Lighting for quality: NRC Canada Workshop

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IESNA QVE Workshop, August 2001

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On Saturday August 5th, 2001 the Institute for Research in Construction of the National Research Council Canada (NRC) had the great pleasure of hosting a QVE committee research workshop for the second time. NRC had successfully hosted a QVE workshop once before, in 1995, on lighting quality and facial appearance (see http://irc.nrc-cnrc.gc.ca/fulltext/nrcc39865.html). Ottawa was the obvious choice for a workshop in 2001: NRC has a strong lighting research group and dedicated laboratory facilities, and folks were already travelling to Ottawa that week for the IESNA annual conference.

Two pilot experiments were conducted at the 2001 workshop. Half a dozen NRC staff set up and ran the experiments, made coffee and ordered pizza, and 22 members and friends of the QVE committee acted as participants. Each participant spent about an hour doing the two experiments, and during the rest of the day they were engaged in fruitful discussions about other QVE committee business.

The two pilot experiments both addressed non-task surface brightness, a topic that has been of interest to the QVE committee for many years. now recognise that quality lighting is about a lot more than simply the visibility of tasks (see Chapter 10 of the Handbook), that the lighting of other areas affects people's impression and satisfaction with a space. We also believe that improved satisfaction is a mechanism for elevating occupant well-being and task performance, which, in a commercial space, leads to benefits for the organisational bottom-line.

We targeted the brightness of vertical surfaces in the field of view, an office lighting issue deemed important in the Handbook. Ideally, when conducting such an experiment one would be able to manipulate the brightnesses of surfaces independent of each other. However, this is impossible to do with conventional ambient lighting systems, where changing illuminance on one surface simultaneously changes illuminance on other surfaces. The two pilot experiments addressed this challenge in different ways. In the first experiment, conducted in a mock-up cubicle office space, the partition in front of the occupant was lit with a custom "partition washer" fixture to preferentially light that surface. In the second experiment, participants viewed images of an office space in which individual surface brightnesses were modified digitally, independent of other surfaces.

In the first experiment two participants at a time were assigned to one of two cubicle workstations, each of which had a different lighting system. Cubicle B had deep-cell parabolics only overhead; Cubicle A had the same parabolics plus a fluorescent partition washer (see Figure 1). Participants spent around seven minutes reading and evaluating an on-screen article and a summary of the article, and completing an on-screen questionnaire on satisfaction with the lighting. They were then given the ability to set the lighting to their own preference using on-screen dimmers (in Cubicle A only the partition washing fixtures were dimmable and the parabolics were fixed at 150 lx on the desktop; in Cubicle B the parabolics were dimmable). After both participants had chosen their preferred lighting conditions, access to the controls was removed and the participants repeated the task and questionnaire. Participants then switched workstations and repeated the procedure under the other lighting condition.

What did we find out? Firstly, participants liked having dimming control over their lighting; satisfaction with lighting was significantly higher after receiving control. This was expected given the results of other research done at NRC and elsewhere on individual lighting control. There was no significant difference in satisfaction between the two lighting systems, nevertheless, there was evidence that participants preferred to have additional illumination on the partition compared to what was available from the deep-cell parabolics alone. You can get more details on this experiment on the web (see http://irc.nrc-cnrc.gc.ca/fulltext/nrcc45354/).

In the second experiment participants viewed successive greyscale images of a cubicle office. Images were displayed on a screen using a computer projector and were viewed at around half of full size, and at luminances typical of office spaces without daylight and without a direct view of a luminaire. The images were based on a photograph of a real office, but software was used to digitally manipulate the brightnesses of six important room surfaces (see Figure 2). The luminance of the computer screen in the image was kept constant (at 53 cd/m^2). Each surface could take on 32 possible brightnesses, so that there were a total of over a billion possible brightness combinations. Participants voted on the attractiveness of each image as it appeared, and we used a genetic algorithm to "evolve" a participant's optimal image by combining characteristics of images that got higher attractiveness ratings. Once the optimal image had been found (on average participants saw 23 images), additional ratings of that image were requested.

Results indicated that the images were a reasonable surrogate for viewing a real space; the results from this experiment are consistent with full-scale investigations. This is essential if other findings are to be taken seriously (and whenever images are used when presenting potential schemes to clients). For example, there was great variability in the preferred brightness combinations across participants. This is a good thing, for when people occupy real spaces and are given dimming controls there is a wide variability in preferred conditions across individuals also. On average, preferred luminances in the images were similar to those found in studies in real spaces, in the range of 40 – 60 cd/m^2. In addition, optimal images contained ceilings that were substantially brighter than other surfaces. Participants seemed to prefer images that had some luminance uniformity, but not monotony, and that were bright without being glary. You can read more about this experiment on the web (http://irc.nrc-cnrc.gc.ca/fulltext/nrcc45356/).

The results of the QVE research workshops should be always considered as preliminary. The workshops involve lighting experts as participants, a group not necessarily representative of the general population! The number of participants is usually small and they are exposed to conditions for a relatively short period, both of which hamper the extent to which the findings can be assumed to hold in the real world. Nevertheless, the workshops are extremely valuable in helping us form hypotheses for more rigorous testing. In fact, the NRC team have completed larger experiments with naïve subjects based on both pilot experiments, analysis is under way.

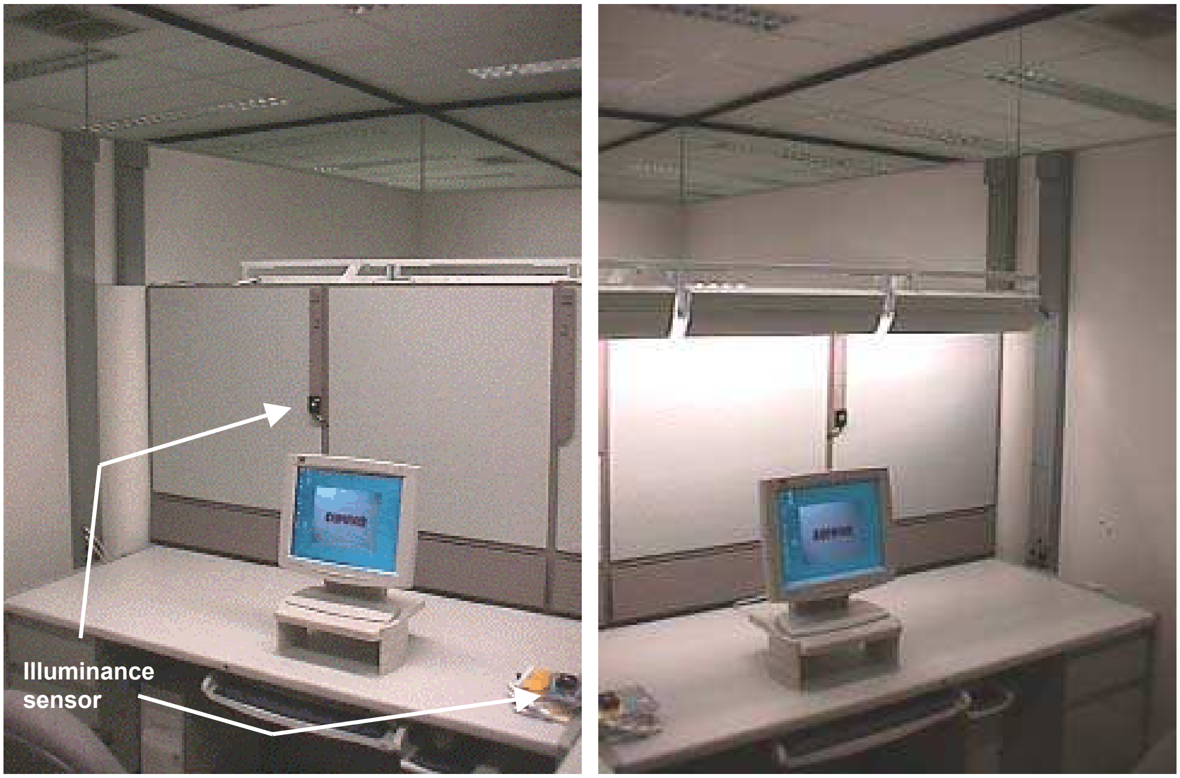

Figure 1. The two lighting systems used in the first pilot experiment.

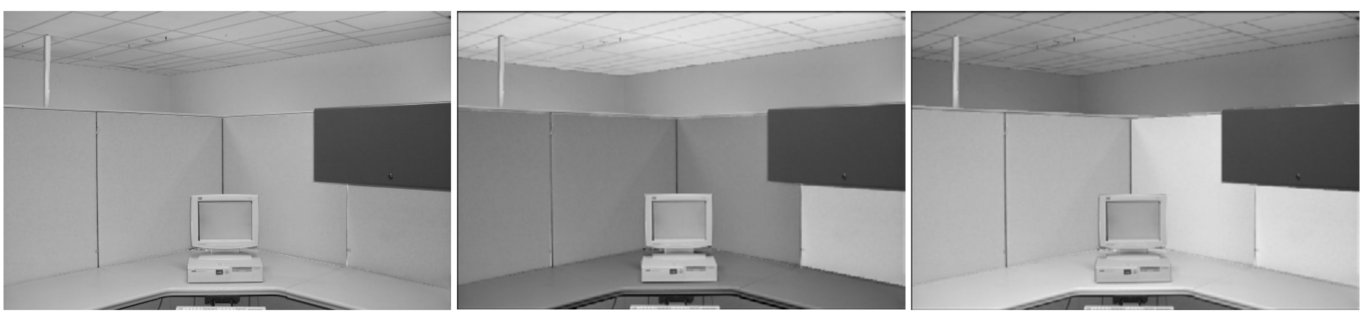

Figure 2. Three possible surface brightness combinations viewable in the second pilot experiment.