

EVALUATION OF DISCOMFORT GLARE THROUGH GLARE SCALES: WHAT ARE WE REALLY MEASURING?

Pierson, C.¹, Wienold, J.², Altomonte, S.¹, Bodart, M.¹

¹ Université catholique de Louvain, Louvain-la-Neuve, BELGIUM,

² Ecole Polytechnique Fédérale de Lausanne, Lausanne, SWITZERLAND

clotilde.pierson@uclouvain.be

Abstract

1. Motivation, specific objective

To collect subjective evaluations of discomfort glare, subjects are usually asked to rate a visual scene on a glare scale. Several glare scales have been defined in the literature, and many replications or derivatives of these scales are currently used. One of the most adopted glare scales is the 4-point Osterhaus' scale – imperceptible/noticeable/disturbing/intolerable –, although scales that used modified versions of the 5 labels from the 9-point De Boer's scale – unbearable/disturbing/just admissible/satisfactory/unnoticeable – are also common. Unfortunately, it is frequent practice by some experimenters to either mix labels from different scales or develop their own glare scale, hence making between-studies comparisons very difficult.

There is a large consensus between researchers that most glare scales are unipolar, going from a “no glare” to a “very glary” end. These scales are usually treated as such in statistical analyses and for their correlation with discomfort glare indices. But, how do the subjects interpret these scales? Up to now, there has been only one study investigating subjects' interpretation of a modified De Boer's scale. The results showed that, besides the confusion brought by the terminology, only 15% of the subjects could reconfigure the labels of the scale in the right sequence.

In an effort to clarify the use of glare scales, the data from two field studies have been analyzed.

2. Methods

Two field studies were conducted in office buildings in Chile and Belgium. The study protocols were the same, collecting objective and subjective evaluations of the luminous environment, and specifically of discomfort due to glare, through a questionnaire translated in the local main language. The questionnaire was divided in three parts: 1) a first assessment of the luminous environment; 2) a set of demographic questions; 3) a second assessment of the luminous environment under different settings of lighting controls.

For the assessment of the luminous environment, the participants were initially asked about their subjective evaluation of the general lighting conditions on a 4-point satisfaction scale. If participants were not fully satisfied with their luminous environment, they could explain the reason(s) in an open-ended question (OEQ). Two glare scales were then presented to the participant, one after the other. The first was a 4-point scale to rate discomfort due to glare: no discomfort/small discomfort/moderate discomfort/large discomfort. The second was a 5-point modified De Boer's scale: imperceptible/perceptible/acceptable/uncomfortable/intolerable.

86 Belgian and 85 Chilean office workers participated in the studies. A dataset of 342 subjective evaluations was used for the analysis.

3. Results

To check the reliability of the two glare scales, the Cronbach's alpha was evaluated. The internal consistency reliability between the two normalized scales was 0.68, which is under the minimal recommended value (0.8). Moreover, the Spearman correlation coefficient between the two scales was 0.53.

Evaluating the distribution of the answers in the two glare scales, an unexpected trend was noticed. Since the data were collected in field studies, and people tend to work under conditions as comfortable as possible, a lower number of evaluations in the scale categories corresponding to “glary” situations was expected. This was the case for the 4-point scale, where the distribution of responses was: “no discomfort”, 52%; “small discomfort”, 31%; “moderate discomfort”, 14%; “large discomfort”, 3%. However, for the 5-point scale, the distribution of responses was: “imperceptible”,

21%; “perceptible”, 16%; “acceptable”, 48%; “uncomfortable”, 14%; “intolerable”, 1%. The 5-point scale might therefore not be interpreted by the participants as intended by the researchers. One reason might be that the participants use the 5-point scale as a bipolar scale with a neutral/no glare condition in the middle. The misinterpretation might also be due to the labels of the 5-point scale referring to two different concepts, namely acceptance and perception.

At last, the two glare scales were transformed to binary scales of discomfort due to glare, to be compared to the responses of the OEQ. The no discomfort category of the 4-point scale included the no discomfort label, whereas the discomfort category included the small, moderate, and large discomfort labels. The division of the 5-point scale was done accordingly to common practice in the literature, namely the imperceptible, perceptible, and acceptable labels in the no discomfort category, and the uncomfortable, and intolerable labels in the discomfort category.

From the participants satisfied with the lighting conditions, 28% felt in the discomfort category when considering the transformed 4-point scale, against only 2% when considering the transformed 5-point scale. From the participants who spontaneously mentioned discomfort glare as a source of dissatisfaction in the OEQ, 95% felt in the discomfort category when considering the transformed 4-point scale against only 40% when considering the transformed 5-point scale. These results could imply, on one hand, that the 4-point scale (or its binary transformation) result in an over-estimation of discomfort due to glare, and on the other hand, that the 5-point scale (or its binary transformation) underestimate discomfort due to glare since 60% of the participants who spontaneously reported glare in the OEQ felt in the no discomfort category. However, these observations could also result from semantic biases affecting the two scales in radically different ways.

4. Conclusions

It was concluded that participants might interpret glare scales differently than researchers, hence providing unreliable answers.

Some recommendations can be given based on these results. First, before asking for a rating on a glare scale, an OEQ should be inserted, since it is the least biased method to recognize whether discomfort glare is a source of dissatisfaction worth mentioning. When using glare scales, experimenters should be clear about what they want to measure: is it the perceived discomfort, or the acceptance of glare? The scales should also be developed in such a way that there is no room for interpretation. At last, the definition of a standard for subjective assessment of discomfort due to glare, such as the ISO 10551 for thermal comfort, would be a great asset for the quality and consistency of future research in this field.

Additional field studies will be conducted with modified methods of assessment of discomfort due to glare, such as the 4-point Osterhaus’ scale, for this issue to be further investigated.