

Effectiveness of Computer Graphic Animation for the Landscape Design of Highway

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(Received July 11, 1995)

Abstract

This paper discusses about the evaluation of whole image of the road, similarity and effectiveness that receive it from the computer graphic animation and real running VTR of KANSAI airport highway by a psychological experiment of semantic differential method. We discussed about the effectiveness and main point of production of computer graphic animation as the tool that examines the inside landscape of highway.

The results are as follows. About the whole image of CG animation, the evaluation of civil engineers is higher than it of general users. About the evaluation of similarity, civil engineer's evaluation is higher than it of general users in standard course. Evaluation of effectiveness is high generally in all groups. A correlation of evaluation of similarity and effectiveness is low, and the evaluation of effectiveness is higher than it of similarity. This reason is not only caused by the evaluation of similarity of structures and background but also evaluation of running reality. Level of production of background and structures at both sides of the road influence to evaluation of similarity for CG animation. In case of toll gate, the level of production of roof and sign influences to evaluation of similarity greatly. It is important to carry out sufficient examination in an advance about accuracy of production of structure and background by the object that examine the landscape design.

1. Introduction

Recently, we are carrying out an examination of the landscape design by computer graphic (below CG) and computer graphic animation in a stage of design of civil structures. Especially, it is pointed out that computer graphic animation is effective as a tool that examine the inside landscape design of highway.

It is the biggest characteristic that computer graphic animation has the sense of emersion approximated in real running condition in comparison with a hydrostatic image. Therefore, computer graphic animation is demanded not only the sense of running but also the reality of the structures on the road unlike the creation of the works of an animation. Accordingly, evaluating the effectiveness of computer graphic animation as a tool that examine the landscape design, it is important that a psychological evaluation of reality of structures and background in running condition.

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Heretofore, there are many cases of the examination of landscape design that used computer graphic or computer graphic animation, and there are reserches of the evaluation of structure design or the design system. However, there are few researches that examined the effectiveness by a comparison with the structure that exists. We carry out a psychological experiment about the evaluation of whole image of the road, similarity and effectiveness that receive it from the computer graphic animation and real running VTR of KANSAI airport highway in this paper, and on the basis of the result, we discuss the effectiveness of computer graphic animation as a tool that examine the landscape design.

2. Outline of the psychological experiment

(1) Computer graphic animation and real running VTR for psychological experiment

The evaluative objects are the computer graphic animation and the real running VTR of inside landscape of Kansai airport highway. We examine 2 cases.

- [1] Running condition in standard course (1.0 km)
- [2] Running condition in IZUMISANO toll gate (0.5 km)

Computer graphic animation is made by the system showed in figure-1. The production procedure of computer graphic animation is shown in table-1. First of all,

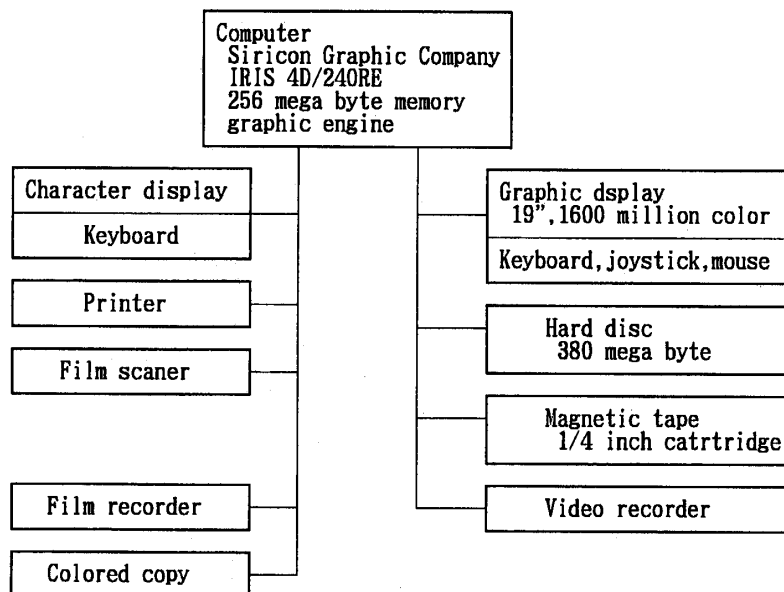


Fig.-1 Production system of computer graphic animation

we input a linear (linear of plane, vertical alignment, cross grade and widening) and structure data of road and decided each color and material by color editor and mapping data. Secondly, we prepared faces of road surface and structure, and carried out a coordinate conversion that arranges the running point of view and prepared a digital model. Thirdly, we calculated scenes of 30 frames per second rates by a

Table-1 Production procedure of computer graphic animation

1. Input of route alignment	1. Horizontal alignment Input of parameter of clothoid, radius, length and start point of curve and these coordinates 2. Vertical alignment Input of distance, height, slope and length of vertical curve at changing point of vertical 3. Cross grade Input of distance and superelevation runoff value at changing point of superelevation 4. Widening Input of distance and widening value at changing point of widening
2. Input of structure	1. Surface railing 2. Noise barrier 3. Highway lighting 4. Emergency telephone 5. Speed limit sign 6. Pill (in the shape of gate and F) 8. Traffic sign 9. Tollgate 10. Lane marking and Zebra marking 11. Elevated railroad (JR and Nankai)
3. Coloring	Simulation of harmonious color and rendering for material
4. Set up condition of computer graphic animation	1. Running simulation Matching running speed of animation to real running at 80 km/h 2. Condition of computer graphic Set up position and direction of view point, visual angle and position and kind of light 3. Recording Recording animation at scenes 30 frame/sec on video tape

simulation corresponding to running speed (80 km/h) and recorded this animation to VTR directly.

About the real running VTR, we drove the same route as computer graphic animation in condition which there is not a running vehicle in the front with a video camera set beside the driver.

(2) Experimental method

We presented the edited VTR of computer graphic animation and real running VTR simultaneously in a large screen by using video projector (16 inches) and poured the sound in car. The procedures of the experiment are as follows. Firstly, VTR was presented once, next we explained the content of question (the evaluation of whole image of the road, similarity and effectiveness that receive it from the computer graphic animation and real running VTR). After that, we present VTR twice continuously and gave the reply time to questions. Finally, the VTR was presented again to confirm and reply leaky points.

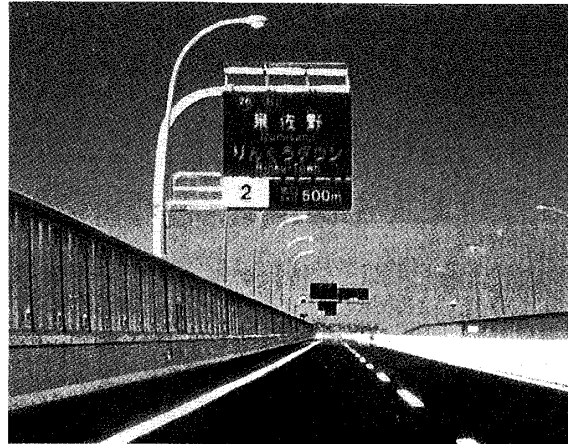
The groups for tests are civil engineers of Japan Highway Public Corporation (Osaka bureau of construction and consulting corporation) as a professional engineer, students of Yamaguchi university (male and female) and Setsunan university (male) as a general user (table-2). Setsunan university students travelled the highway by bus in an advance to examine the comparison of the evaluation with Yamaguchi university students without a real running experience. The reason of constitution of groups is as follows. Firstly, we inspect the difference of evaluation between engineer and user. Secondly, we inspect the influential degree of running experience to the evaluation of the effectiveness of computer graphic animation.

Also, in the following analysis, we give each 1.0, 0.75, 0.5, 0.25, 0.0 values to adjectival 5 stage evaluations.

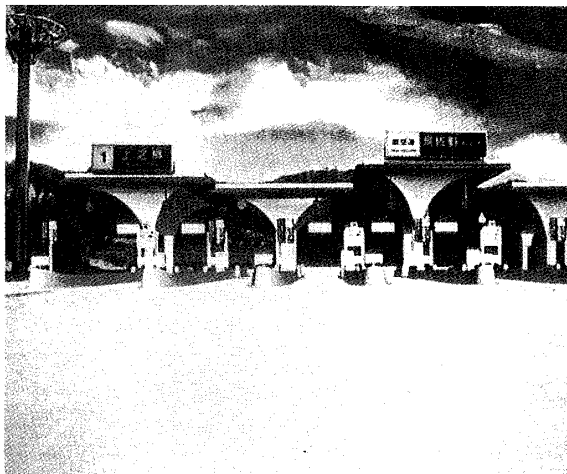
KANSAI airport highway
compute graphic animation



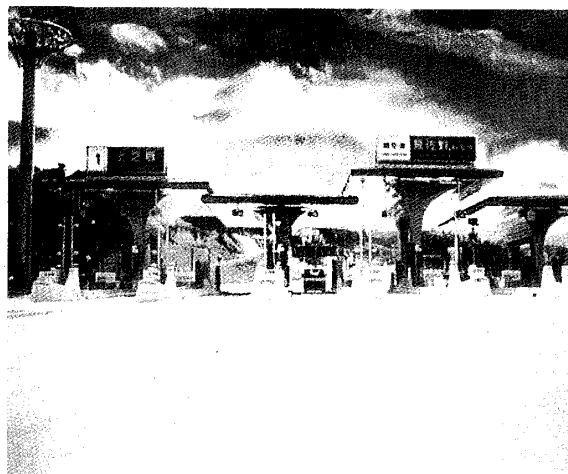
real running VTR



IZUMISANO toll gate
computer graphic animation



real running VTR



photograph-1 Computer graphic animation and real running VTR used a psychological evaluation

Table-2 Group and age of testers

group age	total	Japan Highway Public Corporation	Consulting Corporation	Yamaguchi University Male	Yamaguchi University Female	Setsunan University Male
total	240	47	47	49	47	50
10-19	1	-	-	-	1	-
20-29	176	10	21	49	46	50
30-39	30	17	13	-	-	-
40-49	27	18	9	-	-	-
50-59	6	2	4	-	-	-

3 . Analysis of Evaluation

(1)Evaluation of whole image of the road

Fig.-2 shows the results of evaluation of whole image of the road of computer graphic animation. The evaluation of lightness, sharpness and nimbleness are high generally in case of running condition in standard course. Especially, the civil engineer's evaluation is higher than it of the general user. Conversely, evaluations of openness of

standard course	openness	nimbleness	sharpness	freshness	lightness	emersion
evaluation	0.5	0.5	0.5	0.5	0.5	0.5
total	●	●	●	●	●	●
Japan Highway Public Corporation	●	●	●	●	●	●
Consulting Corporation	●	●	●	●	●	●
Yamaguchi University Male	●	●	●	●	●	●
Yamaguchi University Female	●	●	●	●	●	●
Setsunan University Male	●	●	●	●	●	●
difference	○	○	○	○	×	○
toll gate	softness	openness	nimbleness	sharpness	freshness	emersion
evaluation	0.5	0.5	0.5	0.5	0.5	0.5
total	●	●	●	●	●	●
Japan Highway Public Corporation	●	●	●	●	●	●
Consulting Corporation	●	●	●	●	●	●
Yamaguchi University Male	●	●	●	●	●	●
Yamaguchi University Female	●	●	●	●	●	●
Setsunan University Male	●	●	●	●	●	●
difference	○	○	×	×	○	○

- * '●' is the mean of computer graphic animation.
- '|—|' is standard deviation.
- '○' is that there is difference between each group.
- '×' is that there is not difference between each group.

Fig.-2 Evaluation of whole image of the road

females of Yamaguchi university is in a low trend. There is statistical difference with dangerous rate 5% except for lightness. And the civil engineer's evaluations are high relatively regarding emersion and the evaluation of students are low.

In case of toll gate, the evaluation of sharpness and nimbleness are high generally and softness is low relatively. The civil engineer's evaluation is a little higher than it of users in softness, openness, and freshness, the evaluation of toll gate is lower in comparison with standard course about emersion and civil engineer's mean is about 0.5.

As a result, the civil engineer's evaluation is higher generally than it of users and there is not almost influence of running experience about whole image of computer graphic animation.

(2)Landscape component evaluation and whole evaluation of similarity

We examined about the similarity of landscape component that prescribes reality of computer graphic animation. The landscape component that shown in figure-3 was

standard course	noise barrier (form)	noise barrier (color)	median strip (form)	median strip (color)	illumination (form)	road surface (color)	sky (color)
evaluation	0.5	0.5	0.5	0.5	0.5	0.5	0.5
total	●	●	●	●	●	●	●
Japan Highway Public Corporation Consulting Corporation	●	●	●	●	●	●	●
Yamaguchi University Male	●	●	●	●	●	●	●
Yamaguchi University Female	●	●	●	●	●	●	●
Setsunan University Male	●	●	●	●	●	●	●
difference	○	○	○	○	×	○	○
toll gate	roof (form)	roof (color)	sign (form)	sign (color)	post (form)	post (color)	box (form)
evaluation	0.5	0.5	0.5	0.5	0.5	0.5	0.5
total	●	●	●	●	●	●	●
Japan Highway Public Corporation Consulting Corporation	●	●	●	●	●	●	●
Yamaguchi University Male	●	●	●	●	●	●	●
Yamaguchi University Female	●	●	●	●	●	●	●
Setsunan University Male	●	●	●	●	●	●	●
difference	×	○	×	×	×	○	○
standard course	background building	material	shadow	image angle	shaking		
evaluation	0.5	0.5	0.5	0.5	0.5		
total	●	●	●	●	●		
Japan Highway Public Corporation Consulting Corporation	●	●	●	●	●		
Yamaguchi University Male	●	●	●	●	●		
Yamaguchi University Female	●	●	●	●	●		
Setsunan University Male	●	●	●	●	●		
difference	○	×	×	○	×		
toll gate	road surface (color)	sky (color)	background mountain	material	shadow	image angle	shaking
evaluation	0.5	0.5	0.5	0.5	0.5	0.5	0.5
total	●	●	●	●	●	●	●
Japan Highway Public Corporation Consulting Corporation	●	●	●	●	●	●	●
Yamaguchi University Male	●	●	●	●	●	●	●
Yamaguchi University Female	●	●	●	●	●	●	●
Setsunan University Male	●	●	●	●	●	●	●
difference	×	○	×	○	×	×	○

- * '●' is the mean of similarity of computer graphic animation and real running VTR.
- '|—|' is standard deviation.
- '○' is that there is difference between each group.
- '×' is that there is not difference between each group.

Fig.-3 Similarity of computer graphic animation and real running VTR

extracted as the similarity item of computer graphic animation and real running VTR. Observing the mean in each group, form evaluations of noise barrier, median strip and illumination beside road are high generally and color evaluations are low in standard course. Form evaluation of roof, sign and post are high and color evaluation are low in the toll gate, and color evaluation of road and sky and evaluation of material and shade are lower than form evaluation of structures. On the other hand, the evaluation of image angle and shaking that is related to animation photographing technology are high about both portraits in all groups. Observing in groups, the evaluation of Yamaguchi university students (female) and Sestunan university students are low relatively in the item that similarity is low in standard course. Especially color evaluation of the road surface and sky by Yamaguchi university students (female) is low in the toll gate.

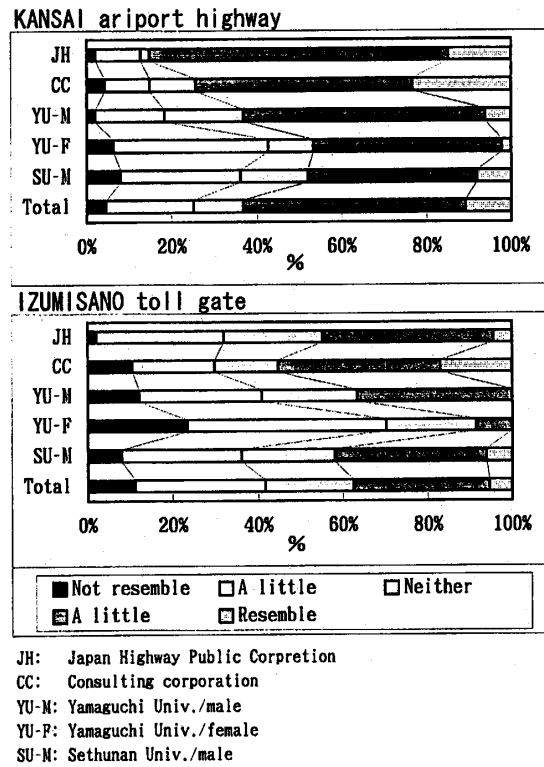


Fig.-4 Rate of whole evaluation of similarity

Table-3 Difference of whole evaluation of similarity between each groups

	KANSAI airport highway					IZUMISANO toll gate				
	①	②	③	④	⑤	①	②	③	④	⑤
①Japan Highway Public Corporation			●	●	●				●	
②Consulting Corporation				●	●				●	
③Yamaguchi University Male	●								●	
④Yamaguchi University Female	●	●				●	●	●		●
⑤Setsunan University Male	●	●							●	

● : There is difference with dangerous rate 5%.

Nextly, result of whole evaluation of similarity is shown in fig.-4. "Resemble and resemble a little" is occupied over 60% in all groups in standard course. Observing each group, it is pointed out that the civil engineer's evaluations of Japan Highway and consulting corporation are higher than it of general users. The result of whole evaluation of similarity between each groups is shown in table-3, there is statistical

difference between Japan Highway engineers and all students with 5% dangerous rate and there is a difference between consulting engineers and the students except for Yamaguchi university students (male) also. On the other hand, "resemble and resemble a little" is occupied about 40% and "not resemble and not resemble a little" is occupied over 40% in all groups in the toll gate, so similarity is lower than it in standard course. In comparison with each group, it is pointed out that the evaluation of Yamaguchi university student (female) is low especially. And the color evaluations of road surface and sky are low in the group. Accordingly, there is a statistical difference between Yamaguchi university students (female) and other groups and there is not a difference between the other groups.

There is a difference in similarity evaluation of civil engineers and general users in case of running condition in standard course, and the engineer's evaluation is higher. A presence of real running experience do not influence to whole evaluation of similarity, so the method comparing real running VTR with computer graphic animation is appropriate.

(3)Evaluation of effectiveness of computer graphic animation

Next, we examined about the effectiveness of computer graphic animation as the tool that examine the landscape design, and that is the main discourse of this paper. The result of each group is shown in figure-5. "Although computer graphic is useful, the

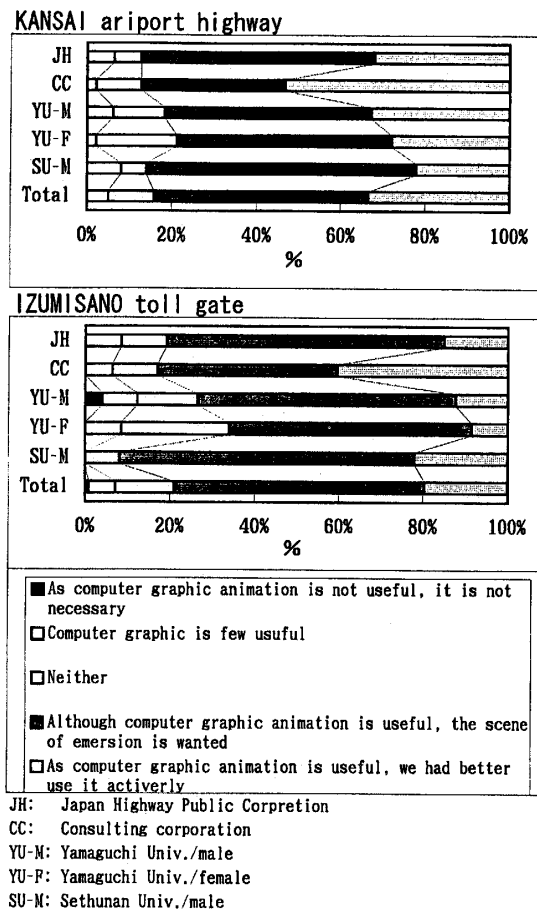


Fig.-5 Rate of whole evaluation of effectiveness

Table-4 Difference of whole evaluation of effectiveness between each groups

	KANSAI airport highway					IZUMISANO toll gate				
	①	②	③	④	⑤	①	②	③	④	⑤
①Japan Highway Public Corporation										
②Consulting Corporation					●			●	●	●
③Yamaguchi University Male							●			
④Yamaguchi University Female							●			
⑤Setsunan University Male		●					●			

● : There is difference with dangerous rate 5%.

sense of emersion is wanted” is highest in 45%. Nextly, ”because computer graphic is useful, we had better use it actively” is high in 35%, so over 80% in all groups are admitting the effectiveness. Observing by groups, the evaluation of consulting engineers is highest and Japan Highway is second. Observing the different result between groups in table-4, there is difference between consulting engineers and Setsunan university students.

It is characteristic that ”although computer graphic is useful, the sense of emersion is wanted” is occupied 60% and ”because computer graphic is useful, we had better use it actively” is occupied 20% in second. In case of tool gate, over 80% in all groups are admitting an effectiveness, but it is lower than standard course evaluation.Observing it in each group, the evaluation of consulting engineers is highest and there is statistical difference between the engineers and general users.

Over 80% testers evaluated that computer graphic is effective as a tool that examine the landscape design. But we must pay attention to the point that ”the sence of emersion is wanted” is the highest. There is not the difference of evaluation between civil engineer and general user like as similarity, and there is not the influence by running experience.

4 . The relation between similarity and effectiveness of computer graphic animation

Generally, it is natural that evaluation of effectiveness goes up if similarity is high. There is a correlation in evaluation of effectiveness and similarity of the computer graphic animation, but both evaluation are not agreeing completely from the result of this examination. The relation between evaluation of effectiveness and similarity is showed in table-5. It does not fill 40% that 5 stage evaluation is agreeing in standard course and toll gate. Coefficient of correlation of both evaluations is 0.44 and 0.52. The reason is that the evaluation of effectiveness exceeds whole evaluation of similarity. Especially, there are many people evaluated that ”neither and not resembles a

Table-5 Relation between similarity and effectiveness

the whole evaluation of similarity		the whole evaluation of effectiveness					
		1	2	3	4	5	total
KANASAI airport highway	1	-	3	2	5	1	11 (4.9)
	2	-	4	9	32	4	49 (20.4)
	3	-	3	4	18	3	28 (11.7)
	4	-	2	10	62	52	126 (52.5)
	5	-	-	1	5	20	26 (10.8)
	total	-	12 (5.0)	26 (10.8)	122 (50.8)	80 (33.3)	240 (100.0)
IZUMISANO toll gate	1	2	7	9	8	-	26 (10.8)
	2	-	7	10	47	9	73 (30.4)
	3	-	1	7	37	4	49 (20.4)
	4	-	-	5	50	22	77 (32.1)
	5	-	-	-	1	12	13 (5.4)
	total	2 (0.8)	15 (6.3)	33 (13.8)	143 (59.6)	47 (19.6)	240 (100.0)

Appendix:

· "(" is rate

· the whole evaluation of Similarity

1. Not resemble 2. A little 3. Neither 4. A little 5. resemble

· the whole evaluation of Effectiveness

1. As computer graphic animation is not useful, it is not necessary.

2. Computer graphic is few useful.

3. Neither.

4. Although computer graphic animation is useful, the sense of emersion is wanted.

5. As computer graphic animation is useul, we had better use it actively.

Table-6 Division of group to analyze effectiveness

division of group		the whole evaluation of effectiveness	
the whole evaluation of similarity	name	group 1	group 2
		Although computer graphic animation is useful, the sence of emersion is wanted Neither	Because computer graphic animation is useful, we had better use it actively
resemble resemble a little	standard course G 1	7 8	7 2
	tool gate G 3	5 6	3 4
		Niether Computer graphic animation few useful	Because computer graphic animation is useful, we had better use it actively Although computer graphic animation is useful, the sence of emersion is wanted
neither not resemble a little	standard course G 2	2 0	5 7
	tollgate G 4	2 5	9 7

Appendix: Figures are number of samle.

little" in similarity and "although computer graphic is useful, the sence of emersion is wanted" in effectiveness. There are many people evaluated that "resembles a little" in similarity and "because computer graphic is useful, we had better use it actively" in effectiveness.

Thereupon, we classified 2 groups that the similarity is different in table-6 in to high group and low group of each evaluation of effectiveness to clear the factors of difference. We carried out the mathematical quantification theory 2 analysis by HAYASHI. Category range, correlation ratio and hit ratio are shown in figure-6. About the standard course, the correlation ratio is 0.54 and hit ratio is 0.74 in G1 that similarity is high, so fine judgement accuracy is not obtained. Observing the ranges, the widest is the sence of emersion and the material, form of illumination pole and

standard course	G 1					G 2						
	division				category score	range	division				category score	range
	1	2	3	4			5	1	2	3		
sence of emersion	●	/	▲	■	●	0.916	●	/	▲	■	●	0.927
noise barrier(form)	●	/	▲	■	●	0.394	●	/	▲	■	●	1.018
noise barrier(color)	●	/	▲	■	●	0.121	●	/	▲	■	●	0.384
median strip(form)	●	/	▲	■	●	0.136	●	/	▲	■	●	0.114
median strip(color)	●	/	▲	■	●	0.222	●	/	▲	■	●	0.558
illumination(form)	●	/	▲	■	●	0.547	●	/	▲	■	●	0.788
road surface(color)	●	/	▲	■	●	0.071	●	/	▲	■	●	0.175
sky(color)	●	/	▲	■	●	0.207	●	/	▲	■	●	0.048
background·building	●	/	▲	■	●	0.388	●	/	▲	■	●	0.308
material	●	/	▲	■	●	0.227	●	/	▲	■	●	0.584
shadow	●	/	▲	■	●	0.788	●	/	▲	■	●	0.842
image angle	●	/	▲	■	●	0.543	●	/	▲	■	●	0.438
shaking	●	/	▲	■	●	0.311	●	/	▲	■	●	0.624
hit ratio	74.0%					68.8%						
correlation ratio	0.544					0.504						
group 1	0.523					0.852						
group 2	-0.566					-0.299						
loll gate	G 3					G 4						
	division				category score	range	division				category score	range
	1	2	3	4			5	1	2	3		
sence of emersion	●	/	▲	■	●	0.957	●	/	▲	■	●	0.572
roof(form)	●	/	▲	■	●	0.275	●	/	▲	■	●	1.015
roof(color)	●	/	▲	■	●	0.445	●	/	▲	■	●	0.583
sign(form)	●	/	▲	■	●	0.722	●	/	▲	■	●	0.657
sign(color)	●	/	▲	■	●	0.324	●	/	▲	■	●	0.377
post(form)	●	/	▲	■	●	0.114	●	/	▲	■	●	0.505
post(color)	●	/	▲	■	●	0.263	●	/	▲	■	●	0.588
box(form)	●	/	▲	■	●	0.342	●	/	▲	■	●	0.376
road surface(color)	●	/	▲	■	●	0.628	●	/	▲	■	●	0.283
sky(color)	●	/	▲	■	●	0.227	●	/	▲	■	●	0.244
background·mountain	●	/	▲	■	●	0.144	●	/	▲	■	●	0.247
material	●	/	▲	■	●	0.283	●	/	▲	■	●	0.573
shadow	●	/	▲	■	●	0.758	●	/	▲	■	●	0.471
image angle	●	/	▲	■	●	0.627	●	/	▲	■	●	0.485
shaking	●	/	▲	■	●	0.119	●	/	▲	■	●	0.584
hit ratio	76.7%					65.0%						
correlation ratio	0.662					0.415						
group 1	0.610					0.830						
group 2	-0.860					-0.207						

* '●' is that evaluation is the most low.
 '▲' is that evaluation is second low.
 '■' is that evaluation is third low.

Fig.-6 Analysis to announce of difference of similarity and effectiveness

shadow is wide in the order. Especially, the category score of sence of emersion and material is high to negative, so the evaluation of effectiveness goes up, in case that similarity to these elements is high. In G2 that similarity is low, correlation ratio is 0.50 and hit ratio is 0.69. G2 is almost the same judgement accuracy as G1. Observing the ranges, the widest is the form of noise barrier and the material, sence of emersion and portrait angle is wide in the order and it is characteristic that influence of sence of emersion and material are wide, that shows the running reality influence to an effectiveness greatly with the similarity of each landscape component. On the other hand, the correlation is 0.66 and hit ratio is 0.77 in G3 that similarity is high in the toll gate. Observing the ranges, the widest is sence of emersion and shadow, the form of roof and color of road surface is wide in the order. Especially, a category score is high to negative in form of roof, sence of emersion and shadow. The evaluation of effectiveness goes up, as similarity to these elements is high. In G2 that similarity is low, the judgement accuracy is low as correlation ratio is 0.41 and hit ration was 0.65.

Not only evaluation of similarity of structures and background but also evaluation of running reality increases to an effectiveness of a computer graphic animation.

5 . Influential degree to whole evaluation of similarity of landscape component

To improve the effectiveness of computer graphic animation, it is important to improve the each evaluation of landscape component that influence to whole evaluation of similarity from the results of analysis. In this chapter, regression analysis of similarity is applied to calculate the fluctuation of whole evaluation of similarity according to the level of each landscape component. We carry out a fluctuative estimation of whole evaluation by using this model.

(1) Estimation of similarity function

First of all, it is shown in table-7 that the result of regression analysis (method passing the origin), in which the whole evaluation of similarity is accounted variable and evaluation in each element is account variable. In standard course, we classified testers into Japan Highway, consulting engineers and students. In the toll gate, we classified them, that was admitted statistical difference to whole evaluation of similarity into female students of Yamaguchi university and the other groups.

In case of civil engineers in standard course, it is admitted that the influence of evaluation to form of noise barrier, median strip, color of road surface, sky and shade of structures. In these elements, standard regression coefficient of form of noise barrier and median strip are high. Adding to them, the form of an illumination pole influences in case of students. The correlation coefficient is 0.98, 0.94 in each.

In case of the group except for female students in the toll gate, the form of sign, color of roof, shadow and color of background and sky influence to it. Especially, standard regression coefficient of form evaluation of sign is high, the correlation coefficient is 0.93. On the other hand, in case of students that the evaluation of similarity is low, the influence of evaluation of color of roof and material are big and the correlation coefficient is 0.73 and the accuracy as an estimation model is low. Accordingly, in the following analysis, we carried out an estimation except for female students.

Table-7 Function of similarity

Standard course	Tool gate
Civil engineers (R=0.981)	Male (R=0.932)
$Y = 0.286X_{11} + 0.223X_{12} + 0.219X_{16}$ $+ 0.213X_{15} + 0.129X_{14}$	$Y = 0.333X_{22} + 0.300X_{21} + 0.234X_{25}$ $+ 0.216X_{23}$
(0.322) (0.237) (0.185) (0.168) (0.123)	(0.447) (0.236) (0.193) (0.168)
Student (R=0.941)	Female (R=0.726)
$Y = 0.258X_{15} + 0.241X_{14} + 0.230X_{11}$ $- 0.146X_{16} + 0.140X_{13}$	$Y = 0.808X_{24} + 0.483X_{21}$
(0.189) (0.236) (0.273) (0.136) (0.190)	(0.420) (0.422)
Y :the whole evaluation of Similarity X ₁₁ :noise barrier(form) X ₁₂ :medital trip(form) X ₁₃ :illumination(form) X ₁₄ :road surface(color) X ₁₅ :sky(color) X ₁₆ :shadow	Y :the whole evaluation of Similarity X ₂₁ :roof(color) X ₂₂ :sign(form) X ₂₃ :road surface(color) X ₂₄ :material X ₂₅ :shadow

Appendix: "()" is standard regression coefficient
 "R" is correlation coefficient

(2)Influential degree to the whole evaluation of similarity of landscape element

Nextly, by using this regression function, we integrated the evaluation variable (Xij) of landscape component as follows, [F1] the form and color of structures. [F2] material and shadow [F3] color of road surface and sky. We substituted 1.0 to each element (=resemble) and calculated the whole evaluation of similarity (Y), and calculated the whole evaluation in case that we substituted 1.0 to all evaluation variables that is incorporated to the regression function. The result is shown in figure-7. In standard course, in case that 1.0 is substituted to evaluation of [F1] and [F2], the whole evaluation rises 0.11 points in civil engineers. In case of [F3], it rises 0.16 points. In students, if 1.0 is substituted to evaluation of [F1], [F2] and [F3], it rises 0.1, 0.08 points and it rises 0.28 points in [F3]. In the running condition in standard course, it is contributed to an improvement of a similarity to improve the production accuracy of color of the road surface and sky that becomes a background. It is contributed in the order of the form of noise barrier both sides of the road and median strip, and shadow. When we substituted 1.0 to the evaluations of all elements, a similarity become 1.0 (=resemble). Improving the production accuracies of these landscape components, the evaluation of effectiveness of computer graphic animation becomes high.

In the toll gate, when we substituted 1.0 to evaluation of [F1], [F2] and [F3], the whole evaluations rises 0.26 points in [F1], 0.15 points in [F2], and [F3] in the groups except for female students. It is contributed to the improvement of similarity to improve the production accuracy of a color of roof and form of sign that

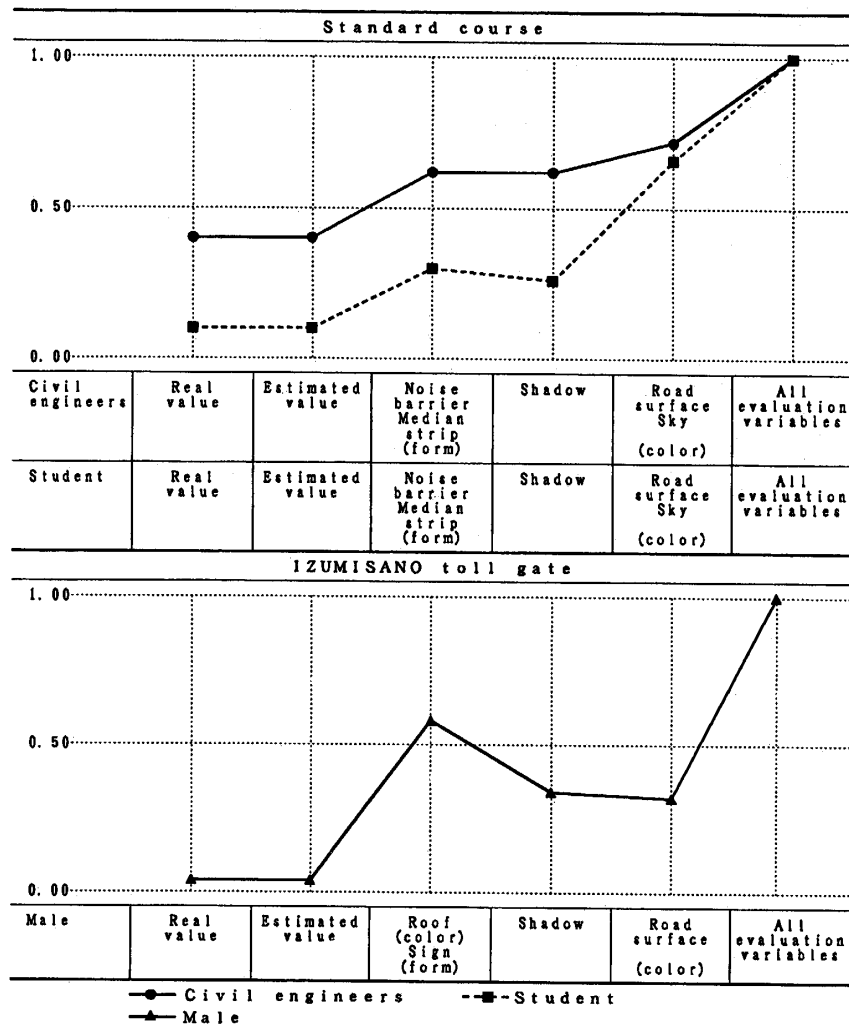


Fig.-7 Estimation result of similarity

is main structure in the toll gate, and in the order material, shadow and the color of road surface.

From the result of these estimations, in case of computer graphic animation in running condition, the background that occupy the large space of portrait and the production level of structures beside highway influence largely to the similarity. In case of toll gate, the production level of roof and sign that are main structures of tool gate influence largely to the similarity.

6. Conclusions

This paper discussed about the evaluation of whole image of the road, similarity and effectiveness received from computer graphic animation and real running VTR of KANSAI airport highway by a experiment of psychological evaluation. The results are as followed.

- 1) About the whole image of computer graphic animation, the evaluation of civil engineers is higher than general users. About the similarity, civil engineer's evaluation is higher than it of general users in standard course. Evaluation of effectiveness is high generally in all groups. the difference between each group is not admitted and there are many evaluations that "the sence of emersion is wanted in computer graphic animation".
- 2) The correlation of evaluation of similarity and effectiveness is low, and the evaluation of effectiveness is higher than it of similarity. Not only evaluation of similarity of structures and background but also evaluation of running reality increases to the evaluation of effectiveness of the computer graphic animation. An evaluation of effectiveness is higher than it of the similarity relatively.
- 3) In case of computer graphic animation in running condition, the background that occupy the large space of portrait and the production level of structures beside highway influence to a similarity largely. In case of toll gate, the production level of roof and sign that are main structures of tool gate influence. It is important to carry out sufficient examination in an advance about accuracy of production of structure and background by the object that examine the landscape design.
- 4) Lastly, real running experience did not influence to evaluation of similarity and effectiveness regarding the method of examination. We think that the method comparing between real running VTR and computer graphic animation is the appropriat approach.

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