

Safeguarding your reading environment: Avoiding pitfalls when radiologists work from home

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INTRODUCTION

During the COVID-19 pandemic, many radiologists transitioned to remote reading at home. This study considers common pitfalls in home reading environment and provides tips to avert the pitfalls.

AIM

To investigate ways to avoid common pitfalls that reduce low contrast visibility at a home reading environment.

METHOD

To understand how the setup impacts low contrast visibility, five basic factors are considered:

- Room layout, such as window/light fixture and location,
- Ambient light level,
- Monitor surface cleanliness,
- Background wall clutter,
- Reflection from reader outfit.

A good setup should have a proper ambient light level, no glare or stain or background reflection, and a reader's outfit in dark colors. To quantify the impact of these five factors on low-contrast visibility, a letter-based test pattern was developed to assess minimum detectable contrast at different display background luminance levels. These test patterns (as illustrated in Figure 5) were displayed on a consumer-grade monitor. The low contrast visibility was measured by detecting the minimum contrast letters under several controlled conditions to investigate the impact of the five factors listed above. Reading results from four sets of test patterns are averaged. A good low contrast visibility results in a lower minimum detectable contrast.



Figure 1. Example of measuring ambient light with an inexpensive photometer calibrated with an in-house photometer with NIST-traceable calibration.

RESULTS

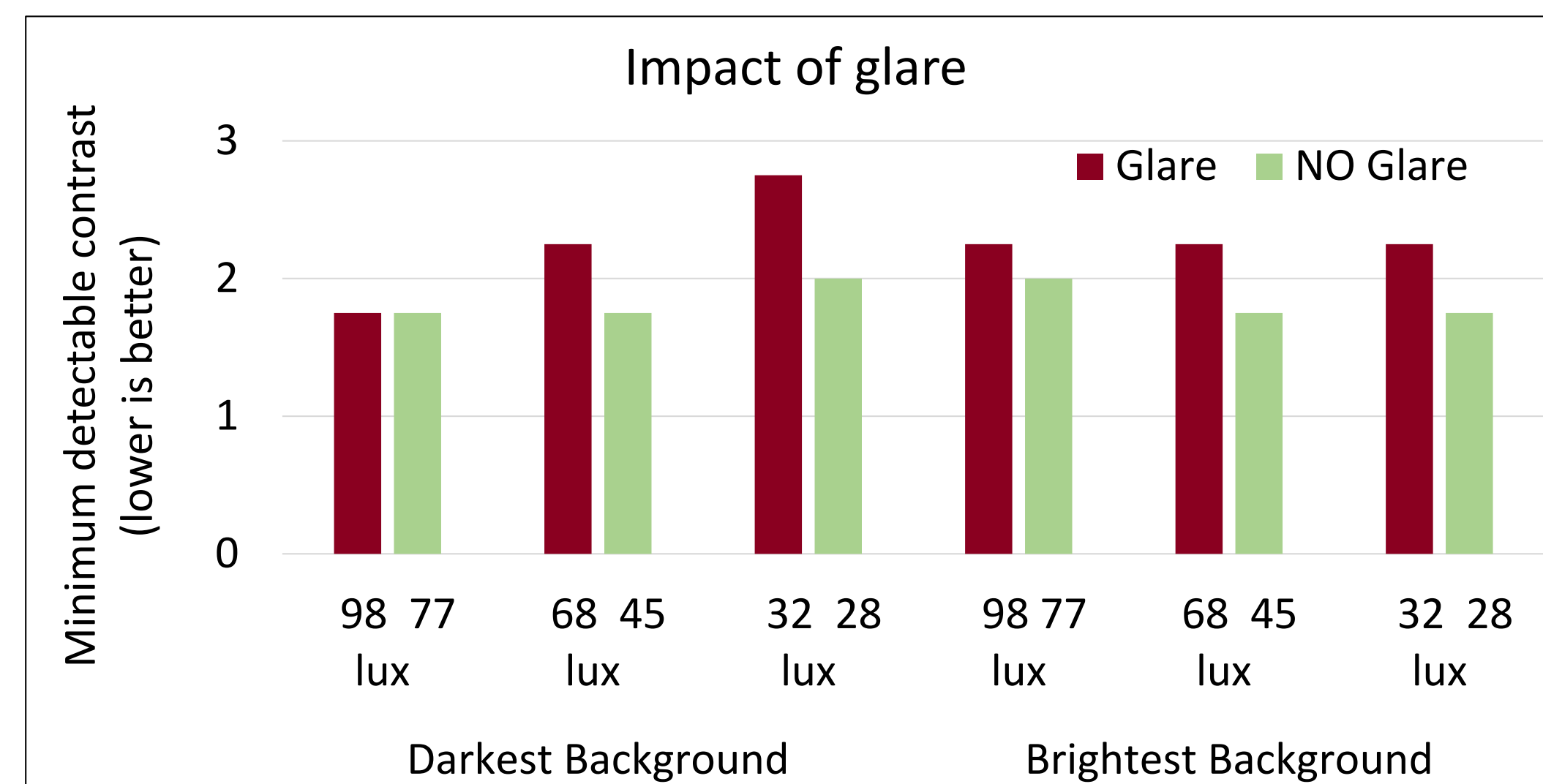


Figure 2: This compares the low contrast visibility between a monitor with glare and the same monitor without glare under high, medium and low ambient lighting conditions. Without glare, the reader can visualize lower contrast.

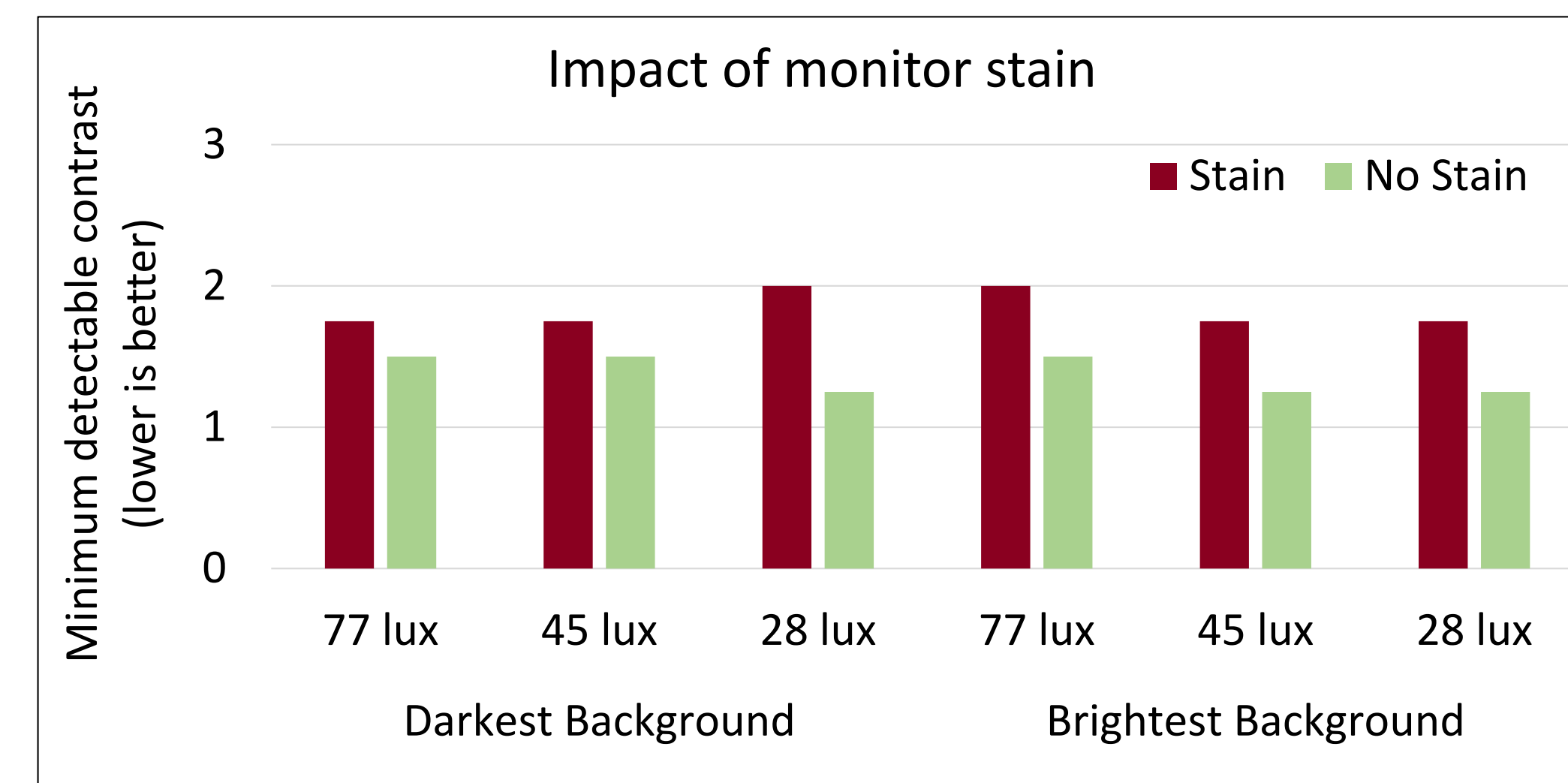


Figure 3: This compares the low contrast visibility between a dirty monitor and the same monitor but cleaned under high, medium and low ambient lighting conditions. Reduced visibility is observed due to stains such as fingerprints, liquid residuals and dust.

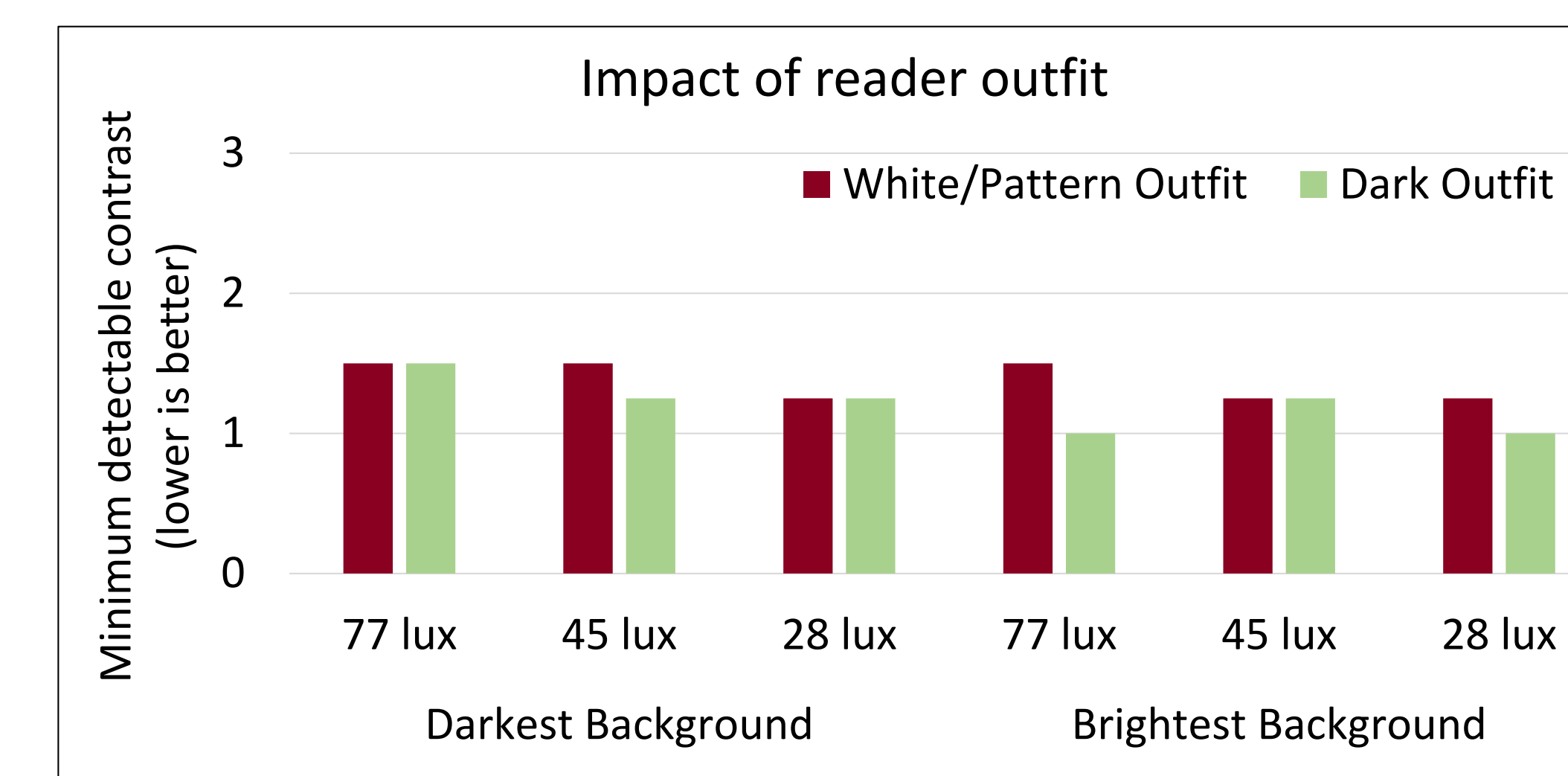


Figure 4: This compares the low contrast visibility while wearing a lighter colored outfit and a darker colored outfit under high, medium and low ambient lighting conditions. Lighter colored clothing reflects more light; thus creating a reflection on the monitor.

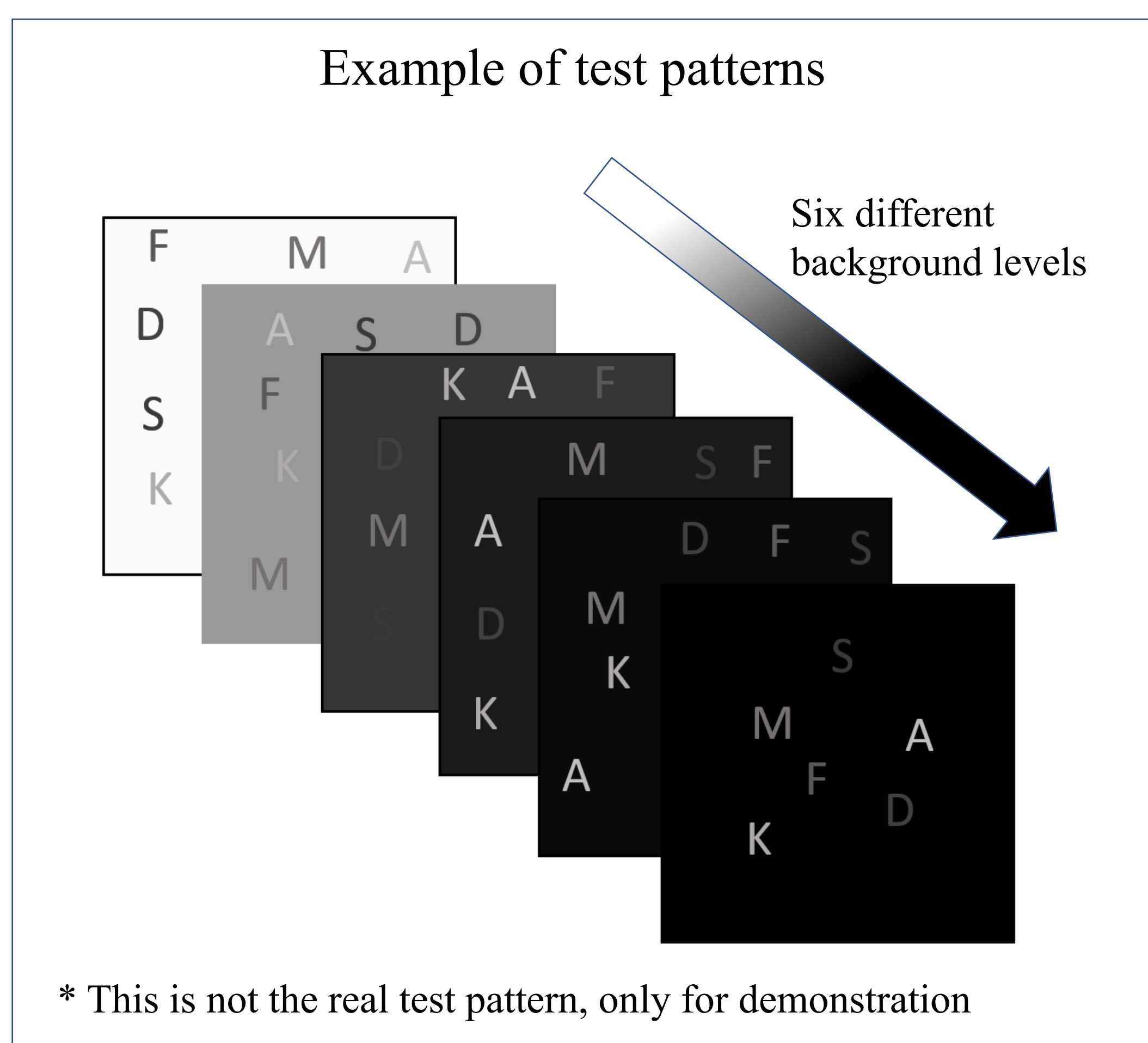


Figure 5. Examples of test patterns with six different background levels from dark to bright over the full luminance range. Capital letters with different contrast are randomly chosen and placed. The faintest contrast is ± 1 from the background. Four different sets of test patterns are developed for each background level to reduce the variability from the reader.

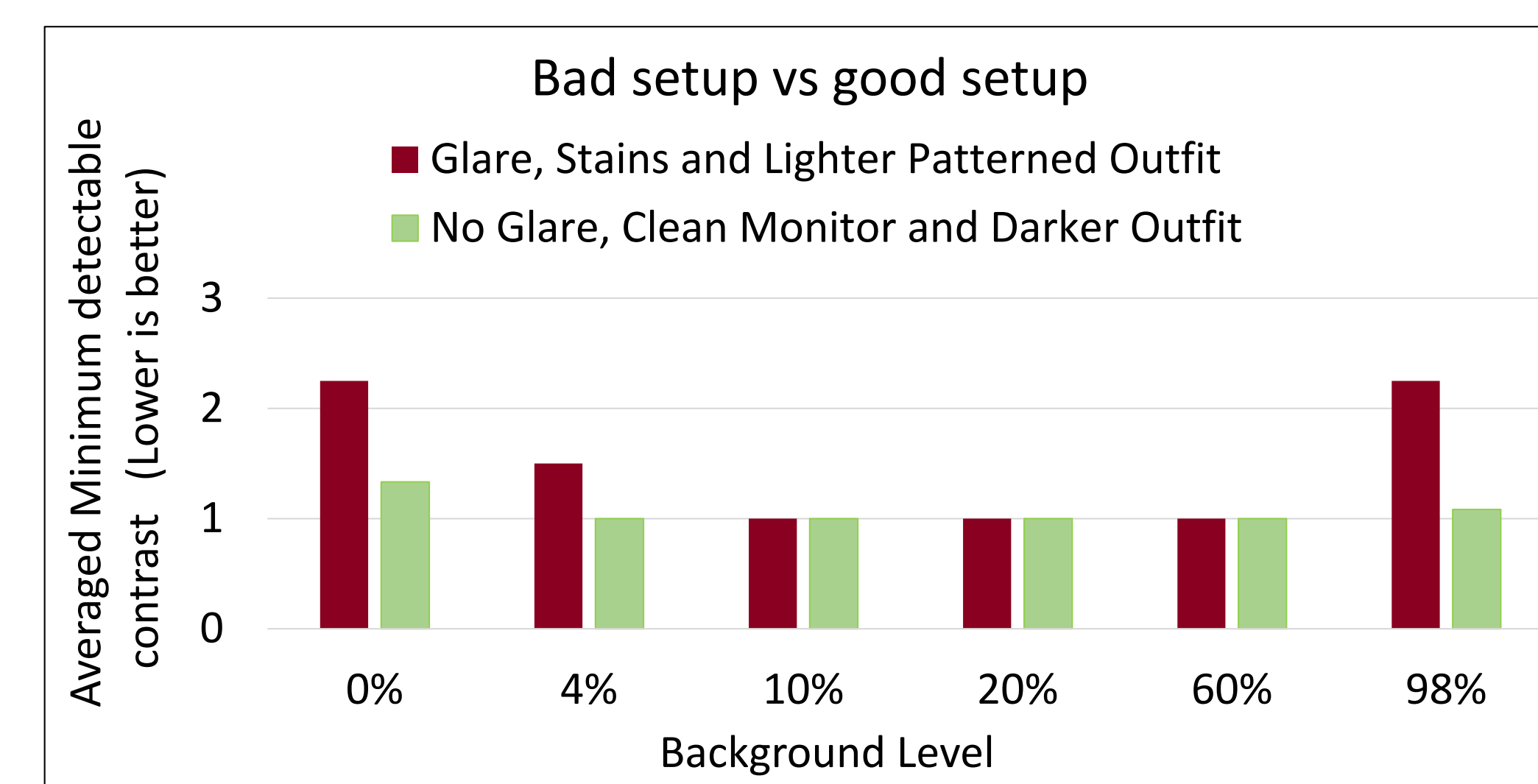


Figure 6: The low contrast visibility results with glare, stains and lighter colored outfit is compared to those without these pitfalls over the full luminance range from 0% to 98%. The detectability is affected the most at the dark background and the bright background. From 10% to 60% luminance range, the impact from these pitfalls is minimal.

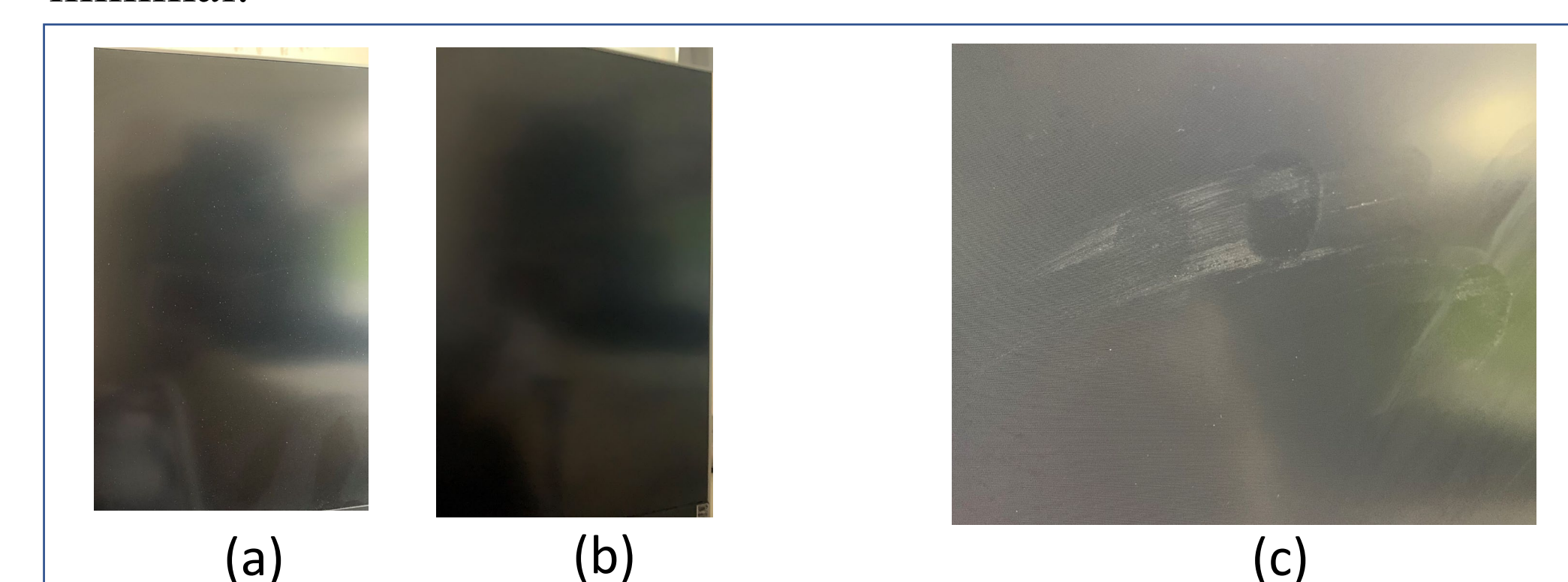


Figure 7: (a) An example of glare due to reflection from window light. (b) After adding a black-out curtain, the glare is reduced. (c) An example of a dirty monitor with stains such as finger prints, hand cream, and dust.

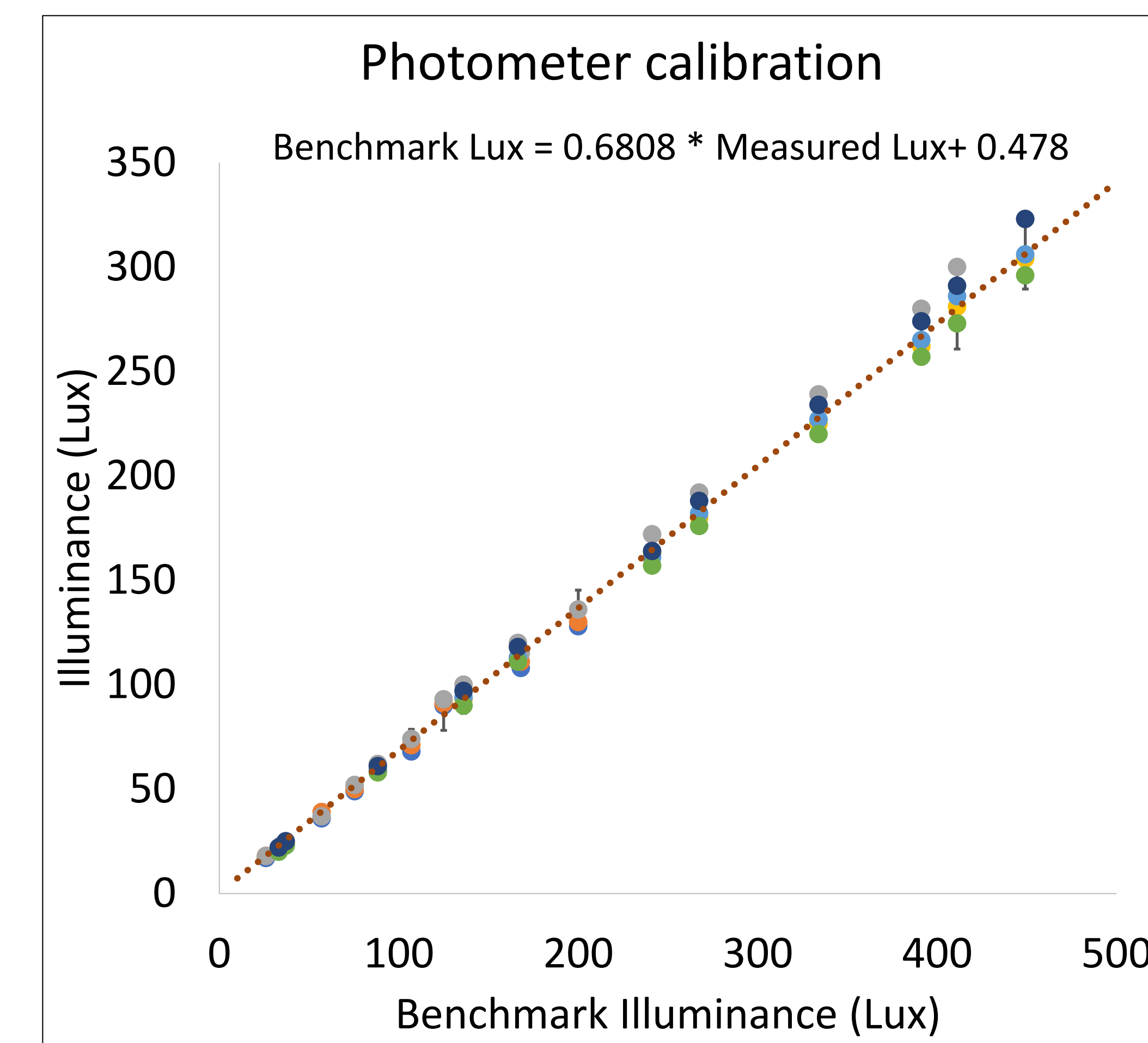


Figure 8: Seven inexpensive photometers are calibrated by using a photometer with NIST-traceable calibration. The results from these inexpensive photometers are consistent with each other and have a 6.7% averaged percentage differences to the averaged values. One thing needs to be noted is that the inexpensive photometers has a curved light diffuser. Compared to the flat ones in the photometer with NIST-traceable calibration, curved diffuser averages more ambient light than the flat ones. Also both nature light source and artificial light source are evaluated, the results are very similar.

REMEDIAL ACTION

Room layout:

1. Face the monitor at right angles so that no window and light sources shine on it.
2. Use black-out curtains that could fully block your window.
3. Use adjustable light fixtures if possible.

Ambient light level:

- Inexpensive photometers are available to monitor ambient light level closely.

Monitor surface cleanliness:

1. Turn off monitors before cleaning.
2. A dry, clean microfiber towel is recommended.
3. If necessary, the cloth may be lightly dampened with pure water or monitor cleaner if instructed.
4. Do not use cloth/paper to clean, might scratch the monitor surface.
5. Please follow manufacture instructions

Background wall clutter:

- Limit reflection from walls and things around the monitor.

Reflection from reader's outfit:

- Wear dark outfit.

CONCLUSIONS

We have explored the basic factors that may impact the reader's performance in home reading environment. Practical solutions are given to avert the pitfalls. It is feasible to do in-house calibration of inexpensive photometers, which enables us distribute these photometers to radiologists who are reading at home. This ensures close monitoring of ambient light levels in their home reading environment. Ambient light not only increases diffuse reflection and degrades the DICOM GSDF calibration, but also increases the conspicuity of distracting specular reflections and dirt on display surfaces.

REFERENCES

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- 2) BARCO cleaning instructions: <https://www.barco.com/en/news/2020-03-27-dos-and-donts-for-cleaning-your-medical-display>
- 3) Eizo cleaning instruction: <https://www.eizo-apac.com/support-service/cleaning>

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