DOCUMENT RESUME

ED 058 772 FL 002 824

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TITLE Some Transformational Effects on Recoding English Sentences.
INSTITUTION Hiroshima Univ. (Japan).
PUB DATE 72
NOTE 16p.
JOURNAL CIT Bulletin for the Teachers of English; n15 p9-24 1972

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Comparative Analysis; English (Second Language); Information Processing; Kernel Sentences; *Language Development; Language Instruction; Language Proficiency; Language Research; Learning Theories; Psycholinguistics; Psychology; *Recall (Psychological); *Second Language Learning; *Sentences; Statistical Analysis; Syntax; *Transformations (Language); Verbal Development

ABSTRACT

The experiment described in this report investigates second language development and the possibility of determining various levels of language acquisition. The subjects involved are Japanese students learning English. The students are given the task of recalling English kernel sentences after hearing them once. The resulting sentences--the paraphrases and transformation used--reveal data concerning language development. The results, subjected to statistical analysis, illustrate error trends and tendencies toward syntactic confusion, i.e. the Japanese students are able to follow the transformational routine to some extent. If it is possible to map what one can do in English as a foreign language on the individualistic chronological scale of learning history, it might be possible to use a developmental procedure in foreign language acquisition. A list of references is included. (Author/VM)

From: A Bulletin for the Teachers of English. Number 15, 1972.

Some Transformational Effects on Recoding English Sentences

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This paper is a report on some of the characteristics found among Japanese in processing English sentences. In the replication of Mehler's test(1963) with two groups of Ss, some effects of transformational complexity on processing English sentences were investigated. Based on the experimental results some instances of grammatical preference among Japanese Ss were discussed.

It was found that the transformational structure was not embedded in the Japanese Ss in the form to be seen in the native speaker. Along with this experiment, validity of transformational measures as a predictor of learning English sentences and the hypothesis of recoding were also partially confirmed.

0. Introduction

0.1.

It is one of the most wanted kinds of study in foreign language teaching how we acquire a foreign language. Regarding as the acquisition of the first language, quite a substantial amount of research has been done, though the final solution is still in the mist far away.

Now it is a common observation that the biological scale of the first language acquisition (Lenneberg, 1967)exists, and that we have now a small fraction of the grammar in children's speech emerged (Bellugi and Brown, 1964). On the other hand we have very little research data on the procedure of acquisition of a second language besides those more or less field-study-oriented reports by such people as Dunkel(1948),

Scherer and Wertheimer(1964), and Crothers and Suppes(1967). It is a too well known observation that actual practice of teaching and learning are so easily influenced by various factors beyond our control, which make experimental research in this field extremely difficult. This being the fact, we could, however, observe, describe, analyze, and synthesize the learner behavior as was laboriously and yet successfully done by those people who have been investigating the mechanisms of the first language acquisition.

As a proposition concerning the desired direction of research in this field, the author suggests that the careful, exhaustive observation, description, analysis, and synthesis of the learner behavior be a promising way to lead us to the ultimate goal, the model of foreign language acquisition. A theoretical development will then follow.

0.2.

As is generally agreed upon among psychologists, psycholinguists, and communicologists, recoding now appears to be a fact rather than a hypothetical concept when we talk about processing of information with human organizations. There are several empirical data that support decoding does exist (Miller, 1956, 1962a, 1962b, Miller, Heise, & Lichten, 1951, Troike, 1970). When we receive information, the incoming stimulus is first sent to the temporary memory storage. Then only the one that can stand further processing proceeds the decoding channel up to the central locus in the brain. We associate, analyze, synthesize, and make decisions on the received information. Toward the last steps in this information processing, the received stimuli, whether or not they are verbal, are said to be transformed into concept, or the like, and not a verbatim even though the original stimulus is verbal. In other words, the processed stimulus undergoes some higher-order semantic interpretation.

Recently scores of psychologists, psycholinguists, and linguists are trying to exemplify this process of verbal coding. Yngve's model of sentence generation will represent one school of ideas, and Chomsky's another. The depth hypothesis recommended by Yngve (1960, 1961) may certainly tell us one aspect of verbal behavior, the apparent

linear succession of verbal forms. Difficulty or ease in sentence processing may partly depend upon the dmax or the mean depth of a sentence, which is supported by Miller's proposition of magical number 7 plus minus 2. Yngve's measure will be a better predictor of relative difficulty or ease and of memory depth in processing sentences than that relying on the mere length of the sentence. However, we must admit Yngve's model is not free from the defects inherent in the Markovian hypothesis. We need still other measures to illustrate the porcess of verbal coding. Chomsky's idea of transformation may temporarily serve for this purpose. By temporarity the author means the as yet inadequate state of Chomskian model in explaining semantic structures of language, besides some grammatical questions. But it is also true that his idea is now being verified by empirical research data presented by some people (Miller, 1962b, Mehler, 1963, Wright 1960, Perfetti, 1969, Savin and Perchnock, 1965).

As was stated in the proposition above, how English is ingrained in the Japanese learner was laid in this investigation as a step toward the ultimate goal of explaining the question of the acquision of a second language. With this principle at the base transformational complexity was picked up as the independent variable and amount and quality of recalling a set of English sentences were set as the dependent variables. Mehler's test was replicated and his results were compared with those obtained from the replication. This comparative study was planned because the difference in recall between Mehler's Ss and the Japanese Ss, if any at all, would hopefully provide us with some clues to un-cover some features in foreing language proessing peculiar to Japanese.

Indeed the transformational matrix in the English language was abopted as the basic factor in this experimental design. But this does not necessarily imply that the transformational theory was taken as the established laws in verbal coding.

0.3.

Before the experiment, the traits of the Japanese learner in coding English were predicted as significantly different from those of the

native speaker's. And a sub-hypothesis was that there would be difference in amount of recall and grammatical confusion between the two groups of Japanese Ss, who differ from each other in learning experience and degree of concentration on learning English. These hypotheses were measured from three points: (1) the difference in the total amount of recall with each syntactic variation among the three groups of Ss, (2) the difference in dispersion of scores in terms of total recall, and (3) the difference in syntactic confusion when incorrect recalls occurred.

The experiment was designed around the following ideas.

Mehler diagrammed the transformational relation used as the core in his experiment as a cube like Fig. 1.[1]

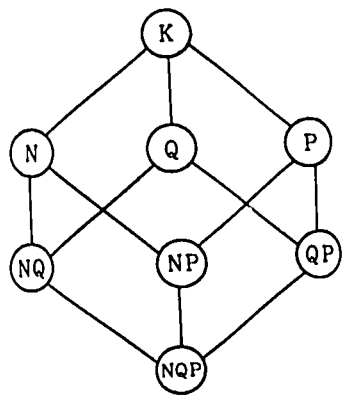


Fig. 1

He developed a hypothesis consonant with Miller's "kernal + transformational tag" hypothesis in recalling English sentences. According to this hypothesis, the load in recall will be heavier when the stimulus sentence is farther from the kernal. That is to say, when the learner tries to decode and store in memory a PN sentence, his cogtive operation is first grasping the general semantic idea of the stimulus information in the form of the kernal, and then remembering P and N sysntactic tags for further processing. This procedure can loosely be called "decoding." If the learner neglects some transformational tag, it follows necessarily that he will reproduce, when required, a sentence on his own generation. There may be intrusion of extra factors such as idiolectic preference over grammatical structures or past associations, and the like. At any rate, however, less instances of recall with grammatical confusion but with semantic correctness is tantamount to a full-fledged stage in decoding function.

Thus, when this test is tried with the Japanese learner of English,

1 J. Mehler, "Some Effects of Grammatical Transformations on the Recall of English Sentences," *J. verb. Learn. verb. Behav.*, 2 (1963), 347.

the tendency in correct recall and syntactic confusion will deviate from the one to be observed among the native speaker. If two different groups of Japanese subjects (mentioned earlier in this section) are tested, and show different turn-outs, it will shed some light on the qestion of whether the biological schedule in language development is also conceivable with the Japanese learner of English. It may also provide some means to clarify the possibility of plotting the growth of linguistic competence in English language learning in terms of learning experience.

1. Method

1.1 Materials

The materials were those of Mehler's (1963). Mehler used eight kernal sentences: *The boy has taken the photograph; The man has bought the house; The student has written the essay; The car has hit the tree; The airplane has carried the passenger; The girl has worn the jewel; The secretary has typed the paper; The biologist has made the discovery.* According to the cube shown above, each kernal sentence produces seven transformed sentences. Thus the total number of sentences was 64(8×8). These 64 sentences were then divided into 8 sets, each of which contained one sentence from the eight kernals, and each representing the other seven sentences with different types of transformation. Each set of materials had all eight different syntactic forms and eight different content materials. Each of the eight sets of materials was the stimulus material for one group of Ss.

As you will notice, these sentences consist of the very essentials of the actor-action type sentence with present perfect tense. Superfluous elements are all cut off to preserve the transformational complexity as the experimental variable. The length of the sentences are from six to nine, which will hardly cause the fluctation in the obtained data due to the sentence length. The present-perfect tense is adopted because we can thus eliminate the conspicuous formal markers which will induce different rate of learning as the syntactic form varies.

1.2. Procedure

Mehler's Ss were 80 American college students, all native speakers of English. In the present experiment, two groups of Japanese college students were used. One was 40 Hiroshima University students currently taking the language laboratory course in English. 20 of them were sophomores, and the other 20, juniors. They were all English major, and all non-native speakers of English. The other group was 40 Ehime University students currently taking the language laboratory course in English, all non-native speakers of English. Eighty-five per cent of them were freshmen, and non English major. The first group is to be called Group A, and the second, Group B, hereafter. The total amount of time in learning English in terms of years and hours and the type of academic training are different between the two.

Both Group A and Group B were divided into eight samll groups. Each small group was presented a set of the test material randomly chosen from among the eight sets for five successive trials. In each trial the sentences were read once. After listening the sentences, the Ss were asked to reproduce the sentences they just heard as much as possible. Answers for each trial were written in the answer booklet with five pages, one for each trial. On each page was a list of eight prompting words printed vertically, one for each sentence; four of them were subjects, and four were from predicates, randomly chosen and arranged. There was no duplication of the same set of words. The four words from the predicates were also nouns, while Mehler did not specify this. This was done in order to avoid a possible difference in the results which could be caused by using two different sets of vocabulary, i. e., noun and verb. For writing their response the Ss were allowed to have as much time as they wanted. The time spent in doing one set of experiment was 35 minutes on average.

The test material was recorded on a magnetic tape by a native speaker. The rate of reading speed was 183 words/minute, which could claim the normal speed of a native speaker. The intonation and the tone of voice was kept as natural as possible and an excessive

emotional coloring was avoided.

2. Results

2.1. Scoring principles

Those of Mehler's were followed as closely as possible. The most basic and important one was that a sentence was judged as correct when it was a word by word reproduction of the stimulus sentence. Second, it was scored as correct if a word or two were replaced by synonyms. Third, it was also scored as correct if there was omission of articles, or misusage between the definite and indefinite articles. Fourth, a change in tense was scored as correct.

The data, which follow next, gathered from the instances of syntactically correct recall and those of syntactically incorrect recall as well whose content was same as the stimulus sentence. Omission of a whole sentence, or imperfect sentences were not collected. Any single omission by which the syntactic form could not be determined was also excluded from the data.

2.2. Rate of acquisition

2.2.1. Acquisition curve

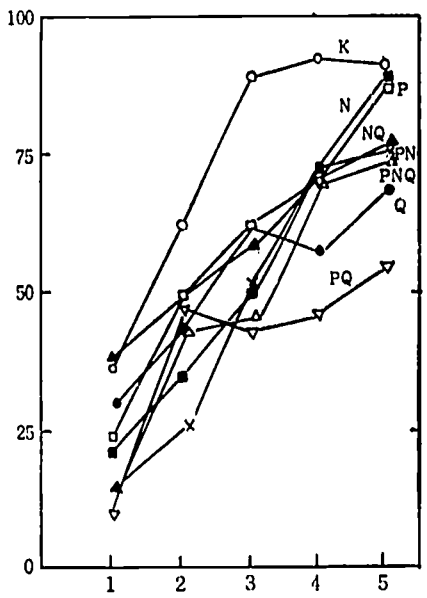
Fig. 2[2] through Fig. 4 show the acquisition curves of Mehler's Ss, Group A, and Group B. Per cent recalled correctly is plotted as a function of the trial number.

We notice at the comparison of the three figures a few strikingly different features between Mehler's Ss and the Japanese Ss. The former shows a sharp rise and remarkably high rate in learning of K in contrast with the others, whereas the Japanese K is no so much distinguished compared with the others. At a glance of these three graphs the number of words in a sentence is not a good predictor of learning with this experiment. Besides difference in the total amount of learning between the native speaker and the Japanese learner, the most conspicuous difference is read from the curve of N. At the last trial the best three recalls by Mehler's Ss are K, N, and P, while with the Japanese Ss they are K, Q, and P. The Japanese N starts

[2] *Ibid.* 348.

low and retains a dull acquisition until the end. This characteristic trait will be discussed later. Another feature worth noticing is the so many ups and downs especially in the figure of Group B. Among others, the curve of NPQ implies that it is highly doubtful whether learning occurred in the course of the trials.

Fig. 2



PER CENT RECALLED CORRECTLY

TRIAL NUMBER

Fig. 3

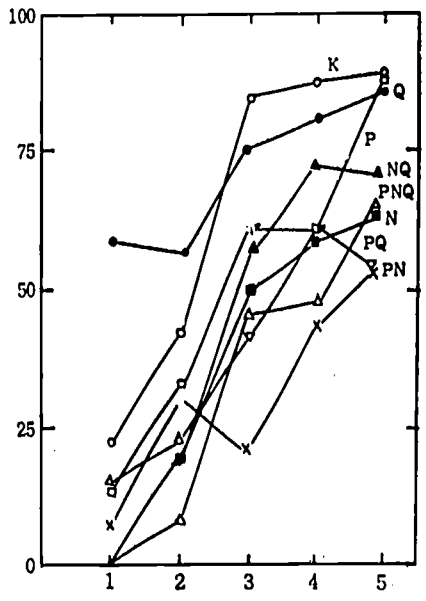
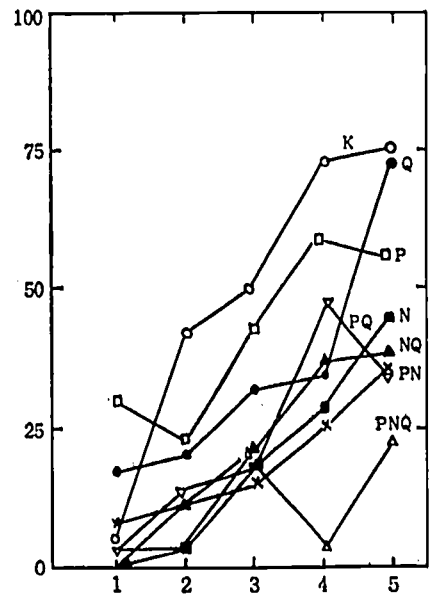


Fig. 4



2.2.2. Amount of recall

The exact numbers for correct and confused recall in all the five trials are tabulated in Table 1[3] through Table 3.

Table 1

n = 400

Stimulus \ Response	K	Q	PQ	P	NP	N	NO	NPQ	
K	300	12	1	14	4	14	8	3	356
Q	31	210	8	1	2	16	72	12	352
PQ	13	32	145	27	15	5	29	60	326
P	43	8	30	243	10	3	15	13	365
NP	6	9	16	18	191	49	16	31	336
N	36	20	6	3	11	234	29	2	341
NQ	29	31	7	3	3	15	221	23	332
NPQ	2	14	38	16	5	2	44	182	303
	460	338	336	325	434	241	251	326	2711

Table 2

n = 200

Stimulus \ Response	K	Q	PQ	P	NP	N	NQ	NPQ	
K	131	4	1	3	0	8	0	0	147
Q	22	106	0	2	0	0	14	0	144
PQ	3	5	79	27	0	0	1	14	129
P	0	0	4	142	9	0	0	3	158
NP	1	1	4	57	61	5	0	7	136
N	48	3	0	1	0	76	6	0	134
NQ	9	20	2	0	1	4	93	0	129
NPQ	4	4	32	16	1	1	2	66	126
	218	143	12	248	72	94	116	90	1103

[3] *loc. cit.*

Table 3

n = 200

Stimulus \ Response	K	Q	PQ	P	NP	N	NQ	NPQ	
K	98	9	0	4	0	7	5	0	123
Q	20	69	1	2	0	4	11	0	107
PQ	4	1	46	18	1	1	0	10	81
P	5	4	7	83	3	1	1	1	105
NP	3	4	6	28	38	4	0	2	58
N	51	9	0	3	0	34	6	0	103
NQ	7	31	1	1	0	1	41	3	85
NPQ	0	1	16	15	3	0	2	22	59
	188	128	77	154	45	52	66	38	748

The rows indicate the syntactic form of the stimulus sentence presented to the Ss. The columns indicate the syntactic form of the response sentence recalled by the Ss. The numbers in each cell are the raw frequencies of the stimulus-response occurrences. The numbers on the diagonal line from the top left to the bottom right, of course, indicate the instances of syntactically correct recall with each stimulus sentence. The numbers on the right end of each row can be interpreted as the frequency of learning arousal at each syntactic form. The numbers on the bottom row are the total frequency of recall as K, Q, P, etc., regardless of the stimulus.

The probability of coding correctly the content of the sentences were respectively .85 for Mehler's Ss, .69 for Group A, and .47 for Group B.

The difference in the total amount of recall between the three was computed. Mehler's Ss recalled better than Group A ($t=6$, $df=14$, $p<0.01$), Group A recalled better than Group B ($t=5.4$, $df=14$, $p<0.01$).

The total amount of syntactically correct recall was computed with each of the three data. The numbers on the diagonal line were divided by the total frequencies of trials with each group. The gross

total frequencies were 400(80×5) with Mehler's and 200 (40×5) with Groups A and B. The means were compared; there was no significant difference between Mehler's and Group A's, and Group A was significantly better than Group B ($t=2.8$, $df=14$, $p<0.05$).

2.2.3. Variance in scores

Dispersion of scores in the total recall was checked in order to know the influence of syntactic variations over recall.

The least variation in the amount of recall was of course found with Mehler's Ss, which was significantly different from Group A's ($F=36.8$, $df=1,14$, $p<0.01$). The widest fluctuation was observed in Group B. It was significantly different from Group A ($F=10.1$, $df=1,14$, $p<0.01$). The quality of recall by Mehler's Ss can be interpreted as having less influence imposed by variation in the stimulus information. On the other hand, the Japanese Ss' learning is more apt to fluctuate on various transformations.

2.3. Error analysis

2.3.1.

Sysntactic confusion was focused upon here.

First, the rate of syntactically correct recall was computed with each stimulus type. The obtained figures were the centering tendency of each stimulus type. Interesting enough, the results indicated there were no significant differences among the three groups of Ss even at .05 level: the proportion of syntactically correct recall to the total amount of recall was rather same among the three in spite of the wide difference in the total amount of learning.

2.3.2.

The question of whether the amount of each syntactically correct recall was significantly different from that of syntactic confusion within each stimulus type was tested.

(1) Mehler's Ss showed a significant difference between the syntactically correct recall and the cofused one at the level of $p<0.01$, except PQ and NP whose levels of significance were respectively

$x^2=4$, $p<0.05$, and $x^2=6$, $p<0.05$. Confusion was apparently less than the correct recall.

(2) Group A failed to satisfy the level of significance at .05 with three cases; NP, N, and NPQ. PQ was at the level of .05, and the others were $p<0.01$.

(3) Group B failed in four cases; PQ, NP, N, and NPQ. The others were significant at the level of .01. What revealed a peculiarity of Group B was that the ratio of correct recall over confusion with N was inversely significant at .01 level. More than half occurrences of recall were in the direction of K.

The observed traits among the Japanese Ss imply together with the dispersion of the learning scores that processing of English sentences is in fairly large measure a function of the syntactic form.

2.3.3. Tendency in syntactical confusion

Mehler referred to this phenomenon just reminding us of a trend that Ss simplified the syntactic structure. This simplification of the syntactic structure according to the kernal plus tag hypothesis may be taken as such that we tend to trace back the adjacent vertices of the transformational cube toward a step of two steps simpler vertex. Here the routes of regression, if it really occurs, or the direction of grammatical confusion is presented. Of course the syntactic stimulus types which produced correct recall of 80 per cent or better will not be dealt with.

Fig. 5 Mehler's

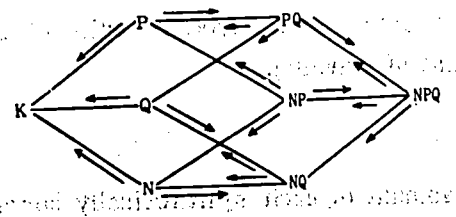
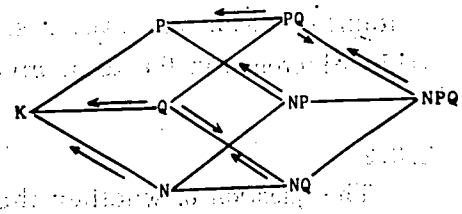


Fig. 6 Group A



The Figures 5 through 7 represent the tendency in syntactic confusion. Mehler's original cube was modified to illustrate more schematically the interrelationships among the syntactic transformations. Each solid line indicates the one step transformation. Arrows indicate the directions of confusion. N → K, for instance, indicates that when

N is presented as the stimulus information, the incorrect recall tends to appear as K.

Together with the diagrams, the directions of confusion and the significant level of difference are shown in Table 4.

Fig. 7 Group B

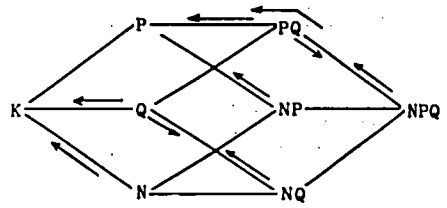


Table 4

	S:	K	Q	PQ	P	NP	N	NQ	NPQ
R: Mheler's	Ss	——	NQ.K ↓ NQ	P.Q.NPQ ↓ NPQ	K.PQ	P.N.NPQ	K.NQ	K.Q.N	NQ.PQ.NP ↓ NQ.PQ
		——	$p<0.01$	$p<0.01$	$p<0.05$	$p<0.01$	$p<0.05$	$p<0.01$	$p<0.01$
Group A		——	K.NQ	P.NPQ ↓ P	——	P	K	Q.K	PQ.P ↓ PQ
		——	$p<0.01$	$p<0.05$	——	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.05$
Group B		——	K.NQ	P.NPQ	——	P	K	Q	P.PQ
		——	$p<0.01$	$p<0.01$	——	$p<0.01$	$p<0.01$	$p<0.01$	$p<0.01$

In the diagrams above, we notice a difference in the nature of confusion between the native Ss and the Japanese ones. The native speaker's confusion occupies all the possible adjacent vertices except only one instance; Q-PQ. The Japanese learner of English, on the other hand, utilizes only half of the existing adjacent vertices. If we call the movement of arrows in Fig. 5 three dimensional, the other two would be called two dimensional model. One of the most characteristic feature with these diagrams is that the Japanese learner is behaving as though there were two basic vertices, K and P. This may be called temporarily a "two-head operation" in sentence processing. Within each operation, the transformational centralization can be observed. It was tested whether there was any observable differences between two strings of operation. The total amount of recall, rate of the

correct recall and the centering tendency were examined. None of these indices showed any significant difference even at .05 level.

2.4. Discussion

With the results presented so far the following things will be said.

First, the total amount of recalling correct content of sentences is a function of total linguistic proficiency and experience in English.

Second, the higher the total rate of recalling correct content is, the less the fluctuation in learning is observed. The fluctuation can be attributed to syntactic variations in the stimulus information.

Third, the more efficient one is in recoding, the more he can recall correctly the sentence content. Or, in other words, the verbatim reproduction of the stimulus information does not necessarily tell a mature function of recoding mechanism. As was shown in 2.2.2., the rate of syntactically correct recall over the total correct recall of content is not a good predictor of telling the native speaker from the non-naitive one. The following suggestion may sound a risky assumption, but it seems possible to be validated as a reliable measure of proficiency. That is, can't we say one's verbal recall is no longer affected by difference in the syntactic forms, once one has established a solid recoding function within himself? As long as one has a weak recoding ability, one has no other choice but to rely on the word by word stimulus when processing verbal information.

Fourth, the syntactic confusion analysis tells us that the native speaker follows the transformational routes fairly closely. When there are n possibilities in branching off from a certain transformational vertex, probability of making one type of syntactic confusion is roughly speaking $1/n$. But the Japanese learner of English cannot do this. There exists a heavy bias in choosing possible syntactic forms.

Fifth, for the Japanese learner the negative information, at any levels of transformation, is something to be avoided or ignored. Probably this trait comes from the Japanese language. In a sense Japanese are conditioned to anticipate negation toward the very end of each utterance. Although each constituent of the sentences in this experiment never exceeds the human capacity for regressive memory

span, it will still be one of the most difficult operations for Japanese to keep the nagative tag fairly long and process the whole sentence with it. The confusion of Q as NQ which was seen in Group A may be interpreted as those students are getting out of Japanese logic and approaching that of English to a certain extent. As Mehler remarked confusion of Q with NQ, and PQ with NPQ is quite naturally observed among the native speakers of English, since both types of question, with or without N tag, do not differ in meaning.

Sixth, the difference and similarity between Group A and Group B indicate that the total amount of experience in learning English and degree of concentration bring about different facility in decoding and encoding of English stimuli, but that seemingly inherent quality in the Japanese does not diminish easily in proportion to learning experience.

As a conclusion, the transformational model works with the Japanese learner somewhat more than the author expected, when it is applied as a measure for detecting recoding characteristics. But it is beyond inference whether or not further training and exposure to English can enable the Japanese learner to fill up the now missing links in the transformational network, and to operate in it. The fact that the Japanese learner follows the transformational routine to some extent makes us hope for some developmental schedule in acquiring English as a foreign language. We do not know yet where we start from, but it is true that there are various levels of acquisition. If we can map what one can do in English as a foreign language on the individualistic chronological scale of learning history, it would not necessarily be an illusion to hope for a developmetal procedure in foreign language acquisition.

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Oct. 13, 1971