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Public lighting and participatory democracy, the contribution of public transport drivers in Nantes Métropole to the evaluation of nocturnal urban ambiances

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Abstract (EN)

The proposal falls within the urban regeneration practices associated with the night and nightlife themes. It presents L'Observatoire de la nuit, a participatory evaluation and design method regarding nocturnal urban ambiances based on dematerialised questionnaires, with digitally mapped-out contributions. The evaluations deal with the conditions of use and temporality of the nocturnal public space. They produce precise knowledge regarding the real activities unfolding. It aims to accompany political and technical decisions made by local authorities. The case study presented here is that of Nantes Métropole, whose Public Lighting Coherence Scheme illustrates the methodology.

Keywords (EN): nocturnal urbanism; participatory democracy; interaction model; public lighting

Abstract (FR)

La proposition s'inscrit dans le cadre des pratiques de régénération urbaine associées aux thèmes de la nuit et de la vie nocturne. Elle présente L'Observatoire de la nuit, une méthode participative d'évaluation et de conception d'ambiances urbaines nocturnes basée sur des questionnaires dématérialisés, avec des contributions cartographiées numériquement. Les évaluations portent sur les conditions d'utilisation spatiales et temporelles de l'espace public nocturne. Elles permettent d'obtenir des connaissances précises sur les activités réelles des territoires la nuit.

Elles visent à accompagner les décisions politiques et techniques prises par les autorités locales. L'étude de cas présentée ici est celle de Nantes Métropole, dont le Schéma de Cohérence d'Aménagement Lumière (SCAL) illustre la méthodologie.

Keywords (FR) : urbanisme nocturne ; démocratie participative ; modèle d'interaction ; éclairage public

Nantes Métropole and the Public Lighting Coherence Scheme

In France, the governance of public lighting enjoys a standardised and legal environment that frames its practice. Voluntary standards¹ and ministerial decrees² provide physical indicators to apply, whose respect is guaranteed by political expertise, i.e. the elected representatives in cities and communities, in order to maintain the *safety of property and people* in the nocturnal public space. In France, this mission falls within the *police duty of the mayor*³. Political orientations are implemented by the departments managing public lighting in the communities – some are handled in-house, while others are delegated to energy authorities or groups of private companies. Regardless of the configuration, the administrators of any lighting system aim to guarantee its proper functioning and its evolution, both geographic⁴, technical and economic⁵.

Our case study is located in Nantes, France. The management of public lighting has been carried out on the metropolitan scale since the establishment of Nantes Métropole in 2001. It is composed of 24 municipalities, with Nantes in the centre. Public lighting is managed into seven divisions, allocated geographically (Fig. 1). Half of the lighting park is covered by contracts with private managers, while the other half is managed by the public authorities.

¹ Here, we refer to European standards, French version EN NF 13 201, which presents the physical recommendations in public lighting.

² Here, we refer to the Decree of 27 December 2018 regarding the reduction of light pollution from public and private artificial lighting on the French territory.

³ “*Le maire est l'autorité de police administrative au nom de la commune. Il possède des pouvoirs de police générale lui permettant de mener des missions de sécurité, tranquillité et salubrité publiques*” [URL] <https://www.collectivites-locales.gouv.fr/pouvoirs-police-et-securite-des-services-publics-locaux#:~:text=Le%20maire%20est%20l'autorit%C3%A9,le%20contr%C3%B4le%20administratif%20du%20pr%C3%A9fet.>

⁴ Challéat, S. & Lapostolle, D. (2014). (Ré)concilier éclairage urbain et environnement nocturne : les enjeux d'une controverse sociotechnique. *Natures Sciences Sociétés*, vol. 22(4), 317-328. doi:10.1051/nss/2014045.

⁵ The key numbers regarding lighting, in terms of costs and quantity, are presented online by the Association Française de l'Éclairage (AFE). [URL] <http://www.afe-eclairage.fr/afe/l-eclairage-en-chiffres-26.html>



Figure 6 – The city of Nantes and the seven local divisions. They locally manage the territories, including public lighting.

The lighting park of the community includes close to 100,000 light points, with an energy cost estimated at 5.6 million euros per year. Since the implementation of the metropolitan administration, the technical lighting experts, composing the EPICE department (*Éclairage Public et Infrastructures de Communications Électroniques*), cover the management of the park with tools that are, for some, obsolete. To manage the 24 municipalities, they only have two lighting development master schemes. One was done in 1993 for the city of Nantes, by the light design studio Concepto, and the other for the city of Rezé in 1999, by Vincent Laganier, an architect-expert in lighting working on behalf of Philips. In both cases, the master scheme guided the practices towards a functional outcome and the promotion of the nocturnal built and landscape environment. For example, Vincent Laganier’s expertise in lighting was qualified as City Beautification⁶.

In 2015, the energy and ecological considerations⁷ regarding the substantial practice of public lighting led actors from the EPICE department to develop the SCAL: The Public Lighting Coherence Scheme (*Schéma de Cohérence d’Aménagement Lumière*). It was initiated by a diagnostic of the physical state of the lighting park. Simultaneously, the agents in charge of the SCAL produced a first form of sensitive evaluation, measured according to the perceptions that they have of the ambiances experienced in the nocturnal public space. The SCAL was developed entirely internally, with our support in the input in terms of methodological and scientific structure. It aims to *produce quality nocturnal ambiances while maintaining energy and light sobriety*. However, it faced arbitration difficulties that confronted security, aesthetic and functional stakes with issues regarding the reduction in the ecological impacts⁸ of lighting on the local ecosystems. The technical expertises conflicted and delayed, even cancelled, the evolution potentialities of artificial lighting on the territory. Under such circumstances, the search for lighting sobriety was met with both normative barriers, considered as refuges, and ideological ones, in particular regarding the importance of the connection between lighting and security, whose

⁶ Lighting Development Master Scheme of the city of Rezé, April 1999, p. 2

⁷ Falchi F. & al (2016). The new world atlas of artificial night sky brightness, *Science Advances* 2(6):e1600377-e1600377 doi: 10.1126/sciadv.1600377.

⁸ Gaston K., Sanders D. (2017). How ecological communities respond to artificial light at night. *Journal of Experimental Zoology Part A Ecological and Integrative Physiology* 329(8-9) doi : 10.1002/jez.2157

rationale is still to be discovered⁹. To address this, the project was conducted towards interaction models¹⁰ dedicated to environmental public policies. It proposes the concept of *users' expertise*¹¹, complementing current technical and political expertises.

In Nantes, participatory policies fall within Major Debates (*Grands Débats*), in particular regarding energy transition¹² or the reappropriation of the banks of the Loire River¹³. On the scale of the city of Nantes, a Committee of the Night¹⁴ carries out consultation actions regarding the policies, stakes and ambiances of the Nantes nocturnal life. In terms of lighting and new technologies, the EPICE department makes available real environments to experiment, which enables the collection of physical and sensitive indicators under conditions of everyday practices¹⁵. This environment, which is open to consultations and experiments, and considering the arbitration difficulties met in the choices of nocturnal territories to illuminate or not, encourages us to develop a consultation methodology at the metropolitan level that is dedicated to nocturnal urban ambiances. In view of the scope of the territory¹⁶ to examine and of the common survey methods affiliated with nocturnal landscapes¹⁷, we directed our consultation methods towards crowdsourcing¹⁸ and digital environments¹⁹.

Digital tools to support a metropolitan survey

Professional users' expertise required in the development of the SCAL

The actors of the city's public transportation are part of the recurring counterparts in the development of the Public Lighting Coherence Scheme. They represent SEMITAN, a semi-public public transportation company in the Nantes agglomeration. This company, known under the commercial

⁹ Mosser, S. (2007). Eclairage et sécurité en ville : l'état des savoirs. *Déviance et Société*, vol. 31(1), 77-100. doi:10.3917/ds.311.0077.

¹⁰ Larrue, C. (2017). Recherche et politiques publiques environnementales : vers un modèle d'interactions. *Natures Sciences Sociétés*, supplément(Supp. 4), 12-17. doi:10.1051/nss/2017039.

¹¹ Sintomer, Y. (2008). Du savoir d'usage au métier de citoyen ? *Raisons politiques*, 31(3), 115-133. doi:10.3917/rai.031.0115.

¹² The city of Nantes organised a large survey with its citizens to identify possible local actions in the implementation of energy transition. [URL] <https://dialoguecitoyen.metropole.nantes.fr/project/grand-debat-sur-la-transition-energetique/step/resultat-de-la-demarche> - Accessed 06/09/20.

¹³ The city of Nantes organised a second consultation called "Nantes, la Loire et nous", whose aim was to "encourage the expression of the city by citizens and by the actors interested in the Loire, a River that involves a large number of activities and representations, but which is also disregarded and abandoned." [URL] <https://dialoguecitoyen.metropole.nantes.fr/project/grand-debat-nantes-la-loire-et-nous/presentation/30-engagements-une-ambition-pour-la-loire> - Accessed 06/09/20.

¹⁴ The Nantes Committee of the Night carried out surveys regarding the accessibility, precariousness and security of the nocturnal public space. [URL]: <https://metropole.nantes.fr/territoire-institutions/nantes/competences-municipales/nantes-ville-la-nuit/conseil-nantais-de-la-nuit> - Accessed 06/09/20.

¹⁵ Houel & al. (2019). Perceptions of the nocturnal public space and technological innovations – citizen evaluation of a smart public lighting installation in Nantes. *SHS Web of Conferences* 64:02003. doi: 10.1051/shsconf/20196402003.

¹⁶ The surface area of Nantes Métropole is estimated at 523.4 km².

¹⁷ Deleuil J-M. (2009). Éclairer la ville autrement, expérimentations et innovations en éclairage public. Suisse. PPUR.

¹⁸ Renault S., Boutigny E. (2014). "Crowdsourcing citoyen : définition et enjeux pour les villes", *Politiques et management public*, Vol 31/2 | 2014, 215-237.

¹⁹ de Feraudy T., Saujot M. (2017). Une ville plus contributive et durable : crowdsourcing urbain et participation citoyenne numérique, Institut du développement durable et des relations internationales.

name TAN, covers the entire transportation network of tramways and Busways (buses with a dedicated lane), as well as a large share of the bus lines. The importance of this transportation network and its crucial use in the movements of many users in the agglomeration makes it a key actor in the technical and sensitive input that is necessary for the development of the SCAL. Therefore, we wanted to add them to the network of contributors in the political and technical determination of lighting practices to associate to the lanes and stops for public transportation. We discussed both the lighting propositions regarding the equipment already implemented, but also the ways to illuminate future equipment, a tramway project connecting the future University Hospital (delivery in 2023 on the Île de Nantes) to the existing network. The public transportation network covers the whole city and operates during a part of the night. We saw here the opportunity to carry out a geographically expanded survey, with a sample of actors relatively limited. The potentiality of a small quantity of data was offset by the quality of the drivers' observations: their comments were free of any aesthetic appreciation and focused exclusively on visual comfort under professional conditions. The survey framework was weighted by the activity: the contributors were banned from doing anything but driving. In order to facilitate their individual restitution at the end of their shift, we developed a digital interface that enabled the geo-tracking, timestamping and argued appreciation of their observations.

Development of a tool dedicated to the consultation of SEMITAN drivers

The project consisted in developing a digital survey interface available in an Internet browser and operated intuitively. This interface has two juxtaposed windows: on the left, the questionnaire, and on the right, the interactive map (Fig. 2). The questionnaire was introduced by a short explanation summing up the exercise, the aim being to situate the participant into a dynamic position that encouraged him to finish his contribution.

Semitan, evaluation of visual conditions for nocturnal driving

This questionnaire aims to collect information regarding the nocturnal driving conditions on the transportation network, thanks to the contribution of transport professionals:

- 1. Select the line you drove on,*
- 2. Slide the blue marker on the observation area,*
- 3. Write the date of the observation,*
- 4. Write the time of the observation,*
- 5. On a scale from 1 to 5, mark your nocturnal visual comfort,*
- 6. Explain your mark with a short sentence.*



Figure 2 – Interface of the sensitive indicator collection tool for the nocturnal drivers at SEMITAN. We have a window for the questionnaire on the left, and the interactive map on the right. The green lines follow the TAN lines, the white polygons represent the buildings on display at this zoom level, the (T) icons show the stops, and the blue marker represents the reference position at the start of the interface. The latter can be moved by the participants in order to single out the specific area of their observation. © Nicolas Houel

We aimed to get precise answers from the drivers, and we made sure to facilitate the filling out of the questionnaire. Therefore, the selection of the line can be done via a drop-down menu, and the selection of the date can be done with a clickable timetable (Fig. 3).



Figure 3 – Interface of the sensitive indicator collection tool for the nocturnal drivers at SEMITAN. At the top, we can see the drop-down menu to select the transportation lines. At the bottom, a timetable facilitates the selection of the day of the observation. © Nicolas Houel

Development of an interactive element to localise the observation area

We also wanted to take advantage of the potentiality of the map interactivity to accurately determine the position of the location observed. The participants were invited to move a blue marker on the map to indicate their position at the time of the observation. The motion of the pointer instantly updated the *Latitude* and *Longitude* fields of the questionnaire on the left. It also allowed the map to focus on the area indicated. The movement of the map facilitated the definitive position of the marker. Likewise, the automatic filling in of the GPS coordinates helps us to position exactly the contribution of the driver on a map dedicated to results (Fig. 4).



Figure 4 – The positioning of the blue marker at the location of the observation allows the map to focus and to automatically fill in the coordinates. © Nicolas Houel

Lastly, the participants reached the two questions regarding the sensitive indicators. The first one was formatted like a Likert scale, from 1 to 5 (1 being the lowest value and 5 the highest) about their visual comfort at the location of the observation. To answer it, the drivers ticked a box according to their appreciation. To guide their choice, we captioned each value:

- 1: *Very uncomfortable, I could barely distinguish the forms and colours*
- 2: *Uncomfortable, I had trouble seeing the forms and colours*
- 3: *Correct, I could identify most of the forms and colours*
- 4: *Comfortable, I could see the majority of the forms and colours*
- 5: *Very comfortable, I could see every form and colour*

Here, we focused on the task carried out by the users, i.e. nocturnal driving. Their evaluation of the nocturnal environment dealt only with their visual perceptions. However, we tried to stay vague regarding the question of lighting. It was purposely omitted from the questionnaire, as the point was to focus on the *visual conditions for nocturnal driving* (in the title) and the *nocturnal visual comfort* (introduction and question 5). In this manner, we tried to assess the share that artificial lighting represents in the individual appreciation of nocturnal driving comfort. We anticipate that the results will also provide information on other themes, such as affluence, traffic, weather conditions, activities or the presence of darkness.

The last step was a *free comment*. In this spot, the participants could briefly explain the mark given in the previous question. We hoped here to collect a balanced quantity of contributions between *negative* (limited comfort) and *positive* (significant comfort) observations. Lastly, the *submit* button enabled the validation of the questionnaire and the redirection to the results page.

Development of a page dedicated to results

The completion of the questionnaire led directly to the results interface (Fig. 5). While half of the observations were done in the centre of the agglomeration, the other half was scattered relatively homogeneously across the periphery. The interface to check the results showed a visual contrast with the map used for the questionnaire. The pastel tone of the background and the green colour of the markers aimed to create a neutral effect, where the positioning and content of the contributions were the priority. Here, the participants could access information given by their colleagues. They could take note of its content with a click on the marker (Fig. 6) and get more information on their contribution. Lastly, the *Make another contribution* button, at the top of the map, allow them, if needed, to fill in the questionnaire another time.



Figure 5 – The completion of the questionnaire directly opens the results interface, which are geo-tagged at the location given by the participant – results on 15 February 2020, 64 contributions were recorded. © Nicolas Houel



Figure 6 – Clicking on the marker displays the elements filled in the questionnaire: line used, date and time, location, mark for the visual comfort, detail on the mark. The results vary depending on the environments and lines. On the left, the driver marked his visual comfort at 2/5, highlighting a discomfort from the headlights of the cars going out of the tunnel close to the tram line. On the right, the driver gave the highest mark (5/5) and proposes to use the lighting in this stop as a reference. © Nicolas Houel

Discussion of results

In a month, 65 contributions were recorded. To avoid any disruption in their activity, the drivers, who are forbidden from using their phone while in service, were allowed to use a notebook to take notes of areas, times, perceptions and comments regarding the environments they considered comfortable or not. They then gave their notebooks to their team leader, who filled in the questionnaire with the information given by the driver. This process enabled the collection of sensitive indicators from professional users without affecting their tasks too much. It also gave the drivers the opportunity to share their work environment while involving them in a renewed observation of the nocturnal urban landscapes that they see every day. We started the analysis of their contributions with the recurrence of lines used (Fig. 7) and with the synthesis of comfort marks (Fig. 8).

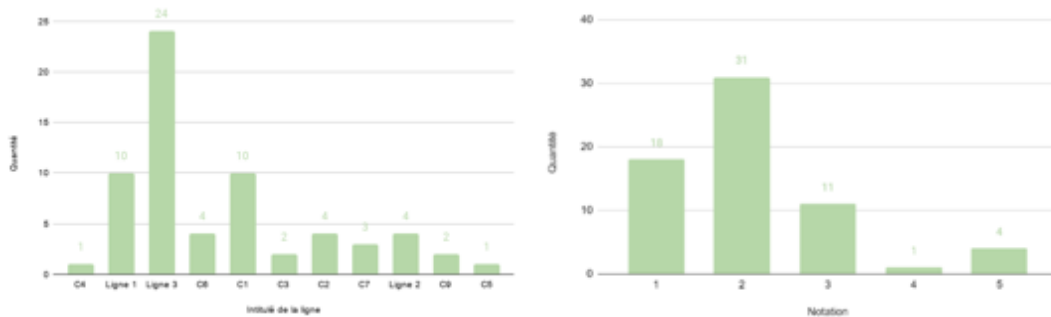


Figure 7 – On the left, synthesis of recurrences of lines. The tramway line 3 is largely mentioned. Then, the line 1 and the C1 Chronobus line are commented on. On the right, synthesis of the visual comfort marks, out of 5. 18 marks were 1/5, 31 were 3/5, one was 4/5 and 4 were 5/5. 75,4% of the marks are thus below average.

Lastly, we examined the comments. While four fields were left blank, the remaining 61 were largely referring to the question of lighting. We established a value scale to sum up the content of the comments (Fig. 9):

1. *Lighting lacking,*
2. *Poor lighting,*
3. *Lighting badly distributed,*
4. *Good lighting,*
5. *Very good to perfect lighting, to use as a reference,*
6. *Glaring lighting.*

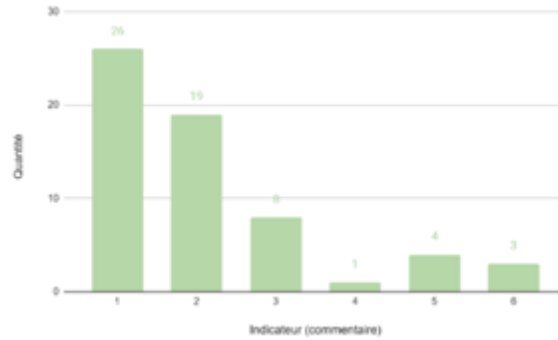


Figure 9 – Synthesis of the comments. Indicator 1 corresponds to a *lack of lighting*, 2 to *poor lighting*, 3 to *badly distributed lighting*, 4 to *good lighting*, 5 to *perfect lighting*, and 6 to *glaring lighting*. The distribution of indicators underlines the strong lack of lighting, particularly highlighted by the drivers.

In the case of Indicators 1, 2 and 3, we recorded the following terms: *lack of luminosity; no lighting; dark area; no light on this line; station turned off; complete lack of lighting, etc.* Amongst the explanations, a driver reported an *unsafe area for the users (editor's note: of TAN)* while another indicated *not enough light at the terminus, which is dangerous because many young people go there (close to school) in the evening.* As for these last two cases, we noticed that the drivers' comfort also involved the safety of the people using the space around the lines used. The drivers tried to anticipate any incident with other users of the public space. While lighting seemed to be an expected answer, it could also be troublesome. On that topic, three contributions noted external sources to public lighting, identified in the rank 6 (Fig. 9):

- *Left traffic lights too bright, blind us,*
- *Billboards too bright,*
- *No lighting at the pedestrian crossing, and the cars coming from the tunnel blind us with their lights.*

These observations, all associated with a blinding sensation, targeted static or moving light elements in the public space. Did the traffic lights blind the drivers because they were at a certain height, or was it because they have a more powerful lighting technology than others? Do we consider billboards as part of public or private lighting? What were the contractual terms that allowed the operator of such furniture during the night, possibly at a luminance level that blinded the drivers? Lastly, the spatial configuration of the tunnel (with an upward configuration) oriented the front of the cars towards a higher level. During the day, the headlights are off, and this configuration does not affect the drivers coming on the other side. At nightfall, when the headlights are on, the light beams of the cars go directly into the driver's cabin, blinding him as it has been reported in the sensitive diagnostic. The construction of the public space was here questioned, at least the level of the street, which included the outline of the lanes and the infrastructures of light signalling. The coexistence of different modes of transportation (cars, pedestrians, cyclists, public transportation), often operated with a series of juxtaposed lanes, seemed to reach one of its limits when night fell, in particular when it came to the discomfort created by nocturnal contacts and the risks of perpendicular crossings, when they remained in the dark.

We completed the statistical analysis with a comparison between the rating levels and the six explanation levels (Fig. 10). We learned that the absence, the lack or the bad distribution of lighting determined, in our case, the levels of comfort from 1 to 3. The marks from 4 to 5/5 were given from the moment when the drivers assessed the lighting as very good or perfect. The glaring effects were confirmed as visual discomfort, and the marks associated with their identification went from 1 to 2/5.



Figure 10 – Comparative graph between the sensations of comfort experienced by the users and the indicators that they gave. The blue curve represents the indicators, the green one the levels of visual comfort. We can see that the level of comfort varies between 1 and 3 when lighting was lacking, insufficient, badly distributed and good. The concept of comfort gets marks from 4 to 5 only when the lighting is seen as good or perfect. Lastly, the glaring phenomena lead to a comfort that is between 1 and 2 out of 5.

The expertise of use as a lever for the improvement of nocturnal urban ambiances in Nantes

The pooling of the physical (street, built environment and landscape, protected natural area) and sensitive (Fig. 11) indicators allowed us to identify five potential improvements for the nocturnal ambiances of Nantes, considering the opinions of the nocturnal drivers:

- *Extended outages,*
- *External sources of discomfort,*
- *Difficulties to identify other users,*
- *Nocturnal ambiances to use as examples,*
- *Lighting regimes adaptable to nocturnal uses and environments.*



Figure 11 – Cartographic representation of the sensitive indicators. On the left, the SEMITAN contributions alone are displayed. On the right, we layered the contributions, the types of streets, the natural spaces, the buildings and the light points.

Identification of extended outages

Around 10% of the comments highlighted out-of-power or dysfunctioning equipment:

1. *Streetlights out of service over the whole section,*
2. *The five lamps on the building of the AUCHAN parking lot that goes along Line 3 have been out of service for over a year. Starting at 10pm, we can't see anything,*
3. *HLP ÉCLAIRAGE path is out of service on the Croisy roundabout,*
4. *Two streetlamps out of service, little discomfort,*
5. *One streetlamp out of service + 1 BLINKING STREETLAMP,*
6. *The three lights of the park-and-ride facilities have been out of service close to the bus/tramway lines FOR 8 MONTHS (after the management change for the parking lots between SEMITAN and NGE),*
7. *Streetlamp out of service.*

These observations can be found on the digital map. We can see that two of them (2 and 6) were geographically very closer (Fig. 12). They created an environment marked at 1/5 in terms of comfort, which had been going on for at least 8 months (Comment 6), and possibly for over a year (Comment 2).

The change in management for the parking lots and the comment underlying that at 10pm the visual comfort dropped could make us think that it is potentially a timed shutdown to satisfy possible energy saving challenges, whose impact could have direct consequences on the professional environment of the nocturnal drivers.



Figure 12 – Cartographic representation of the sensitive indicators provided by the nocturnal drivers of public transportation. Opening the indicators informs us on a potential extended outage, which can be seen potentially as a choice of lighting regime to save energy, to the detriment of visual comfort. The two geo-tagged comments allow us to check the relevance of the tool for the collection of sensitive indicators

in the identification of potential improvements for the lighting park. Here, we can imagine adapting the lighting regime for the traffic lanes of public transportation, at least over their everyday service hours.

The external sources of discomfort

The drivers recounted the environments in which lighting, in contrast bright or coloured, became a source of discomfort. Amongst the comments, we could find:

1. *No lighting at the pedestrian crossing, and the cars coming from the tunnel blind us with their lights.*
2. *The billboard at the stop is much too bright,*
3. *The billboard blinds us,*
4. *The left traffic lights are too bright and blind us,*
5. *The white light of the Beauséjour parking lot contrasts with the yellow lights of the street,*
6. *Billboard is too bright.*

Out of six comments, half of them dealt with the lighting of billboards. This information supports the actions carried out by the Résistance à l'Agression Publicitaire collective²⁰ for a better consideration of the regulations in terms of lighting. The concepts associated with the planning of public space (traffic lights, pedestrian crossings and entrances of tunnels) are elements that highlight the importance of both a diurnal and nocturnal reflection around public space and its development. Lastly, the contrast in colour temperatures identified by Comment 5 confirmed the discomfort experienced by the drivers in that kind of nocturnal ambiances, which thus could be the subject of a standardization to improve the drivers' visual comfort and thus the quality of the service and the safe of its users and of the users of the nocturnal public space.

Difficulties to identify other users

The drivers indicated, in certain environments, that they experienced difficulties to identify users of the nocturnal public space that were close to the lanes and stops of public transportation. Amongst the comments, we found:

1. *Lighting only towards the city centre, the road is well lit, but the pavements in particular towards the outskirts are in the dark, which represents the risk of a pedestrian coming out from between parked vehicles,*
2. *No lighting, hard to see the cyclists,*
3. *The clients waiting at this stop are not very visible (Line 11, no reference),*
4. *No lighting on this whole portion, which makes the visualization of bikes and pedestrians difficult,*
5. *The presence of trees creates shade, which hinders the vision when there are pedestrians or cyclists,*
6. *No lighting in the turnaround area, which is completely dark, we can't see if people are walking to the bus stops (currently under construction).*

²⁰ The Résistance à l'Agression Publicitaire collective carries out concrete actions of awareness to illegal and polluting forms of advertisement, in particular lighting ones. [URL] <http://nantes.antipub.org/>

This sample of comments allowed us to understand the importance that the drivers give to a good visibility of other users of the nocturnal public space, in particular those using soft mobility. Pedestrians and cyclists were largely identified, as the drivers must show, at night, even more caution in the identification of moving objects in their vicinity, in order to anticipate any accident. Here, could we imagine that the absence of lighting, or its presence in bad conditions, represented an additional mental load in the practice by the professionals at night? Identifying bikes and pedestrians on the road also allowed them to anticipate any potential collision, while the need to see their clients waiting at the stops could stem from a stronger desire at night to note before the stop whether the passengers were drunk. Identifying the people moving or waiting could be considered, in the case of the drivers in Nantes, as a need to secure the infrastructures and the people, both outside and inside the means of transportation.

Nocturnal ambiances to use as reference

Although it was rarer, the drivers also noted some nocturnal ambiances that were resolutely comfortable (Fig. 13). Their comments were more concise:

1. *Very good lighting, to use as reference,*
2. *Lighting of that stop to use as reference,*
3. *Lighting of the boulevard in both direction, great visibility,*
4. *Perfect.*

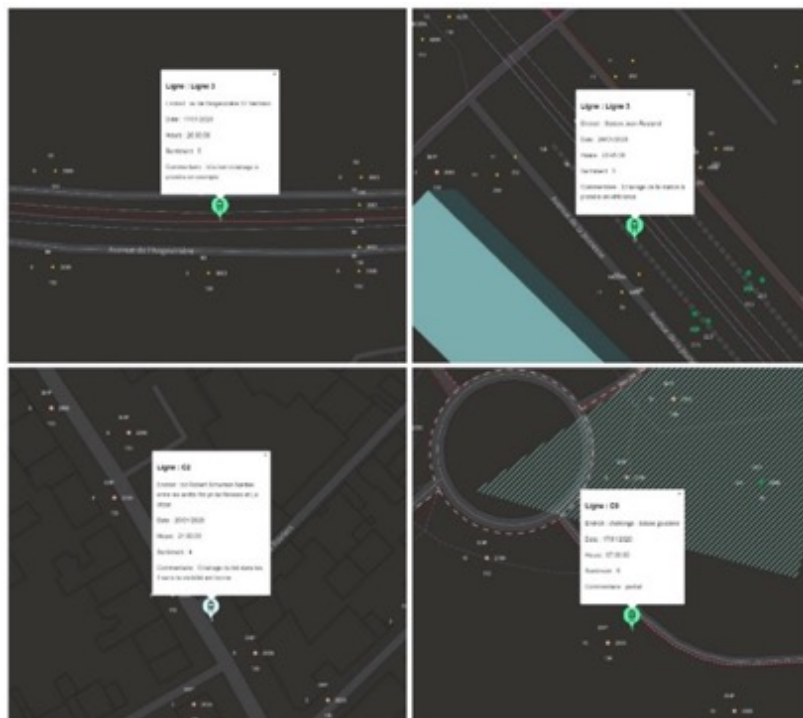


Figure 13 – Cartographic representation of sensitive indicators. A sample of four comments enables the identification of situations deemed very comfortable.

With these comments, we identified in the drivers an ability to provide positive feedback, unlike the negative one collected during the previous steps. For the latter, causes of discomfort were identified. In the comfortable situations, the comments remained vague and the absence of details prevented us from truly understanding the drivers' perceptions in such environments: was the visual comfort experienced associated with the lighting intensity, the colour temperature, the uniformity of the lighting, or regarding the affluence of users in the public space in this place and time?

These comments were shared in very different lighting environments. As indicated on the map (Fig. 13), three types of light sources were found:

- Metal halides: 150 W; 3000°K; installation at 9 metres in height (1),
- Metal halides: 70 W and 250 W; 4200°K; installation at 11 metres in height and LED: 22,5 W (only data available) (2),
- High pressure sodium: 150 W; 2000°K; installation at 8 and 10 metres in height (3 and 4).

The power, colour temperature and construction height are decisive in the production of light ambiances. LED, which represents around 10% of the lighting park in the city, remained significantly absent from the diagnostic, and it prevented us from determining situations of comfort and discomfort as part of this research. However, the positive indicators, coupled with further examination of the physical ones (built and vegetated environment, influence of the street and of the parking space, mobilities met on site, etc.) could allow us to consider a form of predictive approach regarding lighting ambiances towards nocturnal drivers and users of public transportation, with the partial or complete reproduction of the comfortable environment in future infrastructures, as with the tramway lanes that are planned on the Île de Nantes in the coming years²¹.

Lighting regimes adaptable to nocturnal uses and environments

Lastly, the drivers allowed us to identify certain potentialities in terms of transversality in the practices of public lighting and nocturnal public space (Fig. 14). For example, the highly contrasted rankings for the same environments, at two different times. The first, observed on 17 January 2020 at 7.55pm, indicated a “*very good lighting*” with a 5/5 feeling of comfort. The second, at the same place, several days later and at 1.07am, indicated a 1/5 feeling of comfort, justified as follows: “*complete shutdown of public lighting on this area of the Couëts at the late hour*”.

²¹ By 2026, the city of Nantes should be fitted with new public transportation lines, in particular new tramway lines to the University Hospital, under construction on the Île de Nantes. [URL] : <https://www.20minutes.fr/nantes/2535691-20190607-nantes-lignes-tram-6-7-8-busway-prolonge-nouveau-reseau-transports-commun-devoile> – last accessed on 1 July 2020.

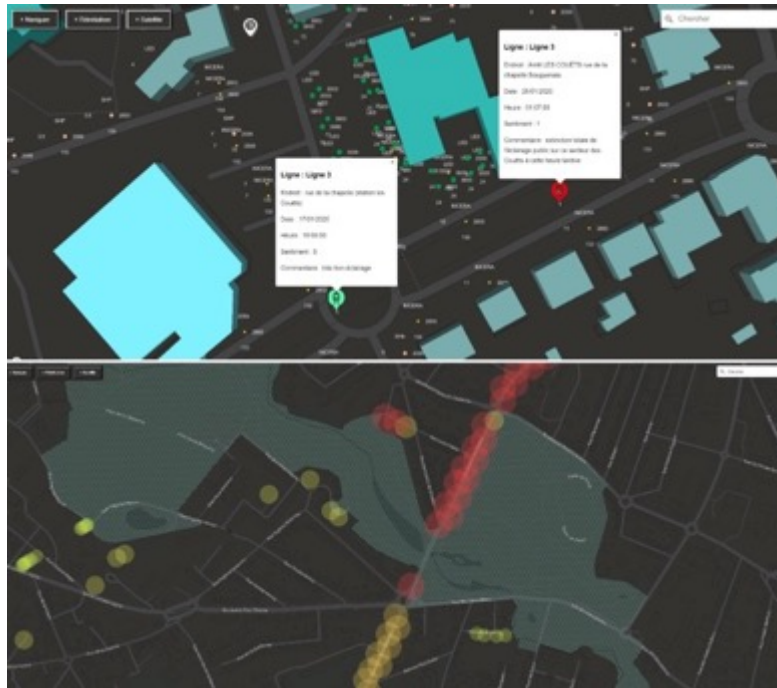


Figure 14 – Cartographic representation of the potentialities regarding the transversality of the uses of the nocturnal public space. At the top, the drivers indicate limited visual comfort because of the shutdown policy by the municipality in the middle of the night. This feedback can help us argue towards a better consideration of nocturnal uses in the practice of public lighting and open reflections on the transversality of the management of the nocturnal public space. This approach is confirmed by the crossing of physical indicators, such as lighting and natural environment, at the bottom, which underlines an artificial lighting installation with potentially damaging effects on a protected natural area. From these two illustrations, we can outline potentialities of light sobrieties localized on the territory, one by the uses of the public space, and the other by the presence of a natural environment to be respected.

Shutting down this area seems to be incidental to the shutdown policy by the municipality of Bouguenais in the middle of the night, apparently in order to reduce the energy consumption. The municipality has been shutting down the lights at midnight and turning them back on at 5.30am every day since 2011²². Estimated by ADEME²³ at around 37% of the total electricity bill, public lighting represents a source of economy easily accessible with the sole shutdown of the infrastructures. Is this energy and economic ambition, represented by the shutdown of public lighting, enough to justify the reduction of visual capacities of the professional and individual users of the nocturnal public space? The planned shutdown, at this place, represents a unilateral solution. The information given by the drivers highlighted the potentiality of transversality accessible through the expertise of use, that digital tools can get independently and over a large territory.

The information given by the drivers allowed us to consider nuances in the shutdown policies: would it be possible to adapt the public lighting operating hours more finely, by focusing, for example,

²² The online cartographic interface *Nuitfrance* allows us to access lighting and shutdown information in French cities. [URL] : <https://www.nuitfrance.fr/?page=extinctions> – last accessed on 6 September 2020.

²³ ADEME presents an article called « Éclairage public, un gisement d'économies d'énergie », in which key numbers regarding the energy consumption of territories are presented. [URL] : <https://www.ademe.fr/collectivites-secteur-public/patrimoine-communes-comment-passer-a-l'action/eclairage-public-gisement-deconomies-denergie> – last accessed on 6 September 2020.

on a specific area of the territory where the uses continue later in the night? Beyond the continuation of the working of the transportation service, the transversal management of the public lighting policies could also apply to security in the nocturnal public space. A more precise observation of the map (Fig. 14, at the top) shows the icon of a drinking place, in the north. This is a place where parties take place in the evening or at night. Shutting down the nearby lights could create a potential danger for the clientele, which finds itself in an urban environment that is limited in terms of visual landmarks late at night. This configuration can also generate risks for other users of public space, e.g. car drivers, whose anticipation of obstacles can be altered due to the lack of lighting²⁴.

Lastly, we would like to stress that the concept of *users of the nocturnal public space* encompasses living species beyond the sole human beings. The fauna and flora of natural environments, shown with the green hatched area on the map (Fig. 14, at the bottom) are part of protected areas of the territory. The challenge of light sobriety carried out by the SCAL, in addition to the preventive measures already implemented by the departments of the city, aims to protect them. The impact assessment of artificial lighting on such areas, here featured with a circle, which represents the average radiance of the light source towards its periphery, highlights once again the potentialities for light sobriety. This time, it involves greater respect for natural environments, like ZNIEFF²⁵. The red circles, representing fluorescent mercury lamps, have been prohibited since 2015. For example, their replacing could be accompanied by the localized management of photometric criteria of future lighting equipment: the colour temperature, light intensity and construction height could be adapted to the local context to provide the users with an appropriate lighting service and meet the needs in terms of respect of fauna and flora ecosystems.

Conclusion

The research presented in this article introduced a methodology for the collection of sensitive indicators on the metropolitan scale, with a limited number of participants and in condition of professional activity in the nocturnal public space. The exclusive destination of the protocol towards professionals of public transportation allowed us to frame the questionnaire and to facilitate its handling. Purposely, we eliminated the aesthetic considerations of lighting to focus on the functional and visual aspects encountered by the drivers. On the surface, our survey protocol seemed to address questions of nocturnal mobilities. However, it focused more on the concept of safety of property and more importantly of people, who are both in and out of the public transportation vehicles. The results gathered showed the relevance of a digital and professional evaluation protocol of the lighting park: the survey perimeter was broadened to the entire metropolitan territory, and only weighed by the drivers' trajectories. The questionnaire was limited to considerations regarding the visual comfort of a professional practice, whose contributions are situated in space and time. They allowed to establish a

²⁴ Jackett M., Frith W. (2013). Quantifying the impact of road lighting on road safety — A New Zealand Study. *IATSS Research*, pages 139-145, ISSN 0386-1112, <https://doi.org/10.1016/j.iatssr.2012.09.001>.

²⁵ *Zones naturelles d'intérêt faunistique et floristique*. (Natural zones of ecological, faunal and floral interest)

localized overview of illuminated environments, whose general cartographic representation signals global actions, both in the renewal of uncomfortable areas and in the production of the nocturnal ambiances of future stations on the territory, thanks to the observation of positive environments in terms of visual comfort, potentially replicable in the future. However, the rankings and comments from the expertise of uses underlined a majority of uncomfortable situations in the professional practice of the public space illuminated by the city of Nantes. Is it a sensitive and shared representation of the physical state of the lighting park, a stronger ability of participants to identify uncomfortable environments, or a balance between the two? The positive environments, identified with the 4/5 and 5/5 marks, were rare. Their presence remained significant: public lighting can provide comfortable environments, and they were recognisable by the participants surveyed. Thanks to their relevant contributions, the participants showed the ease they experienced to handle the survey tool, as well as their ability to observe, appreciate and comment on the nocturnal environments they faced.

Moreover, we have also strengthened the theory that artificial lighting represents an indispensable value in the representations of nocturnal public space. Our approach purposely omitted any term regarding the concept of light, asking the drivers to assess only their nocturnal visual comfort. Every time, the answers were weighted by the forms of lighting in place, regardless of their origins (public lighting, illuminated signs, billboards, tram station lighting, vehicle headlights). Two statements emerged from the results: the first is psychological, that the representations of nocturnal visual comfort in urban environments are deeply determined by the presence of artificial lighting. The second is physical, which situates the participant in an environment where space is, at all times and in all places, illuminate, which prevents their evaluation of visual comfort in a dark milieu. Lastly, the spatial representation of physical indicators allowed us to identify environments conducive to light sobriety. The example of the respect for natural areas was a very precise representation of the possibilities offered by a dynamic cartographic tool supplied with transversal information: the physical indicators allowed, as a preliminary step, to identify areas considered *potential for light sobriety*. With the collection of sensitive indicators, these areas were then confirmed or rebutted according to the expertise of uses encountered.

According to us, this is a complementary approach to the current forms of public lighting practices, here understood as shutdown policies and technological modulation innovations that allow, among other goals, to adjust the light flux and the colour temperature. The digital cartography represents the mediating and pedagogical element. With the transversality of the physical and sensitive indicators of the targeted territories, the mapping enabled a fine analysis and an objective arbitration of nocturnal landscapes and their uses. It also materialised the challenge of light sobriety with programmes and projects of nocturnal urban ambiances that are precisely adjusted, and adjustable, to their environments.

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