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Effect of 2Dimesion and 3Dimension Images on Human Factors

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Abstract

This study aims to examine the effects of watching 2D and 3D images on the blink rate. Regarding the image watch, their blink rate for 2D and 3D images was separately checked for 1 minute in the 1m distance, before the watch, after 15 minutes of watch, and after 30 minutes of watch. About the change of their blink rate in the 2D image watch, it tended to become higher than that before watching the image; however, there was no statistical significance (paired t-test, p=0.106, p=0.062). And in the 2D image watch, it tended to increase in comparison between after 15 minutes and after 30 minutes, but there was no statistical significance (paired t-test, p=0.623). Meanwhile, about the change of their blink rate in the 3D image watch, it tended to decrease statistically significantly both after 15 minutes and after 30 minutes when compared with that before watching the image (paired t-test, p=0.000, p=0.000). In the 3D image watch, it tended to increase in comparison between after 15 minutes and after 30 minutes; however, there was no statistical significance (paired t-test, p=0.867).

Keywords: *3D image, Asthenopia, Visual function, FPR, Blink rate.*

1. Introduction

Stereoscopic 3D images that have us perceive depth by binocular disparity are based on the principle that the brain perceive two different images through sensible fusion. Many different kinds of stereoscopic display methods using anaglyphs, concentration difference, films patterned, or shutters are grounded binocular disparity. However, the stereoscopic sense that humans get to have is not just resulted from binocular disparity but from other binocular factors like convergence as well as monocular factors; thus, 3D image watch based on binocular disparity is causing a lot of visual side effects. Due to this trend, researches on

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visual fatigue have been conducted in many areas for the stable watch of 3D images.

In Shin [1]'s research, a function of prediction was developed with mathematical methods used on the size of a subject perceived by the watcher from a 3D image according to the value of depth. And in Jeong [2]'s research, an independently developed questionnaire was used to perform 3D image evaluation focusing on the watcher's subjective view. Gam [3] and Gang [4] analyzed correlation with the objective depth of 3D images through geometric analysis between 3D display and interpupillary distance (IPD). At the 2D/3D image watch, the intensity of their gaze at the image increases, so their blink rate decreases. In 3D images, as the sense of reality is elevated [5], it may work as a greater factor. Because blink rate is one of the crucial factors that can affect ophthalmologic disease like corneitis or dry eye directly, it needs more special attention [6].

2. 3D Images & Visual Fatigue

It is known that visual fatigue starts to appear around 30 minutes after watching a 3D display; however, it may appear either sooner or later than 30 minutes depending on what kinds of parameters the factors inducing fatigue actually have. What is important here is that visual fatigue indicates the user's psychological/ physiological conditions. The report from the consultative body for image stability under the International Organization for Standardization (ISO) suggests the aspects of stability to be considered in the provision of images in the following three ways: the first is photosensitive epileptic seizures, the second is visually-induced motion sickness, and the third is visual fatigue. Visual fatigue includes not only the fatigue experienced before a 3D display but the fatigue caused by doing a long-time task before a 2D display.

The stereoscopic display method based on the visual function of binocular disparity as well as eye movement employs the technology to reproduce the space that is either convexo or concave from the reference surface. However, it still exhibits the aspects that do not conform to the other factors regarding focus adjustment or relation to convergence. Therefore, the space reproduced still remains unnatural, and it also seems to form the factor that causes dizziness. The importance of relative perception to each of the distortions is independent, and also, researches that deal with the effects on distortion at the time that various factors are combined should be conducted afterwards.

3. Target and Methods of Study

Before participating in the experiment, the tastes were examined about the factors that could affect the experiment through medical examination. Before the watch, the basic refraction test was conducted to adjust their corrected vision. The 3D image device used for this experiment was a film-patterned 32-inch TV. And about the images used for the experiment, the most appropriate action genre [7] with 3D images was selected. About the time zone for watch, 1 to 4 p.m. was selected as it was the most stable time zone for visual function. Regarding the watch time, based on Lee [9]'s research that comparatively analyzed 20-minute watch and 40-minute watch, the study chose 30 minutes as a compromised time zone. About the blink rate test, the testees' blink rate was measured before the image watch while they were undergoing medical examination by using a camcorder (NV-GS400, Panasonic, Japan) through mirror reflection so that they could not recognize it. And later, while they were watching TV, it was measured total three times, 1 minute for each, after 15 minutes and after 30 minutes during their image watch.

4. Results and Analysis

4.1 Blink rate changes during 2D image watch

Regarding comparison on their blink rate during their 2D image watch, the result shows how it was measured for 1 minute, before the image watch, after 15 minutes in their image watch, and after 30 minutes in their image watch (Table 1).

Table 1. Blink rate change after watching 2D images (unit: count/min)

Mean±SD		MD	t	p-value
Before (16.92±5.61)	15minutes (19.42±11.76)	-2.50	-1.649	0.106
Before (16.92±5.61)	30minutes (19.82±12.15)	-2.90	-1.909	0.062
15minutes(19.42±11.76)	30minutes(19.82±12.15)	-0.40	-0.495	0.623

SD : standard deviation MD : mean difference

4.2 Blink rate changes during 3D image watch

Regarding comparison on their blink rate during their 3D image watch, the result shows how it was measured for 1 minute, before the image watch, after 15 minutes in their image watch, and after 30 minutes in their image watch (Table 2).

It tended to decrease in comparison between before the image watch (16.92±5.61 times/min.) and after 15 minutes in their image watch (11.36±10.32 times/min.), and there was statistical significance. And in comparison between before the image watch and after 30 minutes in their image watch (11.42±10.06 times/min.), it tended to decrease, and there was statistical significance. And also, in comparison between after 15 minutes in their image watch and after 30 minutes in their image watch, it tended to increase slightly, but there was no statistical significance.

Table 2. Blink rate change after watching 3D images (unit: count/min)

Mean±SD		MD	t	p-value
Before (16.92±5.61)	15minutes (11.36±10.32)	5.56	4.054	0.000
Before (16.92±5.61)	30minutes (11.42±10.06)	5.50	4.095	0.000
15minutes(11.36±10.32)	30minutes(11.42±10.06)	-0.06	-0.168	0.867

SD : standard deviation MD : mean difference

5. Conclusions

This research aimed to examine the change of blink rate at the 2D and 3D image watch and suggest reference indexes for advisable watch for each individual to realize stability at the stereoscopic image watch. Unlike 2D images, 3D images are realistically unfolded in front of your eyes, so they tend to increase your interest in the images themselves. But this kind of factor may lead to reduction of a watcher's blink rate. And this may form a serious pathological factor on your eyes, so if you are an adult, it is recommended to stop your watch for a while when you feel any dryness on your eyes subjectively during a watch and let your eyes rest. And for children, it is needed for their guardians to give a plenty of instruction for their watch.

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