



Review

Brains in the city: Neurobiological effects of urbanization

Kelly G. Lambert^{a,*}, Randy J. Nelson^b, Tanja Jovanovic^c, Magdalena Cerdá^d^a Department of Psychology, Randolph–Macon College, Ashland, VA 23005, USA^b Department of Neuroscience, The Ohio State University Wexner Medical Center, Columbus, OH 43210, USA^c Department of Psychiatry & Behavioral Sciences, Emory University School of Medicine, Atlanta, GA 30303, USA^d Department of Epidemiology, Columbia University, New York, NY 10032, USA

ARTICLE INFO

Article history:

Received 8 October 2014

Received in revised form 27 March 2015

Accepted 22 April 2015

Available online 1 May 2015

Keywords:

Urbanization

Psychiatric illness

Natural environment

Light pollution

Depression

Socioeconomic disadvantage

Intercity violence

PTSD

Self-efficacy

Collective efficacy

Animal models

Agent-based models

ABSTRACT

With a majority of humans now living in cities, strategic research is necessary to elucidate the impact of this evolutionarily unfamiliar habitat on neural functions and well-being. In this review, both rodent and human models are considered in the evaluation of the changing physical and social landscapes associated with urban dwellings. Animal models assessing increased exposure to artificial physical elements characteristic of urban settings, as well as exposure to unnatural sources of light for extended durations, are reviewed. In both cases, increased biomarkers of mental illnesses such as major depression have been observed. Additionally, applied human research emphasizing the emotional impact of environmental threats associated with urban habitats is considered. Subjects evaluated in an inner-city hospital reveal the impact of combined specific genetic vulnerabilities and heightened stress responses in the expression of posttraumatic stress disorder. Finally, algorithm-based models of cities have been developed utilizing population-level analyses to identify risk factors for psychiatric illness. Although complex, the use of multiple research approaches, as described herein, results in an enhanced understanding of urbanization and its far-reaching effects – confirming the importance of continued research directed toward the identification of putative risk factors associated with psychiatric illness in urban settings.

© 2015 Elsevier Ltd. All rights reserved.

Contents

1. Introductory comments	108
2. The effects of natural and artificial habitats on environmental engagement and emotional resilience	108
2.1. The neural impact of qualitatively different environments	108
2.2. Urban and rural environmental influences	109
2.3. Environmental engagement, contingency building and emotional resilience	110
2.4. Conclusion	111
3. Effects of light pollution on neuroinflammation and mood	111
3.1. Light at night	111
3.2. Effects of light at night on humans	111
3.3. Effects of light at night on nonhuman animals	112
3.4. Conclusion	113
4. Violence in the city: biomarkers in children and adults	113
4.1. Brain response to fear	114
4.2. Fear conditioning	114
4.3. Biomarkers of fear in children	114

* Corresponding author at: Department of Psychology, Copley Science Center Rm. 134B, Randolph–Macon College, Ashland, VA 23005, USA. Tel.: +1 804 752 4717; fax: +1 804 752 4724.

E-mail address: klambert@rmc.edu (K.G. Lambert).

4.4.	Transgenerational effects.....	115
4.5.	Conclusion.....	115
5.	Translating animal research to humans: a population-level lens on the urban environment and brain disorders.....	115
5.1.	Population-level patterns of brain disorders in urban vs. rural environments.....	115
5.2.	How can the urban environment shape mood and anxiety disorders?.....	115
5.3.	The next step: generating effective intervention strategies.....	116
5.4.	Using complex systems approaches to identify promising intervention strategies in urban neighborhoods.....	116
5.5.	Conclusion.....	118
6.	Concluding remarks.....	118
	Acknowledgements.....	118
	References.....	118

1. Introductory comments

Humans have the ability to exist in a broad range of environments, demonstrating that they can survive by hunting and fishing in the Arctic, foraging on the African savanna, or living in urban habitats (Laland and Brown, 2006a,b). For the first time in human history, the majority of the world's population lives in urban areas. One hundred years ago, 20% of people lived in urban areas; by 2010, more than 50% of the global population lived in a city. By 2050, it is estimated that 70% of people will live in urban areas (World Health Organization, 2010). In the United States and Canada, for example, 80% of the population lives in urban dwellings (UN-DESA, 2011; Schewenius et al., 2014).

As urban environments represent a divergence from the ancestral habitats of both humans and nonhuman animals, the neurobiological impact of the transition to city living should be carefully examined. E.O. Wilson's *biophilia hypothesis* posits the importance of the natural environment, including flora, fauna, weather conditions, and other variables contributing to individuals' surroundings. Considering the evolutionary importance of species maintaining close ties to the environment in order to acquire life-sustaining resources, there is little doubt that natural environments influenced the evolution of various neural functions ranging from learning to emotional responses (Wilson, 1984, 1993). Given that modern species have retained their ancestral brains, it is interesting to consider the impact of transitioning to new habitats such as urban dwellings over the course of just a few generations (Maller et al., 2005; Fawcett and Gullone, 2001). The identification of health-related urbanization trends is necessary to inform science-based policies for generating urban landscapes consistent with well-being and decreased susceptibility for psychiatric illness (Schewenius et al., 2014).

Whereas urban dwellings can provide a healthy living environment with enhanced access to important medical, recreational and cultural services and opportunities, urban environments also present disproportionate health challenges to certain components of the socioeconomic strata (World Health Organization, 2010; Anakwenze and Zuberi, 2013). Research suggests that urban living is associated with higher rates of psychiatric disorders, with rates as much as 30% higher for conditions such as mood disorders (Peen et al., 2009). The features of the urban environment that shape mental health, and the neurobiological mechanisms through which the urban environment may affect mental health are yet to be definitively determined; however, research has identified several macro-level (i.e., at the level of urban neighborhoods) and micro-level (i.e., within individuals) factors that deserved further investigation. In the current review, these macro- and micro-level factors and their potential impact on emotional well-being are considered from the perspectives of the fields of neuroscience and epidemiology. Starting with a focus on neurobiological mechanisms, animal models designed to evaluate the impact of specific elements of the physical surroundings

(i.e., natural vs. artificial elements), as well as the impact of increased exposure to artificial lights, will be considered. Then focusing exclusively on humans, the influence of urban sources of stress and specific genetic vulnerabilities in the development of psychiatric disorders such as posttraumatic stress disorder is reviewed. Finally, a population-level overview is provided of the types of macro-level features in the urban environment that can shape mental health, and current epidemiological strategies such as complex systems computational approaches to identify predictive factors of urban-based psychiatric illness are introduced. A consideration of such diverse data is necessary to move from the existing associational assumptions in this literature to eventual determination of more specific assumptions of causal inference (Pearl, 2009). Thus, these varied approaches are necessary to generate informed views about short- and long-term neurobiological effects of urbanization.

2. The effects of natural and artificial habitats on environmental engagement and emotional resilience

Evolutionary processes have led to animals with varying behavioral repertoires ranging from stereotyped, hard-wired responses to less prescribed, flexible behaviors. With postnatal care and the transfer of learned information occurring in warm-blooded animals, more flexible responses have emerged to facilitate the animal's requisite adaptive interactions with its frequently changing environment (Varki et al., 2008). Consequently, the importance of environmental context is considered critical in the development of neural functions; in fact, research in the field of artificial intelligence has also identified the essential role of environmental influence in the development of computer-based networks simulating mammalian CNS functions (Maniadakis and Trahanias, 2006). Thus, it is becoming increasingly clear that, in order to thoroughly understand the functions of the brain (both natural and artificial models), a clear understanding of the environment in which it operates is necessary. As various mammals have adopted habitats that differ from their ancestral ecosystems (e.g., humans transitioning to urban settings), the characteristics of environmental surroundings have been altered along several dimensions. These environmental modifications have undoubtedly impacted the neural systems of animals inhabiting evolutionarily unfamiliar terrains. In this section of the review, the potential impact of these environmental changes on neural and behavioral responses related to mental health and emotional resilience will be evaluated.

2.1. The neural impact of qualitatively different environments

At the turn of the 20th century, pioneering psychologist James Mark Baldwin emphasized the influential role of the environment in the acquisition of learned adaptations throughout an individual's life (Baldwin, 1896). Further, the more recent

Download English Version:

<https://daneshyari.com/en/article/937531>

Download Persian Version:

<https://daneshyari.com/article/937531>

[Daneshyari.com](https://daneshyari.com)