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Extending Daylight Glare Prediction to Low-light Conditions

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Aim

To extend the prediction range of existing discomfort glare models to reliably cover low-light ranges.

Foundational Investigations

- Range of under-studied glare stimuli
- Type of glare models of focus on
- Choice of glare questionnaire item

Premise

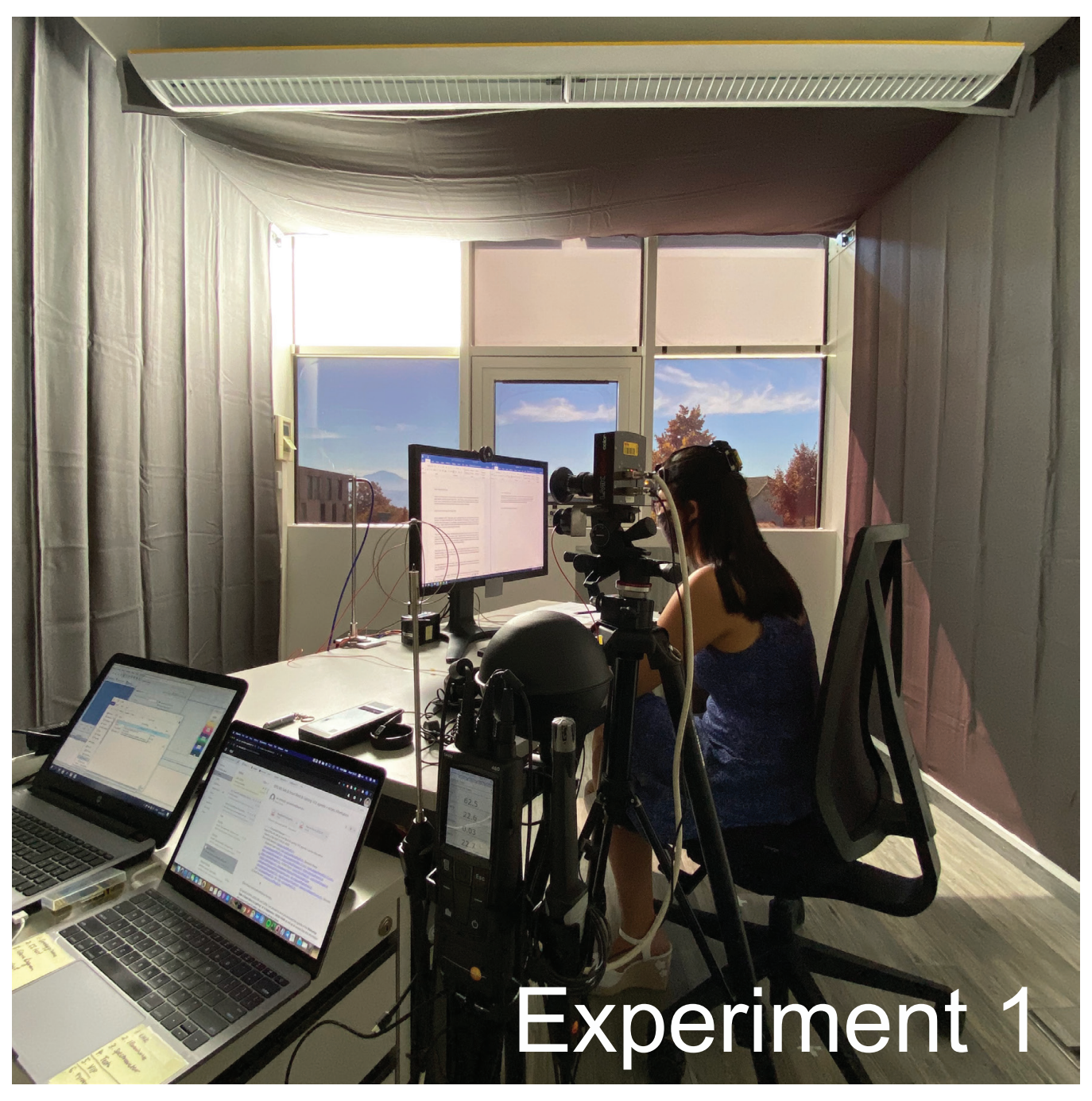
The performance of daylight glare models like DGP, typically derived from brightly lit environments, could be limited in dimmer conditions such as those found in deep open-plan workspaces away from the window.

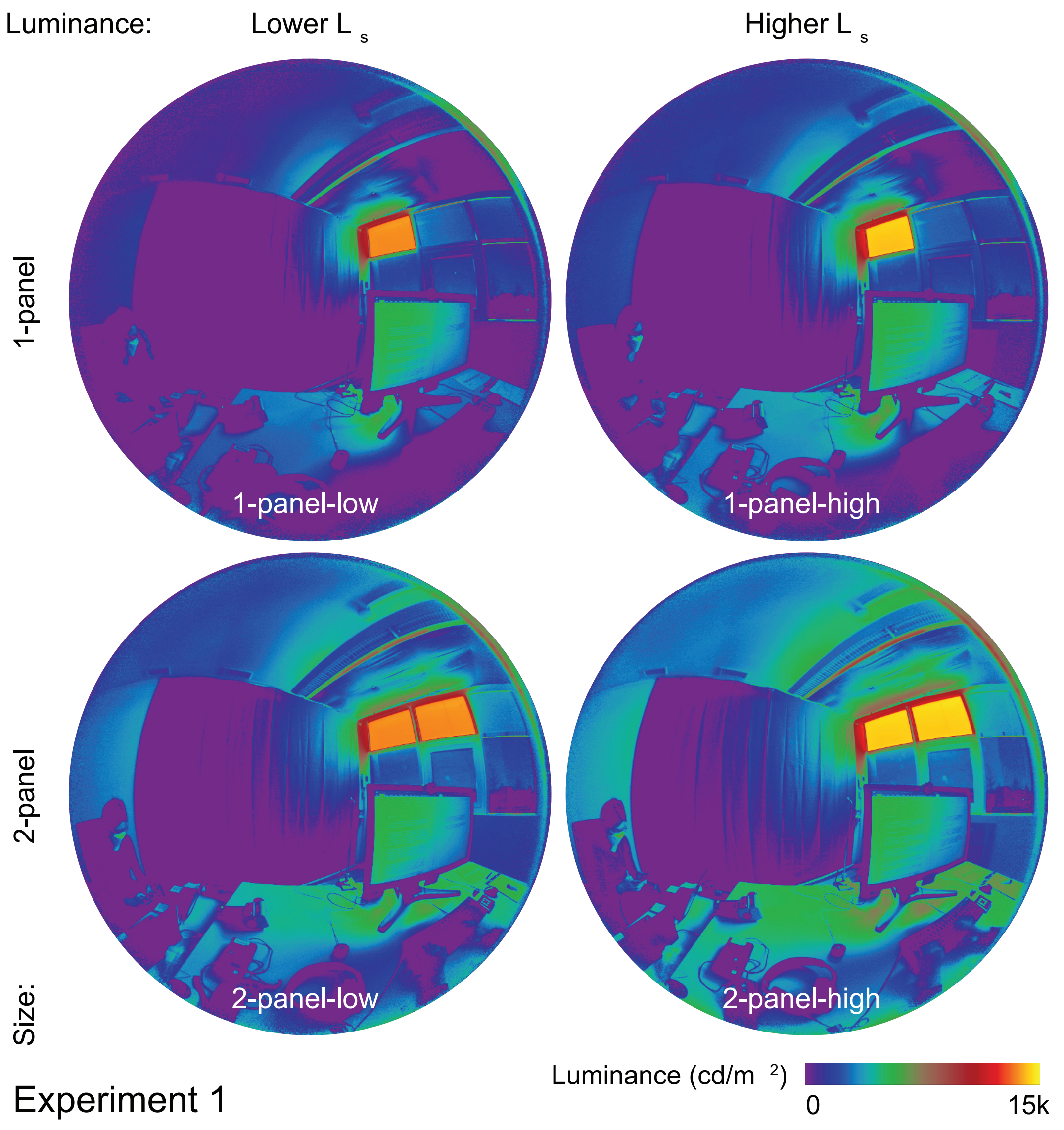
Saturation Effect *Contrast Effect (log_gc)*

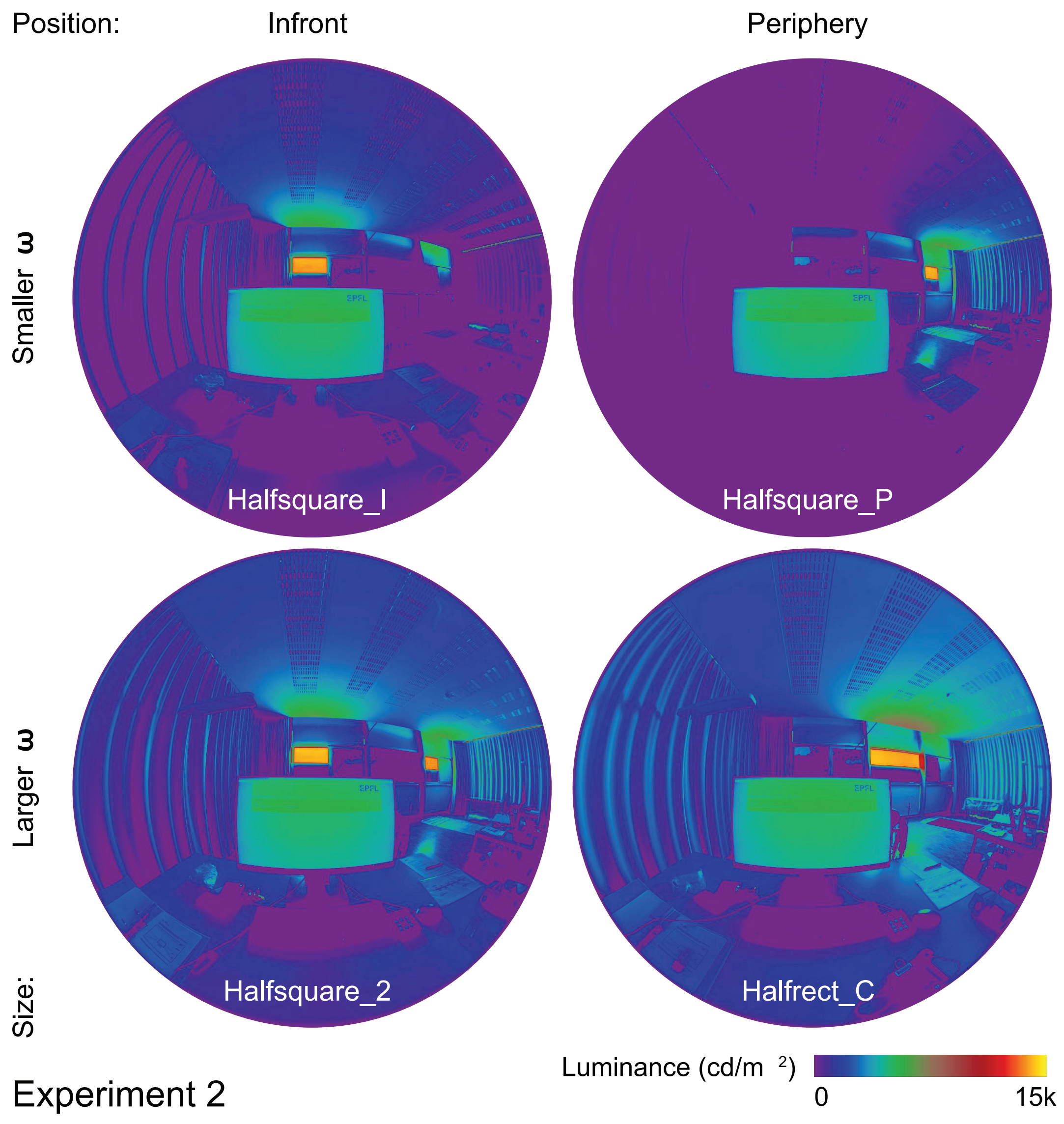
$$DGP = 5.87 \cdot 10^{-5} E_v + 9.18 \cdot 10^{-2} \log_{10}\left(1 + \sum_{i=1}^{n} \frac{L_s^2 \omega_s}{E_v^{1.87} P_i^2}\right) + 0.16$$

Daylight Glare Probability (DGP)

Discomfort glare experiments in low-light conditions

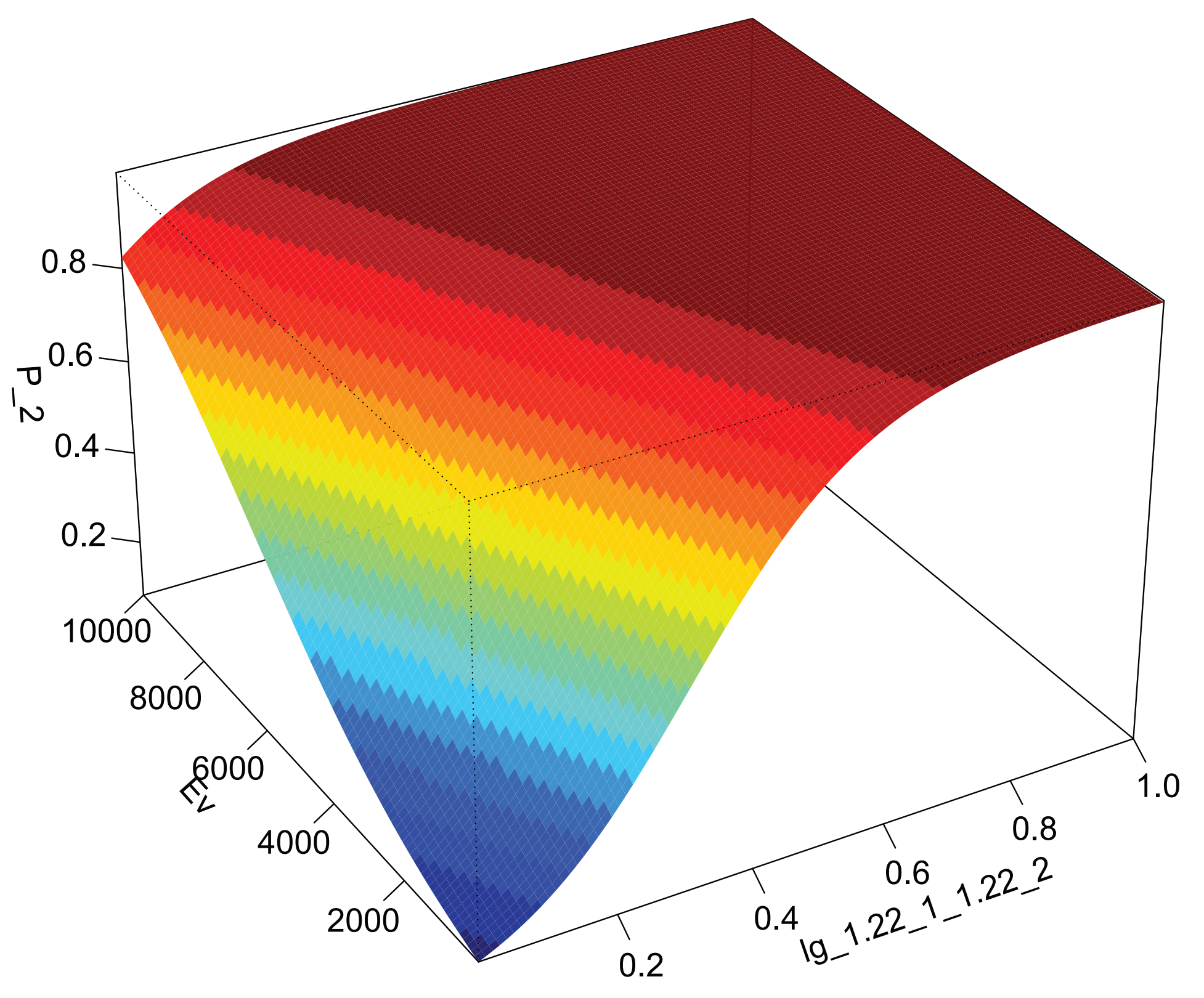






Reformulating a hybrid glare model

A multiple logistic regression model, P_2



$$P_2 = \frac{1}{1 + e^{-(a \cdot E_v + b \cdot \log_{10}\left(1 + \sum_{i=0}^{n} \frac{L_s^i \omega}{E_v{}^k p^2}\right) + c)}}$$

where a = 3.996e-04, b = 8.127, c = -2.459, i = 1.22, k = 1.22

- Minimal collinearity
- More sensitive to contrast in lower ranges of illuminance
- Outperforms DGP in low-light

What's next?

- Training dataset needs more high saturation, high contrast scenes
- Wider validation dataset including low-light scenarios is needed
- What defines a glare source?
- Electric lighting vs. Daylight

Ph.D. Thesis:

LinkedIn:

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Swiss National Science Foundation (SNSF) research project: "Visual comfort without borders: Interactions on discomfort glare" (SNSF #182151) and the Graduate Merit Scholarship from the Singapore University of Technology and Design (SUTD-GEMS)

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