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Opinion

Night Matters—Why the Interdisciplinary Field of "Night Studies" Is Needed

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Abstract: The night has historically been neglected in both disciplinary and interdisciplinary research. To some extent, this is not surprising, given the diurnal bias of human researchers and the difficulty of performing work at night. The night is, however, a critical element of biological, chemical, physical, and social systems on Earth. Moreover, research into social issues such as inequality, demographic changes, and the transition to a sustainable economy will be compromised if the night is not considered. Recent years, however, have seen a surge in research into the night. We argue that "night studies" is on the cusp of coming into its own as an interdisciplinary field, and that when it does, the field will consider questions that disciplinary researchers have not yet thought to ask.

Keywords: night; night science; night studies; nyctology; interdisciplinary studies

1. Introduction

At any given moment, half of the Earth's surface experiences night (Figure 1). The night is not only a time, but in many respects a place: nocturnal environments are critical habitats for both humans and other forms of life. Over the past 150 years, the night has undergone a series of major transformations. Electrification, industrialization, and capitalism have altered humanity's experiences with night as both a time and place. Ecological studies demonstrate that these changes have also affected nonhuman species (e.g., [1,2]). In 1978, Melbin's pioneering article, "Night as frontier" sought to outline a sociology of the night [3]. Otherwise, scholarship on the night has been limited until recently, and disciplinary boundaries have tended to hamper interdisciplinary analyses. We, therefore, still remain in the dark when it comes to our understanding of night, despite the night's importance to natural and social processes.

Figure 1. At any given moment, half of the Earth's surface experiences night. Data by NASA Blue Marble and Black Marble, via John Walker 's webtool "Earth and moon viewer" [4].

The challenges facing our planet and humanity during this century often have direct and indirect connections to the night that must not be overlooked. There is, therefore, a pressing need for interdisciplinary research into the night to come of age, expanding into a recognized field, because the night matters.

2. The Night as an Interdisciplinary Research Challenge

We are a group of researchers and practitioners from diverse backgrounds in the natural and social sciences, humanities, and non-governmental organizations (NGOs), united by our common interest in the night (Table A1). There has historically been a lack of balance between investigations into processes that occur during night versus day, from disciplinary, and especially interdisciplinary perspectives. Humans are diurnal, and it is difficult to conduct research at night, regardless of disciplinary specialization [2]. Moreover, as most people (including scholars) sleep at night, nocturnal processes and issues are easily overlooked. There are also intellectual and institutional reasons for

our limited knowledge about the night. Research on the night is generally fragmented and siloed. Disparate topics too often appear as "someone else's problem" or are considered only as a facet of another field, thereby making interdisciplinary inquiry fundamentally difficult. This fragmentation and the lack of the "professionalization" of night studies as a field to date hamper raising the appropriate questions, let alone finding solutions. In Donald Rumsfeld's famous framing [5], there remain many "unknown unknowns" with respect to the night.

A pressing "nighttime" problem, for example, is growing concern over mismatches between social and biological time in humans. The 2017 Nobel Prize in Physiology and Medicine was awarded for the discovery of the molecular mechanisms in nearly all living organisms that govern circadian rhythms, ranging from activity patterns to blood pressure. The timing of many common human behaviors is often no longer aligned with these biological clocks, and there is ample concern that widespread insufficient or ineffective sleep [6] is detrimental to health. Sleep, however, is not simply a medical issue that can be isolated from broader social, cultural, and economic change. There are complex causes of changes in human sleep patterns over the past 150 years [7]. The development and expansion of artificial light at night has played a central role, with most cities now brightly illuminated [8,9]. Beyond lighting, factors such as incessant processes in industrial plants, connectivity across time zones, provision of 24/7 services including energy, security, and health care, and the possibility of constant technological connectivity in both professional and personal domains have expanded many human activities beyond previous temporal limits (e.g., [10]).

Extending the hours of labor for non-essential services, to take but one example, both reflects and reinforces industrial capitalism [11]. Nighttime shifts that enable factories to raise profits for shareholders often pay more than equivalent day shifts. This financial incentive, in turn, often attracts workers who are economically marginal including many women, people of color, and immigrants. Despite increased compensation, the nighttime economy may end up worsening social and economic inequality and magnifying environmental injustice, for instance, if these groups end up suffering from higher rates of disease and poorer health. There are also social costs due to incongruities between the schedule of workers and those of their families. One may question whether night economies really raise local revenue, once sleep deficits and the healthcare costs of night shift workers are also considered. This example demonstrates how night is an "interdisciplinary object"; physical and social processes at night—circadian rhythms, capitalism, education, race, gender, security, mobility, public lighting, and inequality—are entangled in complex and sometimes unexpected ways.

Now-established interdisciplinary fields such as gender studies and environmental studies provide precedents for the kind of professionalization and institutionalization of research that we envision. Like the environment, the night is an especially broad topic that invites diverse perspectives. Furthermore, night studies scholars have already drawn from a wide range of humanities, social science, and natural science disciplines. Due to the complexity of the night, it is essential to establish deep collaboration among social scientists, natural scientists, and humanists that unites empirically-based understandings of physical or biological processes with similarly empirically-grounded understandings of cultural, social, and historical processes (c.f. [12]). Complex social problems are unlikely to be easily fixed by technoscientific "solutions". For example, therapy based on applied understanding of the "night hormone" melatonin could not solve the sleep crisis on its own.

Failing to consider the full interdisciplinary context of night has already affected real-world situations. Consider the recent replacement of outdoor lighting in Rome in 2017 [13]. The city's lighting transition was undertaken within the frame of energy consumption and cost, and resulted in the replacement of existing warm color lamps with "colder" white LED lighting. Missing from consideration in the policy decision were public expectations and the cultural meaning of urban light, as well as the negative environmental side effects of broad spectrum (white) light [13]. As a result, residents and tourists had strong negative reactions to the light, arguing that the ancient city should not be lit with cold, harsh white lighting [14]. In addition, in trying to address one environmental problem (climate change), Rome may have worsened another (light pollution) in the process.

We suggest that an interdisciplinary approach to night governance that incorporates cultural, economic, environmental, and other concerns would yield solutions to nighttime problems that avoid public backlash, negative impact on tourism, and wasted budget due to reversal of policy (e.g., [15]). Given the broad changes that the night has experienced in recent decades, the quickly spreading recognition of the value of "night mayors" in cities including Amsterdam, London, and New York City [16], and the growing concern over "loss of the night" caused by artificial illumination and shifting schedules, a multi-faceted approach to night as an integrated field of study will redound to the public welfare as well as deepen our knowledge of this critical realm of everyday existence.

Organizations such as institutes, university departments, and research clusters have been established to bring interdisciplinary focus on places (e.g., oceans, polar areas, and area studies), topics (e.g., migration and transportation), and even times (e.g., history). It is, therefore, in some sense surprising that a similar organization has not yet been founded to address the night. Momentum seems to be building in this direction, however. For example, the Consortium for Dark Sky Studies recently established a new undergraduate minor in "dark sky studies" at the University of Utah. Gaston recently made a compelling case in The American Naturalist for why "nighttime ecology" must be established as a synthetic program of research in this scientific field [17], and Shaw has argued for "nightology", proposing an integrated approach to nocturnal urban research [11]. While these are exciting developments, we suggest that the emerging field of night studies must necessarily be much broader.

Beyond advancing interdisciplinary knowledge of the night, we expect that night studies researchers will, in many cases, work closely with organizations on evolving challenges such as those related to night governance, sustainability, or a carbon-free economy. Ideally, knowledge transfer from night studies scholars to practitioners will help them address emerging challenges, rather than responding to them after the fact.

An example of an interdisciplinary challenge for cities where night studies scholars could provide expertise is in the provision of public transit during the night. Night transit serves diverse publics, who surely have different expectations for service and perceptions of safety (e.g., a group of young men heading to a nightclub versus a female, first-generation immigrant nurse returning home alone after working an evening shift). Lobbies for late night transit often include the entertainment industry, while taxi companies, residents, and transit worker organizations are often against expanded night services (e.g., [18]). From an economic perspective, night transit may provide benefits due to increased activity, but impose future costs due to the health impacts of sleep loss by those using the service. Furthermore, long commutes and lost sleep may increase overall social inequality within a region [19]. Without a full picture, governance of the night may therefore serve the interests of a select powerful group, rather than the community generally.

3. Conclusions

The night has experienced major changes in recent decades, and the pace of change is unlikely to slow down. While research into the night has expanded greatly in recent years, we believe that further networking and institutionalization is urgently needed. In order to develop into a recognized interdisciplinary field, night studies will need to see the establishment of journals, conference series, dedicated funding lines, research institutes, and university departments offering programs of study. If the field develops as we hope it will, perhaps it may eventually become recognized by the Greek term "nyctology": the study of night matters.

4. Addendum

Note that another opinion on the "science of the night" with a different focus was recently published by Michele Acuto [20]. We agree strongly with Michele Acuto, and encourage readers to also read his piece. This manuscript was drafted independently over a period of in-person and online meetings spanning from 2017–2019, without any correspondence with Michele Acuto.

Author Contributions: A.J., C.C.M.K., D.H., F.H., J.M., and S.S. initiated the project, and selected and invited the rest of the co-authors to contribute. All authors collaborated on developing the outline and choosing specific examples or case studies via electronic and in-person meetings. Multiple drafts of the opening paragraph were written by co-authors, and ranked by all authors to select an initial opening. S.B.P. wrote the first complete draft of the paper, and all authors critiqued this draft. A.J., A.E., C.C.M.K., C.P., D.H., F.H., J.M., and S.S. edited subsequent drafts. C.C.M.K coordinated the project and was the primary editor. All authors critiqued draft versions of the manuscript and approved the final version. All authors have read and agreed to the published version of the manuscript.

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Appendix A

Table A1. Areas of main activity of the authors.

Area	Field	Name
Humanities	Cultural studies	Will Straw
	History	A. Roger Ekirch
	Literature & gender studies	Susanne Bach
Natural sciences	Chronobiology	Dieter Kunz
	Ecology	Franz Hölker
	Ecology/arctic night	Jørgen Berge
	Physics	Christopher Kyba
	Physics/engineering	Andreas Jechow
	Visual Neuroscience	Manuel Spitschan
NGOs	International Dark-Sky Association	John Barentine
	Night mayor of Amsterdam 2012–2018	Mirik Milan
Science communication		Sibylle Schroer
Social sciences	Geography	Luc Gwiazdzinski
	Planning	Dietrich Henckel
	Planning	Josiane Meier
	Science and technology studies	Sara Pritchard
	Sociology	Christine Preiser
	Sociology/night economy	Adam Eldridge

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