



Reduced street lighting at night and health: A rapid appraisal of public views in England and Wales



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ABSTRACT

Financial and carbon reduction incentives have prompted many local authorities to reduce street lighting at night. Debate on the public health implications has centred on road accidents, fear of crime and putative health gains from reduced exposure to artificial light. However, little is known about public views of the relationship between reduced street lighting and health. We undertook a rapid appraisal in eight areas of England and Wales using ethnographic data, a household survey and documentary sources. Public concern focused on road safety, fear of crime, mobility and seeing the night sky but, for the majority in areas with interventions, reductions went unnoticed. However, more private concerns tapped into deep-seated anxieties about darkness, modernity 'going backwards', and local governance. Pathways linking lighting reductions and health are mediated by place, expectations of how localities should be lit, and trust in local authorities to act in the best interests of local communities.

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1. Introduction

Electric street lighting has been a feature of urban and sub-urban settlement since the end of the nineteenth century. Indeed, the electrification of lighting has in many ways defined the modern city, in extending the visibility of its public spaces, inhabitants and itinerants beyond the hours of natural daylight (Martland, 2002; Otter, 2002) and changing the meanings of the night for city dwellers (Schlör, 1998). However, in many areas of England and Wales, as in other countries, the taken-for-granted assumption that streets and public spaces will be lit at night has been disrupted in recent years. Many local authorities responsible for street lighting have reduced street lighting at night, a policy primarily driven by requirements to reduce costs and carbon emissions under the Climate Change Act 2008 (Department for Environment Food and Rural Affairs (DefRA), 2011), but also with considerations of contributing to reductions in environmental light pollution (The Royal Commission of Environmental Light Pollution, 2009). A rapid growth of technological innovations over the last 20 years has enabled greater control over the colour, intensity and switching on schedules of public lighting stock (Shaw, 2014a), and local lighting authorities across England and Wales have adopted a wide range of interventions. These include: removing, or switching off lanterns in street light columns ('switch

off'); reducing the number of hours that they are switched on ('part-night lighting'); replacing sodium lanterns by 'white' LED light; and 'dimming' lanterns through centrally managed systems. Some of these interventions reduce the amount, or duration of, artificial light at night. Switch off and part-night lighting result in dark streets which were once lit, at least for some of the night time hours.

Changes which reduce lighting, particularly 'switch off' and part-night lighting in urban areas, have attracted considerable public and media concern, centring on crime, fear of crime, perceptions of safety, and road safety. These are all important determinants of health and wellbeing; directly in the case of road safety; and indirectly, in that fear of crime, for instance, has multiple pathways that impact on mental health (Lorenc et al., 2012). To date, empirical research on fear of crime and perceptions of safety have focused largely on improvements to lighting, with the assumption that more lighting will improve security, and reduce fear of crime (Lorenc et al., 2013). However, empirical findings on the impact of improved lighting on perceptions of crime, personal security and road injury have been mixed, with no clear conclusions on how increased lighting does improve these health outcomes (Atkins et al., 1991; Painter and Farrington 1997; Pain et al., 2006). A systematic review of the effects of increased street lighting on crime (Welsh and Farrington, 2008), including 13 controlled before and after studies, concluded that improved street lighting in public spaces did not reduce crimes at night any more than was observed during the day. The authors suggest that the protective mechanism of street lighting may therefore act

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more through increasing pride in the locality or social control, rather than directly increasing surveillance to deter crime. As Koskela and Pain (2000), suggest, 'fear of crime' is a complex outcome of the political and social meanings of space, including gendered meanings, and is unlikely to be deterministically tied to isolated environmental conditions such as public lighting. On road traffic injuries, Beyer and Ker's (2009) systematic review also noted the poor methodological quality of research to date, and suggested more high quality evaluations were needed to adequately determine the effectiveness of street lighting for reducing the incidence of road traffic injury.

If research on how *improved* lighting impacts on health outcomes is inconclusive, that on *reduced* lighting is almost non-existent. There are no good grounds for assuming that the removal of a public good will have the reverse effects to those of providing or improving it. In addition, there are some rather different health outcomes that become the focus of reductions in artificial lighting. These relate to how reductions might mitigate the negative health impacts some have claimed from a growth in, and changing frequencies of, artificial light in the environment (Höller et al., 2010; Falchi et al., 2011). Although the evidence base to date is weak (Vohra, 2013), a growing concern with light pollution as a potential hazard to health draws on studies of animals (Shuboni and Yan, 2010) and shift workers to identify disruptions in circadian rhythms and endocrine processes, which can affect sleep (Navara and Nelson, 2007) and, theoretically, health outcomes such as anxiety, depression, obesity and even cancer incidence (Pauley, 2004; Fonken et al., 2009; McFadden et al., 2014). Broader public health concerns also include the more existential wellbeing effects of being able to see the night sky, and longer term environmental impacts of reduced carbon emissions (Claudio, 2009). The amount, and quality, of light at night has thus become a public health as well as political issue.

There have been some qualitative studies of public views of street lighting, identifying mixed and reflective views on the relationship between light and fear of crime, for instance (Pain et al., 2006). To date, though, there has been little research that directly addresses public views on the possible relationships between street lighting reductions and health more generally. To address this gap, this study therefore aimed to explore public views of the potential health and wellbeing impacts of reduced street lighting. We aimed to explore public understanding of the possible pathways through which street lighting might impact on health and wellbeing, and how reductions in street lighting were understood as impacting on health and wellbeing outcomes.

2. Methods

To map a range of views, we used a rapid appraisal design (Trotter et al., 2001; Beebe, 1995) to collate different sources of

data across eight local authorities in England and Wales. Local authorities were purposively chosen to reflect a range of lighting authorities, geographical regions, populations and types of implemented or planned intervention (see Table 1). These interventions included those which were likely to have noticeably reduced lighting at night (such as the introduction of switch off and part-night lighting) and also those (largely in more urban areas) which were less likely to be noticeable, such as replacing sodium with LED lighting. The aim was not to evaluate these interventions, but rather to use the context of changes to explore what health and wellbeing concerns the public had, and to use this in combination with evidence from the literature to inform a model of the pathways that link street light reductions and wellbeing.

2.1. Ethnographic data

Within each area, we interviewed key informants (including local authority lighting professionals, councillors); collected documentary evidence (including local authority plans, blogs, emails and letters to residents' associations, local newspapers and local authorities); reviewed local authority consultations (if available) and conducted focused ethnographic visits. The data from these visits included fieldnotes from 'walk arounds' of areas with street light reductions, including informal intercept interviews, and in-depth individual and group interviews (which were recorded and transcribed) with a mix of residents, visitors and workers. Fieldwork was conducted between April 2013 and December 2014. We used a mix of recruitment strategies to identify a range of groups and individuals to interview. This included contacting groups such as sports clubs, choirs, youth organisations and workplaces in each locality, and then snowballing from these contacts and local authority staff. We deliberately included workers likely to be using the streets at night, such as police officers, hospitality and transport workers. In total, the dataset included formal individual or group interviews with 57 local residents or workers and 14 key informants; 61 informal intercept interviews; 112 documents; and fieldnotes from locations across the case study areas. After initial fieldwork had generated the main domains of interest to the public, we carried out a household survey in one area to estimate the prevalence of reported negative and positive wellbeing impacts of reduced street lighting.

2.2. Household survey

We identified one area in Shropshire where part-night lighting had been introduced in selected streets, and was scheduled for other streets. Using data provided by the local authority on implemented and planned lighting changes, the roads were divided into 12 strata based on whether lighting reductions had been introduced (yes/no), tertile (low/med/high) of deprivation of the census lower super output areas (LSOA) in which the roads were

Table 1
Case study areas.

Local authority area	Street lighting intervention	Fieldwork settings
Hertfordshire County Council	Part-night lighting approved, trialled and implemented from November 2010 with about 70% lights operating on this basis; also trimming and white light.	Rural/suburban towns and villages in London's commuter belt
Buckinghamshire County Council	Switch off selected street lights at midnight from Aug 2007; extended to more areas in April 2008.	Suburban towns and villages
Shropshire Council	Part-night lighting scheme to convert 70% lights in progress since 2012; also trialled dimming and white light.	Shrewsbury city, and Town and Parish councils in surrounding towns and villages.
Wakefield Council	Trials of dimming, and some white light	City centre and suburbs
Swansea Council	Around 1000 lights switched off; also dimming and white light	City centre, suburbs and surrounding rural areas
London Borough of Hackney	White light.	Inner London borough
London Borough of Southwark	White light, trimming.	Outer London borough
City of Westminster	White light only policy since 2004.	London borough with large numbers of visitors

located, and proportion of postcodes within the LSOA that were pubs, restaurants, shops or other businesses (more/less than 2%, the median proportion). We then randomly selected roads within each stratum and obtained the addresses for every residence on the selected roads to achieve a total sample of 500 houses in streets where lighting had been reduced at night, and 500 in streets unaffected to date. Even if only half of households responded to the survey, the study would have 90% power to detect a 10% absolute difference between affected and unaffected streets in prevalence of wellbeing impacts at the 5% significance level. A self-completed questionnaire was designed to assess feelings about neighbourhood and local authorities, safety, fear of crime, impact of street lighting on sleep, and the importance of seeing the night sky (Web appendix: questionnaire). After piloting, this was mailed to residents, with a choice of return by enclosed stamped addressed envelope or online, followed up by one reminder. A total 483 responses (476 postal, 7 online) were received, comprising 250 (i.e. 50%) responses from the part-night lighting group and 233 (47%) from the unaffected streets. There were no significant differences in the distributions of respondents from the affected and unaffected streets according to gender, age group, or the number of adults in the household.

2.3. Analysis

Qualitative data (interviews transcripts, fieldnotes, documentary data and open comments on the questionnaire) were analysed using thematic content analysis (Green and Thorogood, 2014), with a coding frame drawing on both the literature and inductive coding of early data. The project team met to open code an initial transcript, and generate a draft coding frame. This was applied to early data, with emerging analysis used to identify further sampling.

We created binary variables for each survey questionnaire item using the extreme of the response options (e.g. when asking about personal safety we dichotomised using the response “very safe”; when asking “how often do you walk alone in your neighbourhood at night” we dichotomised using the response “at least once a week”, etc.). The association between each negative or positive wellbeing impact and living in affected or unaffected streets was estimated using odds ratios with 95% confidence intervals. Statistical significance of any differences in prevalence was assessed using a chi-squared test. Data were analysed using STATA-13 statistical software.

2.4. Ethics

In quoted extracts, we have removed identifying place and other information and indicated local authority area (except for stakeholder interviews, where this might breach confidentiality) and source of data: in-depth individual or pair interview (I), group interview (G), key informant interview (K), document (D) or fieldnotes, including informal intercept interviews (F). Written consent was obtained for transcribed in-depth, group and key informant interviews; intercept interviewees were told we were ‘conducting research on street lighting’. Approval for the study was provided by LSHTM Ethics Committee (no. 6341).

3. Findings

3.1. In public fora, views are strong and polarised

Some data on public views about the likely wellbeing impacts of street lighting reductions were already in the public domain, through records of local authority consultations on proposals, and

in the letters pages of many local newspapers in areas where switch off or part-night lighting was being introduced. Unsurprisingly, given these represent members of the public who feel strongly enough to volunteer their views, comments in these fora tended to be strong, polarised, and largely focused on the potential negative impacts of street light reductions on wellbeing. Key negative domains of concern reported were: impact on personal security when walking at night; fear of crime; potential for increased road accidents. Positive impacts reported in public comments were: benefits in sleep with less light pollution; reduced impact on environment through reductions in carbon emissions; and improved ability to see the night sky. Letters to one local paper in Hertfordshire, where part-night lighting was being introduced, are typical of both the polarisation and strength of the individual views expressed in these public domains:

The great switch-off has begun [...] Never have I felt so frightened to walk back to my house from the road after a night out (letter to *The Comet*, May 17th 2012, D23).

Am I alone in thinking it's a fantastic idea? ... the money saved ... can be ploughed back into schools and lollipop ladies.... Sleeping in the pitch black will have amazing health benefits for the people of this town. Not to mention the impact on the environment (letter to *The Comet*, May 10th 2012, D27).

I pay my tax, I now have to walk home in the pitch black [...] I expect a basic service (letter to *The Comet*, May 24th 2012, D14).

As the last extract suggests, concern was often framed in terms of normative expectations of what local authorities should provide by way of public assets. Similar framings, and a similar emphasis on negative wellbeing outcomes, were evident in local authority formal consultations over planned reductions, which typically solicited comments from both representative groups (Parish councils, residents associations), and individual members of the public. One phase of Buckingham County Council's consultation over ‘switching off’ lighting, for instance, attracted 34 comments from individual residents, of which 24 protested the decision, and 8 supported it, with 2 making other or mixed comments. In addition to noting details of particular roads or junctions of concern, respondents also questioned likely cost or carbon emission savings, and questioned the competence of the authority to make decisions:

This is a regressive plan that will make roads more dangerous. Endangering lives to save money is gross mismanagement (anonymous comment, public consultation, Buckinghamshire D104).

3.2. Negotiating views: deliberative settings

If this suggests that public opinion was strong, and deeply concerned about the negative effects on wellbeing of reductions in light at night, a somewhat different tenor was evident in contexts such as group interviews and residents' association meetings. Here, participants were typically equivocal or tentative in offering their assessments of risks or benefits to wellbeing. This group of neighbours, for instance, despite expressing concern at the possible impacts of dark streets on mobility, all go on to agree on the benefits of seeing the night sky, a contributor (they felt) to feelings of wellbeing:

F1: I really notice being able to see the stars.

F2: Yes, yes, I have, too.

F1: And one night I even

F3: It's lovely.

F1: I woke up because we had our curtains open, and I woke up

and it was really bright outside.... It was just so beautiful. (G3 Hertfordshire)

In group interviews, participants explicitly noted such potential trade-offs between the outcomes likely to accrue from reductions in street lighting, and also to explore the differential impact these might have across their communities. For instance, after rehearsing the negative impacts, particularly (they felt) for older residents, these members of a residents' association then went on to discuss potential benefits of changes:

M1: Uh, it's, there's a balance to strike, isn't there? ...

F1: [indicates agreement].

M1: I'm a reasonable man but I know if there was no cost to it I, I'd probably rather have more lights than less...

M2: I do feel slightly better for thinking, well, we're doing our bit towards cutting down carbon (G5 Buckinghamshire).

Similarly, a group of teachers in Wakefield debate the likely impact of reductions from dimming street lighting in some areas of their town drawing on news coverage, their own experience, and anecdotes from others to collate their knowledge, and to then test out a rather more tentative assessment than those typical of local authority written consultations:

F2 And they're, they are actually energy saving ... there were a big piece on [local TV news programme] or something about them...

F1: You wouldn't want them to just totally switch things off. I guess if they did it at a certain time, you know, when the majority of people aren't on the roads?

F2: I don't know, because it's, on estates, because I know what [colleague] was saying, since she got burgled, because it's so well lit where she is. She says, the policeman said, if it hadn't had been as well lit and they hadn't been able to see into your garden, your house, your garage, etc.

F3: I suppose you're never going to please everybody are you? (G9 Wakefield).

In discussions (whether in a routine residents' association meeting, or a group interview brought together for research) participants have to both offer evidence for views, and reflect on them with others. The 'public view' therefore appears a little less solid, in that it evolves over the course of the discussion, suggesting a malleability, and it incorporates a wider range of health and wellbeing outcomes, as different speakers bring other domains (such as carbon reduction, or seeing the night sky) into the frame.

3.3. Lack of opinion

Both the strength of opinion expressed in public fora, and the nuances of reflections on wellbeing outcomes expressed in group interviews suggest a level of engagement with the topic of street lighting that was not evident in intercept interviews in areas affected by reductions, or in in-depth interviews in settings with other interventions, such as white light. Indeed, the majority in intercept interviews in locations with switch off or part-night lighting responded that they had not noticed any local changes, had no opinion, or that any changes had no effect:

I don't notice really, as I don't go out after dark (F22 Swansea).

To be honest, I haven't got an opinion, (F28 Swansea).

A group of customers and barman in a pub in a town in Shropshire illustrate the typical lack of concern about wellbeing impacts. Although they reported going home after midnight (the time of local 'switch off'), they were either unsure whether their

streets were affected, or unconcerned about the implications for their own mobility or safety if they were:

M1: I don't notice to be honest.

M2: That's because you're pissed! [all laugh].

F: They're all off in my area – I think they go off at 2 or something.

M (Barman): people are leaving about 2, 2:30 – we kick them out then and, to be honest, most of them are getting taxis home anyways. It's just one of them things, street lights, doesn't really make much difference... for most people, no one's going to notice – in my street, it's only really me coming back past midnight, no one else. (F4 Shropshire).

This disinterest in intercept interviews in areas with switch off or part-night lighting was echoed in responses to invitations to take part in more in-depth interviews in areas with less noticeable interventions, with many initially unsure whether they would have any views to share. One young woman (who in fact went on to provide a detailed account of how lighting in her neighbourhood affected how, when and who walked around it) commented: "I'm not going to lie, when you first suggested it to me, I was like, eh, street lights? That's a random topic" (I60 Hackney). It was also reflected by some local authority consultations over a proposed 'white light' scheme, which was described by the lighting engineer as having gone "down like a lead balloon—we didn't get any response at all" (K2).

Given the low awareness in general of many interventions, it is not surprising that few intercept interviewees spontaneously raised wellbeing impacts. The exception was seeing the night sky. Where street lighting reductions had been noticed, the most common spontaneous responses related to pleasure in this. Although rarely an issue in more suburban areas (where light pollution from nearby towns and cities was too great to see stars anyway), it did get raised in both in in-depth and intercept interviews in the more rural neighbourhoods. One young man, relatively recently moved to a rural area, described walking home at midnight the night before: "there was no Sun, no Moon – but I could still see the way; no torch – just starlight – you get amazing skies here" (F31 Swansea). Another in the same area had noticed changes: "They've changed them to what do you call it, Low Density Lights – good for the star-gazing – now you can see the sky, see whole... you've got the whole world in front of you!" (F23 Swansea). In urban areas with white light interventions, if people had noticed or had a view, it was more likely to relate to light pollution and impact on sleep from existing lights.

When asked directly about negative impacts on determinants of health such as mobility, many said this was not an issue as "most of us drive" (F34 Hertfordshire), suggesting that dark streets do not deter motorists. We deliberately included those likely to be out after dark or before sunrise, including workers such as taxi drivers, hospitality workers and police officers. In general, even those who did report working in or leaving and returning home in dark streets did not report significant impacts from street lighting reduction: largely, they reported using cars to get to and from work, and the only reported impacts of dark streets were marginal, in that taxi drivers, for instance, reported that it could be difficult to see house numbers. The exception was police officers, some of whom did report very strong negative views about the impact of switch off, in particular, on their work. They reported concern about public perceptions of fear of crime, even where they had no evidence of impact on crime levels. Some had particularly strong views that lights should not be switched off, particularly on housing estates, as dark streets both fostered crime, and made it more difficult for them to respond appropriately, given the added time it could take to find addresses in the dark, and also to see the

perpetrators of low level crime: “we go out, and we literally can't see them – we can hear them making a noise, but you can't see who it is” (Hertfordshire I66).

3.4. *Private concerns*

The apparent lack of engagement by the public might suggest that characterising public concern by the expressed views of those who do write into local authority consultation risks exaggerating the strength and negativity of views. However, when given the chance to provide considered views more privately, some participants reflected on more deeply held concerns. In public, accounts of the impact of street light reductions on personal security or mobility were circumscribed by the need to present a competent self, with participants reluctant to admit that fear of the dark, for instance, would curtail their activities. Wellbeing impacts of reduced street lighting were therefore largely presented as rational concerns about road safety, or crime, and its impact on more vulnerable others. In more private settings, though, some interviewees reflected not so much on the impacts of darkness itself on wellbeing, but more specifically on the ‘switching off’ of lights, and what this meant for both their own ontological security and the wellbeing of their neighbourhoods. These more private concerns were elicited in a number of contexts: typically, at the end of group discussions when participants asked to speak privately to the research team, and in in-depth individual interviews. Here, participants were more likely to reflect on the meaning of dark nights, and to express more uncertainty and anxiety about the implications of reduced street lighting not just for their own individual wellbeing, but also for their neighbourhoods as healthy places to live, as these excerpts from notes from one visit suggest:

[After the public meeting] a couple of women are keen to talk more privately [...] One says when she first got here “I thought there had been a power cut! I feel quite vulnerable-I won't wait for a bus, because I don't like not being seen. In winter, it does stop me going out – I struggle even to put the bins out” [...] Another woman [concludes that since the switch off] “Here, it is as dead as a doornail, because no one ventures out” (Field-notes, Hertfordshire, Dec 2013).

Three themes characterised these more private views: fear of the dark; wonder at the lights going out; and concern about modernity ‘going backwards’. First, fear of the dark is perhaps difficult to admit to in public, given the need to present oneself as a mature, coping adult, but in more private settings, participants were more willing to speak about how darkness affected their mobility: often prefaced by an apologetic ‘I don't know if this is just me...’. This young woman, for instance, talked about visiting a family member who lived in the suburbs, where “come eight o'clock all the street lights are knocked off”, which affected her willingness to walk there:

You need a car basically to move around there. So yeah, and it's really scary, like you have to take, when I'm going there, say if I go there late at night, I have to take a cab there, I wouldn't walk there (I60 Hackney).

In more private settings women, in particular, described in more detail why darkness was threatening, because “you imagine someone there in the shadows” (F20 [in a private setting] Westminster), and how this might limit mobility. This woman, for instance, described a recent emergency at night which necessitated driving, suggesting this would have been difficult in her old (unlit) neighbourhood:

I used to live out in [small village], it's very rural there, it's completely different. When I was there I didn't go out as much at night, I didn't feel as secure. Here I go out to the theatre,

cinema, I feel safe.... in [village] the lighting wasn't very good you feel much safer in the town (I20 Wakefield).

However, if the dark itself could be disturbing, to the extent of shaping preferences for more urban settings, for others it was the fact that lights had been ‘switched off’ which was unsettling. The visible instant change from lit streets to dark ones evoked a range of emotions in those living in areas where local authorities had instigated part-night lighting. This included wonder: again something participants often flagged as perhaps an individual, or idiosyncratic, reaction:

I know this sounds weird, but I got quite obsessed by it when they first started turning them off at midnight, I started to stay up to watch them going out – just to see how dark it was. It was so strange watching the lights going out – an odd thing to happen (I37 Hertfordshire).

For others, the anomaly of lights going out at a certain time was simply strange: a humorous disruption, given expectations one might have of either modernity or what a walk home in an urban area should entail:

They go off at midnight – it's hilarious, it's like going back to the Dark Ages! (I34 Hertfordshire).

There were some people walking ahead of us, and the light was literally turning off as they got to it... and we thought, ha, ha, that's quite funny! (I7 Hertfordshire).

The concern, it is implied, is not the dark per se, but the inappropriateness of the dark: something which, in urban areas, was out of time and out of place. If some described this in humorous terms, others were more disturbed. Private accounts included some reflection on the meaning of this switch off, and the symbolic breach in expectations of progress and modernity that it heralded:

The streetlight thing seemed to me a big step forward in quality of life... the thought of actually going backwards seems to be quite appalling. I've never lived in a non-suburban or non-town area my entire life. Um, and I think, and I would choose not, I, you know, I would actively choose not to live in the country.... I would prefer to be somewhere where there are lights (I2 Buckinghamshire).

3.5. *Wellbeing outcomes: the importance of normative expectations*

As both the humorous and more anxious accounts of ‘switching off’ suggest, feelings about both darkness and the lights being switched off are framed by a number of normative assumptions about mobility in time and place. Those above make sense in terms of assumptions about street lighting being a taken for granted backdrop of urban space, reassuring for city dwellers:

I'm always relieved when I've been driving along country roads to get back to the bright lights of the city (F19 Southwark).

In contrast, those in, or from, more rural areas could present themselves as ‘hardier’ to the removal of artificial light, and taking a pride in coping with the absence of such indicators of modernity as street lighting:

It wouldn't bother me to go out at night. Since I was young I've done that, I've grown up in the country (G5 Hertfordshire).

In accounting for health and wellbeing implications, participants implied and, at times, actively drew on, a number of normative assumptions about how social attributes such as age and gender affected their own and others' mobility, safety and risk in public spaces after dark. Younger adults couched their concerns not in terms of impacts on their own mobility, but the potential for

harm to older neighbours. One couple in their 30s, for instance, recalled moving from the city to a commuter town which had part-night lighting and described their initial discomfort on realising that their local streets were dark by the time they returned from a night out, when “literally around 12 o’clock, you would watch lights going out in front of you as you walked down the road ... it would be pretty pitch black” (I7 Hertfordshire). However, despite reporting a number of challenges this posed (taking care not to trip over unseen hazards, walking in the road to avoid cars parked on the pavement late at night), and the odd danger (being nearly run over on an early morning dog walk) they deflected any suggestion that the midnight switch off had constrained their activities, or particularly affected their mobility:

I: does the lack of street lighting affect what you choose to do?

M: I wouldn't say it bothers me ... if I want to go out, I'll go out... but I'm not a 70 year old person...

F: ... it doesn't impact on anything as in we'd not do something because of the lighting (I7 Hertfordshire).

Symmetrically, older participants also disavowed impact on their own behaviour or wellbeing: either because they were at less risk than younger people, being less likely to be out and about later, or because they considered themselves to be in general ‘more sensible’ and therefore better prepared to cope with navigating dark streets:

F1: I think it needs to be said that, um, someone spoke to me about their teenage children coming back from London, nights out-And they were concerned [about] picking up the, the children coming home from the station and it was dark...

F2: Well, I've walked up from the bottom in the dark when it's been the blackout and I felt perfectly safe... I just walk in the middle of the road ... I found it quite surprising the first time I was coming back in the dark, but actually I've, oh, because I'm, I'm fairly sober and not wearing silly shoes! (G3 Hertfordshire).

The risks of darkness were also linked to unfamiliarity, with belonging and familiarity against the risks of poor light. One young man, for instance, describes in detail the importance of street lighting for security in his neighbourhood, (“if it's more dim, it's easier for crime to take place”) but again utilises age-based expectations (“I'm getting to the stage now where that sort of thing shouldn't bother me”), together with his ‘localness’ to deflect any impact on his own wellbeing. In contrast, he suggests, those less well embedded in the local community might be more vulnerable:

Personally I don't feel unsafe around here because this is my neighbourhood to be honest, I'm quite familiar around everyone and the surroundings, however that doesn't mean everyone who lives here or lives around here or comes here feels safe ...street lighting ... it's a mental thing but I just think it gives people a kind of a reassurance that.. nobody wouldn't try anything because they've got light (I64 Hackney).

In summary, participants in group and in-depth interviews were often careful to claim that, even where lighting reductions were unwelcome, that they themselves could ‘cope’, and that their own competence would offset any impacts on wellbeing. Concerns were rationalised as concerns for others: of different age groups or those lacking local familiarity. The exception was female gender, which could apparently be legitimately used in discussion to justify participants' own concerns. Many women of all ages reported that personal security was an issue for them: or at least that they could flag up concerns ‘as women’ about security. Some reported avoiding travelling after dark on their own. However, the role of street lighting per se, rather than street lighting as an indicator of time of day, was often ambiguous in these accounts. Two railway

workers, for instance, first suggest lack of street lighting early in the morning when they travel to work is an issue, particularly for women, but then go on to suggest that the problem is that the time of night is inherently dangerous, rather than darkness itself:

F: I take a taxi. As a young woman I wouldn't want to be walking out at that time in the morning.

I: Does it make a difference, no street lights?

F: No, I'd get a taxi anyway. It does put you off, not knowing who's around, especially as it's dark. But I'd come by taxi anyway – 10 years ago, would have been different – you don't think about it when you're young do you? But you know, as a woman, you don't want to be out on your own walking around.

M: No, not as a woman. Mind you, same for a lot of men-wouldn't want to be walking, you never know who's out and about (F3 Shropshire).

Here, then, are echoes of concern about simply being ‘out of place’, given social norms about who is, and can be, out and about at night. Those social norms were recognised by both those responsible for lighting and residents, at times explicitly, as from this councillor justifying a decision of midnight switch off:

Between the hours of midnight and 5:30 what is anyone doing anyway? Because people are asleep at that time. The only time I've been out at that time is Christmas Eve, coming back from church (K9).

Being out and about in the dark without good cause still risks raising questions about propriety. For lighting professionals, street lighting could both reflect these normative assumptions, but also shape behaviour, with lighting used to signal legitimate uses of public space in time. Deliberately leaving places dark could therefore demarcate places of exclusion: a reading apparently understood and shared by lighting professionals and residents:

We do switch down park lights ... because we don't want to encourage people into the parks [at night] (K2).

We're going into a park or something, a park after dark like to just go and mess about and chill and whatever. That's the only time we use our phones as torches because there's no lighting in parks, people assume that nobody's in the park at that time, so there's obviously going to be no lighting... (I59 Hackney).

3.6. Wellbeing and governance

Lighting engineers discussed in detail how “the right light, in the right place, at the right time” (K1) – a mantra of their professional values, repeated many times throughout the fieldwork – was essential for not only the security of the communities they served, but also for creating invitations as well as normative exclusions. In city centres, for instance, welcoming lights could encourage night time economies. Lighting did not just make places more visible, but made them identifiable locales which enhanced community wellbeing, through selecting the right quality, intensity, direction and colour of public lighting. Despite a growing ‘corporatisation’ of the use of light to create visual coherence in public space (see e.g. Jones, 2014: 200, on lighting London's South Bank), for the local authority engineers, there was still a keen sense that good lighting was a duty of local government, part of the obligation of public servants to the wellbeing of local communities. One urban lighting professional, who had rejected interventions which reduced lighting, is particularly eloquent on impacts that lighting can have across the range of inter-related environmental, economic, and health contexts of a locality:

[Good lighting makes it] a lot safer to, you know, even, even simple things as you, yourself and a neighbour going to play a game of badminton twice a week..... And it's going to serve

local people and feed back into the local economy [and on] inclusion, civic pride ... We deliver a lighting installation which can contribute towards our Transport Department's drive for sustainable forms of transportation, on our education sector who are looking for safer routes to school to encourage parents to walk ... (S8).

Providing high quality lighting for residents was, then, framed in terms of obligations to provide a good and responsive service that made communities feel that the local authority cared about them. Residents who discussed negative wellbeing implications of reduced light at night typically referenced a perceived failure in this regard. As one resident said: "What does disturb me is they are starting to turn lights off to save money. Because you never know when you're going to be out at that time of night." (I20 Wakefield). A feeling that security was being compromised by cost-saving contributed to a sense of neglect, and lack of trust that the local authority was acting in good faith:

Why do local authorities think it's ok to light up the shopping areas – they seem more concerned at shops and businesses than they do the local residents and people's own homes. We're a bit of an island – when the lights are off, on this road, we're cut off (G2 Hertfordshire).

Thus, it was not necessarily darkness in and of itself that was disturbing, but rather the loss of a public good that had once been enjoyed, and the feelings of disrespect this could engender.

3.7. Does reduced lighting at night make a difference to wellbeing?

The household survey in one area of Shropshire provided some insight into both how typical the views outlined thus far were, and

whether reductions in street lighting did make a difference to feelings about the local area, and to outcomes likely to impact on wellbeing, such as walking and driving after dark, fear of crime, sleep disturbance from street lights and seeing the night sky (Table 2).

Although respondents were significantly more likely to report that the number or brightness of street lights had been reduced within the last few years in the affected streets, only one half had noticed the change. The only item where those in streets affected by part-night lighting made significantly different responses was 'Thinking about the spring and autumn periods, how safe do you feel walking alone in your neighbourhood after dark?', with fewer of those in affected streets more likely to report feeling 'very safe' (15.6% vs. 26.2%; $p=0.004$). There were no significant differences, however, in how many reported walking alone after dark (29% vs. 34%; $p=0.27$). A small proportion (3%) of people reported being 'very worried' about having their car stolen or broken into after dark: this was similar in the affected and unaffected streets. In general, then, in a random sample of the population in affected and non-affected streets, there was little evidence that the introduction of part-night lighting had made significant differences to wellbeing, except in the domain of residents' feelings of personal security.

This is largely in line with the data from the ethnographic visits, given the low awareness overall of interventions, and the suggestions that, even where there were strongly held views, or anxieties about street lighting, few reported direct impacts on outcomes such as mobility. At the margins, some did report behaviour changes to avoid walking, running or cycling in the dark:

What it has changed for me is, because I'm a runner, I run, I can't run early in the mornings like I used to. Or not in the

Table 2
Household survey: summary responses.

	PNL ^a N=250	Non-PNL N=233	Odds ratio (95% CI)	p-Value
Thinking about your neighbourhood in general, would you say that people can rely on each other for help?				
Never	9 (3.6%)	4 (1.7%)	2.14 (0.59–9.62)	0.20
Do you trust your local council to do its best for your neighbourhood?				
Never	14 (5.6%)	15 (6.4%)	0.86 (0.38–1.97)	0.70
Thinking about the spring and autumn periods, how often do you usually walk alone in your neighbourhood after dark?				
At least once a week	73 (29.2%)	79 (33.9%)	0.80 (0.54–1.20)	0.27
Thinking about the spring and autumn periods, how safe do you feel walking alone in your neighbourhood after dark?				
Very safe	39 (15.6%)	61 (26.2%)	0.52 (0.32–0.84)	0.004
Thinking about the spring and autumn periods, how safe do you feel driving home after dark?				
Very safe	115 (46.0%)	117 (50.2%)	0.84 (0.58–1.23)	0.35
How worried are you about having your car stolen or broken into after dark in your neighbourhood?				
Very worried	7 (2.8%)	7 (3.0%)	0.93 (0.27–3.16)	0.89
Please indicate how much you agree with the following statements:				
a. "There is enough street lighting to see clearly at night in my street"				
Strongly disagree	69 (27.6%)	63 (27.0%)	1.03 (0.68–1.57)	0.89
b. "Street lights outside my home keep me awake at night"				
Strongly disagree	186 (74.4%)	162 (69.5%)	1.27 (0.84–1.94)	0.23
c. "On a clear night, I can see the stars if I stand outside in my street"				
Strongly agree	141 (56.4%)	135 (57.9%)	0.94 (0.64–1.37)	0.73
d. "It's important to me to be able to see the stars at night"				
Strongly agree	105 (42.0%)	116 (49.8%)	0.73 (0.50–1.06)	0.09
Thinking about your house or flat, have you or the owner done any of the following within the last two years?				
a. Installed any lights at the front or garden, to improve visibility or security?				
Yes	79 (31.6%)	74 (31.8%)	0.99 (0.66–1.48)	0.97
b. Installed any lights at the back or garden, to improve visibility or security?				
Yes	84 (33.6%)	75 (32.2%)	1.07 (0.72–1.59)	0.74
c. Installed a burglar alarm?				
Yes	24 (9.6%)	24 (10.3%)	0.92 (0.49–1.76)	0.80
d. Made other improvements to the visibility of your front entrance?				
Yes	33 (13.2%)	34 (14.6%)	0.89 (0.51–1.54)	0.66
Has the number or brightness of street lights in your neighbourhood been reduced within the last few years?				
Yes in my street	126 (50.4%)	56 (24.0%)	3.21 (2.14–4.84)	< 0.001
Do you carry a torch with you when you go out at night?				
Always	33 (13.2%)	28 (12.0%)	1.11 (0.63–1.99)	0.70

^a Part-night lighting.

winter anyway. It's too dangerous, with all the narrow roads and that. I have to drive somewhere now to go for a run (F33 Swansea).

However, as for this woman, most described manageable changes to routines, rather than abandoning activities that would have positive impacts on health. Strategies included taking a torch when walking the dog at night, or using main roads for as long as possible on walks home rather than short cuts through unlit side roads.

4. Pathways to wellbeing

In summary, reductions in street lighting at night were reported as potentially affecting wellbeing through a number of pathways (see Fig. 1). Direct positive (improved sleep, existential capital from being able to see the night sky) and negative (anxiety from fear of crime, constraints on mobility at night) effects might arise from darker streets at night. Although negative ones are emphasised in public accounts such as local authority consultations, in more deliberative settings (such as focus groups), participants balanced these implications for personal wellbeing against broader determinants of health, such as carbon emission reduction and divesting resources to spend on other services, which might accrue from reduced energy expenditure. Indirect pathways are more difficult to identify, but there are some suggestions from this rapid appraisal that they derive from the meanings of dark streets in the context of normative assumptions about places that should be lit, and who should be in them, or to the removal of public goods. These direct and indirect pathways are mediated by place, in that normative expectations of which public spaces should be lit relates to whether outcomes such as seeing the night sky or

finding the dark threatening to security are more salient. Health outcomes are also mediated by the governance of place, in that street lighting is a public good, which (when removed) can elicit negative perceptions about the meaning of a loss of amenity for the locality. Finally, claims about wellbeing impacts are shaped by social attributes (such as age, gender) which potentially change the meaning of dark streets (in, for instance, making it more or less likely that one would be in them), but also the possibilities of expressing concern about them. Although highlighted in the scientific literature, concerns about the potential impacts of increases in LED lights on cancer or other chronic health outcomes were not raised by residents or key informants in any settings in the fieldwork, public or private.

5. Discussion

In the light of the strong and polarised comments expressing concern for security and road safety elicited in public fora such as newspaper columns, it was perhaps surprising that direct impacts on individual wellbeing from reductions in street lighting at night were reported as minimal, in both the ethnographic fieldwork and the household survey. Not only had interventions such as dimming gone largely unnoticed, but in informal fieldwork interviews in areas with part-night lighting, few reported that reductions in lighting had made any difference to their everyday lives. Only in a few cases did people report getting more sleep, or changing their habits in the hours of darkness. The household survey in one area supported an initial inference that both public concern about, and impacts on, individual wellbeing and the public health resulting from reduced street lighting are likely to be minimal, in that reductions were not significantly associated with levels of fear of crime, willingness to go out, or lack of sleep due to street lighting.

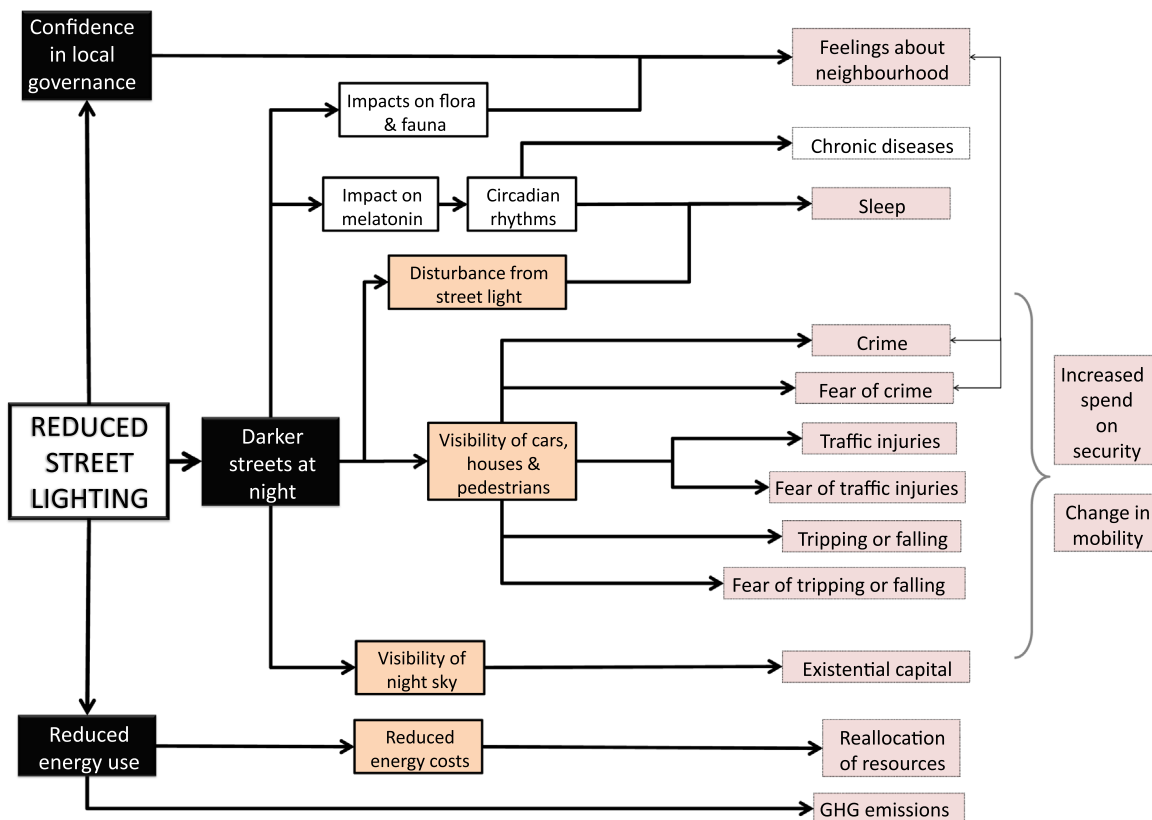


Fig. 1. A model of potential pathways linking reductions in street lighting to health and wellbeing. Health outcomes are on the right, with those raised in the rapid appraisal in shaded boxes.

However, if the direct effects of dark streets at night may be of less public concern than consultations suggest, there were also suggestions that other important health and wellbeing outcomes are not elicited so easily in public domains. The finding from the household survey that those in part-night lit streets were more likely than those awaiting the intervention to report feeling less safe walking after dark, despite no evidence of impact on mobility, suggests that fear of the dark is still an important issue, potentially affecting wellbeing through routes other than that of reducing mobility or increasing crime or road accidents. In the more private settings of one to one interviews were hints also of rather deeper anxieties about the meaning of street lighting for a sense of wellbeing, linked to understandings of locality, neighbourhood and governance. 'Bright lights' have a cultural significance beyond the immediate concerns of crime and road safety. Permanent and abundant lighting signifies the 'modern', and electric lighting has long marked 'progress' (Martland, 2002). For those in urban and suburban localities, this apparent reversal of progress generated a measure of ontological insecurity, even where this is expressed humorously. In short, for those who identified as city dwellers, dark streets at night disrupted contemporary normative expectations. In a context of financial constraints, with the 'politics of austerity' a framing for some contributions we elicited, reductions in service also disrupted taken-for-granted assumptions about the abundance of resources available in a developed economy. Many contributions to both public debate (in local authority consultations, and in newspaper columns) explicitly linked this to a loss of faith in local governance. In this respect, the decisions of local authorities to reduce street lighting may have been important not for creating dark streets per se, but for signalling a lack of engagement with residents' views. As others have described in relation to problems such as dog faeces (Derges et al., 2012), which also causes considerable concern despite the limited evidence on objective public health impacts, 'switching off' lights may have more meaning as a perceived marker of neglect or disrespect than for its direct effects on mobility, safety or sleep. The loss of light could, therefore, also undermine local residents' faith in the trustworthiness of local authorities.

As Shaw (2014a) has noted, if an ability to 'keep the lights on' becomes a symbolic indicator of the administration's ability to maintain order, the 'lights going out' is a very visible failure in governance. A telling detail of the US City of Detroit's bankruptcy in 2013 was the ways in which the decline of the city was described in news coverage, with most newspapers using the same three indicators of a city where governance has failed:

As it stands, 40% of Detroit's street lights are broken. It takes, on average, an hour for the police or ambulance services to respond... Gang murders are carried out in vacant buildings... (Observer 20th July 2013).

That the fact of broken street lights can be used as an indicator on a par with gang murders is a notable reminder that permanently well-lit streets, for urban and suburban citizens, evoke more than a safer place to walk or drive: they indicate good governance, affluence and a taken-for-granted location in the 'modern'. Although few participants in this study explicitly voiced extreme concerns about reductions in lighting at night, the more private views touched on fears of both the phenomenological meaning of darkness (Shaw, 2014b), and more political concerns about whether current levels of taken-for-granted public goods could be sustained. In more rural areas, by contrast, discourses of wellbeing emphasised the 'natural', in terms of being able to appreciate dark skies at night, and a 'hardiness' to the potential safety consequences of lack of artificial lighting.

The impact of street light reductions on wellbeing is, then, likely to be mediated by normative expectations of lighting in place. First, it is mediated directly, in that identifying as a rural or urban resident, for instance, changes the meanings of darkness and artificial light, and the perceived role of lighting in safeguarding wellbeing. Second, place mediates the wellbeing implications of street lighting in terms of how perceptions of neighbourhoods and their governance shape the likely impact of reductions. Here, trust in local lighting authorities to act in good faith is crucial.

6. Conclusion

Rapid appraisal provided an efficient method for mapping public views on the relationships between reduced street lighting and wellbeing. Empirical research is needed on whether reductions in street lighting do achieve financial or carbon emission reductions which would have a positive impact on the public health, and whether any negative impacts on the public health through changes in accident rates, mobility or sleep accrue from different interventions (dimming, part-night lighting or switch off). However, these direct health impacts are not the only ones of concern. Although a household survey identified little direct impact from lighting reductions on determinants of health such as mobility or fear of crime, at a social level reduced street lighting may have significant effects in urban and suburban settings where residents associate well-lit streets with competent and trustworthy government. To achieve sustainability gains without compromising other wellbeing outcomes for affected residents and workers, this study has suggested that attention should also be paid to the more symbolic effects of street light reductions as well as the direct health impacts. The wellbeing impacts of reduced street lighting at night may reflect not darker streets per se, but the fact that a public good has been removed.

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References

- Atkins, S., Husain, S., Storey, A., 1991. The influence of street lighting on crime and fear of crime. In: Laycock, G., (Ed.), *Proceedings of the Crime Prevention Unit Paper no. 28*. Home Office Crime Prevention Unit, London.
- Beyer, F.R., Ker, K., 2009. Street lighting for preventing road traffic injuries. *Cochrane Database of Systematic Reviews Issue 1*. Art. No.: CD004728. DOI: 10.1002/14651858.CD004728.pub2.
- Beebe, J., 1995. Basic concepts and techniques of rapid appraisal. *Hum. Organ.* 54 (1), 42–51.
- Claudio, L., 2009. Switch on the night: policies for smarter lighting. *Environ. Health Perspect.* 117, A28–A31. <http://dx.doi.org/10.1289/ehp.117-a28>.
- Department for Environment Food and Rural Affairs (DeFRA), 2011. *A Review of Local Authority Road Lighting Initiatives Aimed at Reducing Costs, Carbon Emissions and Light Pollution*. Temple Group Ltd, London.
- Derges, J., Lynch, R., Clow, A., Peticrew, M., Draper, A., 2012. Complaints about dog faeces as a symbolic representation of incivility in London, UK: a qualitative study. *Crit. Public Health* 22 (4), 419–425.
- Falchi, F., Cinzano, P., Elvidge, C.D., Keith, D.M., Haim, A., 2011. Limiting the impact of light pollution on human health, environment and stellar visibility. *J. Environ. Manag.* 92 (10), 2714–2722.

- Fonken, L.K., Finy, M.S., Walton, J.C., Weil, Z.M., Workman, J.L., Ross, J., Nelson, R.J., 2009. Influence of light at night on murine anxiety- and depressive-like responses. *Behav. Brain Res.* 205 (2), 349–354.
- Green, J., Thorogood, N., 2014. *Qualitative Methods for Health Research*. Sage, London.
- Hölker, F., Moss, T., Griefahn, B., Kloas, W., Voigt, C.C., Henckel, D., Hänel, A., Kappler, P.M., Völker, S., Schwöpe, A., 2010. The dark side of light: a transdisciplinary research agenda for light pollution policy. *Ecol. Soc.* 15 (4), 13.
- Jones, A.J.H., 2014. *On the South Bank: The Production of Public Space*. Ashgate Publishing Limited, Farnham.
- Koskela, H., Pain, R., 2000. Revisiting fear and place: women's fear of attack and the built environment. *Geoforum* 31, 269–280.
- Lorenc, T., Clayton, S., Neary, D., Whitehead, M., Petticrew, M., Thomson, H., Cummins, S., Sowden, A., Renton, A., 2012. Crime, fear of crime, environment, and mental health and wellbeing: mapping review of theories and causal pathways. *Health Place* 18 (4), 757–765.
- Lorenc, T., Petticrew, M., Whitehead, M., Neary, D., Clayton, S., Wright, K., Thomson, H., Cummins, S., Sowden, A., Renton, A., 2013. Fear of crime and the environment: systematic review of UK qualitative evidence. *BMC Public Health* 13 (1), 496.
- Martland, S.J., 2002. Progress illuminating the world: street lighting in Santiago, Valparaíso and La Plata, 1840–90. *Urban Hist.* 29 (2), 223–238.
- McFadden, E., Jones, M.E., Schoemaker, M.J., Ashworth, A., Swerdlow, A.J., 2014. The relationship between obesity and exposure to light at night: cross-sectional analyses of over 100,000 women in the breakthrough generations study. *Am. J. Epidemiol.* 180, 245–250.
- Navara, K.J., Nelson, R.J., 2007. The dark side of light at night: physiological, epidemiological, and ecological consequences. *J. Pineal Res.* 43 (3), 215–224.
- Otter, C., 2002. Making liberalism durable: vision and civility in the late Victorian city. *Soc. Hist.* 27 (1), 1–15.
- Pain, R., MacFarlane, R., Turner, K., Gill, S., 2006. When, where, if, and but?: qualifying GIS and the effect of streetlighting on crime and fear. *Environ. Plan. A* 38 (11), 2055–2074.
- Painter, K., Farrington, D., 1997. The crime reducing effect of improved street lighting: the Dudley Project. In: Clarke, R. (Ed.), *Situational Crime Prevention: Successful Case Studies*. Harrow & Heston, Guildersland, NY, pp. 209–226.
- Pauley, S., 2004. Lighting for the human circadian clock: recent research indicates that lighting has become a public health issue. *Med. Hypotheses* 63 (4), 588–596.
- Schlör, J., 1998. *Nights in the Big City: Paris, Berlin, London 1840–1930*. Reaktion Books, London (trs: Imhoff, PG and Roberts, DR).
- Shaw, R., 2014. Streetlighting in England and Wales: new technologies and uncertainty in the assemblage of streetlighting infrastructure. *Environ. Plan. A* 46 (9), 2228–2242.
- Shaw, R., 2014b. Controlling darkness: self, dark and the domestic night. *Cult. Geogr.* . <http://dx.doi.org/10.1177/1474474014539250>
- Shuboni, D., Yan, L., 2010. Nighttime dim light exposure alters the responses of the circadian system. *Neuroscience* 170 (4), 1172–1178.
- The Royal Commission of Environmental Light Pollution, 2009. *Artificial Light in the Environment*. The Stationary Office, London.
- Trotter, R.T., Needle, R.H., Goosby, E., Bates, C., Singer, M., 2001. A methodological model for rapid assessment, response, and evaluation: the RARE program in public health. *Field Methods* 13 (2), 137–159.
- Vohra, S., 2013. *Trafford LED Street Lighting Programme Health Impact Assessment*. IOM Centre for Health Impact Assessment, Edinburgh.
- Welsh, B.C., Farrington, D.P., 2008. Effects of improved street lighting on crime. *Campbell Syst. Rev.* 4 (13). <http://dx.doi.org/10.4073/csr.2008.13>.