The Impact on Human Eye Vision of Different Paper Reflective Brightness under Different Lamps

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Abstract. Test reflective brightness, on the market, infant and children’s books, primary and secondary school textbooks, reference books and reading materials, under the 5 watt yellow bold table lamp respectively with the grating and without the granting, and the ordinary 20 watt yellow bulb table lamp. Proposed to improve the manufacturing process of recycled printing paper in China, do not add fluorescent powder, infant and children’s books had better not use halftone paper, and two-colored printing had better not use celadon two-colored printing.

Introduction

In order to implement the “CPC Central Committee on Strengthening Youth Sports to Enhance Youth Physical”, Beijing held middle school student and primary school student “national physical health standard” testing contest each year since 2007, the results showed: the students’ eyesight is overall downward trend. Beijing according to the Ministry of Education “Middle School Student and Primary School Student Myopia Prevention and Control Program”, the Beijing Middle School Student and Primary School Student Vision Monitoring System was introduced in 2008. The system made clear provisions to adjust the sitting position, seat adjustment, controlling classroom lighting, reducing the academic burden of protecting the eyesight of students. Each district and county actually implement these provisions, especially the classroom lighting hardware conditions are at or near the national lighting requirements. So in 2010, the fourth testing results showed that: the overall eyesight of students is still downward, only the rate of reduced vision loss has been checked.

From the above results, we can see that there are some scant attention factors affect the eyesight of students, that is the students’ textbook paper in the light reflective rate relatively high, and it harmful to the student vision. Because, the light reflection can be divided the three kinds: specular reflection, directed diffusion reflection and diffuse reflection. Specular reflection when the light shines bright and smooth surface, the light reflection angle equals the light incidence angle. This centralized nature of the reflected light is likely to cause particularly dazzling light. The directed diffusion reflection also known as semi-specular reflection, the light reflection diffusion is in one direction, and this light will form a visual disturbance. Both reflected lights can easily form a glare indirect and impact the human vision. Diffuse reflection is when the light fell on objects, the reflected light does not directional, showing space divergent pattern, and its effect is very soft. Only control illumination, it will not form harmful glare to vision.

The Generation of Reflected Glare and Its Harm to Vision

According Students’ Supplies Safety General Requirement issued by the state, the students’ textbook, books brightness (whiteness) shall not be more than 85%; generally speaking, it cannot be too white, but there is no mandatory whiteness provisions issued by the state for children’s reading materials.

With the development of printing technology and paper making technology, as well as the improvement of people’s living standard in recent years, students and infants and young children books usually use a letterpress paper, newsprint, offset printing paper, coated paper, dictionary paper etc.; its whiteness and smoothness is increasing; in natural light and artificial light; it is easy to form
directional diffuse reflection, there will be uncomfortable visual sense of students for a long time reading. Controlling glare lighting standard have been taken seriously, but are concerned about the direct glare control, while ignoring the indirect glare.

The paper with high reflective rate in the ordinary lump and other lighting devices usually there will show a brighter white area, the readers read only by continuously adjusting the angle to see the printed word in the paper. This high reflective rate paper, not only to bring a lot of troubles to readers, but also reduce the reading speed, more importantly, this high reflective rate paper will make readers eye fatigue after long-time reading. Long-time reading will bring readers dry eye, eye strain, eye astringent, eye soreness, blurred vision and even vision loss and other symptoms caused by eye fatigue. These symptoms directly affect the work and life of the people. Especially for adolescents and pre-school children, to read books printed in high reflective rate paper, will affect the growth of vision.

**Experiment Design**

On the white matt paint desktop, use the 5 watt yellow bold table lamp respectively with the grating and without the granting as light resource, and use the ordinary 20 watt yellow bulb table lamp as light source, on paper 39 cm height vertical irradiation to provide ambient lighting, and use L88 stilbimeter made by Beijing Aobdi Photoelectric Technology Co., Ltd. at distance the light source point 71 cm and vertical beam angle of 54°, separated to test textbook use printing paper, partial recycled paper, 80g/m² printing paper (no words), 70g/m²printing paper (no words), recycled paper (no words), reference used printing paper (single color printed; red, orange, bright green, celadon two-colored printing), printed with yellow paper and colored Halftone paper reflecting the brightness on the vertical beam. (unit: ×100Cd/m²)

**Experiment Explanation**

Our experiment, the reason for taking the 54° angle brightness test, when chair height is suitable, the standard height students is reading to correct posture, the eye and lamp vertical beam of the paper is 54° (please see Figure 1).

![Figure 1. Angle of reflection schematic diagram.](image-url)
Experiment Instrument

*Stilbimeter*: Designed by Beijing Aobdi Photoelectric Technology Co., Made by Photoelectric Instrument Factory of Beijing Normal University (please see Figure 2).

![Figure 2. L88 stilbimeter.](image)

*Grating*: Ltd. Philips Goethe single arm desk lamp (Grating), Model Number: FDS67 (please see Figure 3)

![Figure 3. Grating.](image)

*Lamp*: IKEA PIANISSIM Ordinary lamp (please see Figure 4). Philips Goethe single arm desk lamp Model Number: FDS67 (please see Figure 5)

![Figure 4. Ordinary lamp.](image) ![Figure 5. FDS67 Philips desk lamp.](image)

Experiment Object

*White matt lacquer desktop*: Please see the above white desktop.

*Printing paper*: HP Everyday paper A4(80g/m²), HP Printing Paper (Common) A4(70g/m²).

*Recycled printing paper*: Sigma A4 recycled copy paper: 60% raw material recycled from beverage cartons.


*Yellow colored paper*: SAT Mold test (XI) Page 17.

*Reference (monochrome)*: Wang Houxiong study-plan; Senior high school mathematics optional; Page 2-2 71.
Experiment Data

<table>
<thead>
<tr>
<th>Measured object</th>
<th>With grating(5W)</th>
<th>Without grating(5W)</th>
<th>Ordinary lamp(25W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White matt lacquer desktop</td>
<td>0.691</td>
<td>0.699</td>
<td>0.882</td>
</tr>
<tr>
<td>80g/m² printing paper</td>
<td>0.747</td>
<td>0.758</td>
<td>0.948</td>
</tr>
<tr>
<td>70g/m² printing paper</td>
<td>0.687</td>
<td>0.694</td>
<td>0.875</td>
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<tr>
<td>Recycled printing paper</td>
<td>0.737</td>
<td>0.752</td>
<td>0.922</td>
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<tr>
<td>Halftone paper</td>
<td>0.725</td>
<td>0.731</td>
<td>0.912</td>
</tr>
<tr>
<td>Partial recycled printing paper</td>
<td>0.631</td>
<td>0.650</td>
<td>0.786</td>
</tr>
<tr>
<td>Yellow colored paper</td>
<td>0.637</td>
<td>0.657</td>
<td>0.803</td>
</tr>
<tr>
<td>Reference (monochrome)</td>
<td>0.648</td>
<td>0.680</td>
<td>0.846</td>
</tr>
<tr>
<td>Reference (celadon)</td>
<td>0.413</td>
<td>0.455</td>
<td>0.603</td>
</tr>
<tr>
<td>Reference (bright green)</td>
<td>0.501</td>
<td>0.509</td>
<td>0.629</td>
</tr>
<tr>
<td>Reference (red)</td>
<td>0.528</td>
<td>0.541</td>
<td>0.658</td>
</tr>
<tr>
<td>Reference (orange)</td>
<td>0.547</td>
<td>0.559</td>
<td>0.697</td>
</tr>
<tr>
<td>Textbook</td>
<td>0.662</td>
<td>0.665</td>
<td>0.855</td>
</tr>
</tbody>
</table>

Note: unit is $\times 100\text{Cd}/\text{m}^2$. Two light sources have the same brightness.

Experiment Conclusion

About Paper

When the light sources is the same in each group experiment, 

As for printing paper: 80g/m² A4 printing paper light reflection brightness is strongest; 70g/m² printing paper light reflection brightness is weakest;

As for monochrome printing: colored printing use Halftone paper light reflection brightness is strongest; partial recycled printing paper light reflection brightness is weakest;

As for two-colored printing: orange two-colored printing light reflection brightness is strongest; celadon two-colored printing light reflection brightness is weakest.

About Light Source

When the paper is the same in each group experiment, when ordinary lamp as a light source mounted yellow lamp with 20 watts, the measured paper light reflection brightness is the strongest; as a light source mounted yellow grating lamp with 5 watts, the measured paper light reflection brightness is the weakest.
Suggestions

The students had better to select 70g/m² printing paper to print files;
Press is better to choose partial printing paper to print textbook, it can protect eyesight as well as protect the environment, while also reducing the quality of textbooks, indirectly protecting the healthy growth of students’ spine.
Students is better to choose matte paint desktop, because the matte paint desktop can be make the beam diffused, which reduces the environmental light reflection brightness;
When choosing the table lamp, the best choice for parents is the table lamp with a grating, low wattage light bulbs, soft light color, and the heavy solid bracket one. First, because of the low wattage and soft light bulb light is not too strong to glare students eye; second, table bracket can avoid light source shaking, and thus avoid the paper reflective brightness frequent movements, thereby protecting the eyesight of students. (Maximum of the paper reflected brightness changes in the test light source shaking can reach 2Cd/m²)
When choosing a desk bracket, the best choice for parents is the heavy stable bracket, the same reason of why parents choosing solid table lamp bracket;
Through interviews, the four colors investigated in this experiment, most people like bright green two-colored printing, and most people hates red two-colored printing.

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References