

# Subjective Organization in Free Recall of Sentences Presented in Context-Disorganized Order

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# SUBJECTIVE ORGANIZATION IN FREE RECALL OF SENTENCES PRESENTED IN CONTEXT- DISORGANIZED ORDER

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Subjective organization in multitrial free recall is investigated with the material of sentences which originally constitute a story. Sentences presented in context-disorganized order are reorganized in Subjects' recall in the sequential order approximating to that in the original story. It is proposed that this organization is called "contextual organization".

This paper is the report of an experiment on subjective organization in multitrial free recall of sentence material. The experiment is a variation of Tulving's experiment on "subjective organization" (1962). Instead of "unrelated words" in Tulving's study, sentences were used here as learning material. Sentences which originally constituted a story were disconnected separately and presented in different orders on successive learning trials.

The purposes of the experiment are to examine the applicability of Tulving's measure of subjective organization to the sentence material and to ascertain the nature of organizing process in such a learning situation.

## METHOD

*Subjects:* The subjects were 13 undergraduate students enrolled in the educational psychology courses at Niigata University (8 females and 5 males). Their mean age was 20 years and 10 months (SD: 8 months). None of them had previously participated in free recall learning experiment.

*Materials:* A story which consists of 16 sentences as shown with number in Table 1 was extracted from the Japanese version of R. Benedict's work "The Chrysanthemum and the Sword" as the original material. Sixteen sentences from the original story were disconnected separately and printed respectively on 128×182 mm white cards.

*Procedure:* Each S was individually given 10 trials of free recall concerning the set of 16 sentences. The order of presentation of sentences was so different on each trial that each sentence was preceded and followed in the series by each other sentence only once in the course of the 10 trials. Although 16 lists of such orders are possible for 16 items, 10 orders were used on 10 trials in the present experiment, eliminating

Table 1. The original story of the learning material\*

① After the air battles were over, the Japanese planes returned to their base in small formations of three or four. ② A Captain was in one of the first planes to return. ③ After alighting from his plane, he stood on the ground and gazed into the sky through binoculars. ④ As his men returned, he counted. ⑤ He looked rather pale, but he was quite steady. ⑥ After the last plane returned he made out a report and proceeded to Headquarters. ⑦ At Headquarters he made his report to the Commanding Officer. ⑧ As soon as he had finished his report, however, he suddenly dropped to the ground. ⑨ The officers on the spot rushed to give assistance but alas! he was dead. ⑩ On examining his body it was found that it was already cold, ⑪ and he had a bullet wound in his chest, which had proved fatal. ⑫ It is impossible for the body of a newly-dead person to be cold. ⑬ Nevertheless the body of the dead captain was as cold as ice. ⑭ The Captain must have been dead long before, (and) ⑮ it was his spirit that made the report. ⑯ Such a miraculous fact must have been achieved by the strict sense of responsibility that the dead Captain possessed.

\* The original story shown here is extracted from the original work by Benedict: Benedict, R. 1946 *The Chrysanthemum and the Sword—Patterns of Japanese Culture*. Boston: Houghton Mifflin Co. The clauses numbered as ⑩, ⑪, ⑬, and ⑮ are independent respectively as a sentence in Japanese version translated by Hasegawa, M.

such 6 orders that are the same or approximate to one in the original story (i.e.; “1, 2, 3, . . . 15, 16”; “2, 4, 6, . . . 1, 3, 5, . . .”; “3, 6, 9, . . . 1, 4, 7, . . .”) and in the reverse order. The order of presentation of lists on 10 trials was also different for each *S*. In the instructions *S* was told that his task was to read aloud at his own pace and remember each of 16 sentences, turning up a given set of cards successively by himself with minimum inter-card interval, that after reading up 16 cards he would subsequently be asked to reproduce orally in any order as many and accurate sentences as he could, and that there would be 10 trials with the same sentences. If *S* himself gave up recalling or there was more than 1-minute silence, the next trial began.

## RESULTS

*Number of sentences correctly recalled (performance)*: Subject's reproductions recorded by a tape-recorder were compared with stimulus sentences to check accuracy. With reference to Howe's (1970) method, the reproduction was scored as correct if necessary minimum components of the meaningful content of the sentences were judged to have been reproduced. Synonyms and alterations in phrasing were considered acceptable if they did not substantially alter the meaning of a sentence.

The mean numbers of sentences correctly recalled by 13 *Ss* on each of 10 trials are shown in Table 2 and Fig. 1. In Fig. 1 the curve of numbers of correct recall is a typical learning curve, showing performance as a function of trials.

*Subjective organization*: The score of subjective organization (SO) for each *S* was computed in exact accordance with Tulving's (1962) method. Ten trials were divided into three blocks: the block of Trials 1-4, Trials 4-7, and Trials 7-10. Then, for each of these blocks, the second-order SO was calculated, based on the matrix of pairs of successive responses pooled for four trials. Repetitions of list sentences were included

in the recall matrix and thus entered the SO score, but not in the performance score.

The curve of mean SO plotted against the midpoints of each block in Fig. 1 shows that the degree of subjective organization increases systematically with repetition of trial. That is, with repeated trials, the order in which sentences are recalled (output-order) becomes progressively fixed or stereotyped, in spite of the different order in which sentences are presented on each trial (input-order). Ss organized their recall sequentially even in the absence of such sequential organization in stimulus lists.

*Correlation between performance and SO:* Correlations between mean performance score and mean SO score for each of three blocks are as follows (Pearson's  $r$ ): for Trials

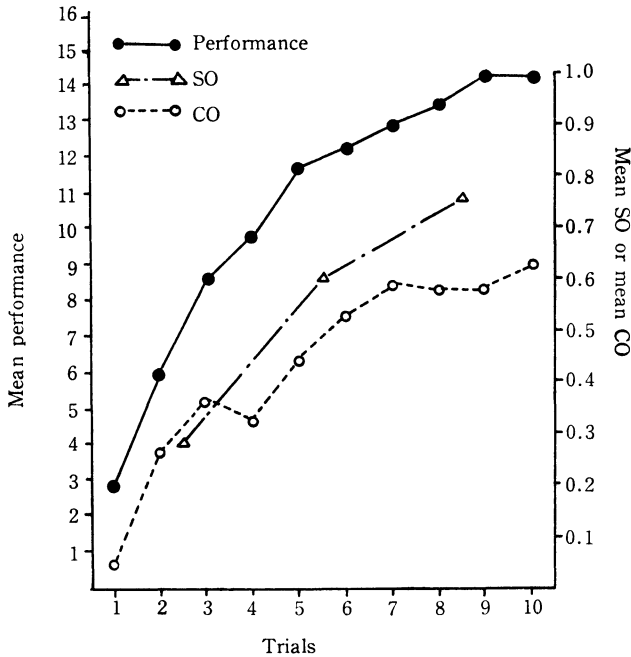


Fig. 1 Mean performance, mean SO and mean CO as a function of trials. (Values of performance are to be read from the left ordinate, SO and CO from the right ordinate.)

Table 2. Means and standard deviations of performance, SO and CO (N=13)

Trials		1	2	3	4	5	6	7	8	9	10
		Mean	2.9	5.8	8.6	9.7	11.5	12.2	12.8	13.4	14.2
Performance	SD	1.8	3.3	3.9	3.7	3.8	3.2	2.8	2.5	1.5	1.7
	Mean	.278			.603			.747			
SO	SD	.173			.234			.212			
	Mean	.064	.265	.355	.329	.445	.529	.586	.578	.581	.626
CO	SD	.122	.223	.279	.274	.249	.221	.226	.187	.192	.164

1-4, 0.772; Trials 4-7, 0.801; Trials 7-10, 0.943, and all of them are significant at 1% level.

*Contextual organization:* Now, it is expected that the sequential relation of the sentences in *Ss'* recall approximates progressively to that in the original story, i.e. to the context, so the degree of this approximation was investigated. Here the author would propose to call such organization "contextual organization" that sentences presented by disarranging the serial position of the original context are reorganized in *S'* recall in the sequential relation approximating to the context.

The degree of contextual organization (CO) was also calculated by the formula for SO, based on the matrix in which all pairs of adjacent sentences in *S'* recall on each trial and those in the original story are tabulated. CO obtained thus can assume all values between zero and unity, the former expressing that *S'* recall does not contain any of the same sequences in the original story, and the latter the maximum degree of such organization that sentences were recalled exactly in the same order as in the original story.

Mean CO in Fig. 1 and Table 2 shows that the degree of contextual organization, according to our expectation, increases with repeated trials. Although the order of sentences in the recall approximates progressively to that in the original story, the former does not accord completely with the latter in so far as the present experiment is concerned. Which sequential relation tends to occur in the recall is also seen in Table 3, in which the total frequencies of adjacent reproduction of 13 *Ss* on Trials 7-10 are tabulated. In the Table symbol  $x_0$  stands for the blank position immediately

Table 3. Frequencies of all pairs of adjacent reproductions pooled over Trails 7-10 (Total for 13 *Ss*)

nth	(n+1) th																$n_i$	
	$y_0$	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16
$x_0$		48			1							1	2					52
1			50	1														51
2				43	2	4		1					1					51
3			1		39	4	2										1	47
4	2	1				9	36	2										50
5	1			1	5		8	12	15				1	1	1	3		48
6						11		34	1									46
7				2		14			32								1	50
8	1									46					1			49
9						2					22	6	12	2	1	1		46
10												13	12			1		26
11	3	1											13	2	2	12	10	43
12	1							1				3		26	12	1	1	45
13		1				2					2		2	17	6	2		32
14	2				1				1		1	11		1		14	5	36
15	11				1					1	1	7	2				27	49
16	31				2	1						1			2	10		47
$n_j$	52	51	51	47	50	48	46	50	49	46	26	43	45	32	36	49	47	768

preceding the first sentence in  $S'$  recall list, and  $y_0$  refers to the blank position immediately following the last sentence in the same list. The entries in the underlined cells represent the frequencies with which sentences are recalled in the same sequential order as in the original story. For example, 46 reproductions of the sentence of No. 9 all followed No. 8, that is, they are recalled completely in the same order as in the original story, while only 9 out of total 48 reproductions of No. 5 followed No. 4. The rate of the reproduction of a sentence in the same sequential relation as in the original story to the total reproduction of the sentence may reflect the degree in which the sentence is constrained by the context in the original story.

#### DISCUSSION

The sentences presented in the context-disorganized order are reorganized in the recall in the order approximating to the original context with repeated trials. The amount of recall also increases with trials. As compared with previous results with unrelated words (Tulving, 1962; Kokubun, 1973) or pictorial material (Laurence, 1966), higher SO values are shown in the present experiment, reflecting the property of the material that originally constitutes a story.

The process of the contextual organization seems to be as follows. First, a few unrelated sentences are learned by rote, then from the set of sentences remembered, a story or a context comes up, though it is still vague or incomplete. Now, in turn, by the mediation of the context, the availability of each sentence increases. If correctly remembered sentences increase in number, the context also will become more distinct and consistent.

Thus, the process of contextual organization seems to be a mutually aided development of the associative process of learning of individual sentences and the cognitive process of understanding of the context. As Jung (1968) concluded at the end of his textbook that "Rather than debate whether learning is associationistic or cognitive, we might more productively consider both types of mechanism as aspects of learning", the learning of sentences in the present experiment also includes both aspects of learning.

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