

## An ANOVA Evaluation on the Visual Cognition of Advertisement Signboards on the Buildings

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Advertisement signboards on the buildings have functionally a visual value as factor of urban and building design. But it is not easy to find any reasonable principles and regulations, how well the signboards deliver the information of stores to the customers, and how they contribute the visual amenity from the sight of urban landscape. Under this context, this study tries to analyze the information delivery power of signboards in relation to the visual cognition. The analysis method is the Two-Way ANOVA (Analysis of Variance) evaluation with factors, such as scale, amount and arrangement of signboards. The scale of letters or figures at Signboards is specified in 3 different sizes such as big, medium and small. The amount is classified into 5 grades from 100% to 20% installation. And the arrangement is divided into orderly and disorderly installation. As the results of the Two-Way ANOVA, the identical scale of signboards is much better for the awareness. And the orderly arrangement shows also the same result. Above all, including these two results, the 80% of installation showed the biggest different result of awareness.

**Key Words :** ANOVA (Analysis of variance), Visual cognition, Advertisement signboards

### 1. Introduction

Traditionally, advertisement signboards on the buildings have had a role of symbolizing building's functional characteristics and delivering its commercial use to the customers<sup>1,2)</sup>. In modern times, it tends to emphasize their visual value as a factor of urban and building design. But the thoughtless and crowded signboards are regarded as a visual pollution<sup>3,4)</sup>. Namely, the excessively big sized letters of signboards, their unharmonious colors and scales cause all of passengers and customers not only to have a unpleasantness, but also to decrease the delivery power of information. Above all, lots of traders try to install their signboards competitively bigger or more colorful, so that they make their own stores standing out. This leads to another competition with other traders. Finally, it is installed too many disordered signboards on a building, which have neither any thorough information delivery power, nor any positive image of

store street landscape. Lots of local governments try to regulate their competition, but in many cases, it is not easy to find any reasonable principles and regulations, even though theoretically they know that the basic purpose of signboards is to inform all of latent customers and passengers of the function of stores and to promote the purchasing desire with the visual advertisement. Recently, a few of thesis are published from the viewpoint of architectural design<sup>5)</sup> to the one of institutional improvement<sup>6,7)</sup>, in order to reasonable control and design. But they are focused on suggesting the policy of outdoor signboards. From this point of view, it is important to perceive the main functions of signboards. In one hand, the signboards have to promote to deliver the information of stores from the sight of traders and customers, and in the other hand, to contribute to the visual amenity from the view of the management of urban landscape<sup>8)</sup>. Under this context, this study try to analyze the information delivery power of signboards in relation to the visual cognition.

### 2. Research process and methodology

The signboards have a role of delivering of in-

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formation and affect the urban landscape in the point of visual cognition, so that all of passengers and customers visually feel pleasant or not. Therefore the analysis on visual cognition toward the signboard will be accomplished by the 3 procedure. Firstly, as the experimental field survey area, it is chosen a bloc of the street mall in commercial zone, where the signboards account for an overwhelming ratio at the front side of buildings. Secondly, it is carried out an experiment of visual cognition of the passengers and customers, how well they are aware of the signboards. For this experiment, it is made up the image slide materials by computer simulation. Thirdly, after finishing this survey and experiment, it is determined the factors and variables for the ANOVA (Analysis of Variance) evaluation, such as scale, amount and arrangement of signboards on the buildings. For this analysis, it is used the SPSS 11.0.

As described, the analysis methodology is mainly divided into 2 processes. The one is an ANOVA evaluation, the other, an experiment of visual cognition of the passengers and customers.

The first is a statistical hypothesis testing as determining process, whether based on the samples from the population any opinions are for the unknown population parameter right or not. It is able to make a scientific and reasonable decision for any unreliable facts or opinions. The hypothesis consists of  $H_0$  (null hypothesis) and  $H_1$  (alternative hypothesis).  $H_0$  (null hypothesis) means a kind of traditional and conservative opinions, which can be expressed "there is not any difference." and  $H_1$  (alternative hypothesis), an opinion to be actively proved, which can be expressed "there is something different.". Here, if the  $H_0$  (null hypothesis) is rejected, the  $H_1$  (alternative hypothesis) is accepted. But in this study, the ANOVA evaluation doesn't come to end with any comparison of 2 populations simply. Rather, for this experiment of cognitive power, it is necessary to use the Two-Way ANOVA, because there are over 2 explanatory variables such as the different scales and the many units of signboards, and these variables interact among them. Especially in this study, the scales and the units of signboards are respectively transformed into 100%, 80%, 60%, 40% and 20% for the simulation. And the experiment is repeated by 60 subject as tested persons, after the signboards are in-

stalled orderly in one hand and disorderly in other hand. And from the each case and its combination, we can get the observed data and analyze the main effect and interaction. The main effect means the result value of the difference of each case and the interaction, the multi-arrangement of over 2 cases.

The second is the experiment of visual cognition to the signboards by the tested persons. For this experiment, all of buildings and signboards are drawn by computer programs. The experiment is carried out under the following condition. They are artificially constructed in the same color and the same scale and arranged in the same form, for the variables for experiment are theoretically made up with various factors, such as visual fields, letter attribution, legibility, scales and forms of signboards, colors and arrangements etc. All of these factors has an influence on the result of experiment interactively<sup>9)</sup>. But it is easy to distort the result value, if including exogenous variables or dummy variables among them. Therefore some variables are selected for this experiment under a restricted condition. And the letters at signboards are given in Korean. All the tested persons watch the signboards from the same viewpoint under the same lightning. Under these conditions, it is possible to minimize observational errors. Finally, after watching the signboards on screen, all the tested persons have to check the terms (words) at a questionnaire sheet, how many terms of signboards they can describe. Nevertheless, it can still happen observational errors in accordance with the social classes and education level of the tested persons. So, in order to avoid this kind of errors as much as possible, the tested persons consisted of student group majoring in Architecture, Urban and Landscape engineering.

### 3. Guidelines of signboard's installation in Korea

In Korea, there is an act, which regulates and manages all kinds of outdoor signboards. In this act, the outdoor signboards on the buildings are described as follows: According to the shape, there are figural signboards with or without backboard, and according to the installation, they are distinguished projection signboards from horizontally or vertically installed signboards<sup>10)</sup>. According to this act, it is allowed to stick the horizontally installed outdoor signboards on the front side of wall in case of buildings below 3

stories. The signboards have to be made up of letters or figures on a board. In case of over 4 story buildings, a signboard in which the office name is described or symbolized, can be stuck at 2 sides of wall. This signboard don't have any backboard. The horizontally installed signboards have neither to excess the width of buildings, nor to cover the windows between the stories. Their projection from the wall is limited within 30 cm. Exceptionally, it is allowed in commercial zone to stick a signboard at the lateral sides of buildings over the 4th floor. The projection signboard have to be stuck above 3 m from the ground and is not allowed to excess the height of wall. Each office in buildings can stick only one projection signboard. In case that over 2 projection signboards are stuck on a building, they have to be arranged in a row at the upper and lower sides. And per 10m width of front side of buildings, it can be added 1 row of signboard. The ending point of signboards has not to be distant within 1.2 m from the wall and their length have not to excess 20 m. Exceptionally, in commercial zone it is specifically allowed the length of signboards not to excess 30 m<sup>11)</sup>.

#### 4. Field survey

##### 4.1. The Status Quo of signboards

The survey areas are accomplished at Jeonju city. Concretely speaking, the one area is located at the main street of Kyongwon district (Zone A), the other, at the main street of Dukjin district (Zone B). These streets are surrounded with 28 buildings. For the field

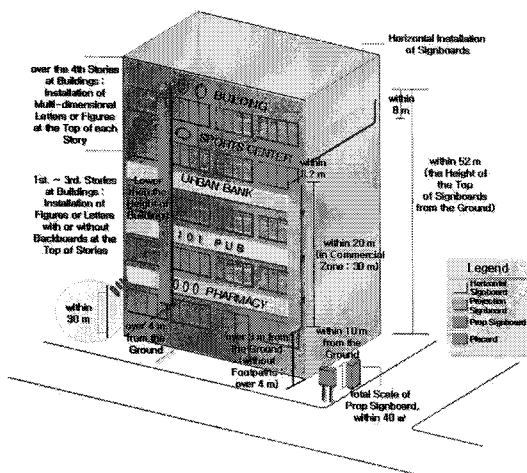


Fig. 1. Principle of signboard's installation on the buildings.

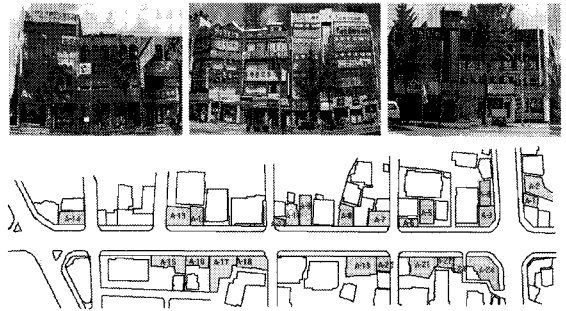


Fig. 2. Zone A for the field survey.

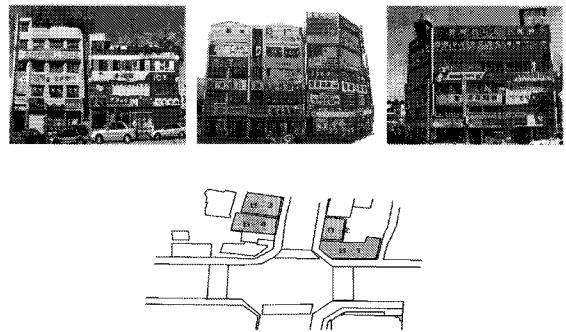


Fig. 3. Zone B for the field survey.

survey, one reporter visited there and documented the size, the number, the installation form, the colors of signboards and the size and sort of letters or figures on signboards. The other one made photographic records.

##### 4.2. Results of field survey

The results of survey are described in 3 different types. The first is the number of signboards on the buildings, the second, the scale of letters or figures of signboards and the last, the color of signboards. Based on these field survey, it is able to confirm, firstly how many signboards are installed disorderly, even though it is given the legal regulation, and secondly, how well they deliver the information of advertisement signboards or how much they cause the visual pollution.

Concretely speaking, as a result of the number of signboards, it is surveyed that each shop in a building installs 3.5 signboards in average. But one of interesting things is, most of all the fewer are shops in a building, the more signboards are installed. This can be interpreted that a few shops in a building can secure more spaces for their signboards.

In relation to the scale of letters or figures, it

Table 1. Status-quo of outdoor signboards on the buildings

Buildings	No. of Shops	No. of installation type of signboards					Total	No. of Signboards/ Nr. of shops
		Horizontal & vertical	Projecting	On the roof	Prop	The others		
A-1	2	3	3			1	7	3.5
A-2	7	7	8			2	17	2.4
A-3	14	17	7		1	9	34	2.4
A-4	11	20	8			7	35	3.2
A-5	5	7	3			1	11	2.2
A-6	3	11	3			4	18	6.0
A-7	5	13	5			1	19	3.8
A-8	4	9	4			3	16	4.0
A-9	4	8	5			1	14	3.5
A-10	2	8	4			2	14	7.0
A-11	3	6	1			1	8	2.7
A-12	3	4	2	1			7	2.3
A-13	6	13	4			3	20	3.3
A-14	8	28	5			1	34	4.3
A-15	6	19	5			2	26	4.3
A-16	5	9	3			3	15	3.0
A-17	4	8	3			2	13	3.3
A-18	3	6	3			3	12	4.0
A-19	4	3	3			4	10	2.5
A-20	3	9	2			1	12	4.0
A-21	3	11	4			6	21	7.0
A-22	5	10	3			1	14	2.8
A-23	4	5	4			2	11	2.8
A-24	15	23	10			6	39	2.6
B-1	10	21	7	1		5	34	3.4
B-2	9	13	6			2	21	2.3
B-3	5	8	2				10	2.0
B-4	6	10	4				14	2.3
Maximum								7.0
Minimum								2.0
Average								3.5

could be confirmed that there is not any harmonized unit of the scale among the signboards, so that it was necessary to classify the scale. The classification was distinguished in 3 different sizes such as big, medium and small, according to the percentage of letters or figures at the signboards. In case that they cover over 70% of the signboards, they are regarded as big size, between 30% ~ 70%, medium size and below 30%, small size. As the result, most of horizontally installed signboards at the top of shops had letters or figures in big size, whereas most of vertically installed signboards at the door sides were small size.

The backboard's colors of advertisement signboards were also quite various. The main color was white,

Table 2. Letters of signboards

Letter No. of Shops	Scale of letters				Sort of languages		
	Big	Medium	Small	Total	Korean	English	Korean & english
159	110	69	130	309	171	43	95
%	35.59	22.33	42.08	100	55.34	13.92	30.74

which accounted for 22.57%, the next was blue, which accounted for 21.19%. The mixed color occupied the 3rd rank. And the red as 9.7% was also one of the favorite colors. But most of all, these colors were not harmonized with the colors of buildings, so that the urban landscape scenery was disturbed. And the primary colors such as red, blue and white held

Table 3. Colors of signboards

Classifi-cation	Chromatic color								Achromatic colors	The others	Sum	
	Colors of warm impression				Colors of cold impression			Neutral				
Back-ground color	Red (R)	Yellow (Y)	Orange (YR)	Crimson (R-YR)	Blue (B)	Bluish green (BG)	Deep blue (BG-B)	Green (G)	White	Black	Mixed	
Nr.	49	41	37	4	107	17	17	41	114	19	59	505
%	9.7	8.12	7.33	0.79	21.19	3.37	3.37	8.12	22.57	3.76	11.68	100

the majority, even though they were regarded as a factor, which deteriorated the legibility.

According to the ratio of installation, the number of signboards on the wall decrease. In case of 100%

## 5. Experiment of visual cognition

### 5.1. Purpose, hypothesis and determination of variables

The purpose of this experiment is to confirm how well the signboards deliver their information. For the experiment, the signboards are produced in a form of pictural image files, which provide various arrangements, various scales and various colors to the tested persons. Here it is possible to analyze how much the tested persons can perceive the information. It means that the signboards affect the awareness of passengers and customers differently, depending on the scale, the color and the arrangement. If this is agreeable, then it is necessary to set up two kinds of null hypothesis as follows:

Hypothesis<sub>0</sub> A: "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the difference of the number and the arrangement of signboards."

Hypothesis<sub>0</sub> B: "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the difference of the scale and the number of signboards."

Under these Hypotheses, the pictural image files are produced by use of the software programs AutoCAD, PhotoShop 7.0 and 3Dmax 6. The image files used as model for the experiment assume the shape of rectangle and their backboard color is white. The color of letters is black and is given in Korean.

### 5.2. Construction of Visual Models as Experiment Methodology

The following figures 4 ~ 8 show the 10 samples for testing the hypothesis A. Here in this experiment, it is tested the difference between order and disorder under the condition of the same scale of signboards.

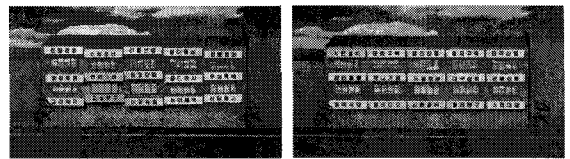


Fig. 4. Disorderly installation of signboards at the front side of buildings with 100% installation (l)  
Orderly installation of signboards at the front side of buildings with 100% installation (r).

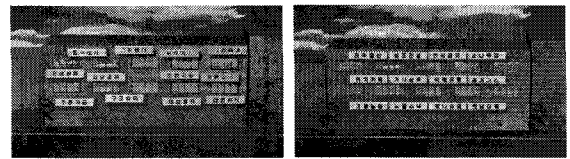


Fig. 5. Disorderly installation of signboards at the front side of buildings with 80% installation (l)  
Orderly installation of signboards at the front side of buildings with 80% installation (r).



Fig. 6. Disorderly installation at the front side of buildings with 60% installation (l)  
Orderly installation at the front side of buildings with 60% installation (r).

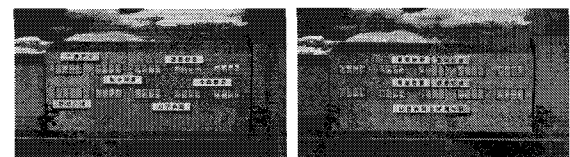


Fig. 7. Disorderly installation at the front side of buildings with 40% installation (l)  
Orderly installation at the front side of buildings with 40% installation (r).

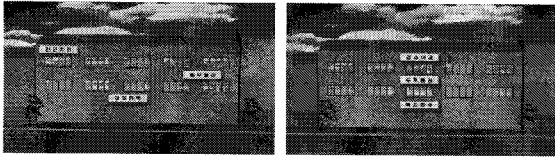


Fig. 8. Disorderly installation at the front side of buildings with 20% installation (l)  
Orderly installation at the front side of buildings with 20% installation (r).

installation of signboards on the buildings, it can be stuck 15 signboards on the wall. And in case of 20% installation, the number of signboards is 3.

The next figures 9 ~ 13 show the 10 samples for testing the hypothesis B. Here for this experiment, one another variable is added. Namely, it is carried out the test of different arrangement under the different scales of signboards.

### 5.3. Statistical analysis on the visual cognition

The Experiment of visual cognition was carried out

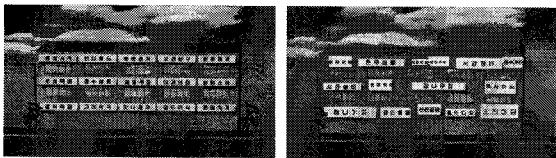


Fig. 9. Identical scale of signboards at the front side of buildings with 100% installation (l)  
Different scale of signboards at the front side of buildings with 100% installation (r).

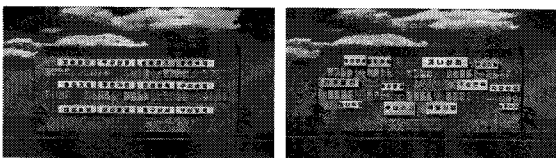


Fig. 10. Identical scale at the front side of buildings with 80% installation (l)  
Different scale at the front side of buildings with 80% installation (r).



Fig. 11. Identical scale at the front side of buildings with 60% installation (l)  
Different scale at the front side of buildings with 60% installation (r).

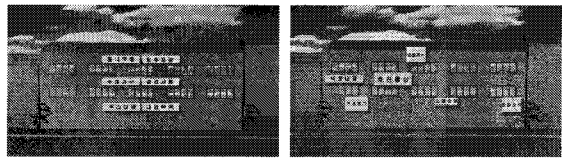


Fig. 12. Identical scale at the front side of buildings with 40% installation (l)  
Different scale at the front side of buildings with 40% installation (r).

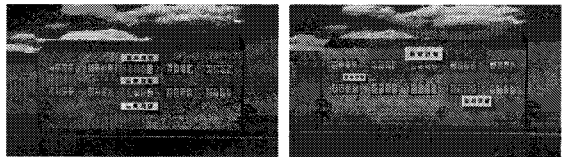


Fig. 13. Identical scale at the front side of buildings with 20% Installation (l)  
Different scale at the front side of buildings with 20% installation (r).

with 60 tested persons, who watched the pictorial image files on screen. The tables 4 and 5 show the result, how many the tested persons perceive the contents of signboards.

## 6. Hypothesis tests approached by Two-Way ANOVA

### 6.1. The testing of hypothesis A

The Null Hypothesis A is described as follows: "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the difference of the number and the arrangement of signboards." On the contrary, the Alternative Hypothesis is "the awareness of outdoor signboards on the buildings has a difference according to the difference of the number and the arrangement of signboards." If it is used the Two-Way ANOVA, the Hypotheses can be re-described as follows:

- $H_{0(a)}$  A : "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the different number of signboards."
- $H_{0(b)}$  A : "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the different arrangement of signboards."
- $H_{1(ab)}$  A : "the awareness of outdoor signboards on the buildings has a difference according to the different number and arrangement of signboards."

The Fig. 14 shows the result of this Two Way

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Table 4. Result of hypothesis A (D = disorderly arrangement, O = orderly arrangement)

Tested persons	Condition of experiment	15 (100%)		12 (80%)		9 (60%)		6 (40%)		3 (20%)	
		D	O	D	O	D	O	D	O	D	O
1		2	5	6	8	7	8	3	6	3	3
2		5	3	2	5	4	4	1	3	3	3
3		4	7	3	8	3	5	3	4	3	3
.		.	.	.	.	.	.	.	.	.	.
.		.	.	.	.	.	.	.	.	.	.
.		.	.	.	.	.	.	.	.	.	.
60		5	6	5	9	5	9	4	6	3	3
total		311	373	256	375	258	354	235	290	176	179
Maximal Number of Perception		8	10	8	9	8	9	6	7	3	3
Minimal Number of Perception		0	2	2	1	2	3	1	1	2	2
Average Number of Perception		5.2	6.2	4.3	6.3	4.3	5.9	3.9	4.8	2.9	3.0
Ratio of Average of Perception		34.6	41.4	35.6	52.1	47.8	65.6	65.3	80.6	97.8	99.4
Variance		3.2370	2.9	2.3	3.3	2.3	3.0	1.4	1.4	0.1	0.0

Table 5. Result of hypothesis B (I = identical scale, D = different scale)

Tested persons	Condition of Experiment	15 (100%)		12 (80%)		9 (60%)		6 (40%)		3 (20%)	
		I	D	I	D	I	D	I	D	I	D
1		9	6	8	5	6	5	6	3	3	3
2		4	3	4	2	6	3	3	4	2	2
3		5	5	3	1	7	5	6	3	3	3
.		.	.	.	.	.	.	.	.	.	.
.		.	.	.	.	.	.	.	.	.	.
.		.	.	.	.	.	.	.	.	.	.
60		10	6	6	8	7	6	6	6	3	3
total		368	301	360	241	306	218	258	213	177	169
Maximal Number of Perception		10	9	10	10	9	6	6	7	3	3
Minimal Number of Perception		1	0	2	1	2	1	2	1	2	1
Average Number of Perception		6.1	5.0	6.0	4.0	5.1	3.6	4.3	3.6	3.0	2.8
Ratio of Average of Perception		40.9	33.4	50	33.5	56.7	40.4	71.7	59.2	98.3	98.9
Variance		4.0	3.3	3.7	3.9	2.8	1.8	1.5	2.0	0.0	0.2

ANOVA. It is presented the comparison of the average number of signboards awareness between the disorderly arrangement and the orderly arrangement. It is sure that the tested persons could better be aware of the signboards, if the numbers of signboards are fewer. But the more important thing is that it could be confirmed that the orderly arrangement is much better for the awareness and the 80% of installation showed the biggest difference of awareness.

According to ANOVA, the variable  $a$  (the number of signboards) has 72.9 as the value of F-assumption, which is bigger than 2.38, the Value of F-Rejection. Therefore  $H_{0(a)}$  A is rejected. And the variable  $b$  (the

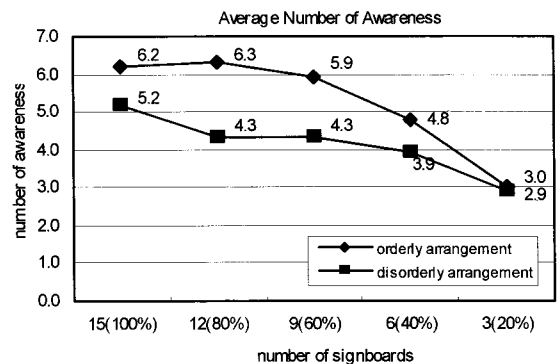


Fig. 14. The average number of awareness (result of hypothesis A).

Table 6. Result of ANOVA on hypothesis testing A

Source	Sum of Squares (SS)	Degrees of freedom (df)	Mean of Squares (MS)	F	P-Value	F-Rejection Value
Variable <i>a</i> (rank)	558.9766667	4	139.7442	72.97238	3.15E-50	2.387037
Variable <i>b</i> (column)	192.6666667	1	192.6667	100.6077	5.73E-22	3.857268
Interaction effect	69.58333333	4	17.39583	9.083852	3.99E-07	2.387037
Residual	1129.866667	590	1.915028			
Result	1951.093333	599				

arrangement of signboards) has 100.6 as the one of -assumption, which is bigger than 3.85, the Value of F-Rejection. Therefore  $H_{0(b)}$  A is also rejected. As the result  $H_{1(ab)}$  A is accepted. And it is confirmed the existence of the interaction effect based on the P-Value (P-Value > 0.05).

## 6.2. The testing of hypothesis B

The Null Hypothesis B is described as follows: "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the difference of the scale and the number of signboards." On the contrary, the Alternative Hypothesis B is "the awareness of outdoor signboards on the buildings has a difference according to the difference of the scale and the number of signboards." Here for the Hypothesis Testing, it is also used the Two-Way ANOVA., And in this case the Hypotheses can be also redescribed as follows:

- $H_{0(a)}$  B : "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the different number of signboards."
- $H_{0(b)}$  B : "the awareness of outdoor signboards on the buildings doesn't have any difference in spite of the different scale of signboards."
- $H_{1(ab)}$  B : "the awareness of outdoor signboards on the buildings has a difference according to the different number and scale of signboards."

At the Fig. 15 it is presented the comparison of

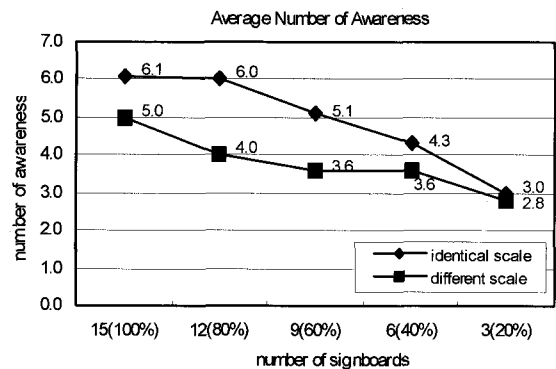


Fig. 15. The Average Number of Awareness (result of Hypothesis B).

the average number of signboards awareness between the identical and different scales of signboards. This result is similar to the one of Hypothesis A. Namely, the tested persons could better be aware of the signboards, if all of scales of signboards are identical. And in the case of 80% installation the awareness of the tested persons has the biggest difference.

According to ANOVA, the variable *a* (the number of signboards) has 54.73 as the value of F-assumption, which is bigger than 2.38, the Value of F-Rejection. Therefore  $H_{0(a)}$  B is rejected. And the variable *b* (the scale of signboards) has 76.22 as the one of -assumption, which is bigger than 3.85, the Value of F-Rejection. Therefore  $H_{0(b)}$  B is also rejected. As the result  $H_{1(ab)}$  A is accepted. And it is

Table 7. Result of ANOVA on hypothesis testing B

Source	Sum of Squares (SS)	Degrees of freedom (df)	Mean of Squares (MS)	F	P-Value	F-Rejection Value
Variable A (rank)	511.9233	4	127.9808	54.73561	2.97E-39	2.387037
Variable B (column)	178.215	1	178.215	76.22006	2.6E-17	3.857268
Interaction effect	59.14333	4	14.78583	6.323694	5.5E-05	2.387037
Residual	1379.517	590	2.338164			
Result	2128.798	599				



confirmed the existence of the interaction effect based on the P-Value ( $P\text{-Value} > 0.05$ ).

Consequently, it is the Hypothesis A and the Hypothesis B are tested that the awareness of signboards is affected by the arrangement, the scale and the installation percentage of signboards.

## 7. Conclusion

This study has a main purpose to know the information delivering power of the advertisement signboards on the street. As the result, it is proved that the cognitive power of the tested persons is clearly affected by the number of signboards and the arrangement of them. Under this context, the conclusion of this study is summarized as follows.

First, the less the number of advertisement signboards on the buildings are, the better is the awareness degree of the tested persons. Namely, in the case that the number of installed signboards on the buildings is 3, the tested persons can be aware of 98% of the signboards. On the contrary, if the number of them increases to 15, then the awareness of the tested persons decreases to 38%. But this can be an undoubted result because of the limit of cognitive power of human beings. And it is impossible and irrational to restrict the number of signboards without consideration of the one of stores. Therefore it is important to find the most reasonable proportion of them.

Secondly, the difference of the awareness toward the signboards in relation to the ANOVA provides the most proper proportion of signboard's installation. Namely, it has been proved that the 80% installation of signboards on the building surface has the best information delivering power.

Thirdly, the installation of signboards on the building surface affects on the awareness of the tested persons. Generally, the tested persons were better and easier aware of the bigger advertisement signboards. It means that it can cause the excessive and unnecessary competition of the traders to install the relatively bigger signboards for their own stores. Therefore in order to avoid this kind of problem and to help the find the information easier, it is most reasonable to uniform the scale of signboards.

In spite of these research results, this study has some scientific limitations, for the visual reality is not compared with the real condition. Therefore it is

acknowledged some follow-up researches for the verification.

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