Specifying enough light to feel reassured on pedestrian footpaths

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Specifying Enough Light to Feel Reassured on Pedestrian Footpaths

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ABSTRACT This article discusses lighting for pedestrians and how investigation of reassurance might lead toward an understanding of the right amount of light. A conventional approach is to evaluate reassurance after dark under road lighting of different illuminance: this tends to show the trivial result that higher illuminances enhance reassurance, and that alone does not enable an optimum light level to be identified. One reason is that the category rating procedure widely used is prone to stimulus range bias; experimental results are presented that demonstrate stimulus range bias in reassurance evaluations. This article also recommends alternative methods for future research. One such method is the day–dark rating approach, which does not tend toward ever higher illuminances, and results are presented of two studies using this method.

KEYWORDS pedestrians, reassurance, road lighting

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1. INTRODUCTION

One reason for installing lighting along roads and footpaths is to improve pedestrians' reassurance [Department of the Environment and Welsh Office 1994]. "Reassurance" describes the feeling of confidence a pedestrian might gain from road lighting (among other factors) to walk along a road, in particular if walking alone after dark, and is used here to encompass the terms "perceived safety" [Knight 2010] and "fear of crime" [Atkins and others 1991] as used in past studies. Reassurance is that which provides the comfort that makes someone feel less worried or less afraid or doubtful and restores confidence [Fotios, Unwin, and Farrall 2015]. Planning guidance from the UK government identified the need for local development plans to "reassure the public by making crime more difficult to commit . . . and provide people with a safer more secure environment" by using the ". . . deterrent effects of good design, layout and lighting" [Cozens and others 2003; Department of the Environment and Welsh Office 1994]. One reason for adopting the term reassurance is that there are doubts over what terms such as fear of crime mean as a social phenomenon [Farrall and others 2009]; past studies do not clearly discriminate between perceived safety and fear of crime, and in the review by Lorenc and others [2013], evidence from both were collated on the same dimension. Using lighting to enhance reassurance (or similarly to raise perceived safety or decrease fear of crime) may promote the decision to walk rather than use motorized transport for a short journey or even whether to leave the house at all.

Using a qualitative approach that aimed to avoid specific focus on lighting, Fotios, Unwin, and Farrall [2015] demonstrated that reassurance is gained by the presence of lighting. This qualitative approach did not permit a statistical analysis of significance but provided parallel support for quantitative investigations that may have unintentionally biased respondents to indicate such an effect; for example, by raising the prominence of lighting among other environmental attributes. Confirmation is found in Loewen and others [1993], who found that 42 of 55 respondents mentioned lighting when asked to list features of the environment that they believed could make it safe from personal crime; this was the most frequent category of response, above other factors such as open space and access to refuge.

Having decided that it would be beneficial to install lighting, the next decision for the lighting designer is what characteristics of lighting are required. This article considers one characteristic, the amount of light, or the light level as prescribed by horizontal and/or vertical illuminances in U.S., UK, and international guidance [British Standards Institution [BSI] 2012; CIE 2010; IES 1994]. In particular, this article discusses research methods that might be used to identify suitable illuminance. A method widely used to evaluate road lighting is category rating of outdoor scenes after dark or images of those scenes: it is first suggested that limitations in this approach render it unsuitable for gathering evidence to set light levels, in part because it tends toward conclusions of ever higher illuminance. One reason for this is range bias and an experiment is reported that demonstrates range bias in evaluations of safety. Three alternative methods are suggested that may yield more credible data.

For clarity, we acknowledge here that changes in lighting other than photopic illuminance may affect evaluations of reassurance, such as the spectral power distribution [Akashi and others 2004; Knight 2010] and spatial distribution of light [Haans and de Kort 2012]. We also acknowledge that lighting alone does not mediate reassurance but that it is affected also by physical features through evaluation of prospect and escape [Fisher and Nasar 1992], by factors of social psychology such as perceptions of attractivity and power, and expectations of evil intent [van der Wurff and others 1989] and that an effect of lighting may interact with these factors; for example, that a higher illuminance may have little effect in a location with a high level of entrapment (or low possibility for escape) [Blöbaum and Hunecke 2005].

2. THE EFFECT OF AN INCREASE IN ILLUMINANCE

Table 1 summarizes six studies using category rating to investigate the effect of an increase in illumination on reassurance [Atkins and others 1991; Blöbaum and Hunecke 2005; Boomsma and Steg 2014; Ishii and others 2007; Loewen and others 1993; Vrij and Winkel 1991]. In five of these studies it was concluded that higher light levels increased the level of reassurance; in the remaining study [Atkins and others 1991], it was concluded that there was an effect for females but not for males and females combined.

The six studies in Table 1 examined just two light levels, concluding that respondents felt safer, or more reassured, with the higher light level. Comparing two light levels within otherwise similar environments will always tend to show a higher rating of safety with the higher light level. The results reported by van Rijswijk [2016], who compared three light levels in a virtual environment, also demonstrated that higher light levels were considered safer. Note also that this conclusion (that higher illuminance yields higher ratings of safety) has been found in studies where the two illuminances were relatively low [Vrij and van Winkel 1991] and where the illuminances were relatively high [Boomsma and Steg 2014], which indicates that the evaluations are relative rather than absolute. A critical question for design is whether more illuminance will always be desirable or whether there is an optimum illuminance above which the increase in reassurance is negligible. Studies such as those in Table 1 provide insufficient evidence as to the possibility of an optimum illuminance, in part because each study examined only two levels of illuminance. Though they were not necessarily designed with the intention of finding an optimal lighting level, the results in some cases have subsequently been used for this purpose.

3. SETTING A LIGHT LEVEL TO GIVE A SPECIFIC RATING

One approach to setting a light level would be to specify the illuminance expected to ensure a certain minimum rating of reassurance having first established the association between illuminance and ratings of reassurance. This

TABLE 1 Past studies investigating the effect on reassurance of an increase in light level

Study	Method	Effect of increase in light level
Atkins and others [1991]	Field study; before and after surveys of unspecified relighting. Fourfold increase in illuminance (values not reported). Evaluated using nine-point rating scale, *very safe* to *very unsafe*	Significant increase for females but not for males or for males and females combined. Insufficient data to support statistics
Blöbaum and Hunecke [2005]	Field study of eight locations around a university campus, chosen to represent high and low levels of brightness. Evaluated using five-point rating scales concerning reassurance (for example, I would walk along this place unaccompanied)	The brighter locations were associated with higher levels of reassurance ($P < 0.01$)
Boomsma and Steg [2014]	Lab study using four 40 s videos of virtual environments, identical except for variation in light level and road width. Intended to represent light levels of 12 and 17 lx. Evaluated using rating scale: I feel safe in this place, *strongly disagree* (1) to *strongly agree* (5)	Higher light level was considered to be safer ($P < 0.001$)
Ishii and others [2007]	Field study in which two conditions were achieved by switching on/off porch lights of residences. Horizontal illuminances of 0.7 and 1.4 lx; vertical illuminances of 0.1 and 1.1 lx. Rating of security *from insecure* (1) to *secure* (6)	Increase in rating of security with higher illuminance but lacks statistical analysis to verify effect. Also, small sample size ($n = 12$)
Loewen and others [1993]	Lab study. Observation of photographs including variations in light level (daylight vs, scenes at nighttime). Rating of perceived safety, *not at all safe* (1) to *very safe* (5)	Daylight scenes considered safer than nighttime scenes ($P < 0.001$)
Vrij and Winkel [1991]	Field study. Before-and-after survey of passers-by with fivefold increase in illuminance; for example, 0.24 to 1.31 lx on the footpath. Evaluation included "To what extent do you feel safe here?" on a scale of *very unsafe* (1) to *very safe* (10)	Increased rating of safety with higher illuminance ($P < 0.01$)

might be, for example, enough light to ensure ratings reached at least four on a five-point scale (5 = *very safe*; 1 = *very unsafe*) in response to a question such as "Does the lighting here make you feel safe or not?" This was the method used to establish light levels for the British standard [BSI 1992]. We demonstrate here why the influence of range bias means that this is not a robust approach.

Range bias means that respondents tend to make the range of observed stimuli fit the range of available response options. This was demonstrated by Poulton [1977] in an experiment where loudness judgments were made using a rating scale ranging from *very quiet* to *very noisy*. For one range of noise levels, 80 to 100 dB, ratings for the 80 dB noises approached the quiet end of the scale and 90 dB marked the transition between acceptable and noisy—the middle of the noise range was mapped to the middle of the response range. With the second range of noise levels, 70 to 90 dB, 90 dB was now considered to be very noisy and 80 dB marked the transition between acceptable and noisy. The same loudness rating was given to noises of different loudness when they were experienced within different ranges; in this case the 80 dB noise from the lower range of noises tended to receive the same loudness rating as the 90 dB noise from the higher range of noises. Note here that an increase in sound intensity of 10 dB means that a sound will be perceived as twice as loud [Moore 1961].

Range bias can be seen in ratings of perceived adequacy of road lighting. Simons and others [1987] carried out field surveys in 24 residential roads, with average horizontal illuminances ranging from about 1.0 to 12.0 lx. A nine-point rating scale was used to rate their "overall impression" of the lighting, with points labeled *very poor* (1), *poor* (3), *adequate* (5), *good* (7), and *very good* (9). The results suggest that higher illuminances lead to higher ratings of overall impression, similar to the ratings of safety discussed above. The data of Simons and others [1987] are of interest because they were the basis for the light levels of the three lighting classes in the 1992 issue of BS5489 [BSI 1992]: Horizontal illuminances of 10.0, 5.0, and 2.5 lx were proposed, because these corresponded to ratings of *good* (7), *adequate* (5), and *poor-to-adequate* (4), respectively.

Twenty years beforehand, de Boer [1961] had also carried out a field study using a nine-point rating scale similar to that used by Simons and others [1987], asking for a "general appraisal" with response points labeled *bad* (1), *inadequate* (3), *fair* (5), *good* (7), and *excellent* (9). The road luminances ranged from approximately 0.06 to 5.0 cd/m^2, which is an illuminance range of approximately 1.0 to 71 lx (assuming an average luminance coefficient of $q_0 = 0.07$, a typical value for an asphalt road surface), a larger stimulus range than that examined by Simons and others [1987]. Range bias is again suggested in these results: the roads of low luminance received ratings near the low end of the rating scale and the roads of high luminance were rated toward the top of the rating scale.

Table 2 compares the illuminances required for ratings of 4, 5, and 7 on a nine-point response scale, the three points used by Simons and others [1987] to note three classes of lighting. It can be seen that "good" lighting in the de Boer [1961] study required a much higher illuminance than in Simons and others [1987], and one reason for this is range bias; in the de Boer [1961] study, the higher end of the rating scale was stretched toward a higher maximum stimulus level (71 lx) than in the study by Simons and others [1987] (12 lx). This demonstrates range bias because the evaluation of a particular light level is made in relation to the range of other light levels experienced rather than being an absolute level. Had the de Boer [1961] study been considered along with, or instead of, the Simons and others [1987] study, then the British Standard may have recommended a different set of illuminances. Three possible reasons why the de Boer [1961] study was not considered are that it focused on drivers rather than pedestrians, it reported light levels as luminances rather than illuminance, and it was not conducted in the UK, whereas that of Simons and others [1987] was.

4. RANGE BIAS IN EVALUATIONS OF PERCEIVED SAFETY

The de Boer [1961] study and the Simons and others [1987] study led to different conclusions regarding the illuminance required for good lighting, where good was defined as a certain response point (7) on a category rating scale. The explanation suggested here for this disagreement is range bias. An experiment was carried out to demonstrate range bias in evaluations recorded using category rating scales, here using ratings of perceived safety [Fotios, Cheal, and others 2015].

The stimuli used were a set of 100 photographs of outdoor locations in Eindhoven (The Netherlands) after dark as used in a previous study to investigate perceived safety [van Rijswijk 2016]. Perceived safety was evaluated using a five-point rating scale (5 = *very safe*; 1 = *very unsafe*), following which the 100 photos were placed in rank order, from least safe to most safe. One interesting point about these photographs is that van Rijswijk [2016] received them from students who had been asked to supply them

TABLE 2 Illuminances associated with ratings of lighting quality in field studies of road lighting where different ranges of light level were experienced

	Simons and others [1987]: ratings of "overall impression"		de Boer [1961]: ratings of "general appraisal"		
Rating scale point	Scale descriptor	Illuminance (lx)	Scale descriptor	Luminance (cd/m^2)	Estimated illuminance (lx)
7	Good	10.0	Good	1.5	21
5	Adequate	5.0	Fair	0.4	5.7
4	Poor to adequate	2.5	Inadequate to fair	0.24	3.4

without any instruction as to the nature of the location(s) they should choose or the intended purpose. In other words, they were not purposefully manipulated to illustrate particular factors associated with safety.

The 100 photographs were divided into two subsets of 55 according to the original rank order. Series A contained the 45 photos given the higher ratings of safety and series B included the 45 photos given the lower ratings of safety. Critically for this analysis of range bias, both series also included the 10 photographs in the center of the rank order of all 100: these 10 photographs were therefore the safest scenes in series B and the least safe scenes in series A.

Evaluation was carried out using a category rating procedure replicating that used in the original study [van Rijswijk 2016]. The 55 photographs within a series were observed individually and in a random order. Following a 5 s exposure, test participants were required to rate the perceived safety of the scene using a five-point rating scale (1 = *very unsafe*; 2 = *somewhat unsafe*; 3 = *neutral*; 4 = *somewhat safe*; 5 = *very safe*) prior to the next image being displayed. The images were presented on a PC monitor screen under low ambient light levels. Each series was evaluated by 27 observers and these were different for each set (an independent sample design). For series A there were 19 females and eight males: the age ranged from 18 to 54 years, with the median age in the 18–24 range. For series B there were 14 females and 13 males: the age ranged from 18 to 44 years, with the median age again in 18–24 range.

The distributions were explored using a range of approaches; measures of dispersion, graphical, and statistical analysis. These, however, were inconclusive regarding normality of the distributions. It was therefore assumed that the data were not drawn from a normally distributed population because rating scale values are essentially ordinal data [Jamieson 2004].

Median ratings for the 10 photographs common to both series are shown in Fig. 1 and Table 3. It can be seen that these images tended to receive higher ratings (that is, considered safer) when observed within series B (that is, alongside the 45 scenes considered the least safe) than when observed within series A, a median increase of 1.0. It can also be seen that ratings in series B and series A tend to lie above and below (respectively) the original ratings when all 100 images were observed during a trial, as would be expected due to observation of the overall range of levels of perceived safety. According to the Mann-Whitney test for independent samples, the differences in ratings between series A and B are significant ($P < 0.05$) for

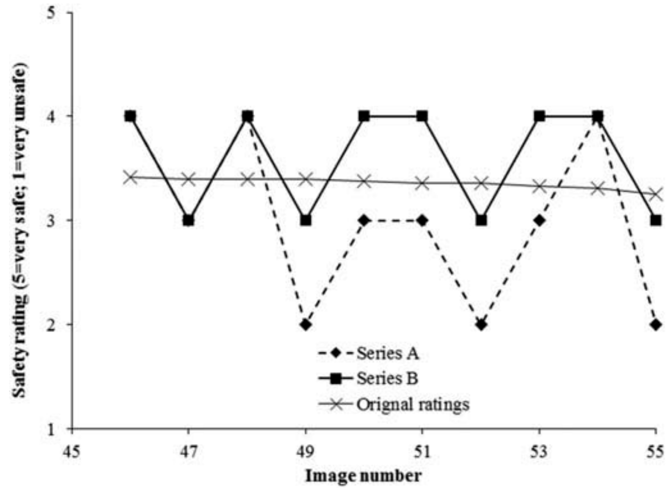

FIG. 1 **Median safety ratings for the 10 common images (image numbers 46 to 55) observed with series A, series B [Fotios, Cheal, and others 2015], and mean ratings from the original rating of all 100 scenes [van Rijswijk 2016]. Note: (i) data points connected here only to reinforce trends; (ii) we have only means for the van Rijswijk [2016] data and cannot present medians for comparison.**

eight scenes but were not suggested to be significant in two scenes—#47 ($P = 0.068$) and #48 ($P = 0.35$) in Fig. 1. Subsequent analysis using the *t* test for independent samples confirmed these conclusions.

These results demonstrate that the rating of perceived safety awarded to a particular scene can be affected by its perceived safety relative to that of the other scenes evaluated: it is a relative judgment, not an absolute judgment. It is, therefore, not appropriate to expect a particular light level to lead to a given level of safety because that evaluation is influenced by experience of perceived safety in other locations. Note here that the randomized order of presentation is used to counter a possible order effect whereby ratings are influenced by the preceding stimuli [Staddon and others 1980; Ward and Lockhead 1970]. As the current results demonstrate, this does not counter range bias.

5. THE DAY–DARK APPROACH

The conventional approach to evaluating the effectiveness of lighting for reassurance is to carry out evaluations after dark or with scenes simulating after dark (for example, the studies listed in Tables 1 and 2). A comparison of evaluations made in different locations with different light levels is then used to indicate the effect of those different light levels. One problem with this approach is that it compounds any effect of lighting with the baseline level of reassurance for the specific location. Consider two roads, A and B, given ratings of 4 and 6, respectively (on a rating

TABLE 3 Results of safety ratings: median ratings and lower and upper quartiles. In these ratings 1 = *very unsafe*, 5 = *very safe*

Image number[a]		46	47	48	49	50	51	52	53	54	55
Photograph number[b]		16	51	10	25	14	70	58	42	91	64
Series A	Median	4	3	4	2	3	3	2	3	4	2
	Lower Q	2	2	2	2	2	2	2	2	2	2
	Upper Q	4	4	5	3	4	3.5	3.5	3	4	3
Series B	Median	4	3	4	3	4	4	3	4	4	3
	Lower Q	4	2.5	4	3	3	3	3	3	4	3
	Upper Q	4	4	5	4	4	4	4	4	4	4
Difference	Mann-Whitney *U*	231	263	314	240	232	236	186	199	203	256
	Significance (*P*)	0.013	0.068	0.354	0.024	0.017	0.02	0.001	0.003	0.002	0.048

[a]Rank order from results of original analysis; #46 had the highest rating of safety and #55 the lowest rating of safety.
[b]Photograph number identified here to aid identification of precise image from original data set.

TABLE 4 Comparison of conclusions drawn from dark-only and day–dark ratings of perceived safety regarding the effectiveness of road lighting

	Evaluations (1 = *safe* to 7 = *unsafe*)			Conclusion about lighting drawn from	
Road	Dark rating	Day rating	Day–dark difference	After-dark rating only	Day–dark difference
A	4	1	3	Better lighting	Less effective
B	6	5	1	Less effective	Better lighting

scale of 1 = *safe* to 7 = *unsafe*). The conclusion drawn would be that the lighting in road A is better because of the higher rating (Table 4). An alternative approach is to use the day–night approach in which ratings of perceived safety are captured during daytime and after dark and the effectiveness of lighting is evaluated against the difference between the daytime and after dark ratings. Consider now that roads A and B are given ratings during daytime of 1 and 5, respectively. Lighting in road B yields the smaller day–dark difference and would now be considered the more effective lighting.

Two studies have used this approach, one evaluating car parks in New York [Boyce and others 2000] and the other residential roads in Sheffield, UK [Unwin 2015]. In both studies, ratings associated with perceived safety were gathered from groups of test participants in several different locations. The results are shown in Figs. 2 and 3, where the difference between day and dark ratings of perceived safety are plotted against horizontal illuminance. One approach to interpretation of these data would be to identify the median illuminance corresponding to a given difference between the day and dark ratings. For a difference of 1.0, these data suggest illuminances of approximately 18 lx in car parks and 3.0 lx in residential roads: for a difference of 0.5, these illuminances increase to approximately 30 and 5.0 lx for car parks and residential roads, respectively.

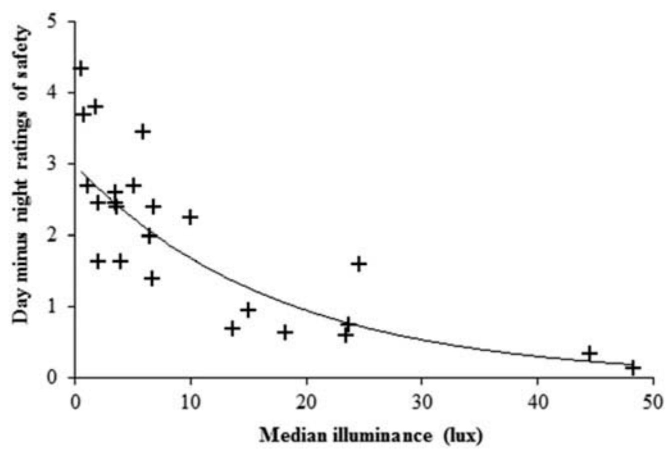

FIG. 2 Difference between daytime and nighttime ratings of perceived safety of car parks in New York plotted against median horizontal illuminance [Boyce and others 2000].

6. ALTERNATIVE METHODS FOR MEASURING REASSURANCE

The quality of evidence in studies associated with reassurance is generally considered to be poor [Lorenc and others 2013]. One problem with rating scales is that they may force test participants to evaluate an item they may otherwise have not chosen to evaluate or considered to be relevant. This effect can be noted in two studies. In one study [Acuña-Rivera and others 2011], a rating scale

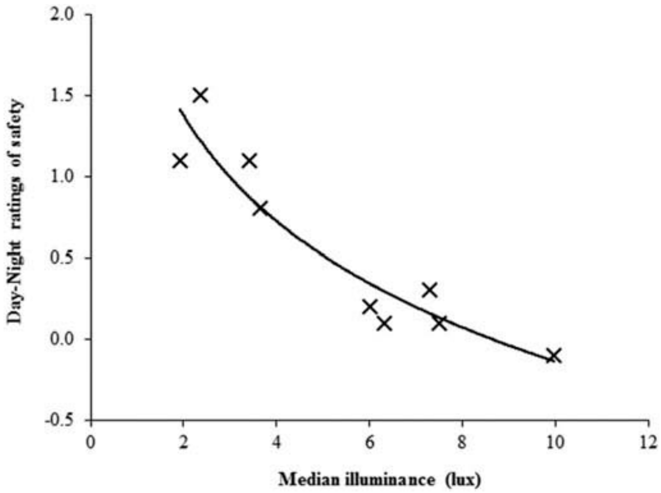

FIG. 3 **Difference between daytime and nighttime ratings of perceived safety of residential roads in Sheffield plotted against median horizontal illuminance [Unwin 2015].**

approach forced test participants to give an evaluation of reassurance that was not otherwise forthcoming in an unfocused, qualitative response (an open question) that was completed before the rating scales. In a second study [Ramsay and Newton 1991], when asked to list the three main disadvantages of their location, only 8% of respondents mentioned poor lighting, but when asked specifically whether better lighting would decrease fear of crime, 80% agreed. What this means is that respondents may have been led to indicate that a higher light level enhances reassurance, a response to an obvious change in lighting, rather than being an opinion they would have expressed without prompt. Being asked to rate something not considered to be relevant or significant may prompt variability in responses. Given that there may be uncertainties when using rating scales to subjectively evaluate the level of reassurance provided by road lighting, we describe here two alternative, objective methods that might be used in further work.

If it is considered that a lower level of reassurance would lead to more calls for police assistance, then the frequency of such calls would provide an alternative measure of the benefit of road lighting. This was examined in one survey in the United States that found that an increase in lighting (expressed as an increase in the number of light fittings rather than as a photometric quantity) did lead to a reduction in calls for police service [Quinet and Nunn 1998]. Counting light fittings is unlikely to be a reasonable proxy for light level: further work with this method should consider measuring illuminance (and/or other measures of lighting quality) rather than counting light fittings. Calls made for police assistance may also be due to occurrence of a crime, rather than because of a low feeling of reassurance, and crime may increase with lower light levels. Therefore, further work should consider the nature of such calls rather than simply their frequency.

The second alternative method is to use an objective measure of the effect of changes in lighting that is associated with the effect on reassurance. People may be evaluated by their faces, among other attributes; for example, recognition of their identity and/or apparent intent. If the ability to evaluate another person by his or her face is associated with reassurance, then a measure of face visibility may provide an alternative measure of reassurance. Wu [2014] sought evaluations of perceived safety using a five-point response scale (1 = *very unsafe*; 5 = *very safe*) for photographs of exterior scenes via an on-line survey. Some of these photographs included a person (an adult male, at a distance of 10 m), and this person was observed under three lighting conditions: face in the dark, face well lit, and face lit from one side. Three types of environments were represented; that is, either a generally open space or with trees or buildings in close proximity. Figure 4 shows mean safety ratings from the 52 observers. In all three environments the "face in light" situation has the higher score, albeit an apparently negligible amount in the "open" environment, and in two cases the "face in dark" situation has the lower score. Wu's [2014] analysis of the overall data suggests that face in light led to a significantly higher rating of perceived safety than did either face half lit or face in dark, with no difference suggested between these two latter cases. Though extensive investigations of lighting and face-based evaluations have been carried out [Fotios, Yang, and Cheal 2015; Lin and Fotios 2015; Yang and Fotios 2015], these were not directly compared with evaluations of reassurance: such comparison might prove to be useful.

These (and other) methods are suggested not as an alternative to subjective evaluation using rating scales but as method(s) to be used in parallel. If the results from different methods applied to the same set of visual scenes converge toward similar conclusions, it will be possible to place more confidence in those conclusions.

7. LIGHTING AND CRIME

This article has examined lighting and reassurance, which may be associated with fear of crime. It is not the intention to discuss the effect of lighting on road-based crime, but for clarity we note here the findings of key articles. Ramsay and Newton [1991] concluded that better

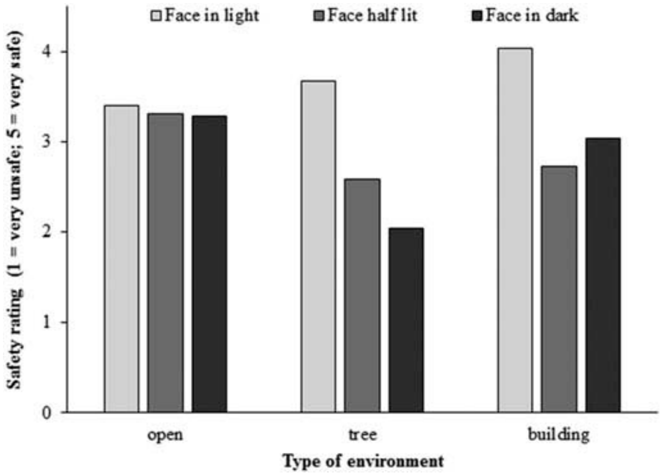

FIG. 4 Mean ratings of perceived safety gathered by an on-line survey for photographs of outdoor scenes with different environments and faces under different lighting expected to affect their visibility, after Wu [2014].

lighting by itself has very little effect on crime. Welsh and Farrington [2008] concluded that improved street lighting significantly reduces crime but that nighttime crimes did not decrease more than daytime crimes, suggesting an effect of community pride rather than the visual benefit of better lighting. A similar conclusion was reached by Pease [1999]. One analysis of the built environment and social factors [Dempsey 2008] suggests that maintenance has a strong association with feelings of safety. Maintenance was characterized by pavement condition, the level of litter, and the state of homes and gardens: refurbishment of road lighting may also be seen as a factor of maintenance and thus that such action by the local authority enhances community pride perhaps regardless of the change in lighting that results.

Steinbach and others [2015] examined the impact on crime rates of four changes to road lighting carried out to reduce energy consumption; permanently switching off, reducing the number of hours switched on at night (part night), reducing the output (dimming), and replacing the widely used (in the UK) sodium lamps for whiter light sources suggested to improve pedestrians visual needs after dark [Fotios and Goodman 2012]. The white lighting strategy enables lower illuminances to be used, but it is not clear whether that benefit was adopted in the current data. Crime and lighting data were gathered from 62 (of 174) local authorities in England and Wales. It was found that neither switching off nor part-night strategies affected crime rates, but there was a weak evidence of a reduction in crime associated with white light and dimming strategies. One caveat of these data is that we do not know the relationship between the absolute level of light and crime. This relationship must follow a plateau–escarpment curve: if it did not, we would expect zero crime under daylight. It may be that road light conditions in this study were in the plateau region, and if changes such as dimming and white light did not reach the escarpment, a negligible effect would be found.

8. SUMMARY

Experimental studies of lighting and reassurance employing only after-dark ratings of reassurance tend to draw the somewhat trivial conclusion that higher levels of lighting improve reassurance. This is because such judgments are relative rather than absolute; the scenes are placed in relative order rather than being an absolute judgment mapped to descriptions of magnitude on the rating scale. This means that we should not place any emphasis on the specific higher illuminance because a further study, with even higher illuminances, will suggest that it should be higher still. Similarly, it is not appropriate to set a light level by picking the illuminance corresponding to a particular point on the rating scale of reassurance. Light levels recommended in BS5489-3:1992 [BSI 1992] were, however, based on such data [Simons and others 1987] and should therefore be questioned along with any further standards subsequently derived from it.

Of the evidence currently available for defining an optimum illuminance, that from rating studies using the day–dark approach offers the most credible data. In particular, the day–dark approach leads to an optimum illuminance, above which a further increase in illuminance has negligible benefit, rather than leading toward the ever-higher illuminance concluded when examining only after-dark ratings. For residential roads, the results of one such study suggest horizontal illuminances of around 3 to 5 lx, but that remains to be validated by repetition and evaluation as to the influence of range bias. It is also desirable for reassurance to be investigated in parallel using alternative procedure(s), preferably using objective measures of reassurance, and to also consider other visual tasks of pedestrians such as trip hazard detection [Uttley and others 2015] and evaluate the intent of other people [Yang and Fotios 2015].

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