Review of: "Finding the illuminance levels for walkers in a prominent public park in New Delhi during the post-twilight period for healthy visual comfort, security, and other related parameters."

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I was asked to review this article by a member of the peer review team at Qeios. I am very sorry to say that the instrument used for the measurement in this experiment was unfortunately not suitable for the conditions in which it was used. The author reports that the lowest measurement interval was 1 lux, and that the uncertainty on the measurement was 0.05 lux. This is incorrect, and is a common misunderstanding that unfortunately appears in a lot of published literature [1].

Consider what would happen if one were to measure the illuminance in an area lit by 1.5 lux with this meter. The meter would presumably report either 1 lux or 2 lux. Both of these would be incorrect by a factor of 0.5 lux. So the uncertainty is clearly much larger than 0.05 lux. In fact, no matter which illuminance meter you are using, you should generally not trust any results that are based only on the last digit. So if your illuminance meter has a smallest value of 0.01 lux, and you measure 0.02 lux, you should think of this as representing something more like <0.1 lux, not an actual measurement of 0.02 lux.

I looked up a datasheet for the LX-1010b[2], and it says the uncertainty is 4%±0.5f.s. I understand this to mean 4% of the value plus or minus 0.5% of the full scale of the meter. So with the meter set on the highest sensitivity setting of 2000 lux, the error is 4% of the value ± an additional 10 lux. That means that nearly the entire dataset was acquired in a region where the luxmeter did not have sufficient sensitivity to make an accurate measurement.

Beyond this main problem, I think it is worth mentioning that generally speaking, there are no places on the Earth's surface that have “zero illuminance”. Natural starlight plus airglow provides an illuminance of 0.6-0.9 mlux [3], and the full moon has an illuminance typically in the range of 0.05-0.1 lux, with peak values around 0.3 lux [4]. Even overcast nights in areas far from cities are not entirely black, although the typical illuminances on such nights are not yet measured. New Delhi is, however, a bright city, and the skyglow over the park would provide roughly 0.025 lux on a clear night [5], and probably 10-20 times that amount on an overcast night. That means that in areas that are not directly lit by artificial lights, it's going to be important to report what the cloud cover was.

In the urban context, poorly designed lights actually create darkness. I have spent a great deal of time in Berlin's Tiergarten in the areas which do not have any direct artificial illumination. Once your eyes have adapted, the visibility in those areas of the park is fantastic, whereas when you are on one of the illuminated the paths or outside of the park looking in, the interior of the park appears “dark”. This example shows that the whole idea that visibility condition can be specified based on illuminance is simply incorrect.

I know that there are probably hundreds of papers saying that “an illuminance of X is needed to recognize faces”, where X is typically something like 2-5 lux. I'd love to be able to take those authors for a walk in the countryside on a summer night with a full moon (perhaps 0.1 lux), and then find out whether they believe their papers or their eyes.

References

1. ^*Eric Abelson, Brett Seymoure, Andreas Jechow, Elizabeth Perkin, et al. (2023). Ecological Aspects and Measurement of Anthropogenic Light at Night. SSRN Journal. doi:10.2139/ssrn.4353905.*
2. ^*REV Ritter LX-1010B Bedienungsanleitung.*
3. ^*Andreas Hänel, Thomas Posch, Salvador J. Ribas, Martin Aubé, et al. (2018). Measuring night sky brightness: methods and challenges. Journal of Quantitative Spectroscopy and Radiative Transfer, vol. 205 , 278-290. doi:10.1016/j.jqsrt.2017.09.008.*
4. ^*Christopher C M Kyba, Andrej Mohar, Thomas Posch. (2017). How bright is moonlight?. doi:10.1093/astrogeo/atx025.*
5. ^*Fabio Falchi, Pierantonio Cinzano, Dan Duriscoe, Christopher C. M. Kyba, et al. (2016). The new world atlas of artificial night sky brightness. Sci. Adv., vol. 2 (6). doi:10.1126/sciadv.1600377.*