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EXPLORING THE NEXUS OF MENTAL HEALTH AND NON-PARK URBAN GREENERY: A DESIGN FRAMEWORK FOR URBAN SALUTOGENESIS

1. INTRODUCTION

While comprehensive health services remain the fundamental basis for responding to mental health challenges in urban areas, more evidence suggests that the quality of our built environment plays a complementary supportive role in maintaining or fostering our mental health [Wolch et al. 2014; Mensah et al. 2016; de Keijzer et al. 2020]. The World Health Organization stipulates that the most urgent challenge for spatial planning is public health, which should be at the same time, the precondition for urban sustainable development and a central priority for urban planners [WHO 2017]. Consequently, the following article not only underscores the importance of urban design as a dynamic determinant of well-being but discusses the rationale behind my research project on this matter: as it aims to contribute to developing a new systematic approach to integrate mental health considerations and urban greenery.

As our comprehension of urban green space (UGS) deepens in relation to an evolving narrative of mental health, it is necessary to develop new methodological approaches to the greenery in our cities: equally focused on its twofold role in promoting urban ecology and improving inhabitants' well-being. Within this dynamic framework, UGS is argued to become one of the most important undertakings for urban planners and decision-makers alike due to its potential therapeutic role in influencing and shaping public health [Buttazzoni et al. 2021]. With extensive research developed on city parks, communal allotments and therapeutics gardens; increasing attention is now being directed in the ecological arena towards the planning of non-park urban greenery (NPUG). This includes verges, street gardens and green urban

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furniture; meadows, wetlands and floodplains; vacant and post-industrial sites; and architectural elements like green roofs and living walls.

Despite the greenery being more closely related to inhabitants' residences in cities, non-park urban green space is often overlooked in assessments of accessibility to the greenery in urban areas [Sikorska et al. 2020]. These spaces not only play a crucial role in addressing inequities by enhancing accessibility to greenery [Sikorski et al. 2021], but they also serve a dual purpose by contributing to the preservation of local ecosystems and increasing biodiversity in urban areas [Stanford et al. 2022]. With 70% of the world's population projected to live in metropolitan areas by 2050 [United Nations 2018], more green spaces are expected to be demanded and NPUG is set to play a more pivotal role in urban planning hence, gaining heightened importance in academic research.

The proposed research project underscores this shift in methodological perspectives towards non-park urban green space [Sikorski et al. 2021; Ke et al. 2023] by advancing a new technical approach to analyze the design of NPUG. The study will focus on the greenery that exists in between or adjacent to urban green spaces and examines to what extent NPUG can be substantial in maintaining or fostering inhabitants' mental health through daily access during urban commutes. Accordingly, the empirical work will encompass green verges, meadows, green roofs, living walls and other forms of NPUG in the city of Poznan as a case study.

The project aims to develop a novel methodological approach based on emerging technological tools and investigate a particular aspect of the relationship between environment and health: accessibility to NPUG and its effects on mental well-being. In order to achieve this objective, the project will explore the mental health implications of urban greenery through neuroscientific methods based on mobile technologies, computer vision techniques and virtual reality. This sequential mixed-method research design will draw conclusions from a qualitative analysis of the collected quantitative data. Consequently, the proposed Data-Driven analysis of existing NPUG in Poznan will be focused on measuring three perceptual characteristics: street desirability, cognitive comfort and perceived safety. By examining this potential impact on our individual and collective well-being, the study will provide innovative insights for urban scientists and policymakers to reconceptualize existing NPUG or development strategies for new UGS.

2. PROBLEM AREA, PURPOSE, AND SPECIFIC OBJECTIVES

A fundamental step towards better NPUG is to examine its influence on mental health and whether its design can foster individual well-being while supporting the city's ecology. Several authors have pointed out the general limitation of the extant literature on coherent conceptual models that integrate mental health into UGS [Markevych et al. 2017; Hartig et al. 2014; de Keijzer et al. 2020; Marselle et al. 2021]. Accordingly, the research project contends that while individual well-being,

personal happiness and social inclusion – drawing from the field of positive psychology – are multifaceted constructs that are difficult to define and measure. It is however possible to identify Data-Driven design criteria that contribute to reducing stress, create comfort, improve safety and benefit people both physically and mentally [Antonovsky 1993; Gawlak 2022]. In order to address this problem area, the research contends that NPUG for individual and collective enjoyment should be planned according to reproducible strategies that achieve long-lasting health benefits.

A complementary approach that leverages street-level data over traditional 2D analysis can play a crucial role in improving the design NPUG by assisting in both the selection of sites to intervene and the analysis of urban design scenarios in the early stages of planning as follows:

- Leveraged GPS Information: with passive app location data, to gain insights into the characteristics of different areas within the city. This information can help to identify suitable locations for intervention based on factors like pedestrian traffic, service proximity, access to greenery and density. For example, mining data from mobile apps can provide focal points and trajectories based on interests, demographics, and real-time data that can be combined with the geospatial data already available in OpenStreetMap.
- Computer vision techniques: Semantic Segmentation algorithms like ADE20K will be employed to analyze extensive data sources from Google's Street View API or similar in order to classify types of NPUG into semantic categories: tree (branch or trunk), bush, grass, shrub and soil. This method bypasses limitations of scale and 2D analysis by providing general perceptual characteristics of the environment.
- User Experience and Interaction: AI can enhance the analysis of UX data after NPUG simulations. AI algorithms could help processing the results of questionnaires after a Passthrough API experiment using VR based on the three perceptual characteristics of NPUG defined for the study. This will not only shed light on users' preferences but also improve participation by facilitating co-creation processes with wearable technologies.

As the main purpose of the research is to tackle a scholarly gap by defining a logical and reproducible planning framework for NPUG, the empirical work mentioned above can provide right platform to address the problem area of the research based on state-of-the-art quantitative tools and qualitative user data. The research project will apply the methodological framework in the analysis of existent spaces in the city of Poznan and the evaluation of immersive models aiming to measure street desirability, cognitive comfort and perceived safety in selected NPUG sites.

In order to conduct the empirical work of the study, a precise array of research activities have defined, comprising the following:

- Literature review based on both segments of the problem area: A) the intersection of mental health and green space i.e., salutogenic design, garden therapy, resilient

landscapes and urban ecology; identifying theories and insights to improve health for different users and contexts. B) neuroscientific urban design techniques, mobile technology and data mining in particular, computer vision to analyze human perception and machine learning algorithms for the analysis of large datasets.

- Case study in selected cities that have implemented spatial interventions on UGS that have positively impacted mental-health and well-being in Europe. Specific consideration should be placed to analyzing cities with similar urban conditions to Poznan in order to extrapolate potential findings.
- Theoretical framework defining a set of guidelines and strategies for spatial composition and green systems to address mental health, promotion and prevention through NPUG. By delving into the intricate dynamics of these elements, the framework strives to identify theories grounded in Evidence Based Designed methods (EBD) for maintaining mental health in urban settings, fostering ecological protection and promoting more sustainable living environments for individuals across varied NPUG solutions.

Beyond the technical difficulty of the experiment, there are additional constraints to be considered in order to guarantee the quality and validity of the results. Accessing extensive datasets will be imperative for the exploration and delineation of the experiment. Defining and accessing the multifunctional information for the experimental design should adhere to relevant data protection regulations while avoiding privacy infringements. On the other hand, performing virtual reality experiments with people will not only involve data privacy restrictions but additional considerations to ensure practical, and effective outcomes including ethical guidelines and safety protocols.

3. STATE OF THE ART AND LITERATURE REVIEW

The theoretical foundation for the proposed research is rooted in a cross-disciplinary understanding of UGS as means to foster mental health, which is at the same time an extensive area of up-to-date scientific research [Jabbar, Yusoff, Shafie 2022: 4406; Souter-Brown 2023: 2]. Several authors are currently studying this intersectionality between nature and health from a wide-ranging variety of perspectives that relate to space. Agata Gawlak argues that as the demand for healthcare facilities will only grow in the future, greenery in the structure of the building and therapeutic gardens will be the elements to effectively implement the postulates of a healing environment that both passively and actively support therapy [2022: 39]. Accordingly, stress reduction, improved mood, enhanced cognitive function, and better overall well-being are some of the benefits that are also highlighted in the work of Terry Hartig on restorative environments and quick recovery in green spaces. The author mentions that these can vary from ordinary psychological wear [1991, 2001, 2014] to loneliness and its concomitants, such as hopelessness and despair [2021,

2022]. Together with Pall J. Lindal, more recent studies have also shifted focus towards the built environment and to what extent density and morphology can be adapted to promote psychological restoration in people [2013: 26]. The authors argue that well-designed residential streets might support recovery and bring long-term benefits on mental health which are an urban aspect that directly fall in the category of open spaces in the city. However, the authors also point out that little research has considered the physical attributes that matter in this context and further studies are needed [2013: 34].

More recently, Stefano Capolongo, Monica Botta and Andrea Rebecchi have edited a compilation of methods, design strategies, and the newest scientific approaches to Therapeutic Landscape Design [2023]. The contributions delve into the emerging field of therapeutic spaces for healing, rehabilitation, interaction, and social inclusion. While examinations of the nexus between environment and well-being are made from technical, medical and social perspectives; the book is fundamental as it also offers an insight on potential theoretical approaches to the design and efficacy of therapeutic landscapes for mental and physical health. On this matter, Gayle Souter-Brown offers a framework that encompasses the following theories:

- Biophilia, rooted in the distinctive attention to nature and living beings, as source of form and function in design. It was early promoted by Edward O. Wilson who argued that our affinity for life does not only bind us to nature but allow us to respond more positively to spaces in which contact to nature is fostered [Wilson 1984: 104; Ulrich 1993: 74].
- Attention Restoration Theory, which Souter-Brown argues to take the biophilia hypothesis further by suggesting that the time spent in nature is protective and enhances health [2023: 2]. The theory deals with concept of *voluntary attention*, developed by William James, and the implications of the spam of attention dedicated to objects that do not interest us [1892: 169]. Stephen Kaplan explains that environments that demand this sort of directed attention leads to fatigue and mental wear [1995: 170].
- Salutogenesis, developed by medical sociologist Aaron Antonovsky, focuses on understanding and promoting factors that generate health and well-being, rather than the origins of diseases. The theory emphasizes the dynamic interplay between individual resources and the environment in maintaining and promoting health [1993: 969]. Antonovsky then uses the *Sense of Coherence* (SOC) to refer to a person's continuous state of improvement. Spaces that help develop a strong SOC are argued to be essential for individuals to effectively cope with stress and maintain good health [Lindström, Eriksson 2010].

Just like green space, NPUG is argued to have a restorative property that provides comfort and helps easing fatigue in its users. Defining guidelines to measure SOC in NPUG will be inherent for the design of the experiment. Accordingly, *The Handbook of Salutogenesis* [2017, 2022] is central theoretical contribution to be reviewed as it lays the theoretical and methodological foundations for further developing SOC as

a construct in UGS [Koelen, Lindström 2016; Lindström, Eriksson 2010; Magistretti et al. 2019]. This contribution also provides insights for potential new approaches for qualitative research on the matter of salutogenesis: “If the SOC is indeed related to health, should it not then reasonably be expected to be related to a variety of aspects of well-being? If successful coping with life stressors has positive consequences for health, should it not also have positive consequences for satisfaction, happiness, morale, and positive affect?” [Antonovsky 1987: 180].

One specific way to strengthen the SOC is both provided by or mediated through the surrounding environment, namely formal and informal health services, infrastructure and transportation [Stephens et al. 2015; Koelen, Eriksson 2017]. Features of the natural environment, such as the availability of UGS and recreation areas are also associated to the perception of health and social inclusion [Felix et al. 2015; Stephens et al. 2015; Yu et al. 2019]. Several authors also point out that SOC is not only about access to nature but rather a systematic support to health within communities [Mittelmark, Bull 2013; Von Lindern, Lymeus, Harting 2016; Meier Magistretti 2022]. Consequently, utilizing SOC as a theory that guides the methodological framework of the experiment is sought as a means that increases social inclusivity and mental well-being considerations. Therefore, salutogenesis as a twofold theory that operates through spatial features while providing social support to health is fundamental for the proposed research on NPUG.

A more recent contribution by Lenneke Vaandrager argues that in order to situate salutogenesis on the transdisciplinary academic arena, an essential task for the near future is nurturing its growth and spread to other aspects of society [2022: 565]. Accordingly, NPUG to promote mental well-being as a continuous process is argued to advance our knowledge in salutogenesis if align with the concept of incremental urban planning [Etizoni 1967]. To develop the criteria for the design of NPUG as continuous open projects for salutogenesis, it becomes necessary to connect forms of knowledge to forms of action [Friedmann 1993: 482] by fostering mental health based on constant social learning and public use.

The design of NPUG for salutogenesis: as a nexus that facilitates continuous and incremental development of mental health should be grounded in Evidence Based Designed methods (EBD). Several authors argue that through EBD methods it is possible to plan and employed the therapeutic qualities of outdoor spaces in designed green systems [Sackett, Rosenberg, Gray, Haynes, Richardson 1996; Stichler 2010]. Some of the most current applications of this approach can be found in the work of Andrea Brambilla and Stefano Capolongo for the design and evaluation of health facilities and hospitals [2019]; the guidelines developed by Clare Cooper Marcus for healing gardens and restorative outdoor spaces [1999, 2014]; as well as several advances of a universal design evaluation for assessing the built environment [Mosca, Capolongo 2018; Mosca et al. 2019]. Nonetheless, EBD methods are not only about design but people, culture and politics, an undoubtedly complex operation that encompasses the connection people have with their environment as argued by Stefano Campolongo who rightly asserts that understanding how concrete policies

and strategies aim to increase the use of these spaces is an equally important process to be underpinned [Campolongo et al. 2017]. This logic aligns with the report of the WHO that all urban green space interventions should apply a “dual approach” through which physical changes (e.g., creating new or improving existing NPUG) should be accompanied by social interventions (e.g., social policy and health programs) [2017: 11]. This twofold conceptualization for the methodological framework will allow to further explore the problem area of the research.

4. METHODOLOGICAL APPROACH TO THE PROBLEM AREA AND RESEARCH ACTIVITIES

The dual approach to NPUG: understanding how physical entropy relates to mental well-being, and to what extent design could mediate this nexus is the hypothesis to be empirically studied in the proposed research. The project will address this question by adopting a complementary approach that leverages GPS data with computer vision techniques to determine the types and location of NPUG sites in Poznan and how people perceive NPUG through VR Passthrough and qualitative questionnaire to determine green features that affect street desirability, cognitive comfort and perceived safety.

After the empirical findings and the proposed methodological framework, the final stage of the project will focus on developing general design guidelines for NPUG and collect feedback from a first disclosure of findings.

It is fitting to conclude this presentation of the research project at this stage arguing that as cities continue to expand and evolve, we need to develop new tools to plan cities more supportive of the natural environment and hence, the mental well-being of their inhabitants. It is fundamental to carry empirical research on urban greenery in order to promote accessibility to a broader variety of spaces that might benefit people. Overall, the research is one more step towards understanding the nexus between urban greenery and well-being.

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BADANIE ZWIĄZKU MIĘDZY ZDROWIEM PSYCHICZNYM A MIEJSKĄ ZIELENIĄ NIEPARKOWĄ: RAMY PROJEKTOWE DLA MIEJSKIEJ SALUTOGENEZ

Streszczenie

Wraz z rozwojem wiedzy na temat zieleni miejskiej oraz ewoluującą narracją na temat zdrowia psychicznego konieczne jest opracowanie nowych podejść metodologicznych do zieleni w miastach: w równym stopniu skoncentrowanych na jej podwójnej roli, tj. promowaniu ekologii miejskiej i poprawie samopoczucia mieszkańców. Niniejszy artykuł stanowi wprowadzenie do indywidualnego projektu badawczego podkreślającego transformację perspektyw metodologicznych skoncentrowanych na zieleni miejskiej pozaparkowej (NPUG) poprzez rozwój nowego podejścia do strategii jej projektowania. Badania skupią się na zieleni, która istnieje pomiędzy lub w sąsiedztwie miejskich terenów zielonych, i ocenie, w jakim stopniu NPUG może być istotna w utrzymaniu lub wspieraniu zdrowia psychicznego mieszkańców poprzez codzienny kontakt w trakcie poruszania się po mieście.

W związku z tym prace empiryczne obejmą zielone pobocza, łąki, zielone dachy, żywe ściany i inne formy NPUG w Poznaniu jako studium przypadku.

Celem jest opracowanie nowatorskiego podejścia metodologicznego opartego na nowych algorytmach analitycznych i urządzeniach technologicznych w celu zbadania szczególnego aspektu relacji między środowiskiem a zdrowiem: dostępności NPUG i jej wpływu na samopoczucie psychiczne. W związku z tym proponowana analiza Data-Driven istniejących NPUG w Poznaniu będzie koncentrować się na pomiarze trzech cech: atrakcyjności ulicy, komfortu poznawczego i postrzeganego bezpieczeństwa. Poprzez zbadanie potencjalnego

wpływu na indywidualne i zbiorowe samopoczucie badanie dostarczy innowacyjnych spostrzeżeń miejskim naukowcom i decydom w celu rekonceptualizacji istniejących NPUG lub strategii rozwoju nowych UGS.

Słowa kluczowe: zielen miejska, wizja komputerowa, rzeczywistość wirtualna, zdrowie psychiczne, przestrzeń zielona