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Re-Imaging the Future in Urban Studies and Built Environment Discourse: A Neurourbanism Perspective

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Abstract: Neurological constructs are being applied in various fields; within urban studies and built environments, neurourbanism stands out. To understand this concept, this study seeks to conduct a scientometric analysis of the concept of neurourbanism. To do so, we gauged the intellectual structure and clarified the influencers and emerging themes while seeking to identify essential gaps in neurourbanism research in urban studies and the built environment. Data were sorted from Dimensions Artificial Intelligence platform because of its reliability in providing the needed dataset accurately, and the Citespace software was used to analyze the data. Our results suggest plurality in explaining the risk factors in urbanicity research, particularly regarding prevalence, incidence, and the general cause of psychosis in urban living. The study also shows that players in the construction sector, such as engineers, town planners, and developers, have not fully grasped how the built environment assists in improving well-being, reducing stress levels of urbanists, assisting migrants in settling into the community, and the general mental wellness of those who live in the city. The study also identified a correlation between urbanization and mental health and added that the main recipient of rapid urban transformation countries does not show leadership in neurourbanism studies.

Keywords: COVID-19; mental health; migration; neurourbanism; psychosis; schizophrenia; urban stress; urbanicity; urbanization

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1. Introduction

Several urban centers in the North and South are challenged by wicked problems requiring urgent solutions [1]. Issues of urban design, greenovation, mental health, migration, relics of the COVID-19 pandemic, urban infrastructure, and urban stress are now commonplace in the urbanization discourse. To infuse these complex solutions within a theoretical concept, the notion of neurourbanism was birthed as a bridge towards the oneness of brain functionality and environmental management research in urbanicity [2].

Neurourbanism is a field of growing interest in several disciplines [2]. Within such disciplines as psychology, sociology, environment and conversation, and psychiatry, it is generating traction for research on wellbeing, life expectancy, mental health, stress, and migration [3]. Due to the entry of different scholars from different backgrounds into research on neurourbanism, conceptual clarification, definitional premise, and theoretical postulation are classically discipline-specific. Furthermore, another encumbrance surrounding neurourbanism in recent times is the dearth of systematization of literature to uncover the impact, reach, and implications of neurourbanism research, particularly within urban studies and built environments. With research linking greenovation to well-being and biophilia to life expectancy, the challenge for urban centers that are digital or smart savvy is much more complex, as they require an ardent rethink.

The definition surrounding neurourbanism is usually demarcated into 'neuro' and 'urbanism' [2], with 'neuro' being about brain research, brain structure, and brain functionality, and 'urbanism' deals with systematic planning and development of towns and cities [3]. Therefore, to comprehend this complex field, a combination of the views of scholars in the built environment, urban planning and development, psychology, and healthcare are critical for demystifying the complexities of neurourbanism. Combining the definitions earlier provided of 'neuro' and 'urbanism', one could infer that neurourbanism is a field dealing with the relationship between planning, development, and brain synergy with infrastructures in cities and towns.

Despite the simplicity of the definition provided above, we acknowledge that there exist theoretical debates, including definitional and conceptual imbalances and misapplications of the notion of urbanization. As such, urban research is challenged by multiple realities, requiring quick solutions. Some of the more prevalent issues in urban studies in the 21st century include mental health, urban stress, urban dynamics, urban environment, network interconnectedness and disruption, implementation and adaptability of smart technologies, and migration [4]. The uncertainty about what the future of urban centers holds fuels some level of confusion, which heightens urban stress, anxiety, paranoia, and schizophrenia [5]. These linkages between fears (uncertainty), built environment, planning and design, and technology have an impact on the mental reproduction of the urban populace. Moreover, urban stress, urban well-being, choice of migrant settlement city, and urban health in urban living is, as a result, research on neurourbanism, which categorizes placement for urban living.

Despite the rise in application of the concept 'neuro' in several fields of research, scholars in urban development, infrastructural studies, real estate development, and portfolio management, as well as practitioners, such as town and city planners, developers, and built environmentalist in urban affairs, are unaware or bereft of the notion of how their construction and or their building processes impact mental health, increases urban stress and causes hallucination and paranoia, and also puts pressure on new migrants, particularly of a different language and culture.

The fortitude knowledge of the interaction between mental wealth and architectural designs is sparse among city planners, architects, built environmentalists, and developers. Thus, further exploration is necessary to test what we know about neurourbanism and to ponder on the future of what is yet to discover. For this and subsequent reasons argued earlier, the study perceives that starting with a knowledge structure about neurourbanism within urban studies and built environment provides a baseline to ascertain and develop clearer thoughts for advancing research in urbanism research. For the purpose of clarity, knowledge or intellectual structure is a unified, solid body of facts on a particular subject matter. It can also comprise linkages between the concept and other concepts by a labeled association. It can also be a complex concept/construct with interconnected labels for achieving a topic or debate. Thus, in this paper, we examine the intellectual structure of neurourbanism to gauge past literature, the current situation, and what the future holds for neuroscientific application in urban development. Therefore, the broad aim of this research is to scientifically develop and analyze the trends and dynamics of publication on neurourbanism research. In exploring neurourbanism within the context of neuroarchitecture or neuroinfrastructure in urban centers. Based on the narrative pursued in this discourse, the study perceives neurourbanism as that aspect of neurosciences or architectural sciences that encompasses the relationship between brain functionality and the built environment in urban living. We put out two key objectives:

1. Identify, develop, and analyze some of the emerging themes in neurourbanism research.
    a. Determine key emerging frontiers and influencers in neurourbanism research (authors, countries, and journals).
    b. Build themes that assist in identifying gaps in neurourbanism research in urban studies and the built environment.

2. Identify gaps and challenges in neurourbanism within neurourbanism themes.

To provide evidence for these objectives, this research paper is structured as follows: the literature review comes next, discussing neurourbanism features, the psychology of urban living, and the drivers of urbanization. Following the review, the method of data mining is outlined, demonstrating how the data were collected from Dimensions before the analytical tool was used. Next, the results section provides answers to the research objectives, outlines key aspects of the findings, and finishes with a discussion and conclusion section. The final conclusions provide theoretical information that may be helpful in a change in thinking about neurourbanism; before any of these can commence, the literature review takes center stage.

2. Theoretical Framework

The main aim of neurourbanism is to create a balance between the environment and human cognition. Recounting how to exploit city developers' creativity to effectively build structures that enhance or stimulate positive brain activity in urbanicity is at the epicenter of neurourbanism. Within cognitive urbanization philosophy, the inkling is to empower and embolden developers and city planners to strategically assist builders in constructing infrastructure that may improve the quality of life and life span of city dwellers [6]. Within health, psychiatry, epidemiology, and psychology research, there exists a large body of work on neurourbanism [2,4,5,7], without interaction with or coordination by scholars in urban studies, engineering or built environment. Ordinary, this should not generate concern; at the least, it should be welcomed development. However, the fact that city studies and urban affairs are within the disciplinary context of urban studies, human settlement, architectural science, and built environment. Their non-reflection of the issue of neurourbanism as high priority research area in building the city of the future is of concern because practitioners in building the city of the future depend on academic scholars within their network for advancement in their field rather than seek guidance from scholars from another field. In that, urban studies and allied fields should have served as the unifier of different epistemic discussions, i.e., from epidemiology, health, psychiatry, and psychology concerning neurourbanism.

Buttazzoni, Doherty, et al., in conceptually framing neurourbanism, argued that the intersection between planning and public health is neurourbanism (see Figure 1) [7]. The nucleus of the conceptual framework involves genetics, cognitive abilities, mental health, perception, age, and gender. In providing a revolutionary perception to gauging the conceptual framework, Buttazzoni, Doherty, et al. fragmented into interpersonal, environmental, policy/community, and digital or social media niche areas, where the design of the buildings, care for the vulnerable groups, social cohesion, and interaction are nurtured, while social fragmentation of development is opposed, and migrant integration is considered imperative for enhancing mental health issues in urban centers [7].

Psychotic disorders, such as anxiety, stress, and paranoia, are much more in urban than rural settings. Some of the reasons why more people are urban centers suffer from anxiety and paranoia than those in rural areas is the prevalence of high-storey residential and commercial buildings compared to the structures of housing in a rural neighborhood. Additionally, issues of biophobia or greenphobia are of great concern in urban development and the built environment. Because greenovation and biophilia are considered some of the unique techniques for promoting the future of city lifestyle, but with limited scholars and research in urban studies concerned with neurourbanism, we may never know what these outcomes would be and how they will affect the plans and designs of future cities.

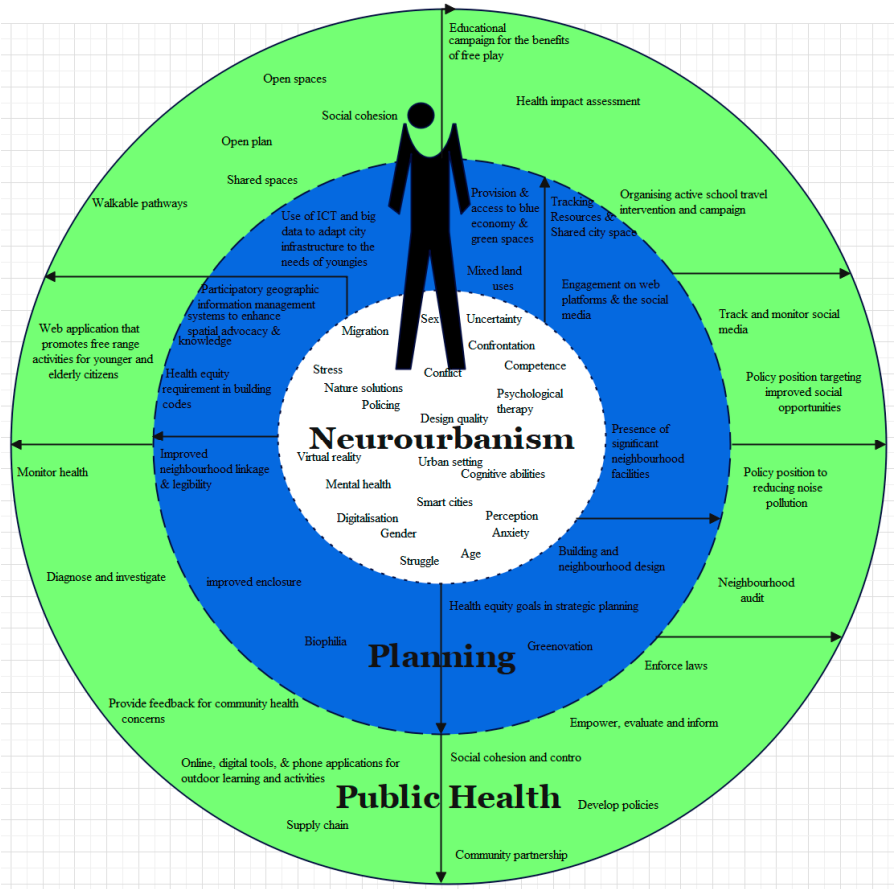

Figure 1. Dimensions of neurourbanism. Source: Adopted from Buttazzoni, Doherty, et al., 2021 [7].

2.1. Psychology of Urban Living and the Twin Step Approach in Urbanisation

Literature from the psychology of urban living and environment (particularly greenovation) increasingly discusses the idea of neurourbanism within the context of neuroscience. Neurourbanism is the application of neuroscientific methodologies to solve challenges related to urban development or to understand the complex discourses revolving around brain functionality and health in urbanicity. Urbanization is considered a multidimensional technique used to promote the development of urban centers [8], and at the same time, an interdisciplinary field of study [9], concerned with the future mediating effects in the complex interplay between brain activity and urban living.

As a technique, urbanization is perceived as a measure used to determine how society transforms, typically from rural (social, economic, cultural, and lifestyle) to urban centers. As a field of study in the 21st century, urbanization is an arm of geography or urban studies concerned with social transformation and smart innovations of the modern age, driven by a multiplicity of factors, which may include economic, social, and environmental variables [10]. Basyal and Khanal, in providing context for urbanization as a discipline, argue that urban centers are not characterized by agricultural dominance, are dependent on industrialization, infrastructural and physical development within cities, an act understood with the index of modernization [11–13].

2.2. Drivers of Urbanisation

Several features play a critical factor in removing individuals from their place of rest or birth to another. While many are based on opportunities, others are based on circumstance. For instance, a movement for economic gain, social status, health, and financial security may be considered opportunity driven. However, in cases of war, conflict, and environmental disaster, such population movement is shaped by circumstance, and the treatment meted

out to migrants of war should be that of empathy than sympathy, but obviously, this has not been the case.

The rise in rural-urban migration [14] is predicated on many factors, such as environmental degradation [15], educational preference, and economic development [16], and infrastructural decay and heightened unemployment rates amongst rural dwellers [17]. Figure S1 demonstrates the growth trajectory, which depicts that in less than 45 years, the population in urban centers grew from approximately 1 billion in 1960 to exceeding the rural population by 2006, and by 2017, the urban population exceeded 4 billion [18]. Thus, conversations surrounding the multiplicity of effects created by the impact of urbanization are gaining momentum. One of them is the depleting reserve of fresh water, which challenges or is a threat to achieving Goal 7B and 7C of the SDGs, which deals with clean water. Other studies, such as those of Hawksworth and Bull, as well as Sahney, Benton, and Ferry, consider that urbanization has a major impact on global warming and the reduction in biodiversity and natural resources that threatens human movement and survival [19,20].

2.3. Challenges of Neurourbanism in Urbanisation and Urban Living

Emerging environmental challenges, such as habitat fragmentation [21], may result in habitat loss [22]. Fahrig has established that habitat destruction and terrestrial biodiversity are complex problems in environmental discourse [23,24]. These challenges suggest a threat to urban environments, where a correlation already exists between urban environment and physical health [25], and urban environment and wellbeing [25,26]. That the urban environmental impacts both health and well-being is often conceptualized within urbanicity discourse [25]. However, when these challenges of physical health and well-being are restricted or reframed due to city developers constructing clustered buildings without necessarily providing for parks, tracks, and an environmentally green atmosphere. This may create a deeper problem for urban living, which may involve less movement of individuals, thereby increasing the chances of obesity due to the inability of city dwellers to explore tracks and parks.

Urbanicity refers to the quality and impact of living in urban centers [5,26]. The concept of urbanicity deals with the entire gamut of human existence in urban areas and, therefore, can be seen to tie to mental health [27]. Living in an urban environment has an association with an elevated prevalence of stress and anxiety-related disorders [28]. This elevation is influenced by a myriad of factors, including gender, age, sex, culture, age, peace, conflict, or whether the surveyed population lives in a developing country or a developed country [29]. Stress and anxiety are also influenced by brain functionality in urban areas [30,31], although in urban studies, this commonality has not been established.

Previous research regarding neuroscience and architecture is also sparse [32,33]. Some studies have investigated how the built environment impacts residents' emotions and well-being [34]. Notwithstanding a rise in research publications on conscious city life and urbanization in urban studies [35,36], residents' emotions are tied to the prognoses of the mind and the brain. Redish noted that such emotions have an undue implication on human choices regarding where we live, work, and raise a family [37].

3. Materials and Methods

The study utilized scientometric analysis to generate datasets for this study. It synchronized scholarly research literature and findings with the keyword "neurourbanism" in full data [38]. Data for generating the intellectual architecture for neurourbanism were exported from www.dimensions.ai on 30 August 2021.

Digital Science & Research Solutions Inc. (Henderson, NV, USA, 2021) Dimensions has proven to be more useful in generating scientometric analysis, hence our adoption of this initiative for data collection [39,40]. Dimensions use custom applications that integrate easily with other local systems. According to Orduña-Malea and López-Cózar, Dimensions is an innovative bibliometric dataset [41], and to Herzog and Lunn, the novelty of Dimensions is its undervalued content types [39], such as grants, clinical trials with

publication, patents, and citation counts and year trends as represented on the interface or dashboard [38].

3.1. Data Search

In data gathering, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) logic has become the appropriate or mostly used method [42] (See Figure 1) for gauging research papers, building research pyramids, and identifying research trends was adopted [43]. See Figure S2 below for how data collected for neurourbanism research were collected in Dimensions. The search term for this research was limited to neurourbanism as there is no clear similar for the concept. Other concepts relating to neurourbanism may include neurourbanistik and neurourbanistic, where neurourbanistic returned similar research papers with neurourbanism, neurourbanistik seem to be German, and since the researchers are limited to English research papers, those were therefore not included in our search parameters for engaging the research. Although concepts such as cognitive health in urban studies are considered related, they do not encapsulate the entire body of what neurourbanism represents.

3.2. Data Selection Using PRISMA

The PRISMA approach identified three major steps in data collection and reporting; the first focuses on the number of databases or registries used in data collection and the number of exclusions resulting from duplication. The initial search for this paper produced 105 research materials, including articles, book chapters, and monographs in the Dimension Artificial Intelligence digital platform. We utilize only the Dimension interface because it is the most reliable and accurate of several databases. From the 105 research materials identified, 7 research papers were flagged as having been duplicated.

The second step is the screening process; due to the deductions from the duplicates, the screened value was 98 research materials. From the 98 research papers, year limitation and publication type limitation brought the figure to 58 research papers.

The third step is the number of research papers includes, and for this paper, the total sum of papers under review is 58 (see Figure S2).

After gathering the data, we utilized Citespace software package 5.8.R1 to analyze the generated results from PRISMA. Citespace is a software used to construct scholarly network connections between variables [44–55] (see in Text S1). Citespace deals with homogeneity, precprecision, and connectivity of clusters [45], in constructing its conceptual and structural metrics. Chen, the developer of the software, argued that while the conceptual metrics are the visual illustration of the input, the structural metrics deal with the following: betweenness centrality, modularity Q, and silhouette score [46].

Betweenness centrality measures the degree of a node to another [47,48]. As Golbeck explains, this measurement determines the flow of information throughout a network cluster [49]. The higher the centrality index, the chance of a stronger association. Blondel, Guillaume, Lambiotte, and Lefebvre argued that modularity Q gives credence to the measure of how relevant a cluster is in a network analysis or community structure [50]. The modularity Q test is insightful in identifying communities in networks since there are different properties, such as clustering coefficient, centrality, node degree, and betweenness [51], from an average node. For instance, a modularity Q of 0.7141 exhibits a high or lower than 5 may be too low [46]. The silhouette coefficient is a system of measurement for calculating the goodness of the clusters. The coefficient's value ranges between -1 and 1, with 1 being the highest and -1 the lowest [52]. Chen states that a figure of 0.3 is low and may not be significant but that 0.5 is homogenous in character [46].

Citespace maps the conceptual metrics of keywords based on themes by using two methods: LLR (Locally Linear Regression): Locally Linear Regression and TFIDF (Term Frequency Inverse Document Frequency): Term Frequency-Inverse Document Frequency. Newey demonstrates that LLR is a much more reliable statistical measurement tool compared to kernel regression [53]. LLR uses locally fitting lines rather than a constant and has

a lesser tendency for bias, particularly when the model is linear. In statistical analysis, the LLR test is utilized for comparing good of fit between two statistical nodes. In this case, it compares the TFIDF, mutual information (MI), and cluster labels (USR) to generate the LLR. According to Shi and Liu, LLR can be used to estimate the *p*-value or in comparison to a critical value, to either accept or reject the null hypothesis [54]. According to Havrlant and Kreinovich, tf-idf is a commonly used method for keyword detection [55].

4. Discussion

4.1. Bibliometric Analysis

The results generated from using the Citespace mapping developed eight themes: from #0 to #7. In CiteSpace, values of importance are presented in ascending order, with #0 being the most impactful and #7 being the least most impactful theme/cluster. The themes generated for this study include (#0) mental health/understanding mental health, (#1) urban China/migrant population, (#2) clinical staging/recent literature, (#3) urban environment/neuroscientific research, (#4) COVID-19 pandemic/COVID-19 pandemic, (#5) urban stress/urban stress, (#6) dynamic urban environment/dynamic urban environment, and (#7) neurourbanistik/neurourbanistik (translated to neurourbanistic or neurourbanism) for neurourbanism research.

As a way of sorting the data for further investigation, the research gathered the most impactful themes based on the research objectives and guided by the title of the research to select the following clusters: (#0) mental health/understanding mental health, (#1) urban China/migrant population, (#4) COVID-19 pandemic, and (#5) urban stress. (#2) clinical staging/recent literature, and (#3) urban environment/neuroscientific research was not considered because #2 deals with clinical staging, which is within psychology, epidemiology, and psychiatry. Neuroscientific methods are not the core of this research. Thus, the more prominent clusters of mental health, migrant population, COVID-19 pandemic, and urban stress, as these are most relevant to provide answers to the aims of the research (See Test S2 in Supplementary) [2,5,56–73].

4.1.1. Trends in Published Research Papers on Neurourbanism (by Citation)

The concept of neurourbanism (brain activity related to urbanization) was first implied in Southworth's (1967) research on 'Signs and Lights' at the Massachusetts Institute of Technology (see Figure 2). The psychological experiments in Southworth's (1967) study published in Environment and Behavior reverberated the debate concerning visuality and sounds in city planning and design, specifically dealing with sensory awareness in providing a responsive city for the blind and the deaf in the community. Southworth (1967) was among the foremost researcher to draw on the notion of neurourbanism, with reference to what we have identified as cluster #1, which deals with urban China/urban migration. Despite publications on neurourbanism being visible from the late 1960s, mental health issues only emerged in 2004, and since then, there has been an uptake in neurourbanism research (see Figure 1). According to Sundquist (2004), who surveyed approximately 4.4 million people/records in Sweden, established that an increase in urban population has a strong correlation with increase in the risk of depression and psychosis for both men and women, but more for men than the women because men are more likely to develop depression and psychotic behavior faster than women.

By 2010, the amount of nature required in urban centers had become a theme in the literature [74]. In the same year, Kelly et al., established Schizophrenia to be more prevalent amongst urban dwellers when compared to rural areas [75], and a meta-analysis conducted by Vassos, Pedersen, Murray, Collier, and Lewis [57], affirmed urbanicity as a risk factor for the rise in Schizophrenic cases in urban areas. According to Aspinall, Mavros, Coyne, and Roe [59], urban upbringing among male children is more likely to be associated with Schizophrenic tendencies. Zammit et al. also argue that social fragmentation [76], neighborhood effect, and deprivation in city life may explain the toxic relation between urbanicity and psychosis at an individual level [57]. Furthermore, Freeman et al. (2015)

found that a rise in paranoia, anxiety, voices, and general negative beliefs about oneself and others is strongly associated with street exposure and urban stress. However, we need to also note that certain factors unrelated to urban stress may act as triggers to paranoia, such as lack of social support, physical attack, and memory impairment attack [48].

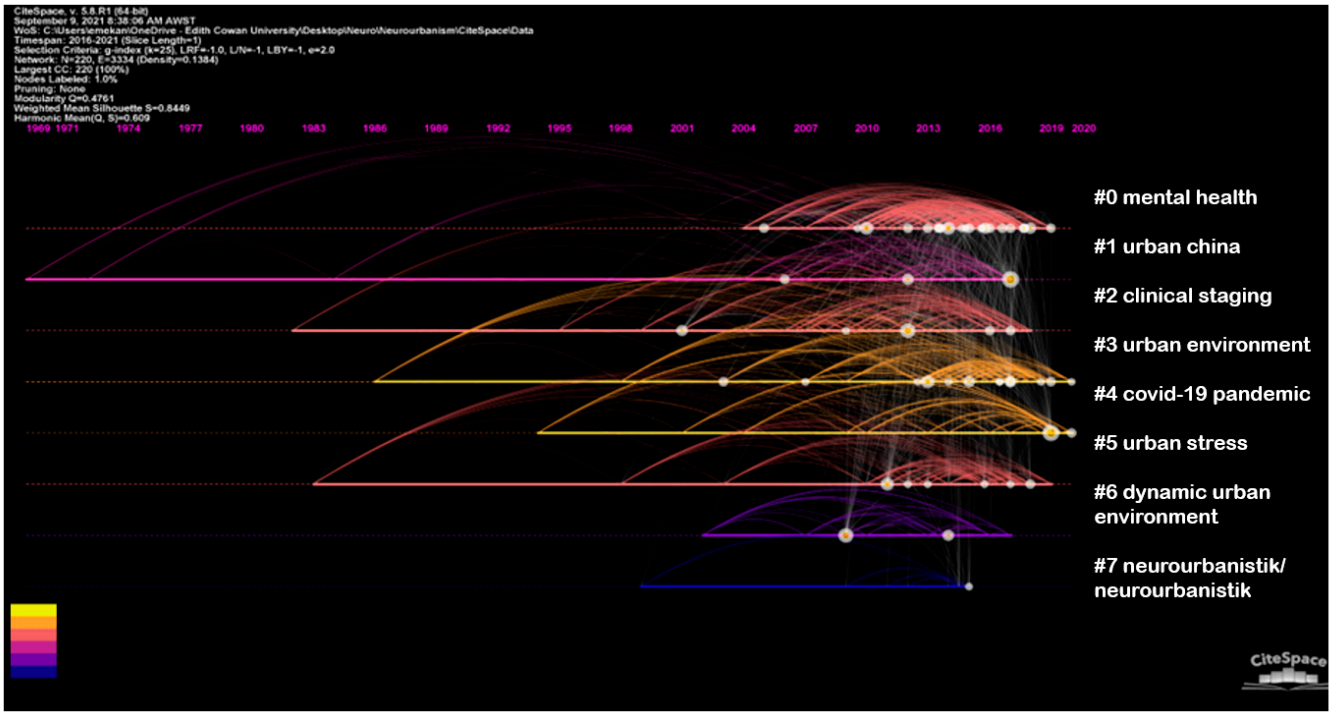

Figure 2. Visualization of the document co-citation network publication timelines and spotlight (Modularity Q = 0.4761; Average silhouette score = 0.8449 (Q, S = 0.609).

In 2015, one of the first studies on mobile phone usage as a neuroscientific method for the treatment of mental disorders was introduced in neurourbanism discourse. Gravenhorst et al., explored how this human-computer interface may act as a support therapy for patients suffering from mood disorders, such as bipolar disorder or depression [62]. This result demonstrates that mental health challenges can be effectively treated if carefully monitored and given the right medication or environment. For example, innovation such as mobile phone usage is creating new opportunities for cheaper healthcare through apps. However, this challenge is not limited to a deficit in collaboration among technological specialists, but also teamwork is required between researchers, politicians, medical staff, large pharmacology companies, and commercial and private healthcare institutions [62].

In 2017, the first journal publication calling for neurourbanism to be seen as a separate discipline was published [2], Adli et al., showed interdependencies between city life and mental health [2], while Fett et al. research assisted in providing links between neurourbanism, urbanicity, and psychosis.

City dwellers have advantages over rural areas regarding healthcare systems, access to professional therapists and psychotherapists, and their proximity to pharmacies and hospitals [2], Despite this, Adli et al., noted that city dwellers have a 38% more chance of developing a mental disorder, a 21% greater chance of anxiety disorders, and 39% of affective disorders [2]. A study published in 2021 demonstrates the relationship between youth, mental health, public healthcare, planning, and neurourbanism [7], including the effects of mental health implications on urbanicity about mobile technologies and neuroscientific approaches [7]. While Ilieva and McPhearson demonstrated the need for collaboration between public health and city developers, they also argue that data from social media and geolocations may be utilized to assess young people's physical activities [77].

4.1.2. Establishing Dimensions, Themes, and Gaps in Neurourbanism Discourse

In the preceding discussion on trends, the section demonstrates how research within neurourbanism developed and the usage of mobile phones for the treatment of the mental disorder. This section will indicate the top themes in relation to themes association with other concepts, the structural metric (silhouette value), most active citers, and journal title and source. As mentioned earlier and seen in Figure 3, there are eight clusters, but the study will only present three of these clusters based on the aforementioned.

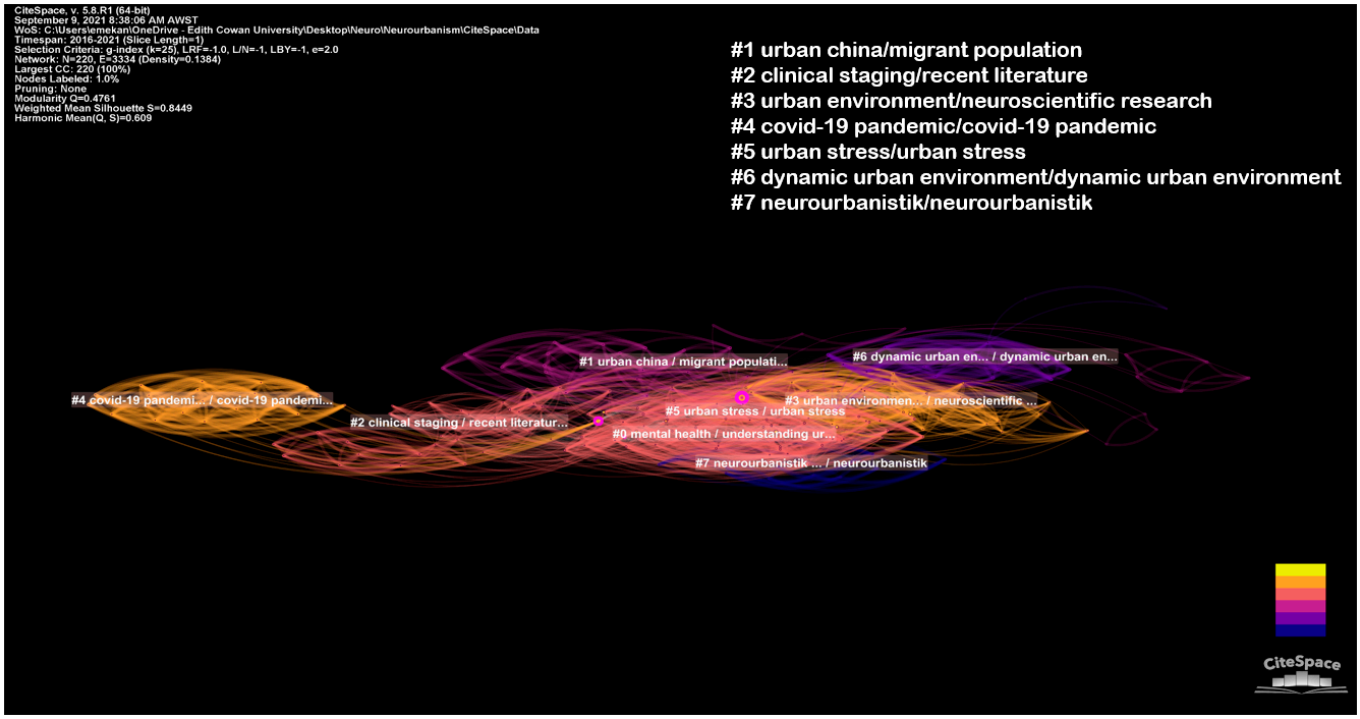

Figure 3. Visualization of the document co-citation network by themes (Modularity Q = 0.4761; Average silhouette score = 0.8382 (Q, S = 0.6073).

In this study, attention is given to the first three clusters, based on the Citespace analysis provided on the most active citers and clusters. The largest cluster (#0) has 45 members and a silhouette value of 0.704. The major tenets of the label concern understanding of how urbanicity, mental health, and familial liability interact (0.81); influence auditory (0.81); verbal hallucination (0.81); first-episode schizophrenia patient (0.81); Medan city Indonesia (0.8). The most active citer to the cluster is Krabbendam, Lydia Understanding urbanicity [27]: Psychological Medicine. Krabbendam et al. appear to be the most impactful paper in the cluster on mental health [27]. This review paper represents a fragmented discussion about the application of neuroscientific practices in various academic disciplines, such as epidemiology, population-based studies, experimental and experience-based research initiatives, built environment and urban studies, and neuroscience. The preceding statement confirms the application of tenets of life science in social sciences, but research has shown its limited scope with the built environment and urban studies. This is one of the studies that seek to understand the neuroscientific application in urban development from the urban study perspective because while urban stress is on the rise due to friction in satisfying urban needs because of both population growth and population density.

The second largest cluster (#1) has 35 members and a silhouette value of 0.91. Migrant population, video ethnography (0.78), and new tool (0.78), among others, are some of the key members of mental health. Baumann, Philipp (2019.0) Urban remediation: Social Psychiatry and Psychiatric Epidemiology, is the most active citer to the cluster at 1350. Baumann et al. argue that since psychosis is a factor of urban living, new methodologies

are required to enhance urban wellness in cities [78]. The authors further demonstrate that the dose-effect relations (number of years lived in childhood before one can develop psychosis—10 and 15) [68,79], the physical urban factors (which include pollution or lack of green spaces and urban design) and the social urban factors (such as neighborhood deprivation, cannabis exposure, ethnic density 'identity', social capital, migration, and social defeat) [70,80] may cause stress and trigger certain brain activity that may result in hallucination and other forms of disorder, such as anxiety and mood swings. Interestingly, our report generated the demographic at the center of migration, China. Gong et al. concur with dose-effect assumption that "China has seen the largest human migration in history and the country's rapid urbanization [66]". As Gong et al. point out, the urban population in China over the last three decades has tripled [67].

The third largest cluster (#2) in this study has 33 members and a silhouette value of 0.768. Recent literature, clinical staging, and urban wilderness (0.08) are some of the relevant debates within the cluster. The most active citer to the cluster is Fett, Anne-Kathrin [5] Psychosis and urbanicity: a review of the recent literature from epidemiology to neurourbanism. Current Opinion in Psychiatry, it is not surprising that the top three more impactful themes in this discourse were published between 2019 and 2020 because the idea that neuroscience and urban discourse can mix have received far less attention and sponsorship until the emergence of the science of cities discourse [4].

Key Institutional and Country Frontier in Neurourbanism by Publication

Based on the data, the top 5 cited sources by centrality include The Lancet Psychiatry (0.13), followed by Nature with a 0.09 centrality score, and the other journals that had reasonable citation were Plos ONE (0.08), International Journal of Environmental Research and Public Health (0.05) and Health & Place, Schizophrenia Bulletin, and Jama Psychiatry (0.05), respectively. Importantly, the publication year, which demonstrates the timeliness of this research, suggests that impactful studies on neurourbanism were promising but novel during 2016–2020; this shows that Southworth's research over 49 years ago on sounds and signs is becoming important research niche areas in the millennium.

Table 1 further reveals the lack of research on neurourbanism in the following fields of study: Urban Studies, Build Environment, Human Settlement, Earth Science, and Studies in Human Society and Social Sciences. With psychologists and psychiatrists at the forefront of research on neurourbanism, city developers and town planners who are informed by urban studies researchers may miss a significant opportunity to address some of the major challenges confronting urbanicity.

While three of the top five journals: The *Lancet Psychiatry, Nature, and Health & Place* publication, were generalistic 'reviews' on a given situation, the other two published one in the United States (PloS ONE) and the other about Switzerland in *International Journal of Environmental Research and Public Health*.

Based on Figure S3, which exhibited the element of the most impactful research institution in neurourbanism in urban studies and built environment, the University of Waterloo, University of Birmingham, and King's College London appear as the leading institutions of reckon for neurourbanism research (see Figure S3).

Figure S4 deals with countries which had embraced neurourbanism research; the United Kingdom, Germany, Canada, the United States, and Australia are the dominant five where research on neurourbanism research is conducted. To buttress the point made here in Figure S4, Table S2 provides a clearer picture of the institutions and their counts in the study of neurourbanism.

Interestingly, the evidence suggests that while urbanization and neurourbanism are of greater consequence for developing countries, scholars from these regions are absent from the scholarly debate on shaping the neurourbanism element, as well as being able to her perception from her point of view. Nonetheless, Malaysia, India, Estonia, Tunisia, and South Africa have been providing conceptual feedback but lacking empirical discussion (see Table S2).

Table 1. Top 20 cited sources (by centrality).

Count	Centrality	Year	Cited Source
36	**0.13**	2017	The Lancet Psychiatry
29	**0.09**	2016	Nature
29	**0.08**	2016	PloS ONE
29	**0.05**	2017	International Journal of Environmental Research and Public Health
26	**0.05**	2017	Health & Place
28	**0.05**	2016	Schizophrenia Bulletin
25	**0.05**	2016	Jama Psychiatry
21	**0.04**	2018	Landscape and Urban Planning
15	**0.04**	2018	Environment and Behavior
13	**0.03**	2018	Journal of Environmental Psychology
23	**0.03**	2017	Social Science & Medicine
11	**0.03**	2017	Urban Studies
20	**0.03**	2016	World Psychiatry
18	**0.03**	2016	Acta Psychiatrica Scandinavica
13	**0.02**	2020	Environment International
25	**0.02**	2019	Current Opinion in Psychiatry
20	**0.02**	2019	Psychological Medicine
18	**0.02**	2019	Proceedings of the National Academy of Sciences of the United States of America
14	**0.02**	2019	Urban Forestry & Urban Greening
14	**0.02**	2019	Science

4.2. Content Analysis

Our study demonstrates that the drivers for rural-urban migration may include education, wealth, health, social stimuli, culture, participation, and personal growth. However, it is threatened by the level of competition, confrontation, and conflict found in urban centers, compared to rural settings.

Figure 1 presents seven clusters generated from the Citespace software statistical package. In this study, urban environment, clinical staging, urban stress, and neuroscientific were clustered into mental health because of the level of similarities within the literature. For instance, when researchers discuss mental health, stress is a factor, and urban environment and clinical staging are part of the discussion surrounding biophilic design and greenovation. After pruning the themes, we were left with three themes, which included mental health, migration, and the COVID-19 pandemic. However, one concept remained reoccurring in three themes, which was urban stress, so it became our fourth team.

4.2.1. Mental Health

Urban living is rife with hazards that create anxiety, stress, and fear responses [81]. Söderström et al., are cited for their work on the relationship between urban living and psychosis [69], while Vassos et al. identified density in households and neighborhoods as a significant determinant for the stress of individuals with a pre-existing psychotic disorder [57]. Steinheuser et al., were instrumental in creating an understanding between urbanicity and psychopathology and establishing the argument that cardiovascular diseases are more rampant in urban centers than rural areas [31], taking into cognizance of the substantial risk of air elevated risk [82]. Castillejos, Martín-Pérez, and Moreno-Küstner suggest that men in urban centers tend to suffer more from psychotic disorder than women,

and this places immigrants within the lower social spectrum in society at risk of sliding into depression [83].

Haddad et al., study perceive a link between urban upbringing and brain structure [61]. The analysis was conducted from an environmentalist perspective; epidemiologists' observations and clinical trials on brain processing and structural brain effects show possible morphological correlates with children at an early age in life. Hence, there is a chance that a child who may grow up in urban centers may stand a higher risk of developing schizophrenia [61]. However, to assist in providing a haven for children brought up in urban centers, exposure to nature and the infusion of biophilic design in the built environment may play critical roles in both the mental wellness and well-being of children. Although, the spike in housing prices, and the deficiency of social housing, particularly in developing nations, makes achieving greenovation in cities a complex challenge. Where the existence of poverty, inequality, affordable housing, inadequate infrastructure, crime rate, and congestion are all on the rise.

Inadequate infrastructures and crime rates may threaten the willingness of people to care for the environment. At the same time, the building of skyscrapers is beginning to gain traction as a strategy for providing low-cost housing amid the cost of land. Some physical infrastructures that may increase occupants' anxiety or fear are heights, darkness, unprotected pathways, enclosed places, and strange places and faces [81].

Nonetheless, there are immense benefits to be explored in uniting with the environment and building sustainable infrastructures that are in tandem with biophilic designs. For instance, James, Banay, Hart, and Laden [84] and Markevych et al. [85] in demonstrating the benefits of greenovation on human health and well-being, Markevych et al. suggest that the innate individual instincts are uncompromised even when removed from its natural environment or living condition, the biophilic cultural rules are unreplaced by modernized versions of equal adapted artifacts [85,86]. In psychology, the term biophilia suggests an inbuilt affinity for living systems or life. The importance of biophilia for this study is in considering the relationship between human beings and the environment; recent studies have linked biophilic design to improved construction and occupants' connectivity to their natural habitat [81]. The hypothesis of biophilia or biophilic design is that nature and humans are one in enhancing psychological and physical health and well-being [87]. The unionism of mankind and nature is one as credence for biophilia practices in the construction of new buildings and creating space for gardens and crops, which improves the mental health and well-being of the individual and the household.

4.2.2. Migration

The oneness or uniformity between nature and man makes city life more complex for the built environment and problematic for both urban planners and providers of healthcare. Though both concepts, city-life, and mental health, are intertwined on several levels, their interaction is not sufficiently understood [2]. Health providers are therefore overwhelmed during crises such as the COVID-19 pandemic. The general lack or gap in knowledge over the years between mankind and nature has tripled on how urban planners design homes and construction workers execute the building of such homes. The gap in the integration of biophilic designs or greenovation cannot be attributed to a communication gap but the flagrant undermining of how nature can change or transform the well-being of individuals.

Cities are social, cultural, technological, and political enclaves, and many have a higher concentration of migrants. However, the literature overcompensates migrants from developing countries or less developed countries to developed countries. For instance, literature documents the movement of people from Sudan, Nigeria, Ghana, or South Africa to America, Australia, and the like. However, the is a dearth of literature on the movement from Spain or France, or Germany to America or Australia and vice versa. Nor is research conducted on a movement of people from Sydney, for instance, to Johannesburg or Lagos. Further, literature is also sparse in discussing the neurological impact of age and language.

For instance, a 40-year-old migrant with dependents, and for whom language is a barrier, is not well captured in migration literature in settlement research in neurourbanism.

The argument is that the brain functionality of individuals who grew up in cities [78] and those who migrated in their adulthood to cities are not the same. There is not enough literature examining their tolerance level or negative emotional levels [58]. This demonstrates that what constitutes a good life or a good city [79] may differ depending on to whom the question is addressed. More so, it is difficult to cluster migrants into groups because their philosophies of life and goals differ significantly. For instance, the goal or expectation of a Nigerian migrant is to build wealth in his country while living bear minimum elsewhere, but migrants from South Africa make it anywhere they find themselves homes. Therefore, grouping migrants into the cluster will generate serious controversies in dealing with complex challenges facing the integration of the new city or smart city. Thus, what constitutes a good city is a city or place that affords an individual the opportunity to reach their goal.

There are many reasons for migration, some of which are health reasons, wealth creation, investment opportunities, the standard of living, better education, better healthcare and health facilities, cultural experience, technological advancement, social stimulation, and personal development [2]. Nonetheless, the need to get the best out of the city creates confrontation, competition, and conflicts [2], which builds into the stress profile of the city [68].

4.2.3. COVID-19 Pandemic

There is no question about whether the COVID-19 pandemic has caused severe stress for urban dwellers. The pandemic created uncertain prognoses and demonstrated the weakness of our medical systems by showing the impending severe shortcomings of medical resources for testing and treatment, as well as mechanisms for protecting both healthcare workers and first responders [88]. Yet, the global interconnectivity of cities has assisted in the spread of the COVID-19 pandemic [89–92], bringing about the lockdown, quarantine, and isolation. The pursuit of a good city or good life [79] currently is to remain alive.

With hospitals clustered in most parts of the world, vaccine hesitation is due to doubts, media portrayers, and indecision of individuals and households. Both the pandemic scare and vaccine discovery generated pluralistic views, resulting from poor communication by government agencies and their agents, government officials, and the media, particularly the unsolicited media, which is social media. Affirming the statement above, Bäuerle et al. [93], within a German context, argues that the COVID-19 pandemic significantly impacted anxiety (44.9%), psychological distress increased by 65.2%, depression heightened by 14.3% and fear due to the pandemic increased by 59%. In the same vein, mental health issues and awareness increased rampantly, particularly with younger people and females, but the lack of trust in most governments around the world increased the stress burdens of individuals and households who pay close attention to the News.

4.2.4. Urban Stress

Bendau et al. [94] acknowledge that media exposure to the COVID-19 pandemic puts a psychological strain on urban dwellers. According to Abbott (2012), stress is a snapshot of what city life entails, and modernity happens to play a critical role in it. Modernization theory presupposes that the transformation of traditional societies and assimilation of modern practices will effectively make a city more powerful and [95] while predicting that resilient cities advance in their modernization process, but the assumption that modernity has its flaws, boundaries, and critiques demonstrates that it cannot be implemented without some realignment. For instance, the major critique about modernity includes that it ignores external forces that shape society, but the challenge is that resilience increases stress levels, and where the stress threshold is exceeded, and the stress threshold becomes uncontrollable, being resilient might have negative consequences because it has the tendency to trigger

diabetics and high blood pressure, which weakens the immune system and the individual's metabolic process [68].

5. Findings

By using the Citespace software package, the study generated eight themes, including (#0) mental health, (#1) migrant population, (#2) clinical staging, (#3) urban environment, (#4) COVID-19 pandemic, (#5) urban stress, (#6) dynamic urban environment, and (#7) neurourbanistik (translated to neurourbanistic or neurourbanism), which emerged as headline research publications in neurourbanism research.

The timelines in Figure 2 specified that research about neurourbanism developed from signage providing aid for crossing roads for the deaf and sound on traffic poles for the blind, the notion of neurourbanism has metamorphosized towards a more complex agenda, dealing with greenovation, outdoor living, nature reserves for youth, and smart transport networks, and tending towards the amelioration of concerns of stress, anxiety, and psychosis on city dwellers.

Despite research on neurourbanism beginning in 1967, the most impactful years for research on neurourbanism was between 2016 and 2020 (see Table 1), based on the number of burst, centrality, co-citation, and readership. We can conclude therefore that research on neurourbanism is still new but novel.

Some of the specific discussions regarding neurourbanism concerning urbanicity, psychosis, anxiety, depression, and mood are particularly found in Psychology. Epidemiology and Psychiatry compared to such research featuring Urban Studies, Build Environment, Human Settlement, Earth Science, Studies in Human Society, and Social Sciences. Thus, architects generate ideas and adapt findings from the built environment, and urban studies magazines may miss the opportunity to provide a solution to urbanicity, now and in the future.

Existing literature has established upbringing/birth in an urban center as informing a tendency to develop schizophrenia spectrum disorders and several other disorders [31,59]. Researchers argue that individuals suffering social fragmentation, deprivation, and neighborhood effect in city life explain the toxicity of urban living [76]. Furthermore, while drug use has been considered another explanatory factor for domestic violence and trauma, culture shock has received minimal attention.

In relation to upbringing and psychosis, Baumann et al. [78] argument on dose-effect relations is imperative; according to Baumann, there is a high tendency that a child may develop psychotic behavior if the child resides in an urban area from childhood to about 10–15 years [68,79]. Nonetheless, research is scarce on analyzing migrant adults from a lesser developed country or migrants whose language differs from the language in the urban center.

Despite research on neurourbanism beginning in 1967, the most impactful years have been between 2016 and 2020 (see Table 1), based on co-citation and readership. We can conclude, therefore, that research on neurourbanism is still new but novel.

While the discussion regarding urbanicity and psychosis, anxiety, depression, and mood, research in Urban Studies, Build Environment, Human Settlement, Earth Science, Studies in Human Society, and Social Sciences is on the rise, its research home remains, Psychology and Psychiatry. Thus, town planners and construction workers who look towards built environment and urban studies magazines may miss the opportunity to provide a solution to urbanicity, now and in the future.

Existing literature shows that children brought up or given birth in urban centers are much more likely to develop schizophrenia spectrum disorders and several other disorders [31,59]. Additionally, some researchers argue that the level of social fragmentation, deprivation, and neighborhood effect in city life may provide an explanation for the toxicity of urban living [76]. However, drug usage has always been considered an explanatory factor for issues bordering on abuse, domestic violence, trauma, and culture shock; nonetheless, these issues in urban studies have received minimal attention.

The dose-effect relations by Baumann et al. [78] establishes the number of years a child needs to live in an urban center before one can develop any form of psychosis, Abbott, Amin, and Baumann et al. [78] all agreed to the ages between 10 and 15 [68,79].

6. Conclusions

Neurourbanism discusses the interface between the application of neuroscientific methods and urbanism, which creates an image of existing prospects and challenges that either one can fully and effectively measure or encapsulate. The fusion of both the neuroscientific method and urbanism help in dismantling the complex changes envisaged in an urban living while, at the same time, providing a remedy for ailing cities. The research established that conflict, competition, and confrontation heighten the sense of self and are counterproductive to altruistic civilization.

The research objective of identifying, developing, and analyzing emerging themes and articulating the challenges of neurourbanism was achieved. Several infractions were generated concerning the neurourbanism phenomenon detailing what it connotes while acknowledging certain disaggregation between philosophers because research on neurourbanism is transdisciplinary. Hence, researchers are confronted with disciplinarity issues regarding how the discipline regards the phenomenon and how it is used or applied within the disciplines. These are challenges in enveloping the universality of neurourbanism, what the concept entails and how it applies within their field.

Based on the systematization of 58 research papers, four major themes from where discussion of neurourbanism mostly emerges, such as mental health stress, uncertainty, and migration, emerged as leaders within neurourbanism discourse. Subsequent to developing the bibliometric matrix and the synchronization of authors' research overtime, dissenting voices were also acknowledged to make for rich research.

In conclusion, one of the fundamental challenges remains the absence of developing countries in discussion fora, particularly if the phrase "you cannot shave my head without me" is important. Africa and other developing countries, which are the center of rapidly growing urban landscapes, are lacking; their output is miniature in the debate on neurourbanism. This leads us, therefore, to question certain behaviors or characteristics exhibited over the years, such as the burning of councils or libraries, or government departments during protests in South Africa; in several developing countries, many may have been misdiagnosed. Hence, the problem of the continent may not be poverty and inequality, corruption, inept leadership, illicit trade, and investment or brain drain, but issues of mental health, adequate or poor built environment, lack of green environment, lack of open and shared spaces. This tends to make people sedentary and thus accounts for some level of obesity. Hence, future studies must rethink the issues of poverty and the myriad of challenges as it concerns the interface between the built environment and the application of a neuroscientific method. Particularly, we have noted that a child who was born and grew up until 15 years has the tendency to have some psychotic issues. More studies and finance need to be expended to extrapolate new trajectories for dealing with issues city dwellers are confronted with daily.

7. Theoretical and Practical Gaps and Elements in Neurourbanism Discourse

This systematic review has demonstrated that globalization has a positive association with an increase in the urban populace, and where city living has a correlation with mental health, then globalization or modernization may not be considered an effective trajectory for development. Although, the United Nations had predicted that the urban population would increase by 70% in 2050. One of the critical challenges for cities will be how to manage this level of change, where a population increase also raises the stress levels of urban dwellers as a result of increasing 3Cs.

The growth in population and the profundity of stress in cities with more population may constitute encumbrances for what is a good city or good life in urban areas. The idea of a good city may be rendered unattainable, particularly for bigger cities, where there is a

gap in the compassionate nature of what affects individuals in society, past, current, and future. This information about what affects people in society provides a baseline for town planners, city developers, and migrants to make informed decisions about people, nature, residency, and their built environment.

With such information, migrants can decide on the best choices that improve their well-being than those environmental factors that stimulate negative emotions. Some of the psychological factors may include higher levels of stress, anxiety, paranoia, and mood swings. However, design factors may include high-story buildings, issues of biphobia, and allergies. Others, such as greenovation, parks, and biophilia, promote wellness and well-being. Fett et al. [5] argue that individuals who reside in less-green zones are more likely to develop psychotic disorders; hence, the old model of urban planning and built environment requires a dynamic rethink. Following Fett et al., the need for dynamic urban systemic planning cannot be overemphasized, nonetheless, issues concerning how diversity is captured or articulated (race and sex) and multiculturality, and both the idea of dynamism in planning and issues of multiculturality must be well captured in what constitutes urban sustainability literature.

On a practical note, class urbanity and urbanicity in city-living arrangements and built environments in urban centers differ in structure and levels of stressors. For instance, despite Cape Town and East London being both categorized as urban centers, the nature of structures and levels of stressors differs significantly, and the difference is tougher when compared to developed cities such as Sydney and Perth. However, the literature does not capture the rift or differentials in competition from city to city, nor does it capture whether the reward is more or less/more risky or less risky. Literature in neurourbanism research in urban studies and built environment tend to omit these dual factors.

The omission of a lower urban center (for instance, Johannesburg) to a higher urban center (for instance, Sydney or Los Angeles) is also lost in transition or transmission. The friction and competition between both cities (mega cities in their rights) are also not well articulated. Moreover, the literature accounts for issues of barriers in language and how it creates heightened stress levels while arguing that the coping mechanisms of individuals are different, particularly for those migrating with dependencies. These five decades of research in neurourbanism have not been cared for, so we are hoping that with the pace of research and discovery, within the next three decades, these omitted research on neurourbanism will be captured. Thus, future researchers in this field of study must bridge several gaps in neurourbanism literature, particularly those aspects related to urban studies and built environmental studies.

8. Limitation

We acknowledge that there are some challenges to this research paper. We reiterate that our research was a systematic review using Dimensions Artificial Intelligence software and developed the PRISMA model from the Estech Shinny Apps. Not only did we collapse the years to a stipulated period, but we also utilized a particular publication type. Nonetheless, it captures all the fields not limited to the built environment and urban studies. Further from the generated eight themes (Figure 2), it was collapsed into four to extensively analyze and capture the essence of the research.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/buildings12122056/s1, Figure S1: title; Rural vs. Urban population (1960–2017). Figure S2: title; PRISMA approach. Figure S3: title; Visualization of the document co-citation network by institution/organization (Modularity Q = 0.4761; Average silhouette score = 0.8449 (Q, S = 0.609)). Figure S4: title; Visualization of the document co-citation network by country (Modularity Q = 0.4761; Average silhouette score = 0.8449 (Q, S = 0.609)). Table S1: title; Top 20 influencers/scholars on neurourbanism (by centrality). Table S2: Cited countries and institutions. Text S1: Citespace. Text S2: Descriptive analysis

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