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EFFECTIVE METHODS OF EMPHASIZING WRITTEN ON-SCREEN MESSAGES

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ABSTRACT:

Various types of information are being provided using visual and audial stimuli. However, the verification of effective delivery methods that provide information satisfying time or quantitative restrictions has been insufficient. Therefore, we need to study the effects of each stimulation method according to the order by which contents are emphasized and stimuli types. In this thesis, the most effective delivery method is suggested through six tests. The test results show different characteristics of each stimulus type and their effects on character presentations. From the way stimuli are conveyed we can understand different effects of single and synchronous stimulus

presentations. Moreover, the degree of the effects resulted from the presentation order of characters can also be understood.

1. INTRODUCTION

After examining the effects of visual and audial stimuli which are applied when displaying characters on a screen, proper delivery methods to provide information to users will be introduced.

The amount of information increases without limit as the number of media that provide information, such as computers or mobile phones, increases. Thus, to provide this increasing information more effectively, information providers should consider more effective and direct delivery methods.

The most typical method in information delivery is to use words: alphabetical or characters. When displaying character information on a screen, time and the number of characters to be displayed are restricted. Therefore, several senses rather than one are stimulated simultaneously with the characters. Information videos of public organizations, for instance, use characters and figures with Sign sounds or voices so that the physically challenged and children understand them easily.

Ads on the Internet and TV or logo tunes also generally use visual stimuli, such as motions, rotations and background color, along with audial stimuli such as voices, music, and sound effects. However, the methods that deliver information using complex stimuli have not been sufficiently studied yet. This thesis suggests an information delivery method through systematic and concrete studies to achieve maximum effects when delivering a large amount of information.

2. BACKGROUND AND GOALS OF THE STUDY

2-1. EFFECTS AND CONDITIONS IN DELIVERING CHARACTERS

A visual information delivery includes characters; the most frequently used items being color, figures, images, videos and animation. Characters are communication tools, and on-screen information generally consists of characters. Plus, figures or images are mainly presented to support character information.

The information delivery using characters has spatial and temporal aspects, and the spatial aspect includes font size, arrangement, background and contrast. The temporal aspect includes second constants which are needed in moving scenes, and display time for still images.

Sperling (1960) conducted tests that presented arrays of prepared characters only for a brief moment as sensory memory tests. The results showed that although people could not memorize all the characters, they remembered at least three to four characters in each row. Furthermore, Miller's test (1956) proved that the amount of information that a person's short-term memory could hold was around seven figures. This formula, however, is useful only when presenting information and it cannot clearly describe the cases in which time limitations and stimuli are presented with information.

In order to measure the presentation time required to recognize character figures, Sperling (1960) suggested a test in which a matrix that contained alphabetical characters was presented for a brief time and later studies have showed that the time needed to recognize and memorize a character is about 300ms for alphabetic characters (Tresselt & Mayzner 1965) and about 500ms for Chinese characters (Imada ＆ Yodogawa 1983). However, this only indicates the time needed to memorize each character.

In communications, voice is an important medium. Audial information includes voice, music and sound. Voice is a sound uttered through the mouth by humans; music is produced with instruments and sound.It is a comprehensive notion that includes voice and music.

In 1965, Moray discovered sound information preservation for the first time. Mayer & Anderson (1991) showed that people understood animation more clearly when it was presented with narration than when it was presented alone. The verification of presentation speed (1997) done by Yokoi Hirokazu ＆ Kuma Hideki (1997) also showed that the number of memorized characters was higher when sound was presented together with characters. Consequently, we can see that a visual stimulus accompanied with sound or just an audial stimulus has greater effects on memory and learning than a single visual stimulus.

The sense of sight, which is restricted by directions, is repeatable, stable, selectable, active, effective for short contents,easy to understand, and the amount of information is small. On the other hand, the sense of hearing, which is not restricted by directions, is unable to be repeated, unstable, unable to be selected, passive, able to understand long contents, difficult to understand and inaccurate, and the amount of information is large.

The senses of sight and hearing play different roles when information is conveyed to people, and the delivery methods are different as well. This thesis aims to find the most effective delivery method by understanding how vision and hearing actually work when information is delivered under different conditions, clarifying each delivery effect ,and finding the best way to appeal to vision and hearing

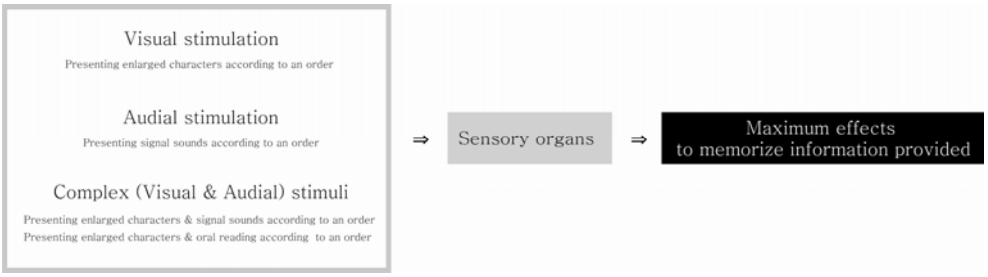
2-2. THE USE OF VISION AND HEARING IN A CHARACTER PRESENTATION

Along with the development of technology, information is generally delivered on screens. The amount and types of information displayed on a screen are limited, while the amount and types of information increase continuously. To deliver as much information as possible, contents should be short and concise to be displayed. Therefore, information providers try to infuse information by using more various stimuli.

As the number of characters and their presentation time are restricted, it has been known that methods which stimulate two or more senses are more effective when conveying information. Among them, the most popular method is to present characters using visual and audial stimuli.

Even though stimulus types and presentation methods that deliver information are diverse, the effects of complex presentation conditions have not been properly verified. The number of characters that can be memorized is restricted and all the information provided cannot be memorized either. For this reason it is important to selectively emphasize contents which should be remembered. Depending on the order followed when emphasizing contents and on stimulus types, examining the effects of different presentation methods becomes necessary. Clearly understanding the effects of different stimuli and presentations allows us to deliver information more effectively.

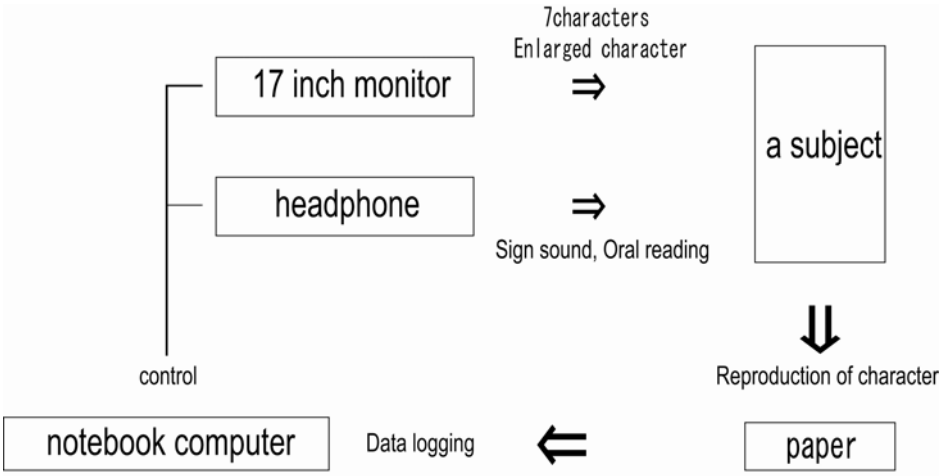
To understand the effects of characters and stimuli in presentations, chapter 3 introduces currently used stimuli and presentation methods and actual tests conducted under time restrictions.



(Fig.1) Structure of the research

3. TEST

3-1. TEST SETTING



(Fig.2) Experimental apparatus

In this thesis, conditions were set for the test as follows:

・Subjects: 22 people

・Age: 21~30

・Distance between subject and monitor: 50cm

・Test device: a 17 inch monitor

・Number of characters: 7

・Font size: 115p (black)

・Presented characters: English consonants (Q,W,R,T,P,S,D,F,G,H,J,K,L,Z,X,C,V,B,N,M)

・Presentation method: Flickering one character at a time

・Character presentation time: 800ms

・Flickering interval: None

・Presentation direction: Left to right

・Character stimulation: Font enlargement, Sign sound, oral reading

・Stimulus Presentation: 1st, 3rd, 5th, and 7th places are stimulated respectively in 4 presentations

・Enlarged font size: 1.5 fold enlargement

・Oral reading: Reading the presented characters aloud

・Audial stimulation: Using a headphone

As shown in Table 1, six tests were conducted under the conditions above.

Test No.	Stimulus presentation	Stimulus type	Number of stimuli
Test 1	0	Character	0
Test 2	1^{st},3^{rd}, 5^{th}, 7^{th}	Enlarged Character	1
Test 3	1^{st},3^{rd}, 5^{th}, 7^{th}	Sign sound	1
Test 4	1^{st},3^{rd}, 5^{th}, 7^{th}	Oral reading	1
Test 5	1^{st},3^{rd}, 5^{th}, 7^{th}	Enlarged character + Sign sound	2
Test 6	1^{st},3^{rd}, 5^{th}, 7^{th}	Enlarged character + Oral reading	2

(Table 1) Test description

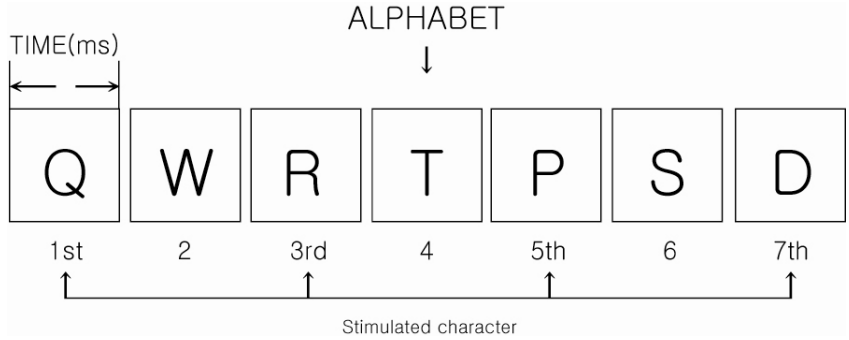
3-2. STIMULI AND METHODS APPLIED TO THE TESTS

Character and Stimulus presentation: As shown in Figure 3, seven English consonants were presented. After presenting the seven characters to the subjects by flickering each character, the subjects were asked to write down what they memorized.

To emphasize the character one character is either presented ; expanded, as a Sign sound, with oral reading, expanded and as a Sign sound , or expanded and with oral reading.

The emphasis was presented in the first, third, fifth and seventh characters respectively in the first, second, third and fourth presentations

As shown in Figure 3 and Figure 4,six tests were conducted under the conditions above.



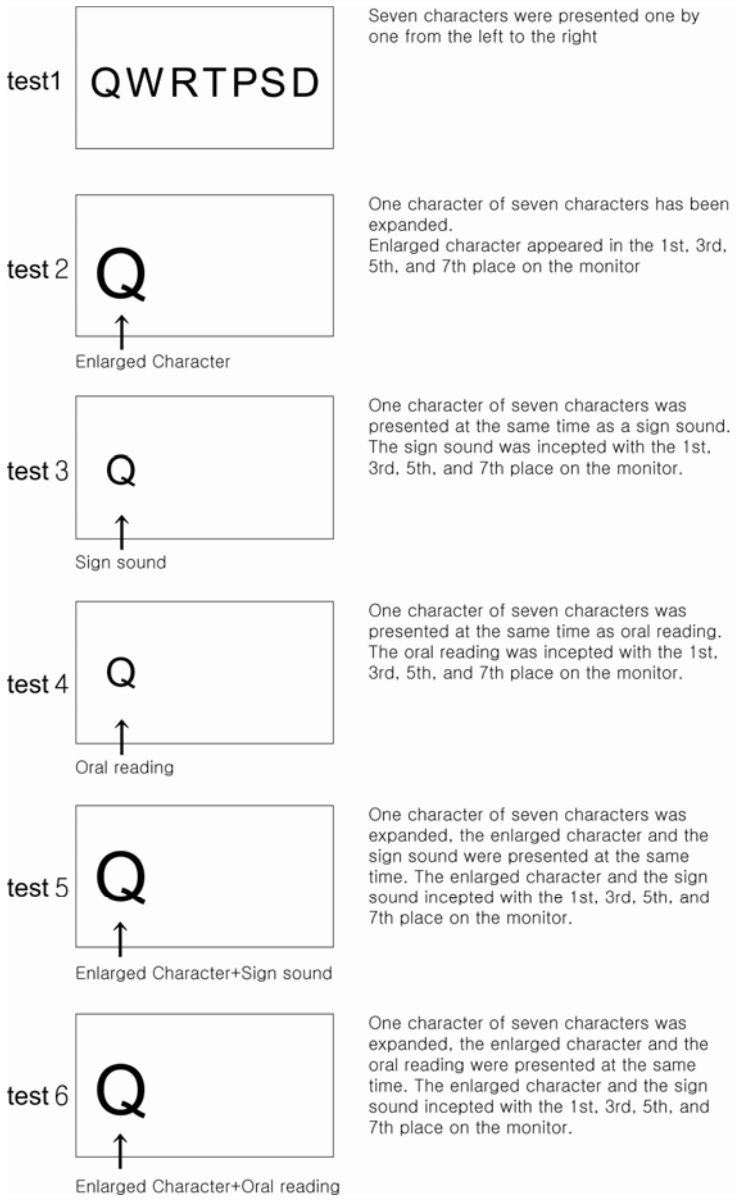
(Fig3) 7 English consonants presented

In the 1st test: Seven same-sized characters were presented to the subjects by flickering each character.

In the 2nd test: This test enlarged a character (1.5x) among the seven and put the enlarged character in the first position for the first presentation; in the third position for the second presentation; in the fifth position for the third presentation; and in the seventh position for the fourth presentation.

In the 3rd and 4th test: A Sign sound (test3) or oral reading (test 4) was applied to only one character among the seven, and it was provided with the first, third, fifth and seventh characters respectively.

In the 5th and 6th test: In both tests only one character among the seven was enlarged and given a Sign sound (test5) or oral reading (test 6) at the same time. The two stimuli were applied to the first, third, fifth and seventh characters respectively.



(Fig4) Experiment kind

4. TEST RESULT ANALYSIS

The influence played on the displayed characters by different presenting methods such as stimulus type, presentation, and emphasis order was examined. To do so, the reproduction rate for each of the seven characters was analysed and compared.

4.1. EFFECTS OF DIFFERENT STIMULUS CONDITIONS ON CHARACTER REPRODUCTION

With the data acquired from the Test 1 to 6, a two-way ANOVA was performed.

Stimulus presentation conditions, the number of stimuli, stimulus types and their effects on the seven characters were studied.

1) Effects of different stimulus conditions on the number of reproduction times and reproduction stimuli

In Table (2), Number of stimuli, Stimulus type, Stimulus presentation, Number of reproduction times and Reproduction stimulation are represented by [A], [B], [C], [D], and [E] respectively.

First, there were no major effects of the number of stimuli on the numbers of character reproduction times and reproduction stimuli. This means there was no difference in the number of reproduction times and reproduction stimuli between tests with one and two stimuli.

Second, the major effects of stimulus types on the number of reproduction times were significant at $F=5.671$ and $p<0.004$, and the effects of the number of stimulus types on reproduction stimuli were also significant at $F=6.404$ and $p<0.002$.

Third, the major effects of presentation positions on the number of reproduction times were significant at $F=10.782$ and $p<0.000$, and the effects on reproduction stimuli were also significant at $F=19.374$ and $p<0.000$.

Fourth, there was no major effect of the number of stimuli and stimulus types on the number of reproduction times and reproduction of stimuli.

Fifth, there was no major effect of the number of stimuli and presentation positions on the number of reproduction times and reproduction of stimuli.

Sixth, the major effects of stimulus types and presentation positions on reproduction of stimuli were significant at $F=3.522$ and $p<0.002$. However, the effects were insignificant on the number of reproduction times.

Finally, the major effects of three presentation conditions, the number of stimuli, stimulus types and presentation positions on the number of reproduction times were significant at F=3.845 and p<0.01.

Source		ss	df	ms	F	P
Corrected		141.870 [a] 27.589 [b]	20 20	7.094 1.379	3.574 11.246	.000 .000
Intercept		6978.500 139.817	1 1	6978.500 139.817	3515.886 1139.921	.000 .000
A	D E	3.480 .230	1 1	3.480 .230	1.753 1.876	.186 .171
B	D E	22.510 1.571	2 2	11.255 .786	5.671 6.404	.004 .002
C	D E	64.202 7.129	3 3	21.401 2.376	10.782 19.374	.000 .000
A*B	D E	2.071 .026	1 1	2.071 .026	1.043 .208	.308 .648
A*C	D E	6.577 .327	3 3	2.192 .109	1.104 .888	.347 .447
B*C	D E	6.486 2.592	6 6	1.081 .432	.545 3.522	.774 .002
N*S*P	D E	22.895 .713	3 3	7.632 .238	3.845 1.938	.010 .123
error		875.318 54.091	441 441	1.985 .123		
Total		10865.000 356.000	462 462			
Corrected total		1017.188 81.680	461 461			

A. Number of stimuli
B. Stimulus type
C. Stimulus presentation
D. Number of reproductions
E. Reproduction stimulation

a.
b. RS=.139 (C RS=.100)
RS=.338 (C RS=.308)

(Table 2) Presentation condition of stimulation, number of reproductions of characters, and decentralized analysis result with reproduction stimulation

2) Effects of different stimulus presentations on each of the seven characters

Table (3) shows the major effects of stimulus presentation conditions on each of the seven characters (1 to 7). The numbers 1 to 7 indicate the presentation orders of the characters.

First of all, there was no significant effect of the number of stimuli on each character.

Second, stimulus types had significant effects 2 at F=4.517 and p<0.011, and the effects of the number of stimulus types on reproduction stimuli were also significant 4 at F=4.362 and p<0.013.

Third, presentation positions had significant effects 1 at F=6.349 and p<0.000, 2 at F=9.804, 3 at F=15.732 and p<0.000, 4 at F=4.739, p<0.003 and the effects of the number of stimulus types on reproduction stimuli were also significant 7 at F=8.136 and p<0.000.The fifth and sixth characters which had lower reproduction rates than the others were not influenced by stimulus presentations.

Fourth, the number of stimuli and stimulus types had significant effects only on 7 at F=6.167 and p<0.013.

Fifth, the effects of the number of stimuli and presentation positions on 1 to 7 characters were insignificant.

Sixth, stimulus types and presentation positions had significant effects only on 7 at F=4.556 and p<0.000.

Finally, the major effects of three presentation conditions, the number of stimuli, stimulus types and presentation positions on 4 and 6 were significant at F=7,979 and p<0.000 and at F=3.476 and p<0.016 respectively.

Source		ss	df	ms	F	P
Corrected	1	3.407 [a]	20	.170	1.494	.078
	2	10.740 [b]	20	.537	3.218	.000
	3	14.264 [c]	20	.713	3.585	.000
	4	13.143 [d]	20	.657	2.996	.000
	5	7.299 [e]	20	.365	1.550	.061
	6	6.758 [f]	20	.338	1.404	.115
	7	14.965 [g]	20	.748	3.356	.000
Intercept	1	238.283	1	238.283	2090.254	.000
	2	194.819	1	194.819	1167.472	.000
	3	151.683	1	151.683	762.501	.000
	4	129.018	1	129.018	588.222	.000
	5	113.562	1	113.562	482.390	.000
	6	109.600	1	109.600	455.587	.000
	7	94.062	1	94.062	421.908	.000
Number of stimuli	1	.003	1	.003	.025	.875
	2	.284	1	.284	1.702	.193
	3	.000	1	.000	.000	1.000
	4	.000	1	.000	.000	1.000
	5	.011	1	.011	.048	.826
	6	.230	1	.230	.957	.329
	7	.000	1	.000	.000	1.000
Stimulus type	1	.207	2	.104	.910	.403
	2	1.508	2	.754	4.517	.011
	3	.956	2	.478	2.404	.092
	4	1.922	2	.961	4.382	.013
	5	.301	2	.151	.640	.528
	6	.510	2	.255	1.061	.347
	7	.292	2	.146	.654	.520
Stimulus presentation	1	2.171	3	.724	6.349	.000
	2	4.908	3	1.636	9.804	.000
	3	9.389	3	3.130	15.732	.000
	4	3.118	3	1.039	4.739	.003
	5	1.743	3	.581	2.468	.062
	6	1.343	3	.448	1.861	.135
	7	5.441	3	1.814	8.136	.000
Number of stimuli * Stimulus type	1	.071	1	.071	.623	.430
	2	.045	1	.045	.272	.602
	3	.284	1	.284	1.428	.233
	4	.045	1	.045	.207	.649
	5	.182	1	.182	.772	.380
	6	.026	1	.026	.106	.745
	7	1.375	1	1.375	6.167	.013
Number of stimuli * Stimulus presentation	1	.099	3	.033	.291	.832
	2	1.011	3	.337	2.020	.110
	3	.386	3	.129	.647	.585
	4	.523	3	.174	.794	.497
	5	1.420	3	.473	2.011	.112
	6	.213	3	.071	.295	.829
	7	.205	3	.068	.306	.821
Stimulus type* Stimulus presentation	1	.486	6	.081	.710	.642
	2	.515	6	.086	.515	.797
	3	.953	6	.159	.798	.572
	4	1.032	6	.172	.784	.583
	5	1.714	6	.286	1.213	.298
	6	1.266	6	.211	.877	.511
	7	6.095	6	1.016	4.556	.000
Number of stimuli * Stimulus type* Stimulus presentation	1	.168	3	.056	.490	.689
	2	1.295	3	.432	2.588	.053
	3	.920	3	.307	1.542	.203
	4	5.250	3	1.750	7.979	.000
	5	.977	3	.326	1.384	.247
	6	2.509	3	.836	3.476	.016
	7	.648	3	.216	.968	.407
error	1	50.273	441	.114		
	2	73.591	441	.167		
	3	87.727	441	.199		
	4	96.727	441	.219		
	5	103.818	441	.235		
	6	106.091	441	.241		
	7	98.318	441	.223		
Total	1	400.000	462			
	2	351.000	462			
	3	310.000	462			
	4	282.000	462			
	5	276.000	462			
	6	266.000	462			
	7	263.000	462			
Corrected total	1	53.680	461			
	2	84.331	461			
	3	101.991	461			
	4	109.870	461			
	5	111.117	461			
	6	112.848	461			
	7	113.284	461			

(Table 3) Presentation condition of stimulation and decentralized analysis result on each of the seven characters

4-2. EFFECTS AND CHARACTERISTICS OF CHARACTER PRESENTATIONS

1). Test 1: Character presentation

Character presentation No.			1	2	3	4	5	6	7
Test No.	Stimulus	Order	Q	W	R	T	P	S	D
Test 1	Character	0	86.4	86.4	81.9	81.9	59.1	31.9	36.4

(Table 4) Results of Test 1

Test 1, presented just seven characters. As shown in Table 4, the first four characters had similar character reproduction rates and the rates decreased from the fifth character.

4-3. EFFECTS AND CHARACTERISTICS OF VISUAL AND AUDIAL STIMULI

The effects of an emphasis were examined by comparing the character reproduction rates obtained when both visual and audial stimuli were provided to emphasize characters with other rates obtained when only characters were presented. The bold characters in Table 2 to 6 indicates that they were provided with a visual or an audial stimulus or both of them; the characters that had higher character reproduction rates compared to Test 1 are displayed in gray

1). Test 2 Enlarged character presentation

Character presentation No.			1	2	3	4	5	6	7
Test No.	Stimulus	Order	Q	W	R	T	P	S	D
Test 1	Character	0	86.4	86.4	81.9	81.9	59.1	31.9	36.4
Test 2	Enlarged character	1	**100**	95.5	72.7	54.5	68.2	45.5	50
		2	86.5	86.5	**72.7**	59.1	68.2	54.5	45.5
		3	81.8	86.5	40.9	40.9	**45.5**	50	68.2
		4	68.2	50	59.1	54.5	50	63.6	**86.5**

(Table 5) Comparison between results of Test 2 and Test 1

Enlarged characters had higher primacy and familiarity effects than normal characters in Test 1.

The fifth, sixth and seventh characters generally had higher character reproduction rates than those in Test 1. This means there were many cases in which the reproduction rates decreased for the first five characters, and then increased for the last two characters.

2). Test 3 Sign sound presentation

The Sign sound presentation had great effects on the first and third character, while the effects on the fifth and seventh character were insignificant. On the whole, the fifth, sixth and seventh character had higher reproduction rates than those in Test 1. The character reproduction rates were generally higher when a Sign sound was applied to the first and third character. This indicates that a Sign sound had influence on the next characters.

Character presentation No.			1	2	3	4	5	6	7
Test No.	Stimulus	Order	Q	W	R	T	P	S	D
Test 1	Character	0	86.4	86.4	81.9	81.9	59.1	31.9	36.4
Test 3	Sign sound	1	**100**	90.1	72.7	63.6	68.2	81.8	40.9
		2	90.1	81.8	**86.6**	72.7	68.2	59.1	54.5
		3	81.8	81.8	68.2	72.7	**59.1**	54.5	45.5
		4	90.1	59.1	72.7	68.2	40.9	45.5	**50**

(Table 6) Comparison between results of Test 3 and Test 1

3). Test 4 Oral reading presentation

All the first, third, fifth and seventh characters emphasized with voice had higher reproduction rates than those in Test 1. However, the rates of the second and third character were generally higher in Test 1. The second, third, and fourth character had higher rates in Test 1 except those that were presented with voice.

Character presentation No.			1	2	3	4	5	6	7
Test No.	Stimulus	Order	Q	W	R	T	P	S	D
Test 1	Character	0	86.4	86.4	81.9	81.9	59.1	31.9	36.4
Test 4	Oral reading	1	**100**	81.8	77.3	86.6	68.2	45.5	22.7

		2	86.6	77.3	**86.6**	68.2	68.2	59.1	68.2
		3	72.7	54.5	36.4	27.3	**63.6**	45.5	63.6
		4	77.3	45.5	40.9	36.4	40.9	54.5	**90.1**

(Table 7) Comparison between results of Test 4 and Test 1

4). Comparison between single stimulus presentations

With single stimulus presentations with enlarged characters, Sign sounds and oral reading, we examined the characters which had the highest reproduction rates.

In the case of the first character, the character reproduction rates were the same for the three stimuli, and the rates of the second character was the highest when the enlargement was applied to the first character in Test 2. The third character had the highest reproduction rate, 86.8%, when a Sign sound or oral reading was presented with the character in Test 3 and Test 4. When oral reading stimulated the third character in Test 4, the fourth character had the highest rate. The fifth character had 68.2% when the three stimuli were presented with the first or third character. The seventh character had the highest character reproduction rate when oral reading was presented with it in Test 4.

4-4. EFFECTS AND CHARACTERISTICS OF COMPLEX STIMULI

1). Test 5 Complex presentation of enlarged character and Sign sound

Complex stimuli generated higher character reproduction rates than those in Test 1 in every character except the fourth one. In particular, the rates were higher when the first or third character was emphasized, but the complex stimuli had little effects on the fifth and seventh character.

Character presentation No.			1	2	3	4	5	6	7
Test No.	Stimulus	Order	Q	W	R	T	P	S	D
Test 1	Character	0	86.4	86.4	81.9	81.9	59.1	31.9	36.4
Test 5	Enlarged	1	**95.5**	95.5	77.3	81.8	36.4	59.1	63.9

	character +Sign sound	2	90.9	90.9	**95.5**	81.8	68.2	86.4	68.2
		3	77.3	59.1	54.5	31.8	**50**	54.5	63.9
		4	86.4	81.8	54.5	72.7	63.9	54.5	**36.4**

(Table 8) Comparison between results of Test 5 and Test 1

2). Test 6 Complex presentation of enlarged character and oral reading

The characters which were enlarged and accompanied with oral reading had high reproduction rates. Furthermore, the fifth, sixth, and seventh character generally had higher rates than those in Test 1.

Character presentation No.			1	2	3	4	5	6	7
Test No.	Stimulus	Order	Q	W	R	T	P	S	D
Test 1	Character	0	86.4	86.4	81.9	81.9	59.1	31.9	36.4
Test 6	Enlarged character + Oral reading	1	**95.5**	90.9	68.2	45.5	63.9	81.8	27.3
		2	81.8	59.1	**95.5**	68.2	63.9	54.5	40.9
		3	86.4	72.7	59.1	63.9	**90.9**	40.9	40.9
		4	81.8	68.2	40.9	50	45.5	54.5	**86.4**

(Table 9) Comparison between results of Test 6 and Test 1

3). Comparison between results of Test 5 and Test 6

The effects of emphasized presentations on the first and third character were the same (95.5%), and the enlargement and oral reading stimuli generated higher rates than the enlargement and Sign sound stimuli for the fifth and seventh character. The second, fourth and sixth character had the highest character reproduction rates when the first or third character was enlarged and presented with a Sign sound in Test 5. Among the characters with two stimuli, the enlargement and Sign sound stimuli in Test 6 generated higher effects and the second, fourth and sixth character had high reproduction rates when the first or third character was enlarged and presented with a Sign sound.

4-5. COMPARISON BETWEEN STIMULUS PRESENTATION METHODS

The effects of single or synchronous stimulus presentations can be examined by comparing the Sign sound presentations with other presentations in which enlargement and a Sign sound were applied synchronously, and the oral reading presentations with others in which enlargement and oral reading were applied synchronously.

1). Sign sounds of Test 3 and Enlarged characters and Sign sounds of Test 5

The synchronous presentations of an enlarged character along with a Sign sound had higher effects on the third character, while the effects were the same for the seventh character.

From the cases where the seven characters had the highest reproduction rates, we can see that every character except the first one had the highest rates when enlargement and a Sign sound were applied and in these cases the stimuli were generally applied to the first or third character.

2). Oral reading of Test 4 and enlarged characters and oral reading of Test 6

Oral reading did not make a significant difference in single and synchronous presentations. The third and fifth character had higher rates when they were enlarged and presented with oral reading at the same time while the first and seventh characters had higher character reproduction rates only when oral reading was presented as in Test 4. The stimulus-free second, fourth and sixth character had higher rates when the two stimuli were applied to the first character; moreover, the second and sixth character had the highest rates when enlargement and oral reading were applied synchronously, while the fourth character had the highest rate when oral reading was provided.

5. CONSIDERATIONS

We have compared and analyzed the different effects depending on time, visual and audial stimuli, single and multiple stimuli and stimulated characters. And the effects of presentation conditions of each stimulus on reproduction of characters and emphasized characters were studied.

The number of stimuli had no effect on remembering the seven characters and emphasized characters. It also had no effect on each character from 1 to 7. Therefore, we can assume that

there is no difference between individual signal sound or oral reading presentations and enlarged character presentations with signal sound or with oral reading.

From the effects of each stimulus type we could see that enlarged characters, when their presentation time was too short, just allowed people to notice the enlarged size and did not influence their reading. The enlargement was not very effective as a visual stimulus although the first and seventh character had some enlargement effects.

When Sign sounds were presented with the first few characters, we could see that their effects were higher when they were presented in the beginning. When comparing the single and multiple stimuli, we had higher character reproduction rates when the first or third character was enlarged and presented with a Sign sound at the same time.

In case of oral reading, the second to sixth characters in the middle had higher rates when oral reading was accompanied with enlarged characters, while the first and seventh characters had higher rates when oral reading was presented alone.

Changing presentation positions of stimuli, which influenced reproduction of characters and emphasized characters, had the greatest effects among the presentation conditions.

Plus, from the test results we see it is effective to stimulate the exact data to be emphasized under limited conditions.

Among the seven characters, presentation time did not affect the first and last characters much, but the characters in the middle were significantly affected by the temporal condition However, when presenting the first and last characters with stimuli, the character reproduction rates were higher than when presenting just individual characters, which is likely due to the primacy and familiarity effects.

During the five stimulus presentation tests, the first character had the highest rates when any one of the stimuli was applied to it. This indicates that stimuli of any kind have the highest effects on the information which is presented first. The results of the two-way ANOVA also show difference in the number of reproduction times only under the condition of stimulus presentation positions.

In case of the third and fifth characters in the middle, higher effects were obtained when they were presented with stimulation in the five tests. Particularly, oral reading had the highest effects on them.

In case of the seventh character which was presented last on the screen, it has been known that the last one can have a high memory effect due to a familiarity effect. As the seventh character generally had the highest rates when stimulation was applied to it, we see that the differences between the effects of each stimulus type were insignificant for the seventh character compared to the others.

The characters without a stimulus were affected by the types of stimuli applied to other characters.

The first four characters in Test 1 had similar reproduction rates; however, the second character had higher reproduction rates when a visual or audial stimulus was applied to the first character. This indicates that a stimulus had influence on the next character.

The fourth character had a higher character reproduction rate with a Sign sound than with oral reading. Oral reading raised reproduction rates of the characters which were presented with it, but it sometimes had reverse effects on the following characters. Consequently, we can say that Sign sounds generally had higher effects on the characters which were without a stimulus than oral reading had.

The sixth character generally had higher character reproduction rates when the third or fifth character was presented with a stimulus. This indicates that the sixth character was highly influenced by prior stimuli.

6. CONCLUSIONS

The goal of this study is to find the most effective character presentation method after examining the effects of multiple stimuli that include three visual and audial stimuli when people were asked to memorize seven characters.

1. Characteristics between stimuli and their effects on reproduction of characters and emphasized characters have been understood.

2. Different effects of single and multiple stimulus presentations have been understood.

3. The effects of presentation conditions on the seven characters which were presented successively have been understood.

The subject of future work is to actually apply these results. Thus, with TV advertisements, we would like to carry out tests by changing positions of contents to be emphasized and stimulus types to find out these tests show the same results.

Plus, there is another task to verify test design with independent factors. As we performed mixed tests, the effects cannot be compared with each other. It will be possible to clearly understand the effects of each individual stimulation presentation and compare them with complex presentation conditions.

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