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PRAXIS OF URBAN MORFOLOGY

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CONFERENCE PROCEEDINGS - PART II

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PRAXIS OF URBAN MORPHOLOGY

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INTRO

ISUF2023 PRAXIS OF URBAN MORPHOLOGY

Coming from 20 architects, geographers, planers and historians, to more than 600 individual and institutional members across the globe, ISUF presents the important international organization of urban form both for researchers and practitioners. Due to its orientation to both of these fields, ISUF 2023 presents a great opportunity to rethink the praxis, perceived as process by which theory/idea is enacted, embodied and realized.

The theme for ISUF 2023 is drawn from the previous experience and ideas, directed toward systematization and synthesis of intellectual knowledge.

Following this line of reasoning, the Conference tracks are envisioned to confront the topics that are represented as being opposed in order to open up a debate how to transfer ideas to operational knowledge.

A. Good in Planning, Landscapes and Townscapes

A1. Urban planning vs. Urban design

A2. *Fringe growth* vs. *Urban belt*

A3. Prescription vs. Description

B. Culture Space, Common Space and Personalities

B.1. East vs. West

B.2. South vs. North

B.3. Networks vs. Individuals

C. History of Ideas and Challenges

C.1. History vs. Future

C.2. Preservation vs. Transformation

C.3. Pre vs. Post

D. Programming and Rethinking Concepts

D.1. Strategies vs. Measures

D.2. Education vs. Practice

D.3. Quantitative vs. Qualitative research

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The current volume contains full papers collected for the XXX ISUF 2023 Conference. The Organisers are grateful to the Reviewers, Session Chairs, and Colleagues and Volunteers who contributed to the organisation and preparation of this conference. The papers' collection and the review process were supported by the Ex Ordo Conference Management System. These papers represent are product of research and represent the opinions of the authors. It is not meant to represent the position or opinions of the ISUF or its Members, nor the official position of ISUF2023 editors.

REFLECTION ON THE CONFERENCE

In its jubilee year of 215 years, the University of Belgrade and the Faculty of Architecture as its constituent member had an opportunity to host the 30th International Seminar on Urban Form Conference (ISUF2023).

This year's conference titled Praxis of Urban Morphology presented a great opportunity to discuss the process by which this discipline is enacted, embodied, and realized. The ISUF 2023 organization committee's endeavor was to build on the previous experience and ideas, and to direct activities toward systematization and synthesis at an international level, aiming to embody these ideas into operational knowledge. The conference was developed in a manner to provide a framework for reflecting on ISUF community intellectual knowledge coming both from the practical and scientific arenas. As a part of side activities, a special issue of the Serbian Architectural Journal - SAJ titled Regional Perspectives of urban morphology was prepared with the goal to demystify advancements of intellectual thought from all continents. Accordingly, the presentation will cover the main issues raised by scholars and practitioners both in SAJ contributions and during conference with the overall goal to contribute to the advancement of knowledge in this field, moreover to reconsider and critically examine advancements and perspectives on urban morphology.

Decision to focus the ISUF2023 conference on the Praxis of urban morphology and SAJ special issue on Regional perspectives on Urban morphology, hopefully, yet unintentionally achieving a harmonious integration of these two. Consequently, the resulting journal double issue serve as valuable testimony of longlisting engagement within the study of urban form in various contexts reflecting a specific moment in time and various perspectives on urban morphology, while conference reveals state of current topics and research fields within the urban morphology. Thus, the first one looks at the history, while the second reflects on the future

The very conference included total of 227 presentations with 580 authors (220 present on site), with representation of participants from 43 countries. The conference was developed in 4 tracks: A. Good in Planning, Landscapes and Townscapes, B. Culture Space, Common Space and Personalities, C. History of Ideas and Challenges and D. Programming and Rethinking Concepts.

Conference proceedings were developed in two parts - One available in print and online format that has texts recomended by session or conference chairs and the second with other submitted full papers.

Editors

PREFACE

The International Seminar on Urban Form (ISUF) gathered for its 30th conference in the Balkans. There was a long way between Lausanne 1994 and Belgrade 2023 – between an exploratory meeting of about 20 urban morphologists, coming from five countries, in Europe and North America, and a robust conference in Serbia gathering more than 200 morphologists coming from five continents. Throughout this way, together, we have increased our knowledge about the basic elements of urban form, how these are combined generating different patterns, and how these are shaped by different processes and agents over time. We also have a better understanding of how these patterns influence the environmental, social, and economic dimensions of human settlements, and how urban morphology can contribute for addressing some of the main challenges of our times, from climate action to the construction of sustainable cities and communities. In a year of celebration, and in addition to the Belgrade conference, some of us have been reflecting on the past, present and future of ISUF (Oliveira, 2024), while others have been debating the role and contribution of our regional networks (Djokić and Samuels, 2023).

The 'Praxis of Urban Morphology' was the last step of a one-decade path starting with the systematic participation of Serbian researchers in ISUF conferences and journal, leading to the creation of the Serbian Network of Urban Morphology, and including the development of research projects with other networks (Kantarek et al., 2022). The 'Praxis of Urban Morphology' organized by Vladan Djokić, Aleksandra Djordjević, Vladimir Lojanica, Ana Nikezić, Milica Milojević, Aleksandra Milovanović and Mladen Pešić was a remarkable event. Each and every part of it was carefully planned, making evident the commitment of its organizers. The event also represented the return to full face-to-face conferences, after two online conferences, in 2020 and 2021, and the hybrid event held in Lodz and Krakow in 2022. The conference was organized in four main themes: i. the good in planning, landscapes and

townscapes; ii. culture space, common space and personalities; iii. the history of ideas and challenges; and iv. programming and rethinking concepts. Each of these themes was then arranged in three pairs of poles to foster morphological debate. The conference had about 230 presentations, authored by almost 600 researchers (more than 1/3 was present in Belgrade) representing more than 40 countries.

Part of the morphological knowledge produced in the Belgrade conference is now gathered in the proceedings edited by Djokić, Djordjević, Pešić, Milojević and Milovanović. The proceedings are a precious record of one week of morphological debate in a notable city, with a rich urban history and built heritage, and a vibrant urban life. They develop new perspectives about our field of knowledge, how urban morphology can support action on the physical form of human settlements (through

planning, urban design, and architecture), and how morphological insights can consolidate knowledge on the main dimensions of urban life, from social equality and good health to decent work, and to responsive consumption of urban energy, to name just a few policy applications. For all this, the International Seminar on Urban Form is grateful to our Serbian colleagues, preparing both conference and proceedings, and to all participants.

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Vítor Oliveira

President of the International Seminar on Urban Form

CONTENTS

Noise Pollution as a Discomforting Factor Within Urban Open Spaces

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ABSTRACT

The global surge in urban population has triggered extensive urban expansion and congested city centres, resulting in a spectrum of public health concerns. Spatial characteristics of urban spaces play a pivotal role in addressing these challenges. This study aims to comprehensively expand the understanding of spatiality at busy junctions. Through a comparative analysis, it investigates the interplay between urban structure configuration, noise pollution, and human behaviour. The study's focal point is exploring how noise patterns influence pedestrian movement, navigation, and co-presence, alongside probing the intricate links between spatial structure and human behaviours that shape noise patterns. The principal aim is to comprehensively understand how noise patterns shape public space utilization and purpose, while interacting with other spatial aspects. The research employs qualitative and quantitative methods, concentrating on four locations within the Camden borough of London. Data collection tools are utilized to observe and map human behaviours, encompassing movement patterns, co-presence, and navigational trends. Manual measurements capture diverse noise patterns through acoustic meters. Space syntax analysis allows the research to delve into urban structure's spatial aspects. Geolocated data undergoes analysis through QGIS, depthmap, and SPSS software. The findings provide insights into the influence of discomfort-inducing noise on human behaviour, particularly co-presence dynamics. The study reveals latent connections between syntactic measures and visual analysis on noise patterns. Ultimately, the research outcomes offer valuable perspectives on the relationship between spatial arrangement, noise patterns, and junction design. This understanding aims to enhance acoustic comfort and public well-being.

Keywords: Noise Pollution, Human Behaviour, Comfort, Urban Structure, Space Syntax

INTRODUCTION

For centuries, the world has grappled with complex challenges, among which the rapid expansion of urban populations is a pivotal concern (Chou *et al.,* 2016). The persistent migration from rural to urban areas continues unabated, fuelling unchecked growth in metropolitan regions. This unchecked growth

poses significant issues encompassing infrastructure, resource allocation, and urban planning. Notably, over half of the global population now resides in cities, with projections indicating a continual rise by 2030 (Galea *et al.,* 2011). This paradigm shifts towards urbanization, driven by the opportunities a city can offer, necessitates a thorough understanding of its reaching consequences. This recognition has prompted researchers and policymakers to unravel the intricate relationship between urban environments and human well-being.

Parks, green spaces, and public squares constitute urban open spaces that significantly impact human quality of life. These spaces foster enjoyment, relaxation, and social interaction, enhancing community bonds and well-being. Their availability and accessibility are pivotal for fostering sustainable and liveable urban communities.

This study aims to explore correlations within the elements of urban open spaces, including the connection between noise pollution and comfort. The main elements of causing discomfort in a space could be many things, and unwanted noise is in that category. It is imperative to investigate its negative impacts, particularly from sources like traffic and industry. The consequences of excessive noise extend to the well-being of urban residents. Understanding noise's causes and effects is vital for devising effective strategies to mitigate its adverse effects and enhance urban liveability.

Moreover, urban soundscapes and visibility are interconnected elements that deserve further exploration. Visibility and noise are indirectly related due to their association with activities. Given the dynamic interplay of these factors, comprehending human behaviour becomes paramount, demanding the application of space syntax theories. Space syntax delves into movement patterns and spatial organization, offering insights into urban dynamics.

In conclusion, this study aims to unravel the complex relationship between urban form, noise pollution, and human behaviours within the public domain. The research seeks to enhance urban liveability and well-being by comprehensively exploring these dynamics.

Research Questions

As mentioned above, noise is a major concern in the field of research, yet many have encountered issues dealing with the data, such as quantifying, testing, and documenting it. One of the associations this paper seeks to make is the connection between noise pollution and its effects on comfort due to the cause of annoyance. They aim to investigate the negative impacts of noise pollution, primarily caused by domestic and industrial sources, with motorised traffic as a primary contributor. Furthermore, establishing a data collection method for noise mapping. As a result, two research questions were raised, and they are as follows:

- RQ1: What impact do noise patterns have on pedestrian Movement, Navigation, and Co-presence, in and around busy junctions?
- RQ2: To what extent does the relationship between spatial structure and human behaviours in busy junctions' impact noise patterns?

RQ1 aims to explore how people utilize and navigate through spaces while engaging in social interactions, investigating the impact of different noise patterns on spatial behaviours. This inquiry will provide insights into human behaviour within public spaces and examine influences on factors such as movement and co-presence based on noise.

RQ2 explores the interplay among space, humans, and noise. Through a comprehensive exploration of the connections between noise, spatial theories, syntactic measures, and human behaviour. Underscoring the significance of how noise, as an environmental factor, influences and is influenced by spatial configurations, and the behavioural patterns of individuals. Aiming to contribute to understanding the complex dynamics that influence human experiences and shape our built environment.

The research will focus on understanding the spatial formation of urban open space created by the configuration of street networks and buildings, specifically busy junctions. Examining chosen junctions will provide valuable insights of noise pollution levels along central London, looking through the lens of comfort.

Area of Study and Justification

This study analyses noise pollution in four prominent high-traffic junctions within a four-mile radius of central London's Northern section, particularly across the Camden borough of London, as indicated in (Figures 1-4).

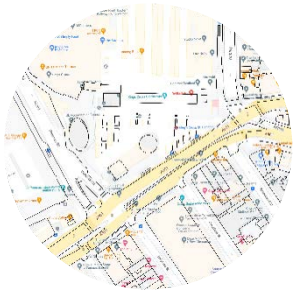


Figure 1. *King's Cross Junction*

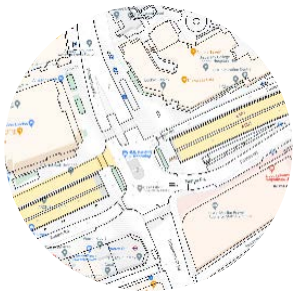


Figure 2. *Hampstead Rd – Euston Rd Junction*

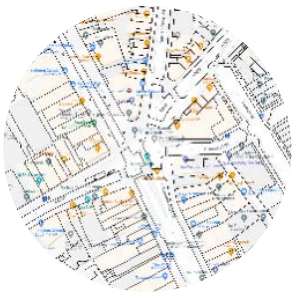


Figure 3. *Camden Junction*

Figure 4. *Mornington Crescent Junction*

Specific criteria meticulously guided the selection of these junctions to ensure their relevance and appropriateness for the study. These criteria encompassed a substantial pedestrian footfall, identifiable spaces within each location to facilitate systematic observation and documentation of human responses to noise, and areas that allow individuals to adjust their paths based on personal preferences.

Knowledge Gap

The existing research indicates a need for more extensive study on the relationship between urban noise levels and human behaviour in public spaces. This ongoing research aims to fill this gap by collecting accurate noise measurements in noisy areas and analysing human behaviour through modelling techniques. Current discussions need more essential insights, and this research strives to provide them. Despite global noise datasets, their scale and accuracy are limited, and accessible human behavioural maps are lacking. The study addresses these issues and enhances our understanding of the complex connection between urban noise and human behaviour in public spaces.

Literature Review

Urban open spaces are crucial in enhancing urban quality and citizens' welfare. The correlation between these spaces and the comfort they provide has intrigued researchers across diverse domains. This literature review delves into fundamental noise characterization, methodologies for analysis, utilization, mapping, and space syntax methodological background, which will serve as a basis for deciphering the case studies.

Core Aspects of Noise in Urban Settings

Noise pollution, defined as unwanted or excessive sound, has become a pressing concern in urban settings. Its adverse impact on human well-being, particularly comfort, has prompted this section's exploration of its consequences. Thus, the fundamental understanding of noise and its spatial relevance is presented.

Sound originates from physical vibrations moving air particles and objects, forming the basis of hearing, communication, and survival (Novak and Sakakeeny 2015: 1). Delving into sound and noise, a distinction between hearing and listening emerges. Voegelin distinguishes hearing as recognition and listening as an engaged mode, embracing the contingent nature of sound (Gross 2011: 53). *'Noises are sounds we have learned to ignore'* (Gross 2011: 129, qtd Schafer 1994 (1977); Truax 1984), highlighting the subjectivity of noise. Noise, often defined by its loudness, is an unwanted sound that can emerge from various sources, with any sound becoming noise at a critical decibel level. Noise is part of sound and receives less social consideration than other sounds (Novak and Sakakeeny 2015: 126). Noise, characterized by high decibels and adverse health effects from prolonged exposure, has detrimental impacts on physical and mental health, being an environmental stressor (Franěk *et al.,* 2018). The World Health Organization predicts a substantial increase in hearing losses, affecting millions globally by 2050 (Manojkumar *et al.,* 2019). Numerous studies reveal the long-term effects of excessive noise pollution, categorized into four groups based on duration and extent of exposure: physical, physiological, psychological, and performance-related effects (Das *et al.,* 2019 qtd Evans & Hygge 2000).

Measuring sound historically employed static air pressure for a quantifiable scale, while the decibel, a logarithmic ratio, is now the standard environmental noise power measure (Offenhuber *et al.,* 2020). A ratio converts sound pressure levels (mPa) into a manageable 0 dB to 140 dB scale (Hadba, 2015: 4). On this linear scale shown in (Figure 5), sound levels are contextualized, for easiness of identification.

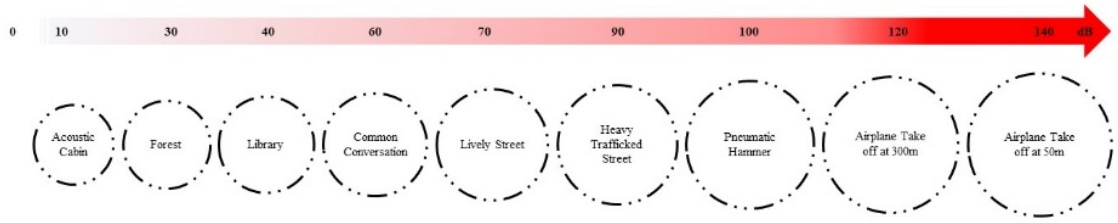


***Figure 5**. Decibel Spectrum*

Noise sources can be technological, anthropic, or natural (Figure 6-Margaritis and Kang 2017: 92). It can be mitigated by addressing sources, paths, or receivers (Figure 7). Measures include reducing source amplitude or modifying operational schedules, implementing government-enforced regulations, using low-noise road surfaces, and employing noise barriers, tunnels, insulation, and green buffers.

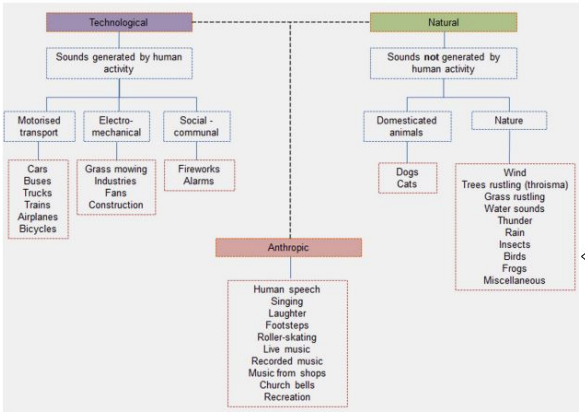


Figure 6. *Noise Categories. Source - Margaritis and Kang*

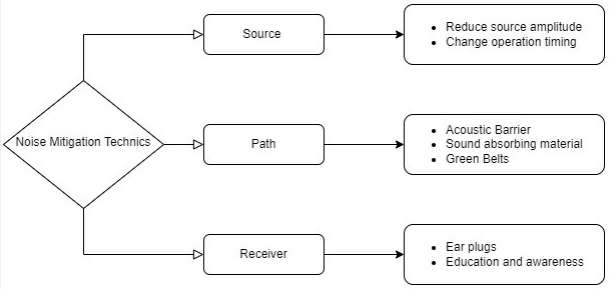


Figure 7. *Approaches to Noise Suppression*

Noise maps visually display noise levels in a specific area using colours or contours to represent intensity zones. As the European Commission's Directive 2002/49/EC outlines, noise maps can be graphical plots, numerical tables, and electronic data. These maps aim to comprehensively illustrate the noise environment, aiding in source identification, impact assessment, and making noise management-informed decisions. Various mapping methods, often employing specialized software like LimA, CadnA, and Geographical Information System software (GIS).

Space Syntax Theoretical and Methodological Background

This section underscores the importance of Space Syntax theory and the need to understand movement dynamics in urban settings. Space syntax serves as both a theoretical framework and a toolkit of analytical methods for studying spatial arrangements in structures and cities. Proficiency in analysing complex city layouts offers insights into spatial structures' social origins and impacts, spanning from urban landscapes to diverse buildings, including residences and complex structures (Hillier and Hanson, 1984). Initially proposed by (Hillier and Hanson 1984) and (Hillier *et al.,* 1987), Space Syntax explains the intricate relationship between urban layout, particularly street configurations, and human activity. It seeks to uncover the complex interplay between pedestrian movement patterns and spatial organization (Penn and Turner, 2002), asserting that spatial arrangement inherently reflects societal dynamics, influencing how individuals perceive, navigate, and utilize spaces across various scales (Penn *et al.,* 1998).

Central to Space Syntax is Spatial Cognition, aiming to elucidate how people comprehend surroundings and how urban layouts direct behaviours, including route choices (Wang *et al.,* 2007). The theory introduces metrics like integration, connectivity, and choice. Integration measures the proximity of spaces to an origin space, while connectivity quantifies immediately connected spaces (Hillier and Hanson, 1984). The choice metric identifies the shortest paths between diverse start and end points (Hillier *et al.,* 1986: 237).

The interplay between space and society significantly influences design and planning, directly connecting with spatial configuration and urban functions. This has led to the developing of methods and modelling techniques for spatial arrangement analysis (Penn, 2008). These techniques are rooted in fundamental aspects of human behaviour, encompassing geometric attributes like sightlines, movement patterns, and visual fields to establish spatial networks (Karimi, 2018).

Hillier's 1993 hypothesis underscores the urban grid's configuration as a primary generator of movement patterns. While factors like attractors play a role, research establishes that configuration is the principal generator of pedestrian movement (Hillier *et al.,* 1993: 31). *'Natural movement'* theory asserts that spatial grid-driven movement shapes urban vitality (Hillier, 1996: 32). The *'movement economy'* theory complements this by explaining how urban activities adapt to maximize movement advantages (Hillier, 1996: 125-127).

In summary, Space Syntax is a multidisciplinary theory and methodology crucial for comprehending spatial configurations in constructed environments, from cities to public spaces. It unveils the interplay between spatial layout, human movement, and social interactions.

METHODOLOGY

The research methodology combines qualitative and quantitative approaches to understand the study's framework. Diverse data collection techniques, including observational analysis, will be employed to address the demands of busy intersections. This section details the approach for each research question outlined above. with the assistance of the depicted methods in (Figure 8).

The chosen case studies, illustrated in (Figures 1-4), view the four primary junctions selected for in-depth investigation, operating at a mesoscale.

- Kings' Cross Junction: Area of 7,850 m² & Parameter of 475 m
- Camden Junction: Area of 4,050 m² & Parameter of 475 m
- Hampstead Rd & Euston Rd Junction: Area of 1,150 m² & Parameter of 240 m
- Mornington Crescent Junction: Area of 1,250 m² & Parameter of 220 m

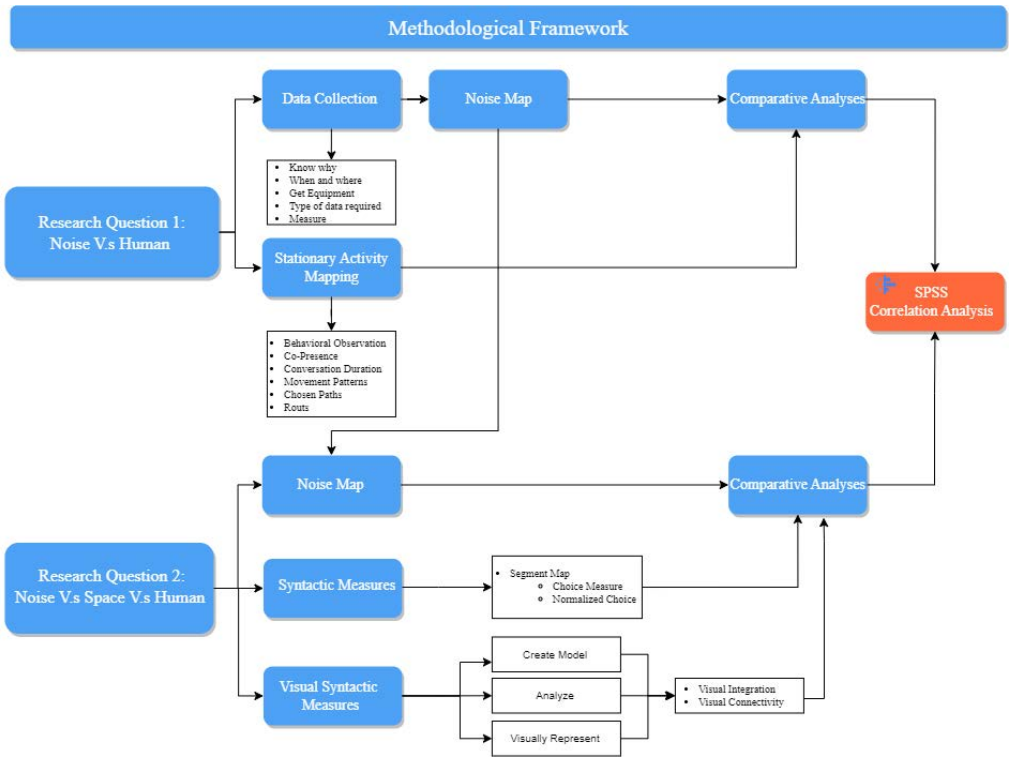


Figure 8. *Methodology Illustrations*

Firstly, to address RQ1, creating noise maps using manual measurements is a must. Albeit, the initial stage would be:

- Knowing why you are collecting this data;
- When and where do you wish to conduct this experiment.

These measurements will serve the purpose of addressing RQ2 as well. The collection of L10 and L90 values, representing noise levels surpassing 10% and 90%, respectively (Abbott, P. G., and P. M. Nelson 2002), enables multifaceted analyses of the noise environment's influence on human behaviour. Measurements are taken during specific timeframes, lunchtime throughout the week, capturing peak human engagement. After completing the noise analysis phase, a method was developed to effectively capture Co-presence and Movement aspects. This involved observing and recording various junctions using a mobile camera for 10 minutes during lunchtime. During this observation, conversations were noted with locations and durations. These data were geographically mapped using QGIS as MultiPoint layers for weekends and weekdays. Longer conversations were represented with larger diameters, quantitatively linking duration to noise patterns. Mapping movement was complex; a method like noise mapping was used. Existing physical maps guided trajectory tracing, supplemented by video recordings. The movement map, involving ongoing conversations, used Line-String layers in QGIS for visualization.

Secondly, to address RQ2, the same map conducted in RQ1 will be employed, with additional calculations. The introduction of 'noise climate' (NC) involves quantifying the extent of sound level variation within a specific time interval using NC = L10 - L90 (Kang *et al.,* 2023).

Furthermore, space syntax methodology, discussed earlier, will be utilized to compute choice and normalized choice measures through depthmap, a software for urban analysis that will facilitate segment analysis based on the theory of pervasive centrality (Hillier, 2009). The Space Syntax segment model will establish a pedestrian model within a 4km radius of central London, mitigating edge effects by extending the study area. Knee-level spatial-visual analysis will explore pedestrian visibility and associated syntactic measures. Visual integration and connectivity (VGA) will be calculated to assess the strength of connections. Conducting a 1.2km radius from junction centres, to reflect the pedestrian perspective and movement accessibility.

Thirdly, referencing all analysis steps to the same geolocated grid in QGIS, exporting this compiled data as a CSV, and importing it into IBM SPSS Statistics. These analyses were then collectively explored using a regression model designed through trial and error for experimentation. The noise was the dependent variable in each run, aligning with the target of investigating. It should be noted that R-squared (R^2) measures how well a linear regression model fits observed data by quantifying the proportion of variance in the dependent variable that is explained by the independent variables (predictors).

Data Collection Method

As previously discussed, the primary purpose of noise maps is to offer a comprehensive snapshot of noise conditions within designated areas, aiding impact assessment and decision-making on noise management. This paper introduces a standardized noise mapping methodology using QGIS, providing a consistent data collection and mapping framework to facilitate both the current study and future research endeavours.

The noise mapping process begins by establishing the justification and objectives for data collection, ensuring a clear purpose. Documentation forms and protocols should be outlined beforehand to provide comprehensive data gathering. Weather data, including wind speed, direction, rain periods, and air temperature, should also be associated with noise measurements to account for environmental variability.

The initial step of noise mapping involves creating a custom grid tailored to the study's scale, such as 10x10 meters for micro-level research. Grid alignment is crucial and can be based on prominent features like busy junctions or high streets. The grid is then populated with points in public spaces where pedestrians can move freely.

Measurement tools, like sound level meters, are employed for accurate data collection. While mobile apps exist, specialized sound level meters with A-weighting filters are preferred for precise measurements. Measurement data are then digitized and associated with respective coordinates. This can be streamlined using applications like 'GPS Logger.'

Finally, noise levels are visually represented using QGIS. A visual representation can be achieved using colour gradients or categorization based on noise decibel ranges.

THE INTERPLAY OF HUMAN BEHAVIOUR, SPACE, AND URBAN NOISE

After aligning each step of these analyses to the same geolocated grid using QGIS, this section delves into a comprehensive investigation of these analyses as a unified entity while visually representing them as individual junctions. The process initiates by presenting syntactic measures from a bottom-up perspective, progressing from a radius of 600, 400, to 200. This progression is followed by VGA. The vertical representation separates weekday on the left and weekend analysis on the right, encompassing NC, co-presence, and movement. Co-presence spans are showcased based on conversation duration graphically sorted. The larger sizes indicate extended conversations, corresponding to the noise levels at that time. Notably, NC, L10, and L90 are selected for noise pattern representation due to their relevance in unravelling spatiality, as referenced earlier.

A prominent pattern within the King's Cross junction arises within syntactic measures (Figure 11). Intersecting segments on the right exhibit a distinct red shade. An examination of the traces map reveals a notable bottleneck configuration within these segments. This coincides with heightened noise levels in the NC graph throughout the week (Figures 9,10). These findings collectively suggest a predicted occurrence of natural movement leading to congestion, elevated pedestrian traffic, and increased noise levels.

VGA analysis highlights clusters of red spots at the centre, signifying visually integrated and connected areas. Interestingly, these regions show subtle variations in the NC data, indicating their suitability for activities and conversations. Co-presence maps corroborate this, indicating a concentration of prolonged conversations in these zones. Conversely, these regions display limited permeability, revealed by lower shades of blue and green in syntactic measures and traces. This underscores their suitability for quieter interactions, aligning with descending noise clusters observed in the NC data.

Analysing the second junction, Hampstead - Euston Road (Figure 12), revealed heightened syntactic measure values for segments linked to Euston and Hampstead roads. This trend remained consistent along the junction's perimeter and was mirrored in the traces map throughout the week. The NC graph displayed distinct fluctuations with intensified green shades along these segments. This resembled a scenario akin to the King's Cross junction, indicating bottlenecks resulting in increased noise levels. Notably, these noise elevations contrasted with the central region of the junction. This noise pattern was further evident in the co-presence map, depicting reduced conversations along these segments.

Upon scrutinizing visual integration, it is evident that the entrance area to the upper-right quadrant building holds a significant position within the VGA. This aligns with the co-presence map, showing increased lengthy conversations in this region, establishing a strong correlation across both

junctions. Furthermore, examining permeability through the tracing map revealed limited accessibility, consistent with syntactic measures denoted by blue and green hues.

Figure 9. *Noise and Conversation Span – King's Cross vs. Hampstead–Euston Rd Junction (Weekday)*

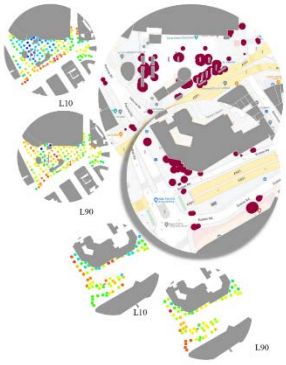
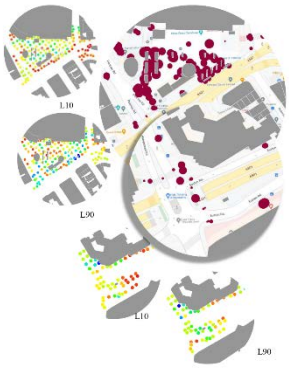


Figure 10. *Noise and Conversation Span – King's Cross vs. Hampstead–Euston Rd Junction (Weekend)*



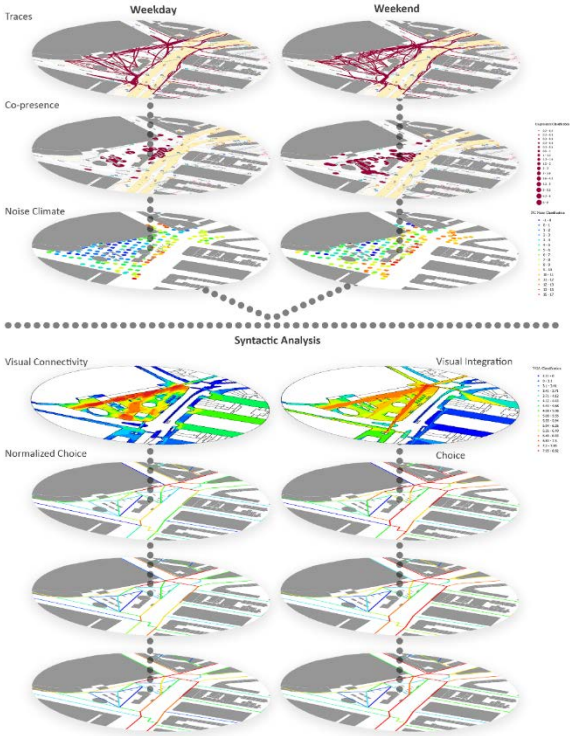


Figure 11. *Vertical Integration of Combined Analyses - Insights and Implications - King's Cross*

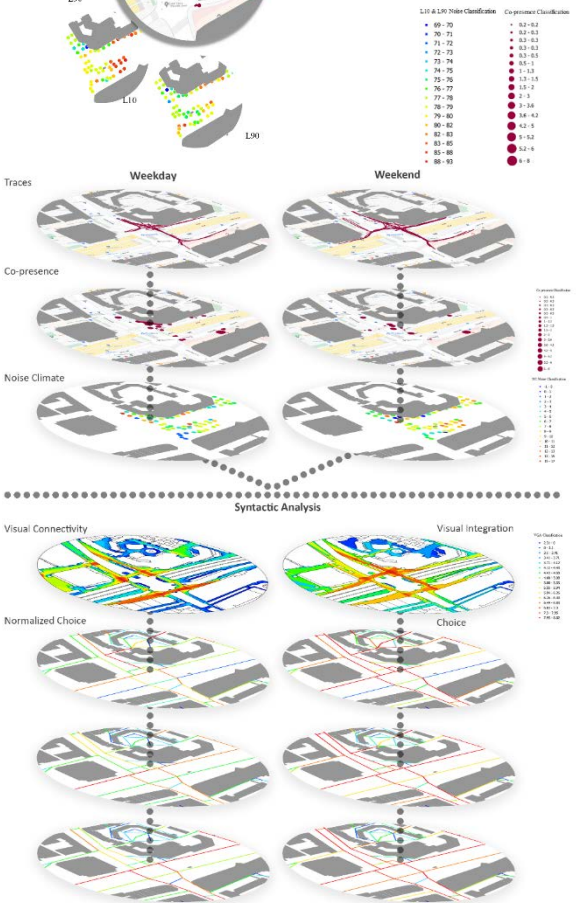


Figure 12. *Vertical Integration of Combined Analyses - Insights and Implications - Hampstead–Euston Rd*

Analysing the Camden junction (Figure 15), a distinct radial pattern emerges in syntactic measures, expanding from the centre. This is mirrored in the visual integration assessment, indicating congestion at the centre. Variations between weekday and weekend NC patterns up to 10 dB are evident, distinct during weekends, as shown also in traces. Co-presence maps mirror this (Figure 13,14), concentrating extended conversations in the central region aligned with natural movement expectations from syntactic measures.

Syntactic analysis in the final junction (Figure 16), reveals a relatively tranquil zone, especially in the upper radii. However, the radius of 200 shows specific segments with an orange hue, bustling in traces, denoting elevated activity and movement. These segments correspond to zones with higher noise levels, substantiated by significantly higher NC values. Yet, only some of these segments exhibit

robust visual connectivity, aligning with absent co-presence initiation in these areas. Concentrated co-presence interactions appear in the most visually integrated and quietest regions, aligning with solid correlations between visual integration, noise levels, and co-presence.

Figure 13. *Noise and Conversation Span – Camden vs. Mornington Crescent Junction (Weekday)*

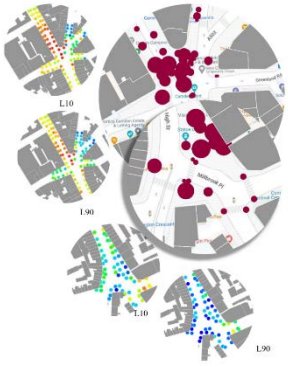


Figure 14. *Noise and Conversation Span – Camden vs. Mornington Crescent Junction (Weekend)*

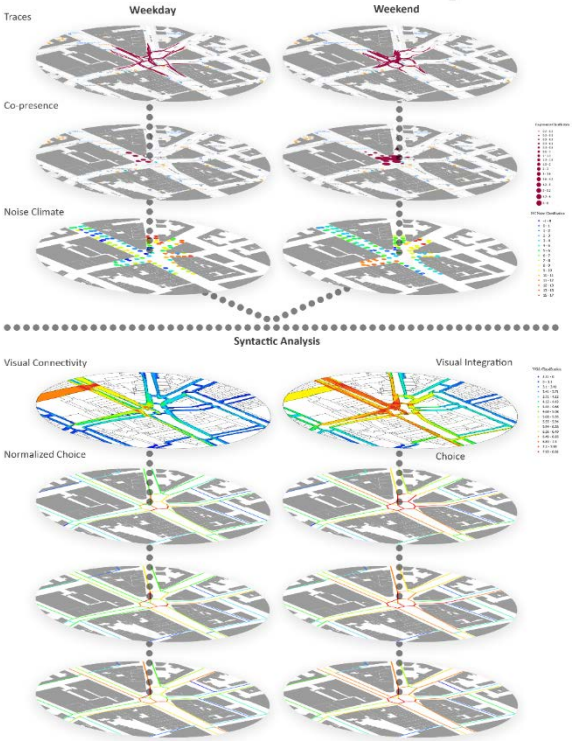


Figure 15. *Vertical Integration of Combined Analyses - Insights and Implications - Camden*

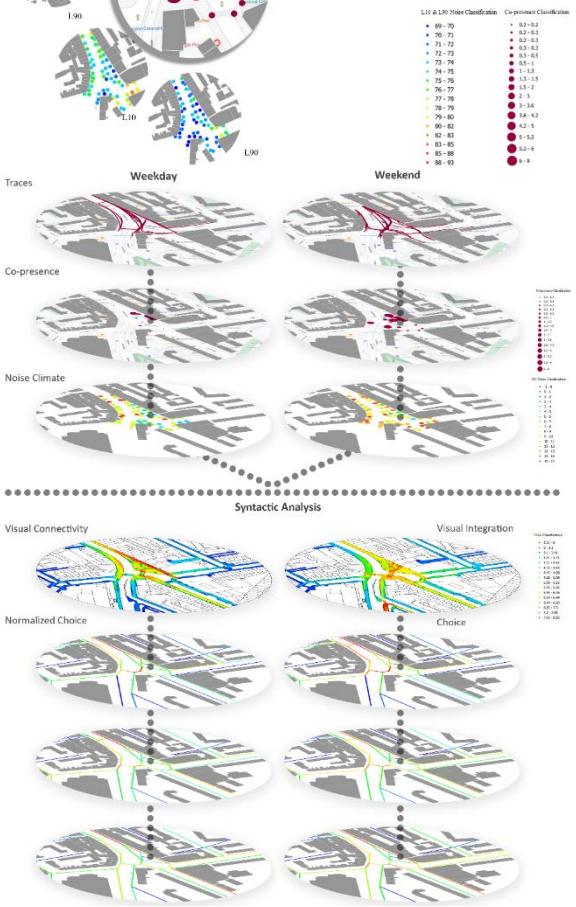


Figure 16. *Vertical Integration of Combined Analyses - Insights and Implications - Mornington Crescent*

Discussion and Results

Firstly, co-presence patterns exhibit differences along the week, with shorter conversations more common on weekends and longer ones on weekdays. The distribution of noise patterns in (Figures 9,10,13,14) significantly impacts co-presence, as noise increases it correlates with shorter co-presence periods. Weekdays exhibit conversations of 4 minutes or more within the 72-76 dB range, while weekends display similarly spanned conversations clustered around noise levels ranging from 74 to 80 dB. These findings underscore the impact of noise on co-presence dynamics, highlighting the importance of noise management for fostering such scenarios. Furthermore, despite effort in

movement and navigation analysis, limited correlation emerged. A linear regression model was applied, yielding an R^2 of 0.197. While a connection between noise per length segment and weekly noise levels emerged, it was not robust, Due to the limitations of observing people's behaviour, and the need of a bigger data set.

Secondly, this process involved compiling NC throughout the week data and testing it independently with each individual element depicted in (Figures 11,12,15,16). This was followed by testing combinations of these elements and eventually the entire set of independent variables. The aim was to assess the potential impact of these independent variables on noise. The same approach was then applied to the average of L10 and L90 measurements over the week. The subsequent part will present the most significant outcomes observed. NC noise levels correlated weakly with choice analysis, with R^2 coefficients of 0.071 for choice and 0.031 for normalized choices. Combining elements raised the R^2 to 0.097, indicating an improved predictive capacity for noise using syntactic measures. Remarkably, VGA analysis revealed substantial results, with visual integration and connectivity yielding an R^2 of 0.417. When adding syntactic measures, correlations increased to 0.429 for weekdays and 0.417 for weekends. Turning to L10 and L90 averages, R^2 values climbed to 0.525 and 0.518 respectively, suggesting potential for predicting noise using these variables.

CONCLUSION

In summary, the investigation into co-presence patterns and their correlation with noise levels has yielded valuable insights. Notably, distinctions throughout the week have surfaced, revealing shorter conversations on weekends and longer ones during weekdays. The significant impact of noise distribution on co-presence dynamics is evident, as higher noise levels correlated with shorter co-presence periods. This accentuates the pivotal role of noise management in shaping social interactions and fostering desirable social scenarios. However, the analysis of movement and navigation showed limited correlations. Modest coefficients from a linear regression model suggest a multifaceted interplay influenced by factors beyond this study's scope, necessitating a larger dataset and more comprehensive behavioural observations. Exploring noise variables in conjunction with spatial elements unveiled insightful outcomes. While correlations with choice analysis were relatively weak, combining syntactic measures displayed potential in more accurately predicting noise levels. Particularly, strong correlations in visual integration and connectivity underscored the significance of spatial structure in shaping noise patterns. Furthermore, examining L10 and L90 averages proved valuable in predicting noise levels. These findings collectively emphasize the intricate interconnections among noise, spatial arrangement, and human behaviour. Noise not only directly affects co-presence but also indirectly influences movement behaviour through spatial metrics.

LIMITATIONS AND ADVICE FOR FUTURE ENDEVOURS

This study had certain limitations that should be acknowledged. One of the primary limitations is that the research was conducted in real-world conditions; numerous variables influenced the recorded sound levels, including short-term weather changes like sunshine, heavy cloud coverage, sudden wind, and traffic density fluctuations. Moreover, the equipment used for noise measurement could have been improved in terms of its precision and up-to-date capabilities. The constrained timeframe for data collection also posed challenges. Furthermore, safety conditions necessitated constant vigilance, as there are hazards when observing, for people may exhibit disruptive behaviour, which further impacts the research process. These limitations should be considered if a similar approach should be attempted again.

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