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Examination of Word Shape Effect by Adjusting the Strength of the Word Shape Determinants of Latin Characters

라틴문자의 단어윤곽 결정요인 강도 조절을 통한 단어윤곽효과 검토

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요약

1887년 제임스 커텔의 실험을 통해 단어를 인지하는 과정이 단순히 단어를 구성하는 낱글자들의 순차적인 지각이 아니라 단어전체의 지각을 통해 이루어진다는 추론을 제기되었다. 이러한 추론과 함께 대문자로만 작성된 문장보다 소문자로 작성된 문장의 가독성이 높다는 사실은 단어윤곽효과라는 가설을 탄생시켰다. 이후 많은 연구자들이 단어윤곽효과를 검증하기 위해 다양한 실험을 실시하였고 일부 연구에서는 단어윤곽효과의 검증에 성공하였다고 주장하였다. 그러나 단어윤곽효과의 검증성공을 주장한 모든 연구가 단어윤곽을 결정짓는 요인을 단순히 어센더 또는 디센더의 존재여부만으로 규정하는 잘못된 전제를 바탕으로 실험이 실시되어 신뢰할 수 있는 결과도출이라 할 수 없다. 이에 본 연구자는 그동안 진행되어온 단어인지효과 관련연구들에서 나타난 오류를 보완하기위하여 단어의 윤곽을 결정짓는 외곽부분을 회색으로 처리하여 시각적으로 단어의 윤곽을 약화한 실험지와 단어의 내부영역을 회색으로 처리한 실험지를 제작하여 독서속도를 측정하는 실험을 실시하였다. 독서속도측정에 있어서는 피험자그룹의 독서능력 차이와 실험용 문장의 난이도에 의해 나타날 수 있는 간섭현상을 제거하기 위해 크로스오버디자인을 적용하였다. 즉 피험자를 두 그룹으로 나누어 한 그룹은 문장A에 내부영역을 검정색으로 적용한 실험지 AI와 문장 B에 외부영역을 검정색으로 적용한 BO문장을 읽도록 하고, 다른 그룹은 문장A에 외부영역을 검정색으로 적용한 실험지 AO와 문장 B에 내부영역을 검정색으로 적용한 BI문장을 읽도록 하였다. 그 결과 단어윤곽을 약화한 실험지를 통한 단위시간당 독서 단어수가 오히려 5% 포인트 가량 높게 나타났으며, 단위시간당 독서문자수 비교에서는 단어윤곽을 약화한 실험지를 통한 단위시간당 독서 문자수가 0.4% 포인트 가량 낮게 나타났다. 이러한 결과는 단어윤곽효과에 대한 가설은 기각되어야 함을 보여준다.

중심어

단어윤곽효과
타이포그래피
가독성
인지요인
라틴문자

ABSTRACT

In 1887 James Curtell's experiment proved that the recognition of a word is done through the perception of the whole word, not the sequential perception of the word constituents. Along with this inferences, the fact that the sentences written in lowercase letters are more readable than the sentences written only in capital letters led to the hypothesis of Word Shape Effect. Many researchers have conducted various experiments to verify the Word Shape Effect and some studies have concluded they succeeded in verifying the Word Shape Effect. However, all the studies that claim the success of verification of the Word Shape Effect are based on the fallacious premise of the factors that determine the shape of the word. Therefore, this study have carried out experiments by complementing the errors in the related studies of Word Shape Effect that have been gone on; measuring the reading speeds by fabricating a experimental paper that the outer areas of words are applied in gray to make word shape weak and a experimental paper that the inner areas of the words are applied in gray. As a result, the mean number of reading words per unit time was about 5 percent point higher by the experimental paper with weakened word shape, whereas the mean number of reading characters per unit time was about 0.4 percent point higher by the experimental paper with enhanced word shape. These results show that the hypothesis about the Word Shape Effect should be rejected.

Keyword

Word Shape Effect
typography
readability
recognizing factor
Latin character

1. Introduction

The purpose of this study is to investigate whether the Word Shape Effect exists.

The Word Shape Effect is a hypothesis that the shapes of words formed by the letters constituting each word acts in the process of word reading. This hypothesis began when it was known that the cognitive process of a word was not simply a process of perceiving individual letters constituting a word in order.

In 1886, it was found by James McKeen Cattell's experiment that there was only a slight difference between the time required to perceive a word and the time required to perceive the word.[1] Besides, in 1969 Gerald M. Reicher dicovered Word Superiority Effect that letters in words are more easily perceived than single letters.[2] In addition, based on the fact that the sentence written in lowercase letters is easier to read than the sentence written in capital letters, Western researchers have focused on the Word Shape Effect and many studies have been conducted to prove it.

Nonetheless, even after about 100 years since the discourse was first raised, there is no definitive basis for the Word Shape Effect. Two possible reasons could be considered why previous experiments could not prove Word Shape Effect in spite of many studies. One of them is that the experiments conducted in the previous studies were carried out under the premise error. The other is that Word Shape Effect does not exist.

Therefore, this study investigates the inference process of Word Shape Effect and the previous studies to verify them in a critical point and tries to design an experiment that eliminates the problems in the previous studies to inspect whether the Word Shape Effect exists.

2. Background of the Inference of the Word Shape Effect

Each word written by a lowercase letter has its own outline surrounding the word. The shape created by this outline is called the word shape.

The discover of the Word Superiority Effect and the better readability of the sentence written in lowercase than the sentence written only in capital letters played a key role in deducing the Word Shape Effect.

2.1. Word Superiority Effect

In 1886, Cattell experimented with using a chronoscope to expose single letter or single word to subjects for a short time of 5 to 10 microseconds. In this experiment, Cattell found that the time required to perceive a word is not the sum of the time it takes to perceive each letter of the word, and that there is only a slight difference between the perceived time of a single letter and the perceived time of a word.[3] In 1969 Reicher found a Word Superiority Effect.

Reicher conducted an experiment to expose four alphabetic words, a non-word created by changing the alphabetical order of the word, and a single character through a tachistoscope and to ask for the presence of certain characters (eg, D or K). In the experiment, the letters in the words were most easily perceived.[4]

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1) Cattell, J., 「The Time Taken Up by Cerebral Operations」, Mind, 11, 1886, pp.385-387 ; Classics in the History of Psychology, ; Republished by York University
at http://psychclassics.yorku.ca/Cattell/Time/part3.htm

2) Reicher, G.M., 「Perceptual Recognition as a Function of Meaningfulness of Stimulus Material」, Journal of Experimental Psychology, 81, 1969, p.275-280.

3) Cattell, J. ibid.

〈table 1〉 Example of Word, Non-word, and Character

	Word	Nonword	Character
example	WORD	OWRD	___D

The results of both Cattell and Reicher show that the cognitive process of words is not simply through the perception of individual letters. In an interpretation of experimental results, Cattell determined that the word as a whole is a unit we perceive.[5)]

2.2. Upper and Lower Case readability

The fact that the sentences written in uppercase and lowercase letters are more readable than sentences written in uppercase letters is not only easily recognizable empirically[6)] but also verified by experiments.[7)] This difference in readability plays a crucial role in the creation of the Word Shape Effect hypothesis, along with the discovery of the Word Superiority Effect.

Since the bottoms of all uppercase letters match the baseline, and the upper ends of them is also on the same line, words written in upper case only have a rectangle-shaped outline with only the difference in length. On the other hand, in the case of a word written in lowercase letters, the ascender and descender's presence and location are determined depending on the spelling of the word, so that each word has its own shape.

The difference between uppercase and lowercase letters and the higher readability of sentences in lowercase letters made it possible to deduce the Word Shape Effect.

〈fig. 1〉 Example of Word Shapes Created by Latin Alphabet

3. Preliminary Study on Word Shape Effect

Various studies have been conducted over a century to verify the Word Shape Effect. G. W. McConkie & K. Rayner conducted an experiment to measure the reading speed by limiting the number of visible letters around the gaze point.[8)] In this experiment, the reading speed decreased as the number of visible letters displayed after the gaze point decreased. This indicate that at the same time as perceiving the letter at the gaze point, the word in the surrounding area beyond the fovea centralis is also perceived. The fovea centralis is the most sensitive part of the eye. The vision deteriorates rapidly as it moves

4) Reicher, G.M., ibid

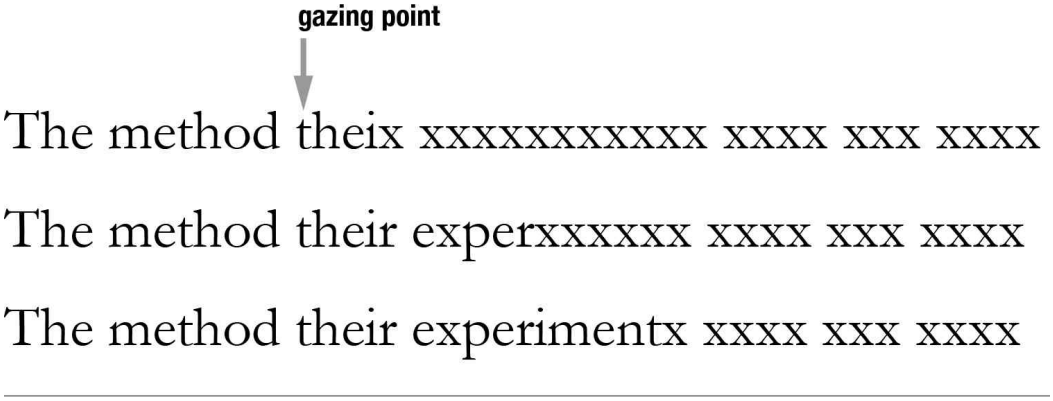
5) Cattell, J., ibid

6) Rehe, Rolf F., 『Legibility : Graphic Design & Reading』, Ed. Gunnar Swanson, Allworth Press. 2000, pp.97-108.

7) Tinker, M. A. & Paterson, D. G., 「Influence of Type Form on Speed of Reading」, The Journal of Applied Psychology, Vol. XII, No. 4, 1928, pp.359-364.

8) McConkie, G.W. & Rayner, K., 「The Span of the Effective Stimulus during a Fixation in Reading」, Perception and Psychophysics, 17, 1975, pp.578-586 ; 재인용 Larson, Kevin(2004) The Science of Word Recognition: or How I Learned to Stop Worrying and Love the Bouma, http://www.microsoft.com/typography/ctfonts/WordRecognition.aspx 검색일: 2017.08.10.

away from the fovea centralis. Therefore, the perception of the next letter that goes along with the coinstantaneous process of letter recognition at the gaze point is a process of grasping a general image such as word shape, not a specific form of grasp.



〈fig. 2〉 Method of McConkie & Rayner's Experiment

Rayner conducted an experiment to verify the hypothesis of the Word Shape Effect through gaze and jump of view point.[9] He modified the test words in normal sentences. The computer initially shows the modified word to a subject. Just before the subject's gaze moved to the modified word, the word was replaced with the original test word. The gazing time of the target word was shorter when the test word did not change or changed non-word that string and word shape is similar to target word than when only word shape or only string is similar.

These experiments do not show that the recognition of a word is done through the recognition of the whole word. However, it does not mean recognition of the word shape. Including shape of word, it could be texture, brightness, and so on. Therefore, these experiments could not be definitive proof.

Ralph Norman Haber & Robert M. Schindler (1981) conducted proofreading test.[10] They classified the alphabet in three categories; those having an ascender, those having a descender, and those having neither of them. After that, they replaced a alphabet in a word in sentences in two ways. Some changed alphabet were in the same category and the others were not. In such a manipulated sentence, subjects were asked to correct the spelling. In this proof reading test, the misspelling failure rate was higher when the changed alphabet was in same category as original alphabet.

9) Rayner, K., 「The Perceptual Span and Peripheral Cues in Reading」, Cognitive Psychology, 7, 1975, pp.65-81.

10) Haber, R.N. & Schindler, R.M., 「Errors in Proofreading: Evidence of Syntactic Control of Letter Processing?」, Journal of Experimental Psychology: Human Perception and Performance, 7, 1981, pp.573-579.

〈table 2〉 Similarity of Letters Judged by Paap, Nwesome & Noel

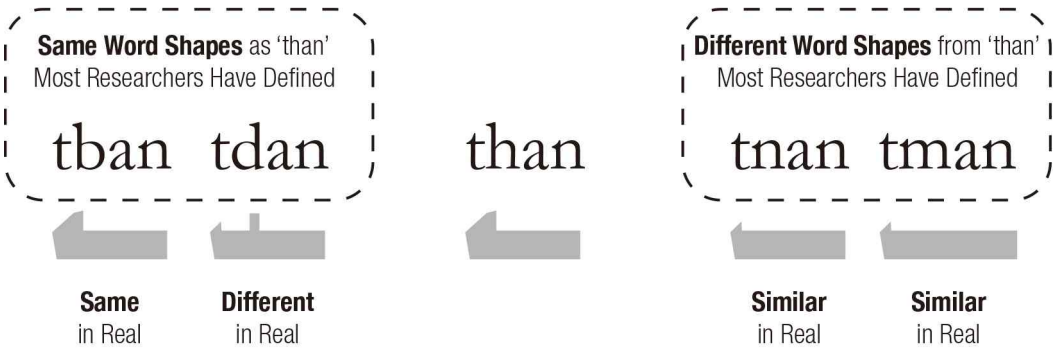
	same category letters	different category letters
than, thin, thought	b, d	n, m
also, plan, ultraviolet	f, b	r, c
most, test, fascinated	v, u	k, l
been, meet, viewers	n, u	d, f
first, faint, relative	k, b	r, w
after, watch, astronomy	k, b	r, w
would, solar, rockets	c, z	p, k
three, carry, through	s, o	t, l

〈table 3〉 Different Word Shapes by Changing Letters in Same Category

Target Words	Modified Words 1	Modified Words 2
than	tban	tdan
thin	tbin	tdin
thought	tbought	tdought
ultraviolet	uftraviolet	ubtraviolet
first	firsk	firsb
faint	faink	fainb
relative	relakive	relabive

However, this study has also errors to judge similarity of word shapes. Haber & Schindler did not provide the examples of materials used in the experiments. Nevertheless, the materials presented in the experiment conducted by Kenneth R. Paap, Sandra L. Newsome & Ronald W. Noel shows that there was a fatal error in their experiment.

Paap, Newsome & Noel used same judgments to classify the similarity of word shape as Haber & Schindler's experiment. According to Paap, Newsome & Noel's material used for their experiment, 'tban' and 'tdan' were similar to 'than', whereas the word shapes of 'tnan' and 'tman' were different. However, the word shape of 'tdan' is completely different from 'than', whereas the word shapes of 'tnan' and 'tman' are more similar to the word shape of 'than.'[11] These kinds of erroneous examples occupy for a significant number of the materials they presented.



〈fig. 3〉 Similarity That Researchers Have Defined and That of Real of Word Shapes

4. Design and Implementation of Experiments

In order to verify the hypothesis of Word Shape Effect, changing the spelling contained in a word may have unintended consequences. Therefore, I have carried out the readability test by controlling the strength of ascender and descender which determine the word shape.

To control the strength of ascender and descender, It was considered to adjust their sizes. In other words, it was considered to measure the readability by making fonts with enlarged sizes of ascenders and descenders and with reduced sizes of ascenders and descenders. However, it was not possible to control the familiarities of the modified fonts

11) Koo, Bonyoung, 「Associations between The Structures of Hangeul Fonts for Text and The Factors of Recognition」, Doctoral Thesis of Dankook University, 2010, pp93-94.

objectively to the same level although familiarity with fonts is also a significant factor in readability,[12)]

Therefore, it was decided to brighten the upper and lower areas of the words on text to weaken word shapes and to brighten central areas of the words on text that have relatively strong word shapes. Using these, it was decided to carry out a readability experiment.

If the Word Shape Effect is real, the readability of weaken word shape will be lower.

4.1 Method

4.1.1. Subjects

Subjects were 113 men and women aged between 18 and 40 years old who live in Savannah, GA, and who speak English as their first language. Because the Word Shape Effect is not expected to be different according to the tendency of subject such as gender or occupational group, demographic statistics were not considered. However, immigrants and foreign students from non-English speaking countries were excluded from the experiment because it is presumed that the Word Shape Effect appears based on the experience of contacting sentences written in English for many years. In addition, subjects under the age of 18 and 40 years or older were excluded from the experiment. In the case of younger than 18 years old, extrinsic factors may act due to differences in readability between sentences and in the case of older than 40 years old, external factors of presbyopia may act.

The experiment was conducted for employees in various stores and offices in downtown Savannah, and undergraduate and graduate students at campus.

4.1.2. Materials

Ten articles were selected from internet sites of American newspapers. The selected articles were with 400 to 500 words, and which were not used complex numbers, symbols, or abbreviations. Articles published within 10 years were not considered candidate, because in a recent article, some of the subjects may have read the article, and this experience may have affected reading speed.

By an American studies expert, two articles (Article A and Article B) with the lowest level of reading difficulty among the 10 articles were selected and difficult words for 9th grade students in the selected articles were changed to easy words.

The selected Article A and Article B were typed on A4 paper with Helvetica Neue 45 Light 12pt, 18pt line spacing, and 130mm line length on a white background.

Two types of letters were prepared; letter type O and letter type I. For the letter type O, black was applied to the strokes of the outer area where the ascender or descender is located and gray(black 50%) was applied to the stroke of the other area. For the letter type I, black was applied to the strokes of the inner area where the ascenders or descenders is not located and gray(black 50%) was applied to the stroke of the other area. The word shapes written in letter type O is relatively clear compared to the word written in letter type I.

12) Tinker, M.A. & Goodenough, F.L, 「Mirror Reading as a Method of Analyzing Factors Involved in Word Perception」, Journal of Educational Psychology, Vol 22(7), Oct., pp.493-502.

〈fig. 4〉 Letter Type I and the Letter Type B

Four types of experimental papers were prepared: Paper AI, Paper AO, Paper BI, and Paper BO. The letter type I was applied to Article A for the Paper AI and applied to Article B for the Paper BI. The letter type O was applied to Article A for the Paper AO and applied to Article B for the Paper BO.

〈table 4〉 Types of Papers by Articles and Color Application Methods

			Article A	Article B
Black **Inner** Area	Black for Inner Area Gray for Outer Area	sample	Paper AI	Paper BI
Black **Outer** Area	Black for Outer Area Gray for Inner Area	sample	Paper AO	Paper BO

Two kinds of handouts, AOBI and AIBO, were prepared with 4 types of experimental paper. The handout AOBI consisted of a cover sheet, a paper AO, and a paper BI and the handout AIBO consisted of a cover sheet, a paper AI, and a paper BO.

〈table 5〉 Page Composition for Each Handout

	page 1	page 2	page 3
handout AIBO	cover	paper AI article A sample	paper BO article B sample
handout AOBI	cover	paper AO article A sample	paper BI article B sample

4.1.3. Procedure

Subjects were run in groups in 2 to 10. The subjects of the group proceeded as evenly as possible, and the handouts AOBI and AIBO were distributed in equal numbers. When the unit of the group progressed to an odd number, similar subjects were selected at the next experiment and the number of subjects was adjusted to an odd number, so that the handout AOBI and AIBO used in the experiment were adjusted to be the same.

Handout AOBI or AIBO was distributed to each subject.

After the experimenter had explained how to participate in the experiment, the subjects were asked to experience the experiment through the sample sentences on the handout cover. When experimenter signaled the start, the subjects turned over

the page and read the Article A (Paper AI or Paper AO depending on the handouts the subjects had received). One minute after the start of reading, when the host had signaled the interruption, the subjects stopped reading and marked the last word they had read.

When the experimenter signaled the resumption signal, the subjects turned over the page and participated in article B (paper BO or BI depending on the handouts the subjects had received) in the same way as before.

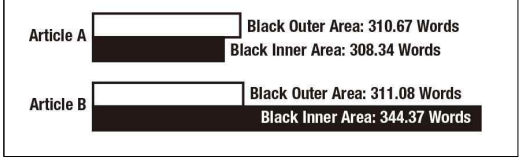
4.2. Results

A total of 107 handouts (52 AIBI, 49 AIBO) were analyzed, except for the cases where all on the article A or B was read and where the last word read was not displayed or was ambiguous among 113.

As a result of the experiment, the mean number of words read for 1 minute was 308.34 (standard deviation: 72.85) for AI, 310.67 (standard deviation: 70.55) for AO, 344.37 (standard deviation: 123.54) for BI, and 311.08 (standard deviation: 84.79) for BO and the mean number of letters read for 1 minute was 1410.92 (standard deviation: 412.88) for AI, 1452.29 (standard deviation:391.60) for AO, 1518.04 (standard deviation: 443.09) for BI and 1486.21 (standard deviation: 504.66) for BO. In the case of the article A, the reading speed of the sentences which weakened the word shape was low, whereas in the case of the article B, the reading speed of the sentences which weakened the word shape was high. This result is considered to be due to the possiblity that the reading ability of the subjects participating in the experiment using the handout AOBI is relatively better than the reading ability of the subjects participating in the experiment using the handout AIBO.

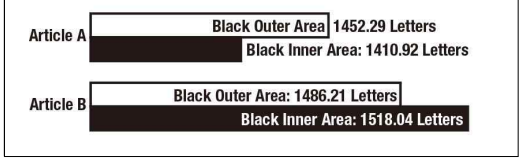
〈table 6〉 Mean Number of Words Read for 1 Minute

	paper AI	paper AO	paper BI	paper BO
mean	308.34	310.67	344.37	311.08
SD	72.85	70.55	123.54	84.79



〈table 7〉 Mean Number of Letters Read for 1 Minute

	paper AI	paper AO	paper BI	paper BO
mean	1410.92	1452.29	1518.04	1486.21
SD	412.88	391.60	443.09	504.66



In order to avoid errors caused by differences in reading ability among the subjects, the reading speed of different types of letters read by the same subject should be measured. However, it is clear that if the same content is repeated twice, the second reading speed will be faster and articles with different contents may affect the results of the experiment due to differences in sentence difficulty. AI/A, AO/A, BI/B, and BO/B values were calculated by the following formula for the number of letters that individual subjects read for 1 minute on various experimental paper to eliminate errors due to differences in sentence difficulty.

$$AI/A = \frac{\text{Number of words read in paper AI}}{\text{mean number of words read in paper AI and paper AO}} \times 100$$

$$AO/A = \frac{\text{Number of words read in paper AO}}{\text{mean number of words read in paper AI and paper AO}} \times 100$$

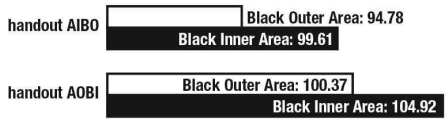
$$BI/B = \frac{\text{Number of words read in paper BI}}{\text{mean number of words read in paper BI and paper BO}} \times 100$$

$$BO/B = \frac{\text{Number of words read in paper BO}}{\text{mean number of words read in paper BI and paper BO}} \times 100$$

The mean of AI/A was 99.61 (standard deviation: 23.53), BO/B was 94.78(standard deviation: 25.83), AO/A was 100.37(standard deviation: 22.79), and BI/B was 104.92(standard deviation: 37.64). Both the comparison of AO/A and BI/B and the comparison of AI/A and BO/B showed high readability of the experimental paper with weakened word shape. Significance tests were not conducted because the result of the Word Shape Effect is denied in both the case where the statistical significance is not significant and the case where it is significant, the result of the Word Shape Effect is denied.

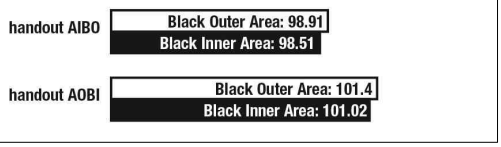
〈table 8〉 Mean of Words Read Correction Value According to Sentence Difficulty

	handout AIBO		handout AOBI	
	AI/A	BO/B	AO/A	BI/B
mean	99.61	94.78	100.37	104.92
SD	23.53	25.83	22.73	37.64
difference	4.83(Inner > Outer)		4.55(Inner > Outer)	



〈table 9〉 Mean of Letters Read Correction Value According to Sentence Difficulty

	handout AIBO		handout AOBI	
	LAI/A	LBO/B	LAO/A	LBI/B
mean	98.51	98.91	101.40	101.02
SD	28.83	33.59	27.34	29.49
difference	0.40(Inner < Outer)		0.38(Inner > Outer)	



These could be the result of the characteristics of the words that each article has. Since the words used in each article are composed of at least 1 to 15 alphabets, the comparison of the number of words read may be problematic. For this reason, the LAI/A, LAO/A, LBI/B, and LBO/B values were calculated by the number of letters read through each test by the following formula.

$$LAI/A = \frac{\text{Number of letters read in paper AI}}{\text{mean number of letters read in paper AI and paper AO}} \times 100$$

$$LAO/A = \frac{\text{Number of letters read in paper AO}}{\text{mean number of letters read in paper AI and paper AO}} \times 100$$

$$LBI/B = \frac{\text{Number of letters read in paper BI}}{\text{mean number of letters read in paper BI and paper BO}} \times 100$$

$$LBO/B = \frac{\text{Number of letters read in paper BO}}{\text{mean number of words letters in paper BI and paper BO}} \times 100$$

As a result, the mean of LAI/A was 98.51 (standard deviation: 28.83), that of LBO/B was 98.91 (standard deviation: 33.59), that of LAO/A was 101.40 (standard deviation: 27.34) and that of LBI/B was 101.02(standard deviation: 29.49). A comparison of LAI/A and LBO/B showed that the readability is slightly lower when the word shape is weakened whereas a comparison of LAO/A and LBI/B showed that the readability of the word shape is slightly higher when the word shape is weakened.

Taken together, the number of words read per unit time is significantly bigger in cases with weakened word shape, and the number of characters read per unit time showed inconsistent results depending on the articel. This shows that the hypothesis about the Word Shape Effect should be rejected.

5. Discussion

A number of researchers have been conducted research to verify Word Shape Effect and the objection has also persisted.

Especially, in Korea, it recognized the Word Shape Effect, which is just a hypothesis, as established theory, and the Word Shape Effect has helped the opinion that Hangeul[13] fonts must cross square borders.

However, the studies to demonstrate the Word Shape Effect have failed, and the experiments that have claimed success also became meaningless research because of the wrong premise. In addition, many research has been carried out with the exception that the possibility that the Word Shape Effect is not real.

On this study, it is found that the Word Shape Effect is a false hypothesis because the number of words read through sentences with weakened word shape per unit time is rather large confirmed by performing experiments that complement the errors of the prior researchers.

However, the cause of the relatively high readability of sentences that weakened the word shape in this study was not analyzed. This point will be investigated through subsequent research.

References

Rehe, Rolf F., 『Legibility : Graphic Design & Reading』, Ed. Gunnar Swanson, Allworth Press. 2000

Koo, Bonyoung, 「Associations between The Structures of Hangeul Fonts for Text and The Factors of Recognition」, Doctoral Thesis of Dankook University, 2010

Beech, J.R. & Mayall, K.A., 「The word shape hypothesis re-examined: evidence for an external feature advantage in visual word recognition」, Journal of Research in Reading, Vol. 28, Issue 3., 2005

Cattell, J., 「The time taken up by cerebral operations」, Mind, 11, 1886

Haber, Ralph Norman & Haber, Lyn R., 「The Shape of a Word Can Specify Its Meaning」, Reading Research Quarterly, Vol. 16, No. 3, 1981

Haber, R.N. & Schindler, R.M., 「Errors in proofreading: Evidence of syntactic control of letter processing?」, Journal of Experimental Psychology: Human Perception and Performance, 7, 1981

13) Korean alphabet

Koo, Bonyoung, 「Causes That Hypothesis about Word Shape Could Not Be Fixed」, 2009 Communication Design Society Conference, 2009

McConkie, G.W. & Rayner, K., 「The span of the effective stimulus during a fixation in reading」, Perception and Psychophysics, 17. 1975

Rayner, K., 「The perceptual span and peripheral cues in reading」, Cognitive Psychology, 7. 1975

Reicher, G.M., 「Perceptual recognition as a function of meaningfulness of stimulus material」, Journal of Experimental Psychology, 81. 1969

Tinker, M. A. & Paterson, D. G., 「Influence of Type Form on Speed of Reading」, The Journal of Applied Psychology, Vol. XII, No. 4. 1928

Tinker, M.A. & Goodenough, F.L., 「Mirror Reading as a Method of Analyzing Factors Involved in Word Perception」, Journal of Educational Psychology, Vol 22(7), Oct. 1931

Walker, Peter, 「Word shape as a cue to the identity of a word: An analysis of the Kuera and Francis (1967) word list」, The Quarterly Journal of Experimental Psychology 39A, 1987

http://psychclassics.yorku.ca/Cattell/Time/part3.htm

http://www.microsoft.com/typography/ctfonts/WordRecognition.aspx