AN OPERATIONAL DETERMINATION OF THE MEANING OF QUANTITATIVE WORDS WITH PRESCHOOL CHILDREN IN THE PRESENT GENERATION

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ABSTRACT

Preschool children of four years, five years and six years of age were tested in order to see how such young children understand the meaning of quantitative words. The method used is simple. It only requires each child to take out "many" or "a few" etc. beads (which are 1.5 cm in diameter) from a container and put them on a tray. This method is significant in that it operationally determines the meaning of a word through action. Because of this simple procedure it was available to preschool children. Stimulus words selected for this study were "very many" , "many" , "a few" and " a very few" . The present authors carried out a study of the same sort thirty years ago. The purpose of this study, thus, is to determine operationally the meaning of quantitative words with preschool children in the present generation, and to compare the results obtained here with those of the same study which was carried out three decades age, making clear the descrepancies between younger children of two generations in the interpretation of the meaning. And this article is mostly concerned with the analysis of results obtained from the present subjects. It was pointed out that scores (which are equal to the actual number taken) of "very many" and "many" were, as expected from the earlier study, very low as compared with the background number. Scores for these two words, however, tended to increase with age. Scores for "a few" and "a very few" were naturally very low. Five- and six-year olds could understand an adverb "very". For four-year olds, however, "very" is weak in meaning, and, in fact, some of them reversed two words: "a very few" > "a few". There were also a few children who interpreted these two words as "a very few" = "a few". In general, the difference between the lowest and the highest scores (that is, the score for "a very few" and the score for "very many") becomes greater with age. The present authors take the view that differentiation was found here. In any age group, the mean scores for four stimulus words increased with the increment of background number, but the scores did not double and treble in spite of the double and the treble increments in the background number.

Introduction

Suppose that two persons judge independently the quantity presented in one situation. One person may call it "many" and the other may say "very many". Here arises the following question. What difference is meant by these two persons in saying "many" and "very many"? Indeed, quantitative words such as "many" and "a few" do not designate determinate quantities, and therefore, when they are used in daily life the meanings are not neccessarily clear. Thus, it can be that "many" for one person is equal in meaning to "very many" for another person; that is, the quantities meant by these quantitative words may differ greatly depending on the person and / or on the situation.

In order to make clear the meanings of such imprecise quantitative words Cohen, et al. tried to determine the quantities which actually correspond to them with school children as subjects, using an operational method which they developed. In this method a subject is requested, for example, to take out "many" or "a few" beads from a container and put them on a tray. The actual number taken was regarded as the score. This method is particularly significant in that it operationally determines the meaning of a word through action. The present authors carried out a similar experiment independently at almost the same time to see developmental changes in the interpretation of quantitative words with preschool children. As it is indisputable that usual methods such as questionnaires or paper-and-pencil tests for the measurement of meaning necessarily limit the age of subjects, studies up to that time in this field were mostly concerned with intellectualy normal school children or older subjests. Cohen's and the present authors' operational method, however, is applicable to preschool children as well as to feeble-minded children, because of its simple procedure.

The findings obtained from our study with preschool children aged four through six using this operational method were unexpected. Generally speaking, for example, scores of "very many" and "many" were very low, compared with the background number which was the number of beads in the container. When the background number was 100; that is, when there were 100 beads in the container, the score of "very many" was only 14.41 in the four year old group, 18.69 in the five year old group, and 23.64 in the six year old group, respectively. In discussing the above fact we introduced Pratt's two types of number concept, suggesting a close relationship between them. According to him, number concepts may be classified into two types: the determinate or definitely limited number, and the indeterminate number whose limits are not well-defined. He states: "..... indeterminate numbers bear the following relation to determinate numbers: whenever man comes to the end of his definite numbers, or finds it impossible or unnecessary to apply those which he does possess, he is, perforce, dependent upon indeterminate number concepts to express himself" (Pratt, 1948, P.215). In fact, a preschool child tends to use the word "many" for a number which exceeds the limit of his determinate number concept; for example, an

infant can count *one, two, three,* etc, but he says "many" for *six,* because six is a number which exceeds the scope of his determinate number concept. As it is natural to consider that in preschool ages, the younger the child, the poorer he is in determinate number concept, it will be expected that he may regard a smaller number of beads as "many", whereas an older child may regard a larger number of beads as "many", because the older the child, the richer he is in determinate number concept.

However, it must be added here that at around the year 1960 when our study was published, the subjects' average upper limit in counting numbers correctly was about 13 at age four, about 20 at age five, and about 30 at age six, whereas in Japan today it is generally recognized that most normal preschool children can count 30 beads correctly at age four, 100 beads at age five, and more than 100 beads at age six, indicating a great advancement in their determinate number concept. The advancement can be accounted for in terms of improvements in environment and educaition as well as in health and nutrition.

Consequently, then, assuming a close relationship between determinate and indeterminate number concepts, the scores of preschool children in the present generation at each age group of four years through six years for "very many" and "many" can be expected to be higher than those of preschool children at each age group in the earlier generation. Will this expectation be right?

At the same time, scores for "a few" and "a very few" which are contrary in meaning to "many" and "very many" should be considered for discussion. How will preschool children in the present generation respond to "a few" and "a very few"? Will the scores for these words be higher, too, when compaired with those of earlier study; or will no difference between them be observed?

In addition to these problems, it must also be observed that how scores for four words which were selected for the present study (very many, many, a few, a very few) increase according to the increment in the background number. It may well be reasonable to consider that the score increases or decreases with the increment or decrement in the background number. But what is the relation between these two variables? Will each score for four stimulus words doubles and trebles, corresponding to double and treble increments in the background number, for example?

Summarizing above, then, the purpose of the present study is to determine operationally the meaning of quantitative words with preschool children in the present generation, and to compare the results obtained here with those of the same study which was carried out three decades ago, making clear the discrepancies between younger children of two generations in the interpretation of the meaning. And in this article our particular concerns are mostly for the analysis of the results obtained from the present subjects.

Method

Materials. — Containers, trays and beads were used in this experiment. Containers were 12 in all and they were all the same in size and color : all were capable of holding about 500 beads. However, they were different in that they contained a different number (background number) of beads, that is, four of them (because four stimulus words were used in this experiment) held 100 beads respectively, the next four held 200 beads respectively, and each of the last four held 300 beads. Thus three background numbers (100, 200, 300) were prepared for each word. The beads were thin and were 1.0 cm diameter. These containers were put on the table one at a time, and the tray in which the beads were to put was placed beside the container. The trays were also the same in size and color: all were capable of holding about 500 beads.

Stimulus words. — Stimulus words were "very many", "many", "a few" and "a very few". *Besides these four words, another word was prepared but has been eliminated here because of the lack of an appropriate English equivalent.*

Table—1

Four stimulus words and three conditions of background number

Stimulus words	Background numbers of beads
very many	100 200 300
many	100 200 300
a few	100 200 300
a very few	100 200 300

Subjects. — The subjects consisted of 30 preschool children aged 4 years, 30 aged 5 years and 30 aged 6 years from a kindergarten (Akebono Kindergarten) in Miyazaki City.

Procedure. — The children were tested individually in 1990. Each child sat down on a chair before a table. He was asked to take out, for example, "many" beads from a container and put them in a tray. This procedure was followed with each of the other three stimulus words. Of course, stimulus words were given to the subjects in randam order. Needless to say, the meaning of each stimulus word was measured under three conditions depending on the background number. Every child thus made 12 responses in all (see Table 1).

Results and Discussion

The actual number of beads taken can be regarded as the score, and Table 2 presents the mean scores of four stimulus words*1 and corresponding standard derivations in three age groups for the background numbers of 100, 200 and 300.

Table—2

Mean scores and standard deviations of four stimulus words under three conditions of background number

stimulus words	age	100		200		300	
		Mean	SD	Mean	SD	Mean	SD
very many	4	21.20	15.84	34.43	32.52	52.17	67.02
	5	37.93	19.62	64.00	27.57	97.13	52.54
	6	41.03	22.23	81.37	37.81	125.90	61.35
many	4	17.17	16.31	28.67	32.75	43.03	62.57
	5	27.00	13.58	48.37	20.19	71.43	35.99
	6	25.30	12.02	61.70	32.66	96.53	52.89
a few	4	4.80	2.17	6.33	4.10	7.50	4.51
	5	7.33	3.46	11.87	5.38	15.87	7.29
	6	7.80	3.71	13.30	7.28	18.97	10.53
a very few	4	4.03	1.96	5.03	3.21	5.43	3.20
	5	5.00	2.38	8.03	4.17	11.17	5.90
	6	4.07	2.25	8.17	5.34	10.93	5.18

Analysis of Variance

A three-way ANOVA was performed on the mean scores of age, background number, and word.*2 The main effect of age reached significant difference ($F=16.404$, $df=2/87$, $P<.01$), confirming the age difference of the mean scores. Similarly, the main effect of

※ 1 As already mentioned in Method, *five* stimulus words were used in the present study.

※ 2 ANOVA was performed on the mean scores of *five* stimulus words.

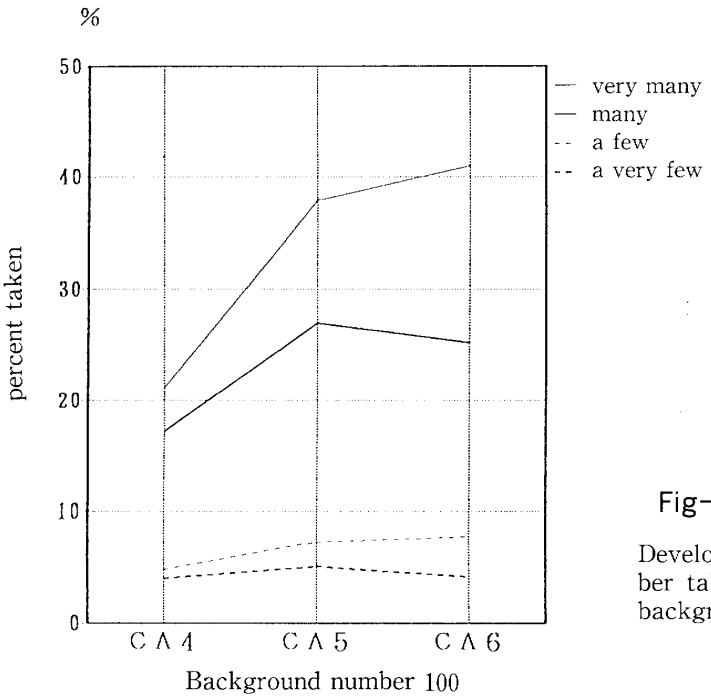
background number reached significant difference ($F=128.772$, $df=2/174$, $P<.01$). The main effect of word was also significant ($F=116.35$, $df=4/348$, $P<.01$). Furthermore, the interaction effect of age and background number was significant ($F=10.062$, $df=4/174$, $P<.01$), indicating that there was a difference in the effect on different background number. Other two interactions reached statistical significance: age × word, with $F=8.265$, $df=3/348$, $P<0.1$ and background number × word, with $F=66.27$, $df=8/696$, $P<.01$. In addition, age × background number × word reached significant difference ($F=4.714$, $df=16/696$, $P<.01$).

"many" and "a few"

For the analysis of the results, the focus will first be on the scores of "many" and "a few".

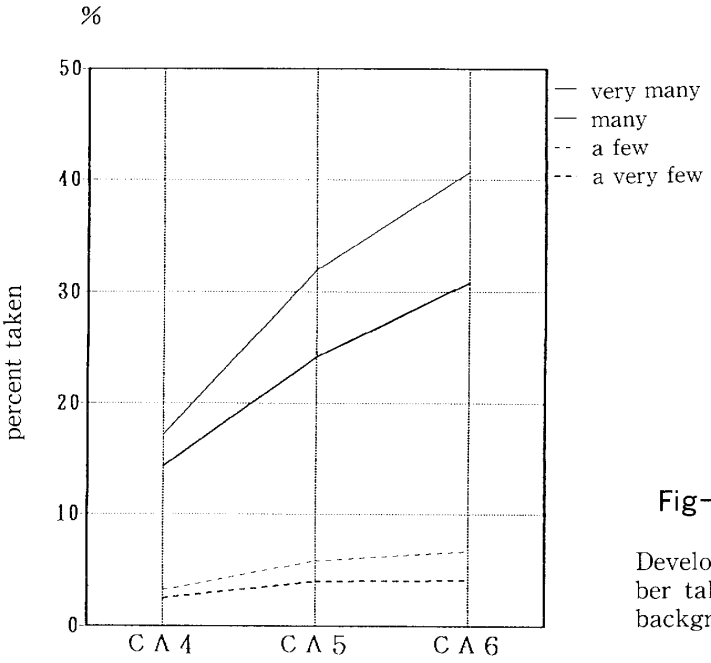
As can be seen in Table 2, the scores of "many" are low in every age group regardless of the background number. When the background number is 100, the score is only 17.17 in the four year old group, 27.00 in the five year old group, and 25.30 in the six year old group. Even when the background number is 300, the mean score for this word is only 96.53 in the six year old group and 43.03 in the four year old group.

These low scores were expected. It is presumed that preschool children's poor determinate number concept due probably to narrow experience, poor experience, and others in daily life may be responsible for that low scores. And the fact that the younger the child, the poorer he is in determinate number concept and *vice versa* may be responsible for the age trend of increasing in the scores (with one exception) for this word, as seen in Fig 1, 2 and 3. These figures were presented in order to see the change with age in the ratio of the number of beads taken under three conditions of the background number.



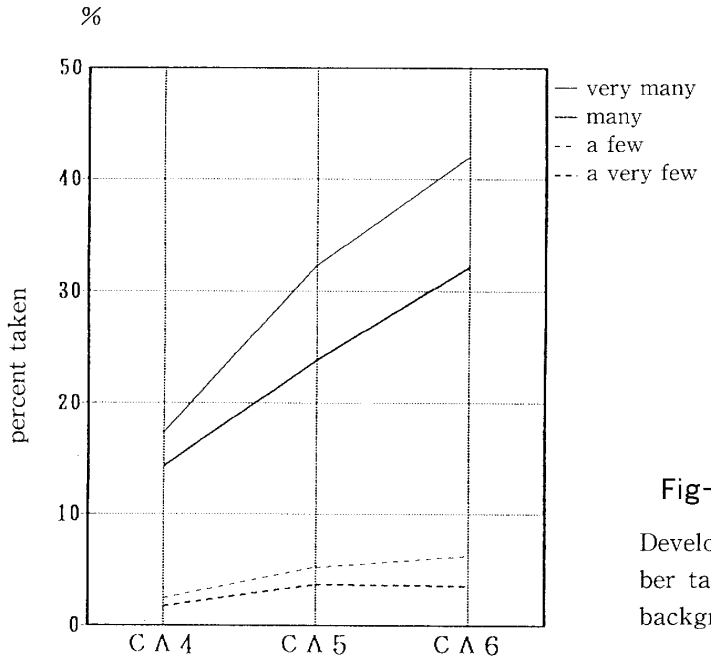
Fig— 1

Developmental change in the ratio of the number taken for four stimulus words when the background number was 100



Fig— 2

Developmental change in the ratio of the number taken for four stimulus words when the background number was 200



Fig— 3

Developmental change in the ratio of the number taken for four stimulus words when the background number was 300

The scores of "a few", on the other hand, are naturally very low in any age group. The highest scores for this word are 7.80, 13.30 and 18.97 in the six year old group for the background number of 100, 200 and 300, respectively, and the lowest ones are 4.80; 6.33 and 7.50 in the four year old group, respectively.

As recognized from Fig 1, 2 and 3, the age trend for this word was also an increase in the score; that is, the score for this word tended to increase with the age.

"very many" and "a very few"

In order to see the effect of an adverb "very" upon the scores of "many" and "a few", another two words, "very many" and "a very few", were given to the children of this study.

It will be noted from Table 3 that the score of "very many" was significantly higher than that of "many" both in five-year-olds and in six-year-olds regardless of the background number; whereas in four-year-olds the difference between mean scores of these two words was not significant in any background number of 100, 200 and 300. Also noted from Table 4 is that the score of "a very few" was significantly lower than that of "a few" both in five-year-olds and in six-year-olds regardless of the background number; whereas in four-year-olds the difference between the scores of these two words could not reach statistical significance, except when the background was 300.

Table—3

The t test of differences between mean scores for "very many" and "many"

	100			200			300		
Age	t	df	P	t	df	P	t	df	P
4	—	—	—	—	—	—	—	—	—※
5	5.144	39	<.0005	4.107	41	<.0005	4.318	39	<.0005
6	5.127	48	<.0005	5.219	58	<.0005	4.299	58	<.0005

※ statistically insignificant

Table—4

The t test of differences between mean scores for "a few" and "a very few"

	100			200			300		
Age	t	df	P	t	df	P	t	df	P
4	—	—	—	—	—	—※	2.016	58	<.05
5	2.988	51	<.005	3.038	58	<.005	2.699	58	<.01
6	4.629	48	<.0005	3.060	58	<.005	3.690	42	<.0005

※ statistically insignificant

How can these facts be interpreted? It will be reasonable to interprete that children of five-and six-year-olds could understand the meaning of "very". For children of these ages, thus, four stimulus words were in correct order: "very many" > "many" > "a few" > "a very few".*3

How can the results above of four-year-olds be interpreted, then? Table 5 shows the percent increase of scores from "many" to "very many" and the percent decrease of scores from "a few" to "a very few". As recognized in Table 5, the percent increase at the age of four years is very small in each of the background number (20~23 % increase) as compared with that of other two groups (30~62 % increase), and the percent decrease of that age is also very small (16~28 % decrease) as compared with that of other two groups (30~48 % decrease).

These facts may suggest that for children of four years of age "very" is rather weak in meaning, and is not so strong as for children of five- and six-years of age. In fact, some of them reversed two words: "a very few" > "a few". There were also a few children who interpreted these two words as "a very few" = "a few".*4

Table—5

Effects of "very" upon the scores for "many" and "a few"

Age	Increase (%) from "many" to "very many"			Decrease (%) from "a few" to "a very few"		
4	23	20	21	16	21	28
5	40	32	36	32	32	30
6	62	32	30	48	39	42
Background number	100	200	300	100	200	300

Age trends

As mentioned, the main effect of age was significant. Increasing tendencies of the scores for "many" and "a few" with age were also referred to.

The age trend of "very many" is an increase in the score; but as far as "a very few" is concerned, the age trend is not necessarily an increase in the score. Because, although the score of five years group for this word is higher than that of the four years group in each background number, the score of the six years group is lower than that of the five years group when the background number is 100 and 300.

As to the age trend of the effect of "very", it will be noted that the curve of "very

※ 3 Here > designates *greater than*. Thus, "very many" > "many" means that the score of "very many" is greater than that of "many".

※ 4 Here = designates equal to.

many" in Fig1-3 rises more rapidly than that of "many", with the difference in the two curves becoming greater with age. Also noted in Fig1-3 is that the two curves of "a very few" and "a few" are widening slightly with age. And the difference between the highest and the lowest scores, thus, becomes greater with age. These findings show that the older the child, the more clearly he discriminates between the meanings of the words. The present authors take a view that *differentiation* was found here. By differentiation is meant gradual discrimination between the meanings of the words with age.

Background number

The main effect of background number was significant. In any age group, the mean scores for four stimulus words increased with the increment of background number, but the scores did not double and treble in spite of the double and the treble increments in the background number. And the ratios, or the percentages, of the number taken compared with the background number were, in general, declining tendencies, with the exception of a rising tendency for the score of "many" in the six year old group which partly explains the significant interaction effect of age and word and background number.

Individual differences

Individual differences indicated by standard deviations in Table 2 may be said to be rather large, and, therefore, it can sometimes occur in preschool age that "a few" for one child is almost equal in meaning to "many" for another child.

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