Age Difference of Stroop Effect in Chinese

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This experimental study explored the age difference of color-word interference effect in Chinese people. Results indicated that Stroop effect existed as a general phenomena, whether in children, youth and middle age or old aged subjects. Youth and middle age subjects showed less color-word interference effect than children and old aged subjects. Due to different S-R pattern, Stroop effect obviously continued to influence the response of reading colored words afterwards, the coding and processing was more complex, the longer time of reading was needed.

Introduction

In 1915 Brown discovered that differences existed in the cognitive process of word-reading and object naming. Telling the name of a familiar object was slower than reading the word indicating the object; that is, asking the subject to tell the color name of a certain color card was slower than reading the word representing the color, although to the subject both were speech sounds of the same syllables. In one of our

recent experiment with children on the reading of color-word material (Lin & Zheng, 1989), such phenomena obviously existed.

Stroop(1935) further approached the phenomena of color-word interference. In his experiment the stimulus word was antagonistic to the writing of its color. For instance, using green color to write the word 'red', asking the subject not to say the word ôredö but to say the word's color 'green'. Due to color-word interference, the reaction time of subject for saying the word's color 'green' was longer than directly saying the color of the color card. This phenomena indicated that under the above circumstance, saying the color was interfered by the word-meaning. Biederman & Tsao (1979) found that the magnitude of color-word interference in a Stroop task is greater in Chinese for Chinese subjects than in English for American subjects.

Did this kind of color-word interference effect have age differences among children, youth and middle-age and old-aged subjects and whether this color-word interference effect continued to influence the latter manipulation behavior of the reading of color word? In this study we designed two experiments to investigate this question.

Experiment 1. Age Difference of Color-world Interference Effect

Materials

The experiment material were three sets of white card boards sized 30 x 30cm. Each set had four boards. On the first set of card boards (A condition) round shaped color discs of red, yellow, blue and green were pasted on the four boards (19 cm in diameter), 16 pieces in total. The four round color discs were randomly arranged, no matter whether vertically or horizontally reading the round color discs there were always four rows on every cardboard, and every color only presented once on every row, in this way the same color presented four times on every card board. On the second set of card boards (B condition) using black colored pen the words red, yellow, blue and green (in regular Chinese regular

script words) totalling 16 words were randomly written on each of the four cardboards. The times of presenting and arrangements were the same as condition A. On the third set of card boards (condition C) colored pens were used to write red, yellow, blue and green (regular Chinese script words) randomly on the four card boards, but the color of the word differed from the reading of the name of the color, that is, using red pen to write the word yellow, using green pen to write the word red, and so on. The times of appearance of every color and arrangement requirements were the same as above.

Procedure

The experiment proceeded according to condition A, B, C sequence. The subjects were individually situated in a quiet room, due to different requirements of each set of experiment, so the different requirements were explained to the subjects when using each set of experiment until the subjects thoroughly understood. When proceeding the first set of experiments (condition A) the subjects were asked to say the name of the color-card from left to right as fast as possible. If any mistake was made while naming the color, the subject was allowed to make corrections immediately, it was not necessary to start from the beginning but from the mistaken name. It was not allowed to point at the board. Every subject had a chance to practice (using another cardboard). The experimenter wrote down each subject's naming-time of all the color cards on every cardboard, and the number of mistakes made, times of correction, times of repetition and number of omissions. When proceeding to the second experiment (B condition) the subject was asked to read from left to right as fast as possible the words written with the black colored pen, the other controlled conditions were the same as in condition A. In the third set of experiments (condition C) the subjects were asked to read the color of words written with different colored pen, such as red colored word 'yellow', the subject does not read 'yellow' but reads 'red'. The subjects were asked to say as fast as possible the color of the word seen, but not to read the word itself. Other conditions were the same as the above.

Subjects

Sixty-six subjects were participated in the experiment, they were divided into aged, youth and middle-aged and children groups, 22 in each group, male and female subjects equally half in number. The age of the aged-group was 57-83 years old, with 64.5 as the average. The youth and middle-aged group was from 20-45 years old, average age 31.1 years old. The children group was from 6-8 years old, average 7.1 years old. They were all tested for color cognition and color naming before the experiment, so they could correctly differentiate the colors and read correctly the names of the colors in order to participate in the experiment.

Results and Analysis

The results of the study can be seen from Tables 1 and 2 and Figure 1.

Table 1. Comparison of Name-reading speed of subjects of different age groups under three kinds of experimental conditions.

Age	color-reading (A)			reading black words (B)			reading color of words (C)		
	child-ren	youth & middle	old-age	child-ren	youth & middle	old-age	child-ren	youth & middle	old-age
Mean (sec)	14.47	8.75	9.91	11.11	5.62	7.76	22.39	15.61	21.47
(SD)	6.77	2.71	2.75	2.97	1.05	1.71	4.95	5.92	7.02

From the results of Table 1, Figure 1 and Table 2 we can see that without exception the three groups of subjects spend the longest reading time in reading the color of the word (C condition) followed by the color-reading (A condition). All the subjects had the fastest speed in reading the black words (B condition). In all the three groups, the F-test was $p < 0.01$, indicating that there were differences in name-reading under

Figure 1. Comparison of Name-reading speed of subjects of Different Age Groups Under Three Kinds of Experimental Conditions.
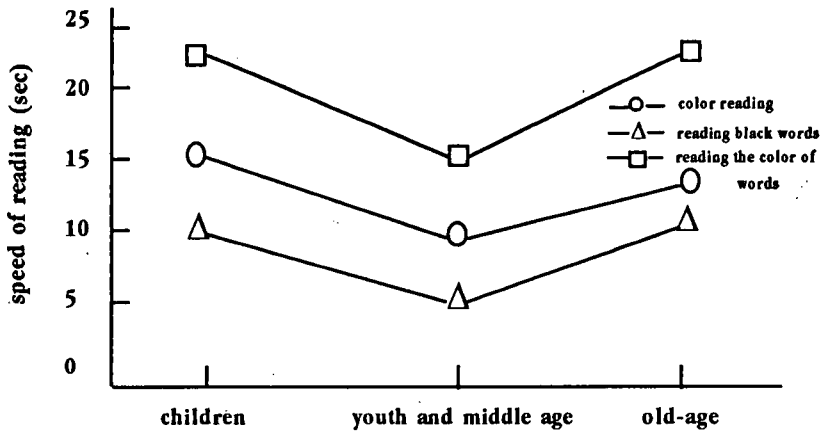
the three conditions. This result demonstrates that if a person recognizes the word and it is stored into the memory very well, it will not be difficult to read the written word-name, a person might have automatization sensation characteristics towards word-meaning processing, there is no need for re-coding process. From above results color-word interference effect existed obviously in every age group. The results indicated, under the three experimental conditions, the youth and middle-aged group got better results than the old-aged group, yet the old-aged group was better than results of the children group. Statistical analysis showed (see Table 2) except the youth and middle-aged group and old-aged group in reading color condition (A) and children group and old-aged group in reading color of the word (C condition), the difference of results did not reach obvious levels but difference in results under other conditions all reached obvious levels. Comparing and analyzing the three conditions of error value (see Table 3), times of error of youth and middle-aged group were less than the old-aged group, the old-aged group were less than the children group, indicating that the ability to resistance to color-word interference effect of the youth and middle-aged group was stronger than

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children group and old-aged group. This might have connection to transfer flexibility of the nervous process.

The results of this study further proved the difference between word-reading and color-reading and in Chinese children, youth and middle-

Table 2. Difference comparison of results in different age groups under three experimental conditions (*t*-value)

	color-reading (A)	reading black words (B)	reading color of words (C)
children-youth and middle age	2.588**	8.175***	4.124***
youth and middle age-old age	1.381	4.926***	2.931***
children - old-age	2.105*	4.554***	0.497

* $p<0.05$; ** $p<0.01$; *** $p<0.001$

Table 3. Error Analysis and Comparison of Different Age Subjects Under Three Experimental Conditions

Subjects (22 in each group)	color-reading (A)			reading black words (B)			reading color of words (C)		
	child-ren	youth & middle	old-age	child-ren	youth & middle	old-age	child-ren	youth & middle	old-age
Number of error	25	14	8	15	11	13	48	96	113
Number of corrections	30	19	14	19	10	18	04	59	60
Number of omission	0	0	0	0	0	0	0	0	0
Number of repetitions	73	8	35	51	4	12	166	43	118
Total	128	41	57	85	25	44	318	198	291
Mean	5.82	1.86	2.59	3.85	1.14	2.00	14.45	9.00	13.23

age or old-aged Stroop phenomena generally existed.

Experiment 2. Continuous Effect of Color-Word Interference Effect

Experiment 1 indicated that there was no difficulty for the subjects to read correctly the black colored words, so there might be no difficulty in reading words written in different colors. But when condition C is carried out by the subjects (reading the color of the words), will the color-word interference effect continue to influence the manipulation of reading colored words afterwards? In order to make clear this problem we conducted this experiment.

Materials

The material of condition B (reading black words) and condition C (reading color of words) of Experiment 1 were used. But under certain condition, the subject were asked to read the name of the word and not its color (as in condition C), thus we have condition D (reading colored words).

Procedure

The experiment proceeded according to condition B-C-D sequence, the subjects were divided into two groups (A and B), all were children subjects of elementary school first grade, average age of group A was 7.1 years old and 7.3 years old in group B, 22 children in each group. Group A children after finishing experiment on black word reading (condition B), the experiment on reading the color of the words (condition C) was inserted, then followed by condition D experiment (reading colored words). The number of experimental and control conditions was the same as required in Experiment 1. The time for reading words and reading colors was recorded. Children in group B after finishing experiment in condition B (reading black words) were asked immediately

to proceed to condition D (reading colored words) without using experiment of condition C (reading the color of the words). The speed of reading was compared with the results of group A children.

Results and Analysis

The results of the experiment can be seen from Table 4.

Table 4. Comparison of Speed of Reading Colored Words of Two Groups of Children Under Different Experimental Conditions (in seconds)

Condition	(B)	(C)	(D)
Group A	11.11	22.39	18.60
Group B	8.63	-	9.48

From the results of Table 4, we can see in group A because experiment on reading color of words was inserted so this affected the following reading of the colored-words, but group B did not show this kind of phenomena. The experimental results indicated that if the subjects were required after finishing condition C (reading the color of the words), then immediately asking the subject to read the colored words, the speed of reading will also be influenced by the former conditions of the color of word being read. Comparing the results of reading of black words and reading of colored words of group A children, the difference was $p<0.01$. Group B children did not show significant differences ($p<0.05$). Due to different S-R pattern, Stroop effect obviously continued to influence the response of the later reading of color words.

The above experimental results indicated that name-reading under the three conditions had different process and levels, the more complicated the processing the more time is needed.

References

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