# A Study on the Quantitative Human Visual Preference with PDP and LCD

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## Abstract

*We carried out the human visual evaluation on PDPs and LCDs to clarify the viewer preference and the related physical and physiological factors. In the subjective evaluation, the impression test using the semantic differential method was carried out. In the objective evaluation, the eye motion tracking system was used. Our study showed that considering the real usage, the optimum display for viewers was that which showed more soft and smooth image without blurring.*

## 1. Introduction

At present, the tendency of evaluation on Flat Panel Display is to obtain the ergonomic requirements and figure out how appropriate the Flat Panel TVs are for user. But there have not been enough studies and obvious evidences to figure out the correlation between the physical values of display characteristics and psychological preference among flat displays. The clarification of a visual display viewer preference factor is one of the most important objective in determining how pleasing the FPD is to the viewer's eye and thus how usable. So, on the basis of human visual system, our study focused on the factors of psychological response and physiological data. The objectives of our study were to identify the most important factors in determining the preferences in each viewing condition by subjective evaluation, and to corroborate the identification with physiological data for the PDPs and LCDs.

## 2. Experiment

We conducted our experiments with six Flat Pane Displays which were manufactured by different major companies, three LCDs and three PDPs.

The experiments were divided in subjective and objective evaluation to clarify the complex relationships among viewer preference and the related physical and physiological factors. Preference was defined by questionnaires which participants scored after viewing several images. In the subjective evaluation, display impression tests using the semantic differential (SD) method with factor analysis were carried out under two different conditions of room illuminance and length of watching time. In the objective evaluation, we used an eye motion tracking camera to obtain data. The viewer's feeling was quantitatively measured from the number of eye blink and the stir of focal point which are generated during watching TVs.

## 3. Results and discussion

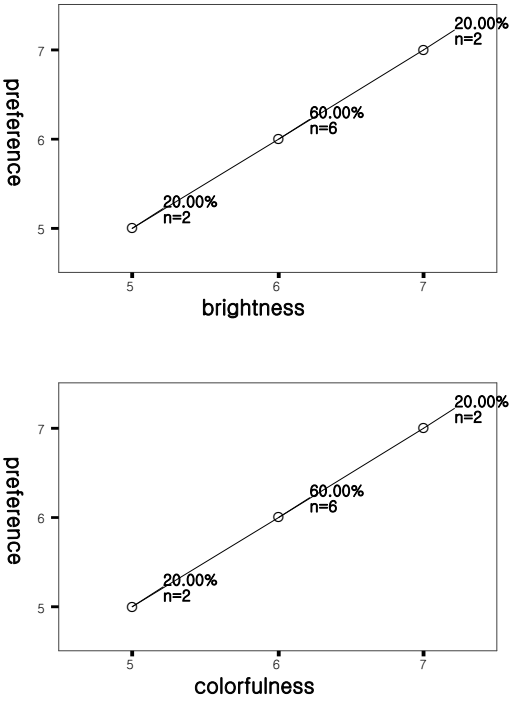
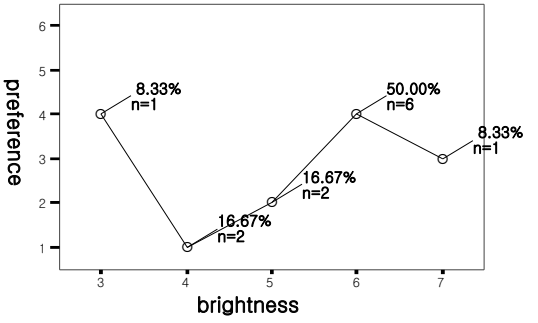



**Fig. 1 Bright room condition (430 lux), short time watching (30 min.)**

The subjective test yielded the results which showed different types of Flat Panel Displays were preferred depending on conditions. Also, conspicuous factors were extracted for determining Flat Panel Display viewer preference as circumstance changed. Fig. 1 shows that under bright room condition, short time watching preference is proportional to display's brightness and colorfulness. But in long time watching under the same room luminance, the viewer preference shows no apparent relation with those physical values as shown in Fig. 2.



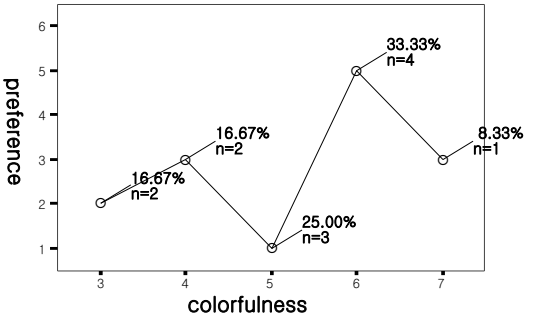
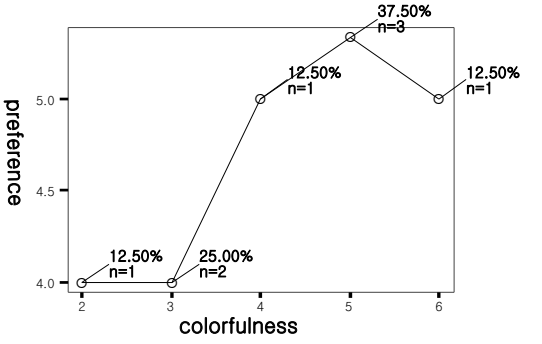




**Fig. 2 Bright room condition (430 lux), long time watching (120 min.)**

Fig. 3 shows the short time watching preference in the dark room condition. It is related to display's colorfulness and clearness as same as in bright condition. But after longer watching time, colorfulness less affected the preference and the clearness was the most critical factor which determined the viewer preference as shown in Fig. 4. Clearness is defined as the state that shows no occurrence of image sticking and blurring when watching images and reading characters especially when the image moves. Fig. 5 shows that when the watching time is varied under dark room condition, the viewer preference is closely linked with the softness of display image. Softness is defined as the pleasant state to look at because it is not so bright.



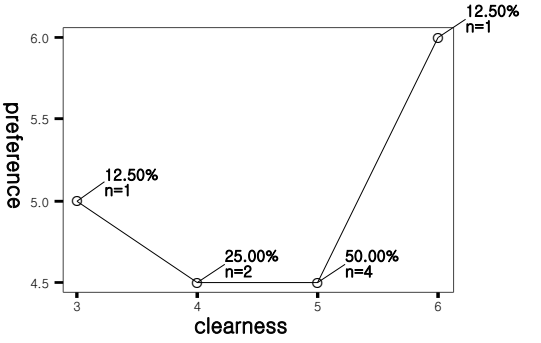
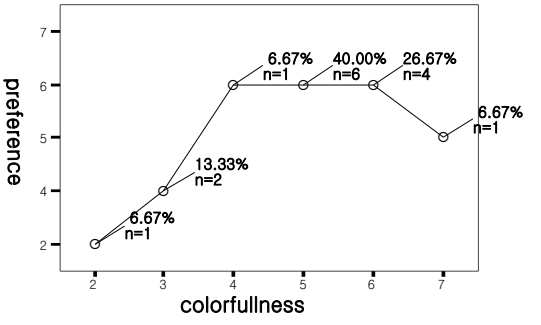




**Fig. 3 Dark room condition (under 5 lux), short time watching (30 min.)**



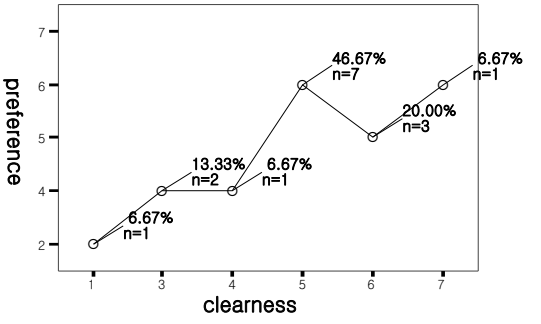
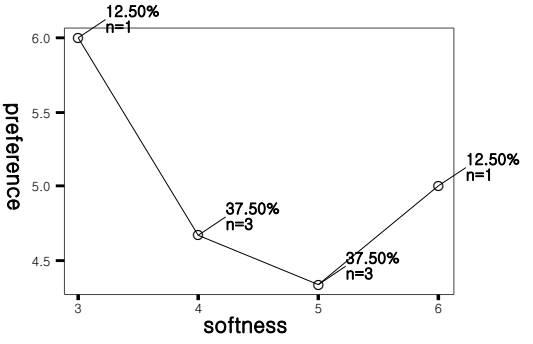
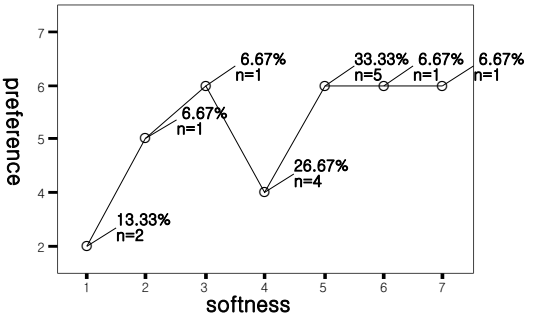




**Fig. 4 Dark room condition (under 5 lux), long time watching (120 min.)**




**(a)**




**(b)**

**Fig. 5 Dark room condition (under 5 lux), preference depending on softness**
**(a) short time (30 min.) (b) long time (120 min.)**

We conducted the objective physiological evaluation in divided three main components-monitoring, reading and tracking-which compose the image. Fig. 6 shows those three experimental results. In every image components evaluation, the quantitative fatigue shows the same tendency. We can also observe the optical properties which correspondent to these objective fatigue results such as shown in Fig. 7. Although we used to regard the high physical valued displays as the best product, the result showed that the high optical values are not always related to viewer preference, instead, are proportional to fatigue intensity.

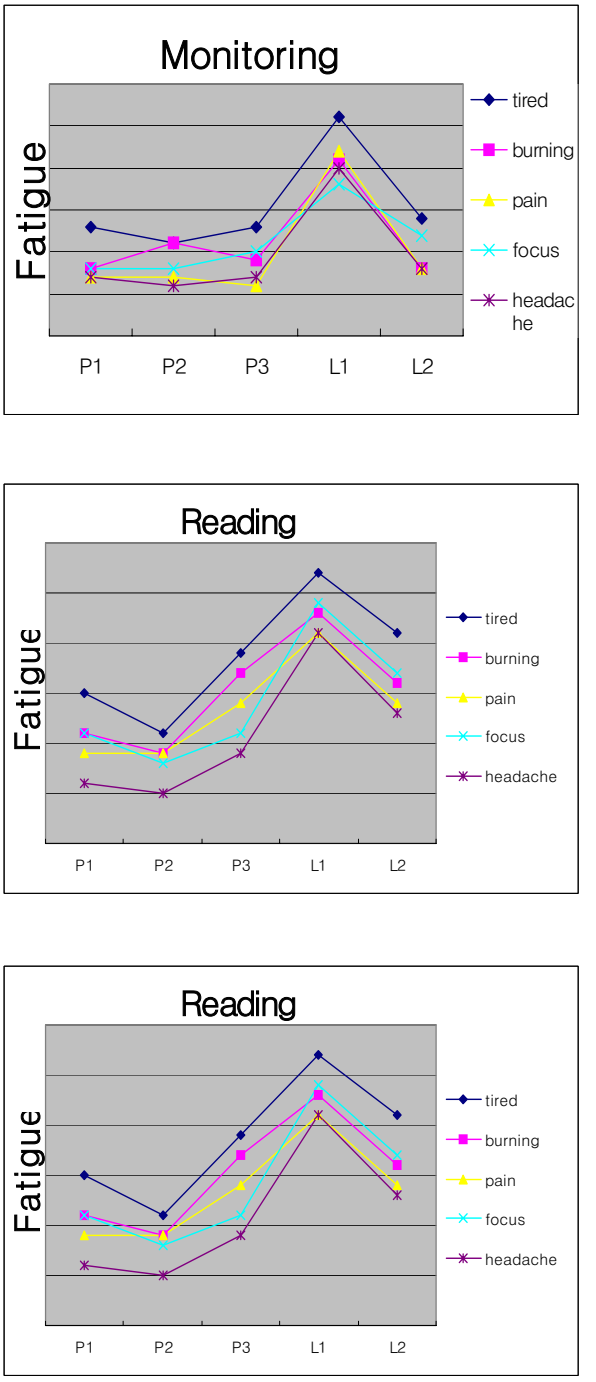



**Fig. 6 Physiological fatigue results in three image components**

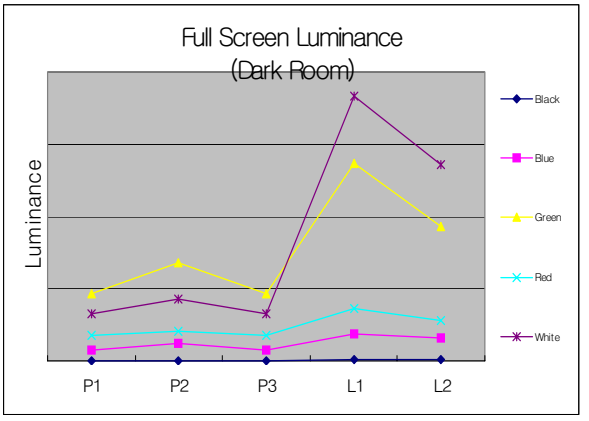



**Fig. 7 Typical optical property correspondent to physiological fatigue results**

## 4. Summary

The main finding of this research is that considering the real usage environment and eye fatigue, the optimum Flat Panel Display for viewer turned out to be the one which showed more clear, soft and smooth image. Our study also suggests that the overall evaluation of user image preference is systemically solvable when it is approached using diverse methodologies including the physical as well as the psycho-physiological ones.

## 5. Acknowledgement

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## 6. References

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