

Research on camera angle in multi-projection image

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Abstract: The perspective projection is a standard technique for drawing 3-dimensional scenes. However, artists often independently alter the projection for each object in the scene. This technique is called the multi-projection. In this study, we prepared two situations of 34 images. In every image, a subject was drawn by using 3-D computer graphics. Situation 1 was a shot of the subject from an anterior view, another situation was a shot of the subject from a quarter view. One image of each situation was an ordinary perspective image with the eye-level camera position. 8 images were drawn by changing the camera angle, from -8 deg to +8 deg (2 deg interval), with the ordinary perspective. And the other 8 images of each situation were multi-projection images, in which the subject of each image was fixed with the eye-level camera position, and the background of each image was changed in the camera angle, from -8 deg to +8 deg (2 deg interval). Then, we investigated human impressions on the subject in these images by varying camera angle or the background. The impressions were measured by the semantic differential method. 20 healthy volunteers were participated in experiments 1 & 2. They rated their impressions according to 10 pairs of adjective-opposites with 7-points scale. The results of ANOVA and post hoc tests indicated that there were main effects of several factors. On “powerful-weakness” there were significant differences between 8deg of multi-projection image and 4, -2, -4, -8 deg of multi-projection images. However, no clear difference was found between the ordinary perspective and the multi-projection in the same camera angles.

Key words: *Multi-projection image, Character, Three-dimensional Computer Graphics, semantic differential method, ANOVA*

1. Introduction

Control of the camera angle in most visual works is a standard technique of artists and designers for transmission of messages, and for making attraction of the works. The camera angle for a shot of person is especially important. In film scene, directors sometimes use the high-angle shot or the low-angle shot to make a person like trivialize character or greatness of the character [1].

In manga (Japanese comic and cartoon) scene, manga artists have special techniques using the camera angle. They change not only the camera angle but also perspectives of a person, the subject, and its background for important scenes. In the first place, artists of paintings often independently alter the projection for each object in the scene. This technique is called the multi-projection. For example, it is famous that the Last Supper by Leonardo da Vinci is drawn by the multi-projection. The viewpoint for Jesus and the Apostles are different from that for the background [2].

On the other hand, several researchers have proposed rendering technology of 3-dimensional computer graphics (3-DCG) for multi-projection image. Agrawala et al. developed a method to generate multi-projection 3-DCG, and showed that this method could cartoony 3-DCG and cartoony animations [3]. Coleman et al. developed a kind of multi-projection rendering method and create animations that bring a strange atmosphere caused by the multi-projection. Our research group also developed yet another method of multi-projection 3-DCG [4]. In a previous study, our group researched impression effect of multi-projection image [5]. In this experiment, a multi-projection 3-DCG imitated like a Giorgio de Chirico. All parameters in 3-DCG, of course parameters for multi-projection also, are numerical values. We can control multi-projection quantitatively, and create various projection images. The results of our previous study showed that multi-projection brought more fantastic impression than the ordinary perspective image. In other study [6], they

used hand-weighting images, and researched an influence of instruction about drawing technique on inaccurate perspective. They showed that distortion of perspective emphasized the effect of “novel” impression.

Multi-projection seems to be a personal technique depended on each artists or designers. However, as mentioned above, we can investigate the multi-projection technique quantitatively using 3-DCG methods.

In this study, we paid our attention to the manga’s special technique, composition of a subject and its background. And we investigated impressions generated by the difference of camera angles between the subject and its background. A previous study reported the effect of camera angle [7], but did not examine the effect in multi-projection. As the manga artists do, can we plant intentionally personality into the subject in 3-DCG? How do we control the personally of subject by using the multi-projection?

2. Experimental method

2.1 images

Two situations were prepared. Situation 1 was a shot of a subject from an anterior view (the upper images of Fig.1). This situation was used in experiment 1. Situation 2 was a shot of the same subject from a quarter-view (the lower images of Fig.1). This situation was used in experiment 2.

We generated 34 images for two experiments. In these images, a subject was drawn in a 3-dimensional scene by using 3-DCG (Fig. 1). One image for each experiment was an ordinary perspective image with the eye-level camera position (the upper center image and the lower center image of Fig.1). 8 images for each experiment were drawn by changing the camera angle, from -8 deg to +8 deg (2 deg interval), with the ordinary perspective. And other 8 images for each experiment were multi-projection images. The subject of each image was fixed with the eye-level camera position, and the background of each image was changed in the camera angle, from -8 deg to +8 deg (2 deg interval).

All images were made by using LightWave 3D (D-Storm inc.), the 3-dimensional application software. The parameters of the camera were fixed as 50 mm focal length, and 35 mm film’s angle.

2.2 Procedure

20 students (10 males and 10 females) participated in experiments 1, and 2. The images were presented on a LCD display (Green house, 17 inch). The images

were set on a uniform black background. The image size was 1280*720 pixels, and the aspect ratio was 16:9. Observing distance was about 60 cm. The observers watched each image in laid-back posture. Each image was presented in a random order. The observers rated impressions for the displayed image according to 10 pairs of adjective-opposites with 7-point scale.

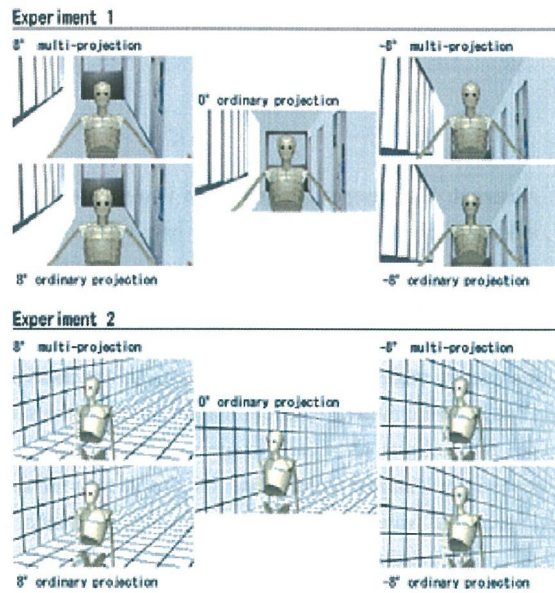


Fig. 1 Images used in experiment 1 & 2

2.2 Adjective pairs

Adjective pairs were picked up from a previous study [6] and added some pairs. The added words were adjectives to describe emotion and personality of characters in the manga scene and the movie scene [1][7]. In experiment 1, the following adjective pairs were used, “gaping - accessible,” “common - extraordinary,” “humanoid - mechanical,” “nice - distasteful,” “powerful - weakness,” “feminine - masculine,” “great - folly,” “dynamic - static,” “attractive - colorless,” and “with sense of existence - without sense of existence”. In experiment 2, the adjective pairs were mostly picked up from words used for description of emotion and personality in the manga scene, because the background image for stimulus was simple like manga works. The following adjective pairs were used, “weakness - powerful,” “weak intention - strong intention,” “attractive - colorless,” “without sense of existence - with sense of existence,” “folly - great,” “static - dynamic,” “bullish - pessimistic,” “planar - stereoscopic,” “distasteful - nice”, and “gaping -

accessible.”

3. Results and Discussions

In experiment 1, we conducted a factor analysis (Principal factor solution, Varimax method) for the rated scores in 10 scales, and extracted three factors: (I) evaluation, (II) ability, and (III) activity (Table 1). We also conducted repeated measure of analysis of variance (ANOVA) with the three factors and the adjective pairs (Fig. 2). The results of ANOVA and post hoc tests indicated that there were main effect of the images for the first factor [F (16.304) =2.559, p<. 05] and the second factor [F (16.304) =6.437, p<. 05], and “powerful - weakness” [F (16.304) =5.347, p<. 05] (Fig. 3), “with sense of existence - without sense of existence” [F (16.304) =5.225, p<. 05]. In the second factor, there were

significant differences between 8 deg of multi-projection and 4, -2, -4, -8 deg of multi-projection. In “powerful - weakness” there was significant differences between 8 deg of multi-projection and 4, -2, -4, -8 deg of multi-projection.

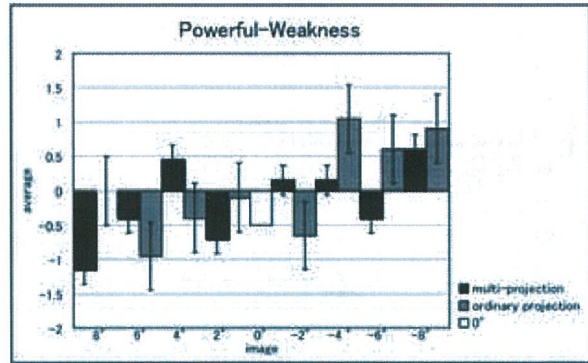


Fig. 3 Averages in “Powerful – Weakness” (experiment 1)

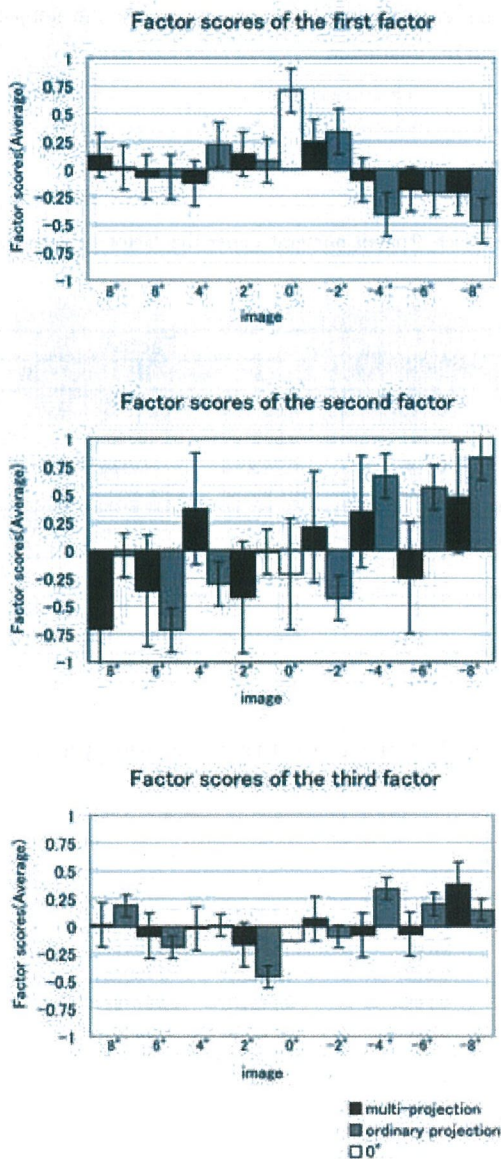


Fig. 2 Factor scores of experiment 1

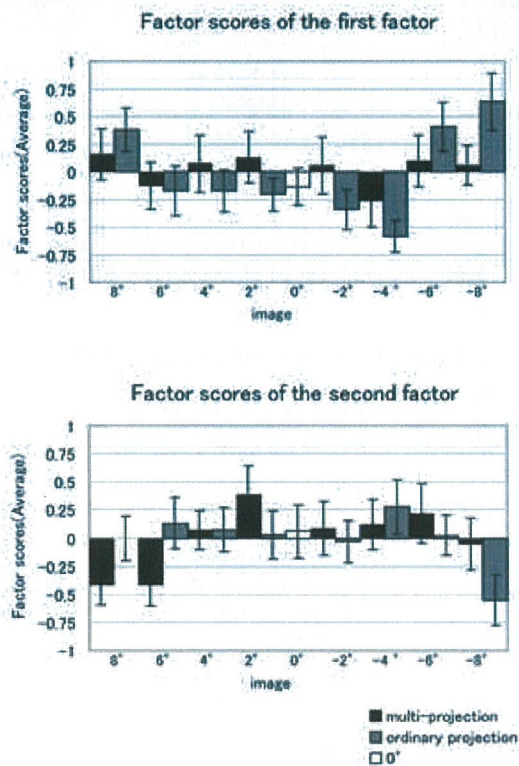


Fig. 4 Factor scores of experiment 2

=2.110, $p < .05$], and the second factor [$F(16,304) = 2.244, p < .05$] and “gaping - accessible” [$F(16,304) = 2.724, p < .05$] (Fig. 5).

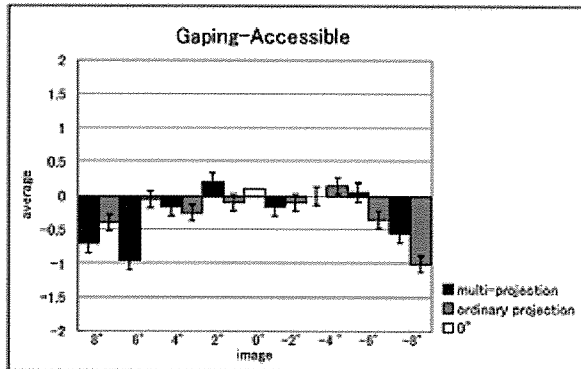


Fig. 5 Averages in “Gaping – Accessible” (experiment 2)

In “gaping - accessible” there was significant difference between 6 deg of multi-projection and 2 deg of multi-projection.

In experiments 1, and 2, there was no significant difference between the same camera angles of ordinary

projection and multi-projection. However impression of several multi-projection images appeared different from that of ordinary projection. In experiment 1, we found opposite impressions between multi-projection and ordinary projection in 4, -2, -6 deg for “Powerful-Weakness”. In experiment 2, we found opposite impressions between multi-projection and ordinary projection in 2, -6 for “Gaping - accessible”.

In addition, it is suggested that the camera angle brings many effects of impression in the film scene and the manga scene. However, in this study, effects of camera angle did not always follow the suggestion. For example, in the film scene, directors sometime use high-angle shots for a subject to be impressed as a atrophic condition. However, the result of experiment 2 showed that, a high-angle shot (8 deg) impressed “great”, and a low-angle shot (-8 deg) impressed “folly”. The effect by camera angle would depend on the subject’s form and his character.

Table 1. Factor loading and communality of each scale in experiment 1. Each Roman numeral under the factor type shows the contribution on the factor.

Experiment 1

Factor type	Adjective pairs	Communality	Factor		
			I	II	III
I 27.00%	accessible-gaping	0.748	0.861738	0.01748	0.072106
	common- extraordinary	0.761	0.865167	0.046748	-0.10227
	human-mechanical	0.605	0.743046	-0.034	0.226464
	nice-distasteful	0.523	0.625354	-0.17517	0.318867
II 21.70%	powerful-weakness	0.809	-0.01271	0.873234	0.214159
	feminine- masculine	0.604	0.222869	-0.67262	0.319811
	great - folly	0.588	0.162851	0.733107	0.155531
III 16.80%	dynamic-static	0.666	0.081525	0.077229	0.808194
	attractive-colorless	0.609	0.411856	0.166312	0.641301
II,III	with sense of existence - without sense of existence	0.643	-0.12903	0.595327	0.521601

Table 2. Factor loading and communality of each scale in experiment 2. Each Roman numeral under the factor type shows the contribution on the factor.

Experiment 2

Factor type	Adjective pairs	Communality	Factor	
			I	II
I 39.90%	weakness-powerful	0.747	0.864101	-0.02576
	weak intention-strong intention	0.704	-0.83881	0.005488
	attractive-colorless	0.610	-0.76294	-0.16925
	without sense of existence-with sense of existence	0.568	0.748697	0.087791
	folly-great	0.527	0.717681	-0.10891
	static-dinamic	0.361	0.56832	0.194007
	bullish-pessimistic	0.278	-0.52723	-0.00005
	planar-stereoscopic	0.177	0.421123	0.010621
	II 5.50%	distasteful-nice	0.534	0.313271
	gaping-accessible	0.177	-0.04615	0.166109

4. Conclusions

In this study, we investigated changing impressions of a character in multi-projection images. Artists of manga change camera angles between the character and its background for manipulation of the character's impression, when camera angles of the character and background are different, the computer generated image is a multi-projection image. We carried out two psychological experiments about the character's impressions in images. The results of factor analyses and ANOVA showed that there were the main effects of the image for several factors of impression. However, there was no significant difference between ordinary projection image and multi-projection one in the condition of the same camera angle. Even if camera angles of the subject and background were different, the impressions of multi-projection images were similar to that of the ordinary projection. However, some multi-projection images appear to be different impression from ordinary perspective in several adjective pairs: "powerful-weakness" in experiment 1, and "gaping - accessible" in experiment 2. The effect of multi-projection is not remarkable, the manga artists probably manipulate these weak effects in their works.

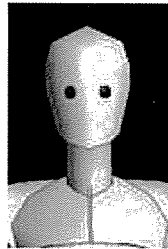
In future study, we should increase the observers and reconsider the manner of instruction and adjective pairs. Considerations of camera angles and the subject's shape for the experiment are also required for more precise investigation.

5. References

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Appendix

Character portfolio in experiment 2



name : Mr. HARIGANE
age : 20 years old
sex : male
base character : commonly

Story:

This is a story of distant planet like the earth in the future. In this planet, human's mind can be translated into a humanoid robot, "HARIGANE." Mr. HARIGANE was formerly a human. However, for some reason, his mind has been confined in "HARIGANE" by a secret organization. He sneaked into a building, the hideout of secret organization, for finding the method to return to his original body. Can he return?