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Livable Cities: A Conference on Issues Affecting Life in Cities

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INTRODUCTION

Livable Cities: A Conference on Issues Affecting Life in Cities

What makes a city livable? Transport, housing, health. Open space, mobility and the environment. Matters of culture, entrepreneurship, crime and safety. Affordability and access to education. Depending on whose 'livability index' you look at, it may include design quality, sustainability and the digital infrastructures of the smart city. Other criteria applied may encompass food access, job opportunities or walkability. Inclusivity and the politics of participation also come into play. Discrimination in all its forms impacts livability and social and political equity.

The past two decades have seen an exponential rise of livability measures. Reflecting increased urbanity globally, they risk making the notion of the city ever more contested. The two cities that host this event are cases in point. The Mercer Livability Ranking takes New York as the datum by which all other cities globally are graded – as better or worse. London, by contrast, measures itself: the London Assembly scoring everything from air quality to indices of deprivation. When we consider the livability of cities then, it is clear we are dealing with a plethora of issues – both isolated and, inevitably, interconnected.

Responding to this scenario, the papers in this publication tackle these issues above from various angles. They examine how we live in cities, and how every issue we encounter morphs with considerations of others, whether housing, architecture, urban planning, health, IT, crime and safety, city management, economics or the environment.

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ARCHITECTURE AND MIGRAINE: AN INCLUSIVE MODEL FOR MIGRAINE-SAFE VISUOSPATIAL ENVIRONMENTS

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INTRODUCTION

As defined for 2000 years, migraine is a complex and variable disease with various symptoms that affect different body parts. It often causes severe headaches, visual disturbances, mood swings, balance disorders, and nausea. Migraine-induced headache is the third most common disease and the sixth-highest specific cause of disability worldwide, determined by genetic and environmental factors.[1] According to the American Migraine Foundation (AMF), the disease affects more than 1 billion people worldwide; it is seen in 1 out of 5 women, 1 in 16 men, and 1 in 11 children.[2]

Migraine has many different sensory triggers among physical, physiological, and psychological conditions. Those, alone or together, are the factors that trigger attacks and headaches in people who are prone to migraine.[3] In addition to situations triggered by visual, auditory, olfactory, and other senses, environmental and biological variables, like sleep deprivation, fatigue, hormonal changes, and sudden decreases in air pressure, have also been identified as migraine stimuli.[4] Along with visually triggered diseases and disorders such as photosensitive epilepsy, fear of light (photophobia), light sensitivity, headache, and accompanying migraine attacks, migraine refers to a much larger community and social burden.[5] Although the causes of migraine allow speculative approaches in diagnosis and treatment, the complex mechanisms of migraine have become more understandable with increasing scientific research, neuroimaging technologies, and new findings in recent years.[6]

Burden of migraine: Migraine and its impact on human life

Every stage of migraine can cause disability in the individual's different domains of private and professional life.[7] Migraine makes seemingly easy tasks much more challenging to complete and takes more time. Individuals with migraine have difficulties that are highly dependent on the individuals' lifestyle and environmental characteristics, as well as the severity and frequency of their symptoms. According to a study conducted in 2019, within the most common themes of the overall impact of migraine disorders, Matilde Leonardi and Alberto Raggi evaluated the effect on home and leisure activities first and the impact on work or school-related activities second.[8] The difficulties mainly arose in work or school-related activities as they require diverse skills for physical and social tasks and maintaining communication and relationship with others. The problems related to work and school are reported to be associated with headache frequency, pain intensity, decreased productivity, and female gender. The authors explain that the burden of headache disorders, especially migraine, is also an economic burden. Much of this economic effect is due to work-related costs resulting from absenteeism and low productivity.

Efforts to improve the quality of life for all are instrumental in mitigating migraine's personal, social, and economic burden. By responding to the causes of migraine in terms of reduced equality, restricted abilities, and productivity, the present study proposes to incorporate the unrecognized relationship between migraine and the built environment through the knowledge of neurology and environmental psychology with architectural design methods and tools. Architecture is a field of practice and research that specifically and extensively deals with the visual perception of spatial relationships. Therefore, through disciplinary know-how, the entrance of architecture into the equation is indispensable in leading research with easily implementable solutions. The first step to unfolding the problem is searching for migraine's intricate mechanisms in the visuospatial field of perception.

MECHANISMS OF MIGRAINE AND VISUOSPATIAL FIELD OF PERCEPTION

The study defines the migraine triggers as "visuospatial factors," as part of the human perception where visual and spatial features of the built environment are joined, and which, alone or together, are both creating, inducing, stimulating migraine and other visually induced discomforting conditions. An inquiry into migraine's visuospatial factors requires a deeper look into the mechanisms of migraine and its relationship with human perception. Arnold J. Wilkins' book *Visual Stress*,[9] in which the mathematics of different elements and disturbing images that create visual stress are explained, is the most comprehensive study describing the relationship between migraine and visual perception. The author attributes the experience of visual disturbance to strong physiological arousal caused by certain visual stimuli and the effects of overstimulation of the brain's visual cortex. Visual stress occurs because unnatural and disturbing images cause an increase in neural activity and metabolic demand, requiring less efficient processing and more oxygenation.[10]

The neural mechanism of the visual cortex processes some images efficiently and others inefficiently. Wilkins states that natural images are processed efficiently and comfortably by the visual system, and the least disturbing images correspond to the characteristic features of the natural visual environment.[11] Many aspects of spatial coding in the visual system are matched with the 1/f spatial structure of the visual environment. Because images with different structures do not fully match the visual mechanisms, so they produce unnaturally strong neural responses and trigger individuals susceptible to migraine or epilepsy.[12] In other words, the mind processes uncertain visual stimuli that it cannot predict with less efficiency, thus causing a stronger neural response and discomfort. Peter R. Boyce and Arnold J. Wilkins state that most studies show a positive relationship between visual disturbance and neural activation of the visual cortex and, therefore, oxygenation, including studies on individuals with migraine with fear of light.[13] Cortical hyperexcitability is thought to occur in migraine and epilepsy, and other neurological disorders where seizures are relatively common, such as autism.[14] Complexity in the visual field creates a computational charge leading to excessive neural activity, and high metabolic demand for oxygenation, eventually causing visual discomfort. High contrasts, frequency in repetitive patterns, and distribution of light and shadow provoke hyper neuronal activity.[15]

The migraine literature needs three dimensional studies on spatial relations. Though neurologists, psychologists, and ophthalmologists deeply dissect the adverse effects of migraine on human health and comfort, their arguments primarily rely on 2D-image experiments. Future work can complete those experiments' deficiencies with the 3D experimental research methods and findings produced in the architecture sciences. Although without any focus on migraine, numerous 3D research has been executed in architecture and building science concerning energy efficiency, lighting comfort, and performance. In these studies, comfort is defined as the minimum required performance, therefore failing to have an inclusive account for people with migraine.

The study claims that it is possible to detect visual factors that can trigger migraine in the spatial organizations of the built environments, therefore, to assess the level of inclusiveness for people with migraine through the computational complexity of visual stimuli in their spatial relations. Since the mechanisms of visual stress and visually induced migraine are similar,[16] investigating the elements and parameters that cause overstimulation of the brain's visual cortex helps establish a framework to include these factors as design considerations.

MIGRAINE AS A SPATIAL CONSIDERATION

Some environmental factors are decisive in designing built environments and measuring spatial comfort and livability. There are prominent studies that are concerned with the spatial comfort and livability criteria; in its greater complexity,[17] comfortable interior designs,[18] and for production of guidelines for accessible spaces.[19] In 1983, Wolfgang F. E. Preiser explored the relationship between human behavior and the built environment and evaluates them based on the topics of habitability, thermal comfort (air conditioning and ventilation), noise control-acoustics, lighting systems (access to natural light), and access to nature (planting). The author defines them as aesthetic and performative components.[20]

Since individuals with migraine are more sensitive to certain qualities of light, sound, odor, or otherwise,[21] they have varying threshold tolerances and respond to the built environments differently. These qualities can effectively form migraine attacks and pain, singularly or cumulatively. In 1995, Oliver Sacks defines migraine caused by such stimuli as "conditional migraine." Therefore, the same physical environment that is habitable and comfortable for healthy individuals may affect people with migraine differently.

Researchers working with the methods of environmental psychology and architecture long studied user experience and the effects of environments on people. However, these studies need to address the architectural design and be occupied with the experience of space from migraineurs' perspective. An extensive set of experimental studies in the literature on migraine and visual stress are conducted from a neurological and psychological perspective. These primarily focus on light, glare, patterns, and color chromaticity. For example, some patterns are known to create visual stress with their dazzling and vibrating effect (pattern glare) and stimulate migraine, even some can lead to epileptic seizures.[22] When we look at the effect of light as another stimulus, it is seen that some situations provoke migraine by creating fear of light and visual stress.[23] These experiments are limited to two dimensions. Spatial conditions such as depth, level differences, movement, and other dynamic factors in the production and experience of space still need to be included in the migraine literature.

According to a study conducted in the USA, nearly 90 percent of daily activity is spent indoors; and, more than half of this time is spent in working environments such as offices and classrooms.[24] Artificial light sources, technological tools, and digital screens bring high visual stress to these working and educational environments. It is known that these factors can trigger visually sensitive migraine and epilepsy.[25] Visually intense environments like shopping malls and supermarkets also trigger vestibular symptoms in vestibular migraine patients.[26] The more exposure time, the greater the possibility of occurrence and impact.[27]

Although the existing scientific literature on migraine is conducted mainly for academy-based researchers, through architecture mediating in between, it becomes possible to augment the impact of migraine research on first design practitioners and secondly to the policymakers and the public to act on the issue. Possible solutions for the mitigation of migraine require an interdisciplinary mindset and approach. Neurology and psychology dominate the studies, yet there are studies conducted, including researchers from engineering and lighting sciences. When the problem is extended towards understanding the mechanisms of triggers within the three-dimensional space, i.e., perceived visuality

of the built environment, existing literature fails to deal with the uncertainty and complexity inherent to the 3D visual field. This gap demands approaching migraine from an architectural point of view. (Figure 1) The agency of architecture is especially crucial when migraineurs are exposed to these spatial triggers for more than half their day in buildings, primarily for work and education. In these environments, they have minimum control over the design and arrangement of architectural elements and spatial relations.

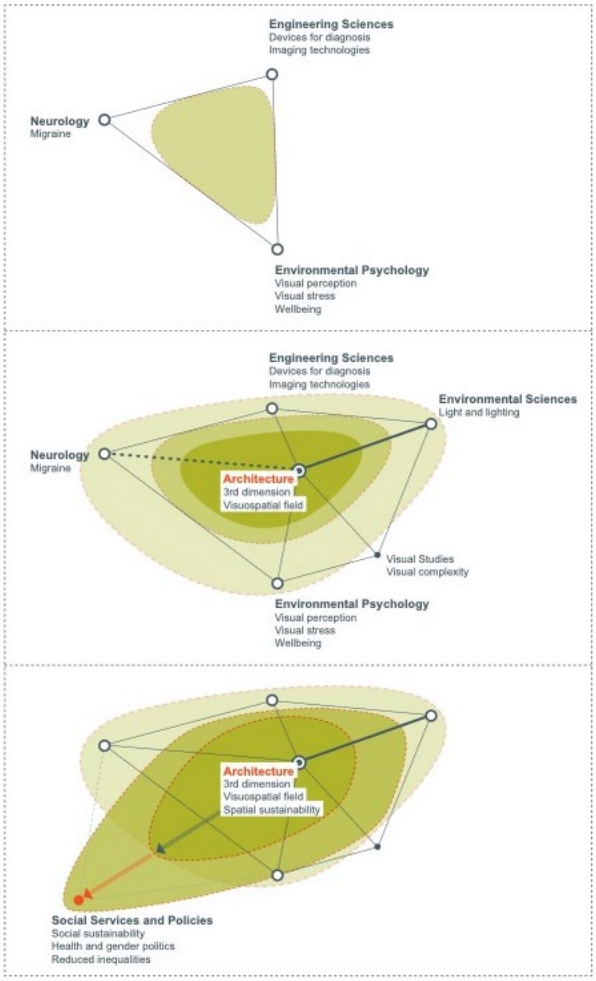


Figure 1. The formation of the proposed interdisciplinary research area extended through the agency of architecture.

VISUOSPATIAL FACTORS INDUCING MIGRAINE AND THE AGENCY OF ARCHITECTURE

This part of the paper presents a framework developed to translate the existing knowledge on built environments as an architectural design concern. The migraine issue has yet to be approached directly from an architectural point of view. How architectural design decisions affect individuals with migraine pain and triggers of attacks has yet to be investigated. The findings also show that no study deals with these elements in their multiple holisms, likely due to the high level of complexity of the visual-spatial field that is quite challenging to control the parameters for experimental studies. This gap interrupts the practical use of the knowledge produced so far. It constitutes the motivation of this study and determines the area it aims to contribute. As the first comprehensive study on the

relationship between migraine and architecture, this paper underlines the massive social burden of migraine by unfolding its visuospatial triggers from a design perspective.
Within the physical characteristics of built environments, the elements and parameters included in this study are defined as the visuospatial triggers of migraine. (Figure 2) Together with the direct triggers of migraine, factors that have the potential to induce migraine by creating visual stress are also included in this study. They are grouped under the headings (1) lighting structure, (2) surface properties, (3) formation of space, and (4) movement. In the literature on lighting structure, light and lighting, visual comfort, and energy efficiency have a relatively large set of empirical information. In addition, surfaces have also been studied under various sub-titles concerning visual comfort and energy efficiency.[28] It is observed from the existing studies that the spatial factors: formation of space and movement, were not covered in the experimental studies, neither in migraine nor visual comfort research, which the author determines as a significant deficiency in the literature.

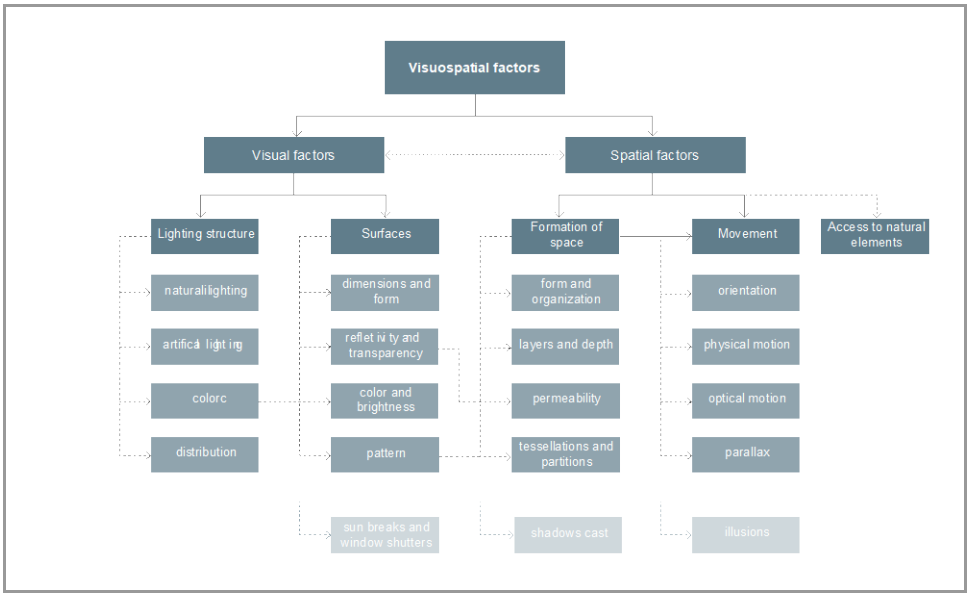


Figure 2. The proposed framework for migraine-safe visuospatial built environments.

TOWARDS MIGRAINE-SAFE ARCHITECTURES: POSSIBLE IMPLICATIONS OF THE STUDY

This project's contribution and widespread impact can be understood when the frequency and severity of the situations in which this large population living with migraine and its accompanying diseases become debilitated, and their productivity is reduced and restricted. Control over built environments will help people with migraine and include them more in social and work-education life. The paper addressed possible implications and related them with the UN's SDGs for the significance and the urgency in finding ways to solve the problem.
The general public has not yet been unable to build a clear understanding of migraine and migraine burden on individual, societal, and governmental levels. This study exposes architecture's agency and influence in making the hard-to-understand scientific knowledge public and developing possible solutions for reducing and regulating migraine triggers. Solving the problem altogether is unrealistic with the current knowledge, though some attempts can be made for effective mitigation. The proposed framework provides architects with accurate predictions for projects at the design stage by leading the way for inclusive environments that consider the well-being of people with migraine.

All people should have access to equal opportunity and comfort conditions to achieve natural equality, including people living with migraine. National and international associations work to raise awareness of migraine, facilitating the follow-up and accessibility of current information, educating healthcare personnel and patients, and supporting research. These include but are not limited to the International Headache Society, the American Headache Society, the American Migraine Foundation, the Migraine Trust, the Association of Migraine Disorders, Headache and Pain Studies Association.

The study creates a groundwork to demand action for the formation and future application of social policies and regulations for the built environments. The implications of the study extend in multiple directions. Explicitly and implicitly, and in various ways, the study contributes to the United Nations' 2030 Agenda for Sustainable Development.[29] The contributed Sustainable Development Goals (SDGs) of the UN are "good health and well-being," "gender equality," "reduced inequalities," and "sustainable cities and communities." By extending its limits, the possible implications and impact of the study are manifold yet can be classified under five interrelated trajectories:

Livable cities and sustainable environment: The paper exposes the wide variety of the burden of migraine and the negative experiences that migraineurs face. Visualizing the actuality and seriousness of the problem and looking for solutions at physical and social levels, the study is intended to guide the research and practice in design fields and policy making. The proposed framework can be a valuable guide for creating new designs to improve built environments in a way that will produce migraine-safe spaces. It can also work as a model to assess and transform the existing spaces in use into inclusive and livable environments. In addition to the considerations on architectural space, the paper presents a groundwork for further study of migraine-safe environments on the perception and experience of urban and city levels.

Health and well-being: The study supports the creation of healthy physical environments to ensure the physical, social, and psychological well-being of individuals with migraine. It aims to increase life quality and migraineurs' active and healthy participation in life as SDG3 aims to "ensure healthy lives and promote well-being all at all ages."

Reduced inequalities: The proposed inclusive framework for migraine-safe visuospatial environments respond to the SDG10 as it advocates for awareness to "reduce inequalities" and "empower and promote the social, economic, and political inclusion of" individuals living with migraine and other visually induced discomforting conditions and disabilities. It also demands equal opportunity and inclusive policies and practices regarding the discrimination created through them.

Employment and work life: An implication of this study is to initiate inclusive and specific policies for individuals with migraine in employment and working life, increasing participation and productivity of groups requiring special policies in the labor force and employment. By reducing inequalities for disadvantaged individuals with a natural equality approach, it is advocated that everyone can reach equal opportunities and comfort conditions, including but not limited to the work environments of offices, coworking, and education spaces.

Empowerment of women in business and academic life: Although affecting both sexes, being female is a risk factor for the chronicity of migraine.[30] Migraine has a more significant effect on females, especially during the reproductive years, due to "female sex hormones, which can have profound effects on the frequency, severity, and type of migraine".[31] The incidence of migraine in women is three times higher than in men, and the risk of attacks during menstrual periods increases the overall burden cumulatively for women. Considering the frequency and severity of situations where females' productivity decreases in their work and education life because they become debilitated, this situation puts women at a disadvantageous position in business and education life compared to men. In this respect, the impact of the study extends towards empowering women in

business and education life, ensuring their access to equal rights and opportunities, and active participation in all levels of education.

CONCLUSION

This study corresponded to the theme of the conference “livable cities” as it has introduced an encounter by intersecting architectural design and health research from a unique perspective to develop methodologies for creating inclusive environments for people with migraine. By responding to the burden of migraine, this paper aimed to detect the visuospatial factors affecting individuals with migraine and questioned why migraine should be a design consideration. Further research is needed to holistically cover non-visual environmental sensory triggers, including auditory and olfactory. It brought a critical perspective to the field by approaching architectural design research and practice, reconsidering the inadequate vocalized migraineurs' side. With this new perspective, the study formed a new area for research and practice by establishing a bridge between migraine studies and architectural design.

NOTES

[1] Amrit Sudershan, et al., “The complexities of migraine: A debate among migraine researchers: A review.” *Clinical Neurology and Neurosurgery* 214: 107136 (2022).
Doğa Vurallı et al, “Cognitive dysfunction and migraine.” *The Journal of Headache and Pain* 19, 109 (2018).
[2] American Migraine Foundation, https://americanmigrainefoundation.org/migraine-101/.
[3] Paul R. Martin, “Triggers of Primary Headaches: Issues and Pathways Forward.” *Headache* 60 (2020): 2495–2507.
Geneviève Demarquay et al., “Revised guidelines of the French Headache Society for the diagnosis and management of migraine in adults. Part 1: Diagnosis and assessment.” *Rev Neurol (Paris)* 177 (2021): 725–733.
[4] Oliver Sacks, *Migraine*. Picador. 1970/1995.
[5] Daniel P. Hayne and Paul R. Martin, “Relating Photophobia, Visual Aura, and Visual Triggers of Headache and Migraine.” *Headache: The Journal of Head and Face Pain* 59 (2019): 430–442.
Arnold. J. Wilkins et al., “Tinted spectacles and visually sensitive migraine.” *Cephalalgia* 22 (2002): 711–719.
Arnold. J. Wilkins et al., “Photophobia in migraine: A symptom cluster?” *Cephalalgia* 41 (2021): 1240–1248.
[6] Sacks, *Migraine*.
Sudershan, et al., “The complexities of migraine.”
[7] Arife Ç. Atalar et al., “Living with Burden of Migraine: The Analysis of "My Migraine Voice" Survey Results in Turkey.” *Noro Psikiyatri Arşivi* 58(2), (2019): 115–120.
[8] Matilde Leonardi and Alberto Raggi, “A narrative review on the burden of migraine: when the burden is the impact on people’s life.” *The Journal of Headache and Pain* 20:41 (2019).
[9] Arnold J. Wilkins. *Visual Stress.* Oxford University Press: Oxford, UK, 1995
[10] Peter R. Boyce and Arnold J. Wilkins, “Visual discomfort indoors.” *Lighting Res. Technol.* 50 (2018): 98–114.
[11] Arnold J. Wilkins, “A physiological basis for visual discomfort: Application in lighting design.” *Lighting Research & Technology* 48 (2016): 44–54.
Arnold J. Wilkins, “Visual stress: origins and treatment.” *CNS* 6, (2021): 74–86.
[12] Igor Juricevic et al. “Visual discomfort and natural image statistics.” *Perception* 39(7) (2010): 884–899.
[13] Boyce and Wilkins, “Visual discomfort indoors.”
[14] Arnold J. Wilkins, *Visual Stress.* Oxford University Press: Oxford, UK, 1995.
[15] Wilkins, *Visual Stress.*
[16] Hayne, and Martin, “Relating Photophobia.”
[17] Wolfgang F. E. Preiser, “The habitability framework: a conceptual approach towards linking human behaviour and physical environment.” Design Studies 4(2) (1983): 84–91.
Ardeshir Mahdavi, “Steps to a General Theory of Habitability.” *Human Ecology Review* 5(1), (1998): 23–30.
[18] Philomena Bluyssen, *The Indoor Environment Handbook: How to Make Buildings Healthy and Comfortable* (1st ed.). Routledge, 2009.
[19] Wolfgang F. E. Preiser and Koridon H. Smith. *Universal Design Handbook*. Second Edition. New York: McGraw Hill, 2010.
[20] Preiser, “The habitability framework.”
[21] Deborah. I. Friedman and Timothy De Ver Dye. “Migraine and the Environment.” *Headache: The Journal of Head and Face Pain* 49 (2009): 941–952.
[22] Wilkins, *Visual Stress.*
James M. Gilchrist and Peter M. Allen. “Lexical decisions in adults with low and high susceptibility to pattern-related visual stress: a preliminary investigation.” *Frontiers in psychology* 6, 449 (2015).
Deacon E. Harle et al., “Visual Stimuli Are Common Triggers of Migraine and Are Associated with Pattern Glare.” *Headache: The Journal of Head and Face Pain* 46 (2006): 1431–1440.
Alex J. Shepherd et al., “Headache.” *Headache: The Journal of Head and Face Pain* 53 (2013): 1087–1103.
Shu Imaizumi et al., “Illusory visual motion stimulus elicits postural sway in migraine patients.” *Frontiers in psychology* 6, 542 (2015).
[23] Wilkins, “A physiological basis.”
Wilkins, “Fear of light.”
Harle et al., “Visual Stimuli.”
[24] Tristan Roberts, “We Spend 90% of Our Time Indoors. Says Who?.” *Building Green*, December 15, 2016.
[25] Wilkins, *Visual Stress.* Wilkins, “Visual stress.” Boyce and Wilkins, “Visual discomfort indoors.”
[26] Doğa Vurallı et al., “Visual and postural motion-evoked dizziness symptoms are predominant in vestibular migraine patients.” *Pain Medicine* 19(1) (2018): 178–183.

[27] Hayne, and Martin, “Relating Photophobia.”
[28] Alireza Hashemloo et al., “GlareShade: a visual comfort-based approach to occupant-centric shading systems.” *Journal of Building Performance Simulation* 9 (2016): 351–365.
Mojtaba Parsaee et al., “Human-centric lighting performance of shading panels in architecture: A benchmarking study with lab scale physical models under real skies.” *Solar Energy* 204 (2020): 354–368.
Alen Mahić et al., “A pilot daylighting field study: Testing the usefulness of laboratory-derived luminance-based metrics for building design and control.” *Building and Environment* 113, (2017): 78–91.
Laura Belli et al., “Lighting in educational environments: An example of a complete analysis of the effects of daylight and electric light on occupants.” Building and Environment. 68, (2013): 50–65.
Peter R. Boyce, “Lighting research for interiors: the beginning of the end or the end of the beginning.” *Lighting Res. Technology,* 36(4) (2004): 283–294.
Peter R. Boyce, “The Present and Future of Lighting Research.” SDAR* *Journal of Sustainable Design & Applied Research,* 6(1), Article 2 (2018): 5–14.
Kevin W. Houser et al., “Human-centric lighting: Myth, magic or metaphor?” *Lighting Research and Technology* 53 (2021): 97–118.
[29] United Nations, “Sustainable Development Goals.” Accessed February 14, 2023. https://sdgs.un.org/goals.
[30] Doğa Vurallı and Hayrunnisa Bolay. “Türkiye'de Kronik Migren Özellikleri ve Hastaya Yaklaşım.” *Turkiye Klinikleri J Neurol-Special Topics* 10(4) (2017): 347–52.
[31] Anne MacGregor, *Migraine in Women* (2nd ed.). CRC Press, 2003.

BIBLIOGRAPHY

American Migraine Foundation, https://americanmigrainefoundation.org/migraine-101/.
Atalar, Arife Ç., Manal Bozkurt, Zeynep Çalışkan, Pamela Vo, Mustafa Ertaş, Betül Baykan. “Living with Burden of Migraine: The Analysis of "My Migraine Voice" Survey Results in Turkey.” *Noro Psikiyatri Arşivi* 58(2), (2019): 115–120. https://doi.org/10.29399/npa.24780.
Bellia, Laura, Alessia Pedace, Giuseppe Barbato. “Lighting in educational environments: An example of a complete analysis of the effects of daylight and electric light on occupants.” Building and Environment. 68, (2013): 50–65. https://doi.org/10.1016/j.buildenv.2013.04.005.
Bluyssen, Philomena. *The Indoor Environment Handbook: How to Make Buildings Healthy and Comfortable (*1st ed.). Routledge, 2009. https://doi.org/10.4324/9781849774611.
Boyce, Peter R. “Lighting research for interiors: the beginning of the end or the end of the beginning.” *Lighting Res. Technology,* 36(4) (2004): 283–294. https://doi.org/10.1191/11477153504li118oa.
Boyce, Peter R. “The Present and Future of Lighting Research.” SDAR* *Journal of Sustainable Design & Applied Research,* 6(1), Article 2 (2018): 5–14. https://doi.org/10.21427/D7853J.
Boyce, Peter R., and Arnold J. Wilkins “Visual discomfort indoors.” *Lighting Res. Technol.* 50 (2018): 98–114.
Demarquay, Geneviève, Xavier Moisset, Michel Lantéri-Minet, Solène de Gaalon, Anne Donnet, Pierric Giraud, Ev Guégan-Massardier, Christian Lucas, Jérôme Mawet, Caroline Roos, Dominique Valade, and Anne Ducros. “Revised guidelines of the French Headache Society for the diagnosis and management of migraine in adults. Part 1: Diagnosis and assessment.” *Rev Neurol (Paris)* 177 (2021): 725–733. doi: 10.1016/j.neurol.2021.07.001.
Friedman, Deborah. I., and Timothy De Ver Dye. “Migraine and the Environment.” *Headache: The Journal of Head and Face Pain* 49 (2009): 941–952. https://doi.org/10.1111/j.1526-4610.2009.01443.x.
Gilchrist, James M., and Peter M. Allen. “Lexical decisions in adults with low and high susceptibility to pattern-related visual stress: a preliminary investigation.” *Frontiers in psychology* 6, 449 (2015). https://doi.org/10.3389/fpsyg.2015.00449.
Harle, Deacon E., Alex J. Shepherd,and Bruce J. W. Evans. “Visual Stimuli Are Common Triggers of Migraine and Are Associated with Pattern Glare.” *Headache: The Journal of Head and Face Pain* 46 (2006): 1431–1440. https://doi.org/10.1111/j.1526-4610.2006.00585.x.
Hashemloo, Alireza, Mehlika Inanici, and Christopher Meek. “GlareShade: a visual comfort-based approach to occupant-centric shading systems.” *Journal of Building Performance Simulation* 9 (2016): 351–365. https://doi.org/10.1080/19401493.2015.1058421.
Hayne, Daniel P., and Martin, Paul R. “Relating Photophobia, Visual Aura, and Visual Triggers of Headache and Migraine.” *Headache: The Journal of Head and Face Pain* 59 (2019): 430–442.

https://doi.org/10.1111/head.13486.
Houser, Kevin W., Peter R. Boyce, Jamie M. Zeitzer, and Michael Herf. “Human-centric lighting: Myth, magic or metaphor?” *Lighting Research and Technology* 53 (2021): 97–118. doi: 10.1177/1477153520958448.
Imaizumi, Shu, Motoyasu Honma, Haruo Hibino, Shinichi Koyama, S. “Illusory visual motion stimulus elicits postural sway in migraine patients.” *Frontiers in psychology* 6, 542 (2015). https://doi.org/10.3389/fpsyg.2015.00542.
Juricevic, Igor, Leah Land, Arnold Wilkins, and Michael A. Webster. “Visual discomfort and natural image statistics.” *Perception* 39(7) (2010): 884–899. https://doi.org/10.1068/p6656.
Leonardi, Matilde, and Alberto Raggi. “A narrative review on the burden of migraine: when the burden is the impact on people’s life.” *The Journal of Headache and Pain* 20:41 (2019). https://doi.org/10.1186/s10194-019-0993-0.
MacGregor, Anne. *Migraine in Women* (2nd ed.). CRC Press, 2003. https://doi.org/10.3109/9780203427187.
Mahdavi, Ardeshir. “Steps to a General Theory of Habitability.” *Human Ecology Review* 5(1), (1998): 23–30. Accessed December 20, 2023. https://www.jstor.org/stable/24707103.
Mahić, Alen, Kiara Galicinao, and Kevin van den Wymelenberg. “A pilot daylighting field study: Testing the usefulness of laboratory-derived luminance-based metrics for building design and control.” *Building and Environment* 113, (2017): 78–91. https://doi.org/10.1016/j.buildenv.2016.11.024
Martin, Paul R. “Triggers of Primary Headaches: Issues and Pathways Forward.” *Headache* 60 (2020): 2495–2507. https://doi.org/10.1111/head.13901.
Parsaee, Mojtaba, Claude M. H. Demers, Jean-François Lalonde, André Potvin, Mehlika Inanici, and Marc Hébert. “Human-centric lighting performance of shading panels in architecture: A benchmarking study with lab scale physical models under real skies.” *Solar Energy* 204 (2020): 354–368. https://doi.org/10.1016/j.solener.2020.04.088.
Preiser, Wolfgang F. E. “The habitability framework: a conceptual approach towards linking human behaviour and physical environment.” Design Studies 4(2) (1983): 84–91. https://doi.org/10.1016/0142-694X(83)90038-8.
Preiser, Wolfgang F. E. and Koridon H. Smith. *Universal Design Handbook*. Second Edition. New York: McGraw Hill, 2010.
Roberts, Tristan. “We Spend 90% of Our Time Indoors. Says Who?.” *Building Green*, December 15, 2016. Accessed December 20, 2023. https://www.buildinggreen.com/blog/we-spend-90-our-time-indoors-says-who.
Sacks, Oliver. *Migraine*. Picador. 1970/1995.
Shepherd, Alex J., Trevor J. Hine, and Heidi M. Beaumont. “Headache.” *Headache: The Journal of Head and Face Pain* 53 (2013): 1087–1103. https://doi.org/10.1111/head.12062.
Sudershan, Amrit, Kanak Mahajan, Kuljeet Singh, Manoj K Dhar, and Parvinder Kumar. “The complexities of migraine: A debate among migraine researchers: A review.” *Clinical Neurology and Neurosurgery* 214: 107136 (2022). https://doi.org/10.1016/j.clineuro.2022.107136.
United Nations. “Sustainable Development Goals.” Accessed February 14, 2023. https://sdgs.un.org/goals.
Vurallı, Doğa, and Hayrunnisa Bolay. “Türkiye'de Kronik Migren Özellikleri ve Hastaya Yaklaşım.” *Turkiye Klinikleri J Neurol-Special Topics* 10(4) (2017): 347–52.
Vurallı, Doğa, Cenk Ayata, and Hayrunnisa Bolay. “Cognitive dysfunction and migraine.” *The Journal of Headache and Pain* 19, 109 (2018). https://doi.org/10.1186/s10194-018-0933-4.
Vurallı, Doğa, Funuzar Yildirim, Didem T. Akcali, Mustafa N. Ilhan, Nebil Goksu, and Hayrunnisa Bolay. “Visual and postural motion-evoked dizziness symptoms are predominant in vestibular migraine patients.” *Pain Medicine* 19(1) (2018): 178–183. https://doi.org/10.1093/pm/pnx182.
Wilkins, Arnold. J. “A physiological basis for visual discomfort: Application in lighting design.” *Lighting Research & Technology* 48 (2016): 44–54.
Wilkins, Arnold. J. “Fear of light: On the cause and remediation of photophobia.” *Lighting Research & Technology* 53 (2021): 395–404.
Wilkins, Arnold. J. “Visual stress: origins and treatment.” *CNS* 6, (2021): 74–86.
Wilkins, Arnold. J. “Visually-induced seizures.” *Progress in Neurobiology* 15 (1980): 85–117.
Wilkins, Arnold. J. *Visual Stress.* Oxford University Press: Oxford, UK, 1995.
Wilkins, Arnold. J., Ragini Patel, Peyman Adjamian, and Bruce Evans. “Tinted spectacles and visually sensitive migraine.” *Cephalalgia* 22 (2002): 711–719. https://doi.org/10.1046/j.1468-2982.2002.0036.
Wilkins, Arnold. J., Sarah M. Haigh, Omar A. Mahroo, and Gordon T. Plant. “Photophobia in migraine: A symptom cluster?” *Cephalalgia* 41 (2021): 1240–1248. https://doi.org/10.1177/03331024211014633