, for all words from all lists. The results showed no effect of serial input position. The conclusion made was that this absence of a negative recency effect supports the proposition that recency effect obtained in the initial recall was in fact not a STM phenomenon. However Bjork and Whitten's experiment failed to get any recency effect in the final recall test. In a recent study by Tzeng (1973) the flat final recall curve reported by Bjork and Whitten (1972) has been attributed to the tremendous amount of output interference resulting from their experimental procedure. Tzeng (1973) investigated further the same proposition by reducing the overloading of retrieval mechanism. Tzeng employed the same procedure of Brown-Petersen and free-recall paradigm. Before and after the presentation of to-be-recalled words, there was a 20 second period of counting backward activity. At the end of each 10-word list, subjects were asked to free recall the words in the list. After 4 such lists, they were asked to free recall all the words from the four lists. It was found that not only did the initial recall show a pronounced positive recency effect, but so did the final recall. The results thus suggested that the observation of a recency effect in a free-recall experiment might not reflect the output of short-term memory. However, a study by Restle (1970) offers strong support for the contention that kinds of processing subjects employ in response task demands can substantially influence recall performance. Thus, it would appear that the long-term recency effects could be traceable to the modified methodology employed in these studies.

Modality effects in free recall :

A number of studies have investigated modality effects in short-term memory. Most of these studies have found auditory presentation of verbal material to result in better retention than visual presentation. Sperling (1967) has suggested a visual information storage and an auditory information storage. The visually presented material goes through a programme is converted into some form of auditory representation. This model characterizes that the component involved in laboratory studies of STM is essentially an auditory system. According to Atkinson and Shiffrin (1968), the information in the short-term store does not depend necessarily upon the form of the sensory input. For example, a word presented visually may be encoded from the visual sensory register into an auditory short-term store. A two-store hypothesis has been suggested in connection with modality effects reported by Murdock (1966, 1967).

Murdock and Walker (1969) compared auditory and visual presentation in a single trial free recall study. Experiment I used 20-word auditory or visual lists; Experiment II used mixed lists either 10-10, 2-10-8, 5-5-5, or random; Experiment III used 10-word lists either auditory, visual or random. The results showed that modality affected the recency part of the serial position curve but not the asymptote, mixed-list presentation greatly magnified auditory superiority, and the order of recall was organized by mode of presentation. The results seemed clearly inconsistent with a Sperling-type one-store model. Instead it confirmed the notion that there are separate prelinguistic auditory and visual short-term stores which may have persistence at least as long as 5-10 seconds.

Craik (1969) reported an experiment in which the recency effect and the auditory-visual difference were undiminished when recall was delayed by an unfilled interval of up to 15 seconds during which covert word rehearsal took place. Craik concluded that it was not necessary to postulate separate storage systems (Murdock & Walker, 1969) in order to explain output organization, as identical effects were obtained with immediate and delayed recalls.

Watkins (1972) in an experiment compared the free recall of lists of short and long words to find the locus of modality effect. The size of modality effect was found to be independent of word length. On the basis of these results it was suggested that a single process underlies the modality and the recency effect.

Discussion

From the studies discussed it was found that serial position curve obtained in a single trial free recall reflects the operation of two memory systems. The recency effect is attributed to a fixed capacity, highly accessible primary memory, while the prerecency items are considered to be recalled from a more commodious and permanent secondary memory (Norman & Waught, 1966 ; Atkinson & Shiffrin, 1968). Craik's (1970) findings of negative recency gave considerable support to this two-process view of short term memory. The negative recency effect was further evidenced in experiments of free recall by Craik *et al.* (1970), serial recall by Cohen (1970) and single-trial cued recall by Madigan and McCabe (1971). However, Craik *et al* (1970) and Cohen (1970) offer conflicting evidence as to the appearance of the effect when recognition instead of recall procedures are used in the final test. The results of these studies have usually been attributed to recency items gaining less rehearsal and therefore less registration in secondary memory than prerecency items. The role of rehearsal in negative recency has been investigated by several studies and has been found to support the quantity-of-rehearsal point of view (Rundus & Atkinson, 1970; Rundus, 1971 : Rundus *et al.* 1971). However this point of view has been questioned and a number of studies reported having very low or even zero correlations between the amount of rehearsal and secondary memory registration (Craik & Watkins, 1973 ; Marshall & Werder, 1973 ; Jecoby, 1973). Several studies with an interpolated distractor task between presentation and recall also give good support to this point of view (Glanzer & Cunitz, 1966 ; Jacoby & Bartz, 1972 ; Baddeley, 1968). Thus, it was suggested (Craik & Lockhart, 1972) that rehearsal can be usefully broken down into its "maintaining" and its "elaborating" functions, for STM and LTM respectively. This quality-of-rehearsal interpretation has been supported by a number of studies (Craik & Watkins, 1973 ; Watkins & Watkins, 1974). Watkins and Watkins (1974) concluded that when subjects can identify during input which items are terminal ones, they will process them in a fashion which on the one hand enhances their immediate recall, but on the other hand gives rise to poor long-term retention. However, it is not at present apparent how the effect of presentation conditions on FFR can be reconciled with the view that negative recency is due to the last items being given progressively less rehearsal (Rundus, 1971).

Other variables discussed influencing recency effect in serial position are the experimental paradigm and modality. Bjork and Whitten (1972) and Tzeng (1973) found positive recency in both immediate and final recall and attributed it to LTM rather than STM. More research is needed to confirm this hypothesis. Lastly, presentation modality has been unequivocally shown to have the converse effect, with an auditory over visual advantage restricted to recency items (Murdock & Walker, 1969). However, Watkins (1972) and Craik (1969) suggested that a single process underlies the modality and the recency effect. Perhaps more elegant way of expressing these notions is to follow Tulving (1968) in using a retrieval rather than a storage metaphor. Accordingly, the covert phonemic labelling following visual input would activate the same retrieval cues as for auditory input but at a lower intensity. The retention of early list items in PM would be achieved by the same process of covert labelling or rehearsal as for visual terminal items, irrespective of presentation modality, so predicting Craik's (1969) results.

From the above discussion of studies it seems that a theory of memory is yet to be formulated which will account for all the variations in the findings. However, multi-store models of memory have played a useful role, but they have often been taken too literally (Craik & Lockhart, 1972). The present situation seems more speculative rather than complete.

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A Study of Drive, Performance And Reminiscence

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In this experiment 40 female subjects (mean age being 18 years), selected on the basis of their scores on Eysenck Personality Inventory, worked on substitution task and inverted alphabet writing. These subjects were on the extreme ends of the dimensions of Extaversion and Neuroticism. Inter task correlation was found to be very significant for performance and reminiscence. The drive and performance were found to be negatively correlated. But results failed to give any conclusive evidence of the relationship between drive and reminiscence on these two tasks.

Malmo (1958), Martin (1960) and Eysenck and Warwick (1964) reported Neuroticism (N) to be concomitant with drive. It governs emotional reactivity through the neurophysiological mechanism of autonomic arousal. Jones (1960) too states that in a number of investigations the effect of N (as measured through inventories) on performance, has been equated with drive. Most of these results have indicated better performance of neurotics on simple tasks and of stables on complex tasks ; this tendency has been termed as the Yerkes-Dodson Law (Broadhurst, 1959 ; Madan, 1967).

The effect of drive on reminiscence in psychomotor tasks, as surveyed through the literature of 60's, seems to yield contradictory findings. The usage of different tasks has produced different kinds of relationship between reminiscence and drive. According to Eysenck (1965) and Mohan and Kumar (1973) it is a non-general phenomenon. The task differnces have great implications on the growth and dissipation of reactive inhibition, conditioned inhibition and consolidation. In a parallel work Mohan (1969) too emphasized that the lack of conformity of findings may be due to the task specificity.

The present investigation is an attempt to ascertain the effects of drive on reminiscence and performance with two verbal tasks.

Method :

The drive level was indexed through the scores on neuroticism as measured by EPI (Eysenck and Eysenck, 1964). Ss scoring 1/2 SD ± Mean on N and within 1/2 SD Mean on Extraversion were regarded as neurotics and stables respectively.

Tasks:

a) Substitution :

Twelve random alphabets were assigned numerical values which acted as the key. The Ss task was to assign numbers to the randomly presented alphabets.

b) Inverted Alphabets :

The S was required to write the English alphabet from left to right in the reverse order.

Subjects :

A total of 40 female Ss, their mean age being 18 years, were selected on the basis of their scores on EPI. The Ss scoring more than 4 points on the lie scale were rejected. Ss scoring 11.00 ± 2.25 on N were classified as neurotics and stables respectively.

In order to neutralize the position effect in the presentation of tasks, a rotation of the order A B B A, was applied.

Procedure :

Each S was made to perform on substitution and inverted alphabet (IA) writing for 5 minutes each. It was followed by a one minute rest and 2-minute post-rest performance. For both the tasks a one minute trial record was maintained. Inter task interval was of ten minutes. The performance was measured in terms of the number of letters substituted correctly and the number of alphabets reproduced in the corrected order.

Reminiscence score was calculated by substracting the scores of the last pre-rest trial from the first post-rest trial scores for both the tatks (as done earlier by Mohan, 1966).

Results :

The means and SDs of the 40 Ss on EPI (N Scores), performance on substitution and IA writing and reminiscence scores on both the tasks are presented in Table I.

Table 1.

Means and SDs for Drive (N) performance and reminiscence.

	Means	SDs
1. Neuroticism	11.08	5.07
2. Substitution	193.25	34.02
3. Inverted Alphabet	247.45	74.4
4. Substitution Reminiscence	4.90	3.92
5. Inverted Alphabet Reminiscence	5.05	3.75

Correlations were then obtained amongst the individual scores on all the five measures ; N, substitution, IA writing and the two reminiscence scores. These are presented in Table 2, showing the Inter-Correlational Matrix.

Table 2.

Intercorrelation Matrix for Drive (N), Performance & Reminiscence on substitution and inverted alphabet writing.

	N (1)	Subs. (2)	IA (3)	Subs. R. (4)	IAR (5)
1. Neuroticism	X	-.31*	-.43**	-.23	-.36*
2. Substitution		X	.62**	.28	.20
3. Inverted Alphabet			X	.08	·31*
4. Substitution Reminiscene				X	·41**
5. Inverted Alphabet Reminiscence					X

* Significant at ·05 Level.

** Significant at ·01 Level.

In order to test the differential effect of high and low drive on performance and reminiscence separate means & SDs were calculated of the neurotic and stable Ss for substitution and inverted alphabet writing, and their respective reminiscence scores. A t-test was applied on the four values for the two personality groups. The result of the analysis is presented in Tab...

Table 3.

Significance of difference between the main performance of neurotics and stables on substitution and inverted alphabet writing.

	Neurotics		Stables		t-ratios
	Means	SDs	Means	SDs	
1. Substitution	186.7	35.2	201.2	30.6	1.35
2. Inverted Alphabet	22.35	72.3	277.1	64.0	2.42
3. Substitution Reminiscence	4.31	4.18	5.61	3.35	1.04
4. Inverted Alphabet Reminiscence	4.18	2.51	6.05	4.63	1.49

Discussion

An inspection of Table 2 shows that performance on substitution task and inverted alphabet writing is highly correlated ($r=.62$). This high correlation indicates further that the difficulty level of the two tasks is almost similar, both being verbal tasks.

As regards the effect of drive (N) on performance of verbal tasks, the results yield a significantly negative correlation between the two (See Table 2, $r=-.31$ and $-.43$). A further analysis of the mean performance of neurotics and stables too bears out the trend that stable Ss perform better on substitution and inverted alphabet writing than neurotic Ss, though the t-ratios have failed to reach significance (See Table 3). The verbal tasks may be regarded as higher up in the hierarchy of complexity. Hence in consonance with the views of Broadhurst (1959), Child (1964) and Madan (1967), the Yerkes-Dodson optimum in such case may fall favorably on the stability end of the continum.

The scores on reminiscence too show that the two tasks – substitution and inverted alphabet writing—are positively related (See Table 2, $r=.41$). The relation of drive with reminiscence is not, however, yielding any categorical results. With inverted alphabet writing the stables seem to be yielding higher reminiscence than the neurotics (the respective means being 6.05 and 4.18 and $r=-.36$). The trend is similar for substitution though not significant. These results on the relation of the drive with reminiscence are similar to those obtained by Eysenck and Willett (1962), Mohan and Shashi (1972) and Mohan and Munjal (1973).

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The Effect of Value on the Estimation of Size

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The present study was designed to investigate the influences of value on the estimation of sizes of coins as valued objects. Two groups of subjects, each containing 7 students of Class VIII, were selected from two different local schools randomly. Their task was to estimate the size of coins of different values under three different conditions namely, Coin Phase, Memory Phase and Board Phase.

The present findings were : (1) Over-estimation is more when the sizes of the objects are larger and their values are also greater ; (2) Over estimation as a function of value and need was found to be present both when coins were present as stimulus objects and when their sizes were judged from memory.

A study to determine the effect of value on the perception of size immediately calls for the definition of the term perception. Traditionally, perception is concerned with the problem of correspondence between the nature of the physical world and the character of perceptual experience. Perception is most appropriately defined in term of experiences that stem directly from sensory stimulation. But much experience closely related to perception is more remote from sensory stimulation. Generally, perception is defined as the process through which the organism becomes aware of the environment. Perception is the attachment of meaning to objects viewed.

The perception of objects is influenced by stimulus as well as subjective factors. The stimulus factors include size, intensity, frequency, etc. Subjective factors include perceiver's set, motive, attitude, value, etc. The value-patterns of two individuals affect their readiness to percieve things differently according to their values. Experimental studies also support the view that the individual's value system may influence his perceptual set. Postman, Bruner and McGinnies (1948) found that the individual's value-systems influence his perceptual organization. Social factors may affect the perceptual process with the distortion of judgements of magnitude under various experimental conditions. Several investigators have demonstrated that the judgement of size of objects can vary systematically with the value of the objects to the perceiver. Simple size judgements are made of various stimulus objects clearly in view.

In an early experiment conducted and reported by Bruner & Goodman (1947), ten-year old children estimated the size of coins by adjusting a circular spot of light so that its areas seemed to them to be equal to the size of the coin. In order to do this, the child turned a knob on a box which controlled the size of a spot of light projected from behind on a ground glass screen. Coins used were the penny, Nickel, Dime, quarter and a half-dollar, and as control object, gray card board discs of the same size were employed.

The estimated size of every coin was found larger than its true size, and the overestimation increased with the value of the coin from one to 25 percent, but it dropped with the half-dollar. These effects were not found with a control group which estimated the size of the card board disc.

In order to find out individual differences in the value placed upon coins and their effects upon perception, size estimates were also made by children from well-to-do homes and from poor homes. In the case of every coin the poor children over-estimated its size on the average more than the rich children. Finally, subjects were not given a coin to match but were asked to imagine one and to match its size from memory. With this procedure over-estimations similar to those when the coins were present were reported by the poor children, but to a lesser degree. Such over-estimations were given by the rich children only for the half-dollar. Bruner and Goodman lebelled this tendency to over-estimate the size of valued objects 'perceptual accentuation'. As anticipated, estimates of the size of the coins were accentuated according to the value of the coins to the perceiver at the time judgements were made.

However, all experiments have not supported the hypothesis of 'perceptual accentuation'. Carter and Schooler (1949) made one repetition using more regorous controls and failed to confirm the earlier findings except in the non-perceptual area of memory for coin size.

In another experiment Bruner and Postman (1948) set up conditions for studying the effects of negative as well as positive sign value upon perceived size. The apparatus was the same as that used earlier by Bruner and Goodman ; a dollar sign (positive sign), a swastika (negative size) and an abstract geometric design (neutral sign) were drawn on bright pink plastic disks of identical size. The subject's task was to match their sizes (when held on the palm of the hand) with the manipulatable spot of light according to the method of average error. An F-test indicated significant variation on the basis of the symbol used. Both positive and negative signs showed greater over-estimation than the neutral control.

Bruner and Postman suggest that negative sign values lead to accentuation of apparent size by alerting the organism to danger or threat. Perhaps this significant factor simply enhanced distinctiveness of the size of the negative object.

Other studies have been made to investigate the effect of "value" on perception. But the results of these studies have also been varied. In some studies discs bearing dollar signs or dollar bills were over-estimated in size, or their distances under-estimated in comparison with discs or pieces of paper bearing meaningless figures while in others these findings have been contradicted. But in an experiment with children it was found that pictures of foods which they liked were perceived as being relaitvely larger than pictures of foods they disliked. In an experiment hungry and thirsty adult observers perceived pictures of articles of food and drink as being relatively brighter than those of objects unrelated to food or drink. The estimates of brightness increased steadily in amount until the observers had been eight hours without drinking. They were then allowed to drink all they wanted ; and immediately brightness of the pictures fell to the same value as it had at the beginning of the experiments.

Thus, it may be concluded from all these experiments that in ambiguous situations, qualities of objects which are rather independent of their values, are nevertheless, distorted or biased in some way as a function of values. It is doubtful whether such effects would occur in the clearer and less ambiguous perceptual situations usually encountered in everyday life, especially in circumstances in which correctness of perception is important.

In the light of the above background, the present investigator made an attempt to determine the effect of value on the perception of the size of coins of one taka, 50 paisa and quarter taka.

Objective of the Study

The aims of the present study were : (1) To study the effect of socio-economic status on the perception of coins of different values, (2) To study the effect of the presence or absence of coin on the estimation of its size as a valued object.

Hypothesis

(1) The greater the individual need for socially valued object (coin) the more will be the over-estimation of its size.

(2) The estimation of size of a valued object will be more in its presence than in its absence.

METHOD

Subjects

The Ss were 14 male students of class VIII. Their ages ranged between twelve and fourteen years. They were collected in two groups from two different schools. Seven were from 'Azimpur Boys High School' and the other seven from Dacca University Laboratory High School. The Ss taken from Laboratory High School were from rich families and the Ss taken from Azimpur Boys High Shool were from poor families, They were matched with respect to intelligence, age, sex and educational level, They were selected on the basis of their teacher's report. The information regarding the socio-economic status of each subject was collected from the school and the students' report. After determining the socio-economic status of poor and rich children, lists of 25 poor and 25 rich children were prepared. From these two lists the first two were selected on die tossing and then every third one was selected. In this way two lists of 7 poor and 7 rich were prepared.

The bio-data of each subject were recorded in a proforma after the experiment was over. From these records it appears that the monthly income of the poor group ranges from Taka 125.00 to 350.00 and of the rich group from Taka 970.00 to 4,500.00. In the poor group one resides in their own house and six others live in rented houses. In the rich group 3 lives in their own house and 4 other in rented house. In the rich group all the subjects had both their parents alive except one who had only his mother alive. In the poor group five had both of their parents alive, one had only his mother and the other had none alive.

Apparatus and Accessories :

The following apparatus and accessories were used for conducting the experiment :—

(1) Coins of one Taka, Half Taka and Quarter Taka denomination

(2) Stop Watch ;

(3) Hard Board :- One piece of hard board (18″ × 18″) was specially designed for this study. Three holes were engraved on this board equal to the size of coins of one Taka, Half Taka and Quarter Taka of Bangladesh Coin. Arrangements were made to expose only one coin at a time.

(4) Screen ;

(5) Art paper ;

(6) Scale, Pencil, Table, etc.

Design :

The following variables were manipulated systematically in our experimental design.

(1) *Value of Coin.* Both the rich and the poor groups were presented with a Taka, Half Taka and Quarter Taka coin to judge in the "Coin-Phase". The same two groups were asked to estimate the size of these coins immediately after the coin phase from memory. In the 'board-phase' the same groups estimated the size of holes equal to the sizes of three coins.

The experiment was conducted first with the poor group. On the following day it was conducted with the rich group.

(2) *Attitude preconditioning* : Before conducting the experiment on a particular subject he was motivated to think about money in terms of its value through general discusion. The subject was first asked to estimate the size of the coin and immediately after that with the same attitude preconditioning he was asked to estimate the size of the same coin from memory, of course, in a different room. Just after memory phase he was asked to estimate the size of holes while attitude preconditioning remains the same.

(3) *General randomisation* : The order of presentation of the different sizes of coins and holes was randomized.

(4) *Placement of coins and holes* : The coins were placed on a table one at a time at a distance of one foot from the subject for both the groups. The holes were also at the same distance and one was presented at a time.

There were three phases in this study :- (1) the Coin phase where coin was physically present. (2) The Memory phase where the Ss estimated the size of coins from memory ; and (3) The Board phase where the Ss estimated the size of coins by seeing holes on a hard board equal to the sizes of the three different coins. The experimental design provided for a four-factor analysis of variance to test the influence of social status of Ss and the three phases i, e. Coin, Memory and Board.

Procedure :

Ss were brought to the psychological laboratory with the permission of their teacher.

Only one coin was presented at a time and Ss were instructed to give its measurements by rolling a piece of art paper, five inches long and one cm in width. The experimenter then took the measurement of the rolled-diameter by placing the art paper on an inch-scale.

In both the groups the instructions to the subject in three phases (coin, memory, board) were as follows :—

Coin Phase :

In this phase Ss were asked to look at the coin placed in front of the subject on a brown table at a distance of 1 ft. from the Ss. Each coin was shown for one minute and Ss were asked to complete his rolling while seeing the coin (i. e. within one minute); after the completion of rolling Ss handed over the rolled paper to the experimenter who took measurement. There were four trials for each coin and the coins were presented randomly.

Memory Phase :

In this phase subjects were asked to estimate from memory the size of one coin at a time. The number of trials and other procedure were the same as before.

Board Phase :

Here Ss were asked to look at a hole engraved on a piece of hard board. There were three such holes which were different in size—one equals to 'one Taka' coin, another to 'Half Taka' and the third one to "Quarter Taka". The subject was shown one hole at a time for one minute to give its measurement by rolling a piece of art paper as described earlier. As in memory phase the coin was also absent here.

RESULTS :

In the four factor Analysis of Variance viz :— (i) Social status, (ii) Coin values, (iii) Phases and (iv) Students serial number, it has been found that there is significant difference in the estimation of coins of different values by the rich and the poor groups. Thus it is clear from the present findings that social status of the observers and the perceived value of the objects influence our perception like all other physical and physiological properties involved in the process of perception. From table 2 it is evident that there is significant interaction between social status and value of the coin.

In the 3-factor Analysis of variance, it has been tried to find out whether there is any significant difference in the estimation of size of each type of coin (taken separately) in different phases by the rich and the poor groups. It is evident from table 3 that there is significant difference in the estimation of size of one Taka and $\frac{1}{2}$ Taka coins in the different phases. From these same tables it is also found that there is significant difference in the estimation of sizes of one Taka and half Taka coins by the rich and the poor groups. From Table 3 we can say that there is no significant difference in the estimation of size of $\frac{1}{4}$ Taka coin due to social status.

Table 1

The mean difference of the estimation of size between the rich aud poor groups for all the three coins in the three phases.

Name of Phase	Actual size of coin or neutral (in cm)	Mean estimation by the rich group	Mean estimation by the poor group (in cm)	Difference between the groups (in cm)
COIN	One Taka (9 cm)	10.62 (+1.62)	9.41 (+0.41)	+1.21
	Half Taka (7.50 cm)	8.73 (+1.23)	8.28 (+0.78)	+0.45
	Quarter Taka (6. cm)	5.88 (—0.12)	5.72 —0.28	—0.16
MEMORY	One Taka (9 cm)	10.21 (+1.21)	9.60 (+0.60)	+0.61
	Half Taka (7.50 cm)	8.61 (+1.11)	8.19 (+0.69)	+0.42
	Quarter Taka (6 cm)	5.69 (—0.31)	5.92 (—0.08)	—0.23
BOARD	One Taka (9 cm)	9.17 (+0.17)	9.11 (+0.11)	+0.07
	Half Taka (7. 50 cm)	7.79 (+0.29)	7.59 (+0.09)	+0.20
	Quarter Taka (6 cm)	6.34 (+0.34)	6.05 (+0.05)	+0.29

Table—2

Four-Factor Analysis of Variance.

Sources of variation		D.F.	SS	M SS (variance)	F	F. tabulated 5%	1%	P
Coin value	V	2	299.3392	149.6696				
Phase	P	2	4.5533	2.2766	10.3938	3.129	4.932	Near 0
Social Status	S	1	4.0393	4.0393	18,4413	3.97	7.01	Near 0
Number	N	6	15.8636					
Interactions		38	29.1021					
Error		76	16,6467	0.219035				
Total		125	369.5442					

DF=Degree of freedom
SS=Sum of Squares
MSS=Mean Sum of Squares
=Unbiased estimates of variance.

Table 3

Three Factor Analysis of Variance for each of the three Coins separately.

For One Taka

Sources of Vartiation		DF	SS	MSS (V)	F	F-tabulated 5%	1%	P
Phase	P	2	6.4241	3.2122	8.5905 8.5109 *	3.88 3.30	6.93 5.34	0.0049 0.0013
Social Status	S	1	4.1991	4.1991	11.0736 11.1264 *	4.75 4.15	9.33 7.50	0.0064 0.0035
Pairs of boys	N	6	10.0271					
Interactions		20	7.5263					
Error		12	4.5503	0.3792				
Total		41	32.7269					
Combined Error		32	12.0766	0.3774				

For 1/2 Taka Coin

Sources of Vartiation		DF	SS	MSS (V)	F	F-tabulated 5%	1%	P
Phase	P	As above	5.5098	2.7549	10.7403 8.4636 *	As above	As above	0.00030 0.00103
Social status	S		1.3825	1.3825	5.3899 4.2473 *			0.00411 0.00481
Pairs of boys	N		7.0966					
Interactions			7.3390					
Error			3.0785	0.2565				
Total			24.4064					
Combined Error			10.4175	0.3255				

For 1/4 Taka Coin

Phase	P	As above	1.4228	0.7114	5.2931 3.2588 *	As above	As above	0.0234 0.0524
Social status	S		0.0656	0.0656	0.4881 0.3005 *			ns ns
Pairs of boys	N		4.5975					
Interactions			5.3730					
Error			1.6129	0.1344				
Total			13.0718					
Combined Error			6.9859	0.2183				

* Tested against combined error; Others tested against error.

Table-4

The differences of mean size estimates and the calculated and tabulated t values.

Coin	Phase	Mean difference in estimates between the two groups (in cm)	Colculated t values (d. f. 6)
1 Taka	Coin	+1.210	11.03 (P < .001)
	Memory	0.611	1.60 (P > .05)
	Board	0.075	0.19 (P > .05)
1/2 Taka	Coin	0.451	1.963 (P = .05)
	Memory	0.437	1.274 (P > .05)
	Board	0.200	0.604 (P > .05)
1/4 Taka	Coin	—0.163	0.593 (P > .05)
	Memory	—0.227	—0.9 4 (P > .05)
	Board	0.301	0.861 (P > .05)

Discussion

Bruner and Goodman (1947) have shown that the estimated size of a coin increases with the increase of its true size. they found that the overestimation of a coin of higher denomination was larger than the coin of a lower denomination. Bruner and Postman (1948) put forward the "accentuation hypothesis" wherein they have tried to demonstrate the influence of value and need by showing that the mere presence of a value symbol, such as a dollar sign or a swastika on a disc, caused its size to be overestimated. The present findings are fairly in accord with the findings of Bruner and Goodman (1947) and Bruner and Postman (1948) in the sense that here also coins of higher denominations i.e. one Taka and half Taka have systematically been overestimated by the rich and the poor groups in both the 'Coin' and 'Memory' phases. This is, of course, not true with the quarter Taka coin which has been underestimated by the rich and the poor groups in the 'Coin' and 'Memory' phases but whose size has been overestimated in the 'Board' phase by both the rich and the poor groups. The underestimation of quarter Taka by the rich and the poor groups in both the 'Coin' and 'Memory' phases may be due to its negligible practical value. As its buying power is very less, so the viewers might have attended to its objective physical size more instead of being influenced by its subjective value. Thus, in both the 'Coin' and 'Memory' phases the estimations of the rich and the poor alike have approximated almost to the objective size of the coin. In the 'Board' phase we find a reversible trend in the sense that here larger holes have been overestimated relatively less than the smaller holes by the rich group whereas the poor group has systematically overestimated all the coins including the size of quarter Taka which has never been overestimated in any other phases in this study.

Although the present findings substantiate the "accentuation hypothesis' in the sense that here in general overestimation increased from one to 20 p.c. where the coins varied from ¼ Taka to one Taka ; it is doubtful, however, as Carter and Schooler have shown (1949) whether this simple formula covers all instances in which value is a factor in the situation'. According to Carter and Schooler (1949) more needs to be known about the interrelationships of valuer, value, the relation of personality and perception and the experimental conditions, such as, the size-estimation method, the intensity of the value, the difficulty of the task itself, the figural properties of the value—stimuli, and the gross presence or absence of any figure, value or neutral.

In this study it was not possible to vary all the factors enumerated above. Here social status of the perceivers, intensity of the stimulus—value and the gross presence or absence of the value were varied, to see their effect on the 'accentuation hypothesis'. In the present study coins of higher value i.e. one Taka and half Taka have been overestimated by the rich and the poor group in the 'Coin' and the 'Memory' phases. But the nature of overestimation of the rich and the poor groups is not the same. From Table 2 it is clear that the rich and the poor groups differ in their estimation of size and from Table 4 we can see that they not only differ in their size estimation but the nature of their difference also varies from coin to coin and from phase to phase. From Table 4 it is evident further that these two groups differ significantly in their estimation one Taka and half taka in the 'Coin phase' only. The difference of their estimation of size of one Taka in the 'memory' phase comes only closer to the level of significance. In all other situations these two groups have not been found to differ significantly in this study. Thus we can say with Carter and Schooler that the accentuation hypothesis is not tenable in its simples from as proposed by Bruner and Postman (1948) rather it needs to be suplemented by other principles which can take into account overestimation of neutral objects also which Carter and Schooler consider to be a great challenge to the accentuation hypothesis. In this study the neutral figures in the 'board' phase have also been overestimated and the peculiarity of the overestimation is that here larger figures has been overestimated less by the rich group in contradition to the the findings of Bruner and Goodman (1947) and the general principle of accentuation hypothesis. But it cannot be claimed that this peculiarity is due to neutrality of the objects alone. Carter and Schooler (1949) hints at ego-stucture of Ss as one of the possible explanations of this They also speak of a constant error which means a tendency to favour overestimation on the part of the observer. The greater overestimation of smaller wholes by the rich group may be due to the haziness generated by the difficulty of the task. Though this difficulty was equally present to both the rich and the poor groups, the rich group which is traditionally known as pleasure loving and less painstaking might have given their estimation carelessly only to avoid the pains of becoming careful.

Although the present findings give mild support to the accentuation hypothesis of Bruner and Goodman (1947) they contradict those of Bruner and Goodman also in the sense that here children from rich families overestimated the size of all the coins on the average more than the children from poor families whereas in case of Bruner and Goodman it is just the opposite. One explanation of this may be that for the rich group one Taka coin was something worth desiring, whereas for the poor group this was beyond their expectation and as such the poor group did not pay much attention to its value, rather they attended more to its physical properties. Another explanation for this deviation may be that one taka coin was just going out of circulation when this experiment took place.

The rich group might have been seen one Taka coin in show-case and even may have exchanged it for goods on some occasions. This rareness of one Taka coin might have accentuated its value to the rich group The poor group here might have seen one Taka coin in pictures alone as they generally cannot afford a show-case. The children from poor families may not have any practical knowledge about the usuable value of one Taka and as such their estimation of its size is likely to be determined more by the physical properties of the coin than by its value. And once the estimation of size of one take coin has been accentuated by the presence of value for the rich group it is most likely to have a hallow effect on the subsequent estimations of other coins according to the principle of 'perceptual constancy' proposed by Carter and Schooler (1949) and which has been found to be the case here in the estimation of size of 1/2 Taka coin by the rich group.

Conclusion

It may be concluded from the present findings that overestimation was more in the 'coin' phase in general, than either in the 'memory' or in the 'board' phase. Again in the Board phase both the groups seem to be more accuracy oriented where the amount of overstimation is negligible.

The present findings substantiate the accentuation hypothesis of Bruner and Goodman (1947) According to them the greater the value fo coins, more their sizes are overestimated. Here also the larger coins having greater value have been overestimated more than the smaller coins. But the present findings contradict the findings of Bruner and Goodman (1947) in the sense that here rich group has overestimated more than the poor group.

However, the present findings are not at one with the findings of Carter and Schodler (1949) in the sense that larger holes have not been overestimated more than the smaller holes, where real value attached to the object was absent. Here smaller holes have been overestimated more than the larger holes by the rich group.

In both the 'coin and 'memory' phases the rich group have overestimated larger coins more than than the poor group. But with the smaller coins the rich have understimated more in the 'memory' phase than in the 'coin' phase.

In the Board phase no significant difference between the rich and the poor proup have been found here in their estimates.

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