

## 5 Thematic Synthesis

To Recap: Our study's aim was to explore present day machine learning techniques and in turn to use these techniques to explore the visual nature of London's Built Environment.

Our study's method was twofold: Firstly to enquire whether we could reach equally high scoring accuracy rates as achieved by Kang et Al in their US Cities Study on a CNN Image Classification Task performed upon London New Development Building Types. Secondly, we sought to apply Image Embedding methods to further explore the typological character of our model by re-using the image vectors produced in the earlier CNN Training Stage.

Early runs of the workflow achieved accuracy rates of > 66 % on best of class label sets, and > 75% on One vs Rest (aka OVA, OVR or binary label). Our strategy for dealing with early signs of model overfitting involved 4 approaches:

1. Secondary Validation of the Address Data
2. Applying common Model Fine Tuning Methods
3. Varying Label Set Creation Approaches
4. Visualizing Classification Decisions made by the CNN

None of the 4 achieved significant improvements upon the initial promising classification results. Given the extent of the validation and ML treatment we suggest that this might point to specific characteristics of the London urban environment being modeled.

The wide spread prevalence of ambiguous label classifications in our London Data underlines the predominance of a Mixed Use policy in current planning decision policy touched upon in the study literature review. In addition the high levels of occluded and invalid unusable images in the London street level image dataset highlights the predominance of building interfaces which lean to the upper more Private/Inaccessible End of the scale in Dovey and Woods nomenclature.

In outlining the theme of Urban Fluidity in Typological terms at the beginning of the study we came across Lefebvre's concept of Blind Fields. According to Lefebvre, 'blindness' as an ideology is situated between the 'presentation' of facts as they appear to us and their 're-presentation' (the interpretation of the facts). These moments do not follow each other smoothly; there are ruptures and conflicts between the presented and the re-presented. The blindness or the blind field occurs during these moments of misinterpretation and misunderstanding (leading to a failure of recognition, and mental and social false consciousness) as our consciousness oscillates between the presentation and the re-presentation (Lefebvre 2003).

Street Level Imagery and Street Level Data Experiences , we suggest, offer an empirical conduit into this conceptual domain. Exactly what our study and

its visual model uncovers or precipitates is not conclusive, however we argue that an enfranchised and visual approach such as that presented here, be it narrative or empirical in its origins or scope, allows for research and further discussion rooted in Levebres' urban ontological feature space.

The difficulties which our study came across can also be seen to emphasize the challenges faced in applying a variety of Image Classification Machine Learning techniques to the complexity and ambiguity of a modern urban environment(see the recent reassessment of delivery times for robust driverless car technology). The workflow experience underlines the fundamental difference between conception of an idealized Elegant AI conception and the reality of a complex hybrid pragmatic ML implementation and goes part way to illustrate the state of the science at odds with much of current media and political narrative framing.

Potential beneficial applications for the analysis and workflow methods explored can already be found in the OSM Missing Maps and Facebook Map Challenge initiatives which use AI and Hybrid AI-Manual workflows to assist in Mapping and indexing the vast amounts of uncharted geographic regions.

These methods also allude to the potential and feasibility of fresh thinking in terms of an Aggregate Design solutions approach that if realized might allow us to re-appraise and re-approach neglected architectural methodologies, such as those espoused in Christopher Alexander's Synthesis of Form and the Timeless Way of Building. Here an approach to Urban Design and Architecture is proposed which re-considers aesthetics on a scale that is both local and global.

One further outcome of the study is the material it allows us to apply to a Cadastral narrative on real time management and optimization the economics of a society's building stock and/or housing need. Again, it is the manipulation and assimilation of fundamentally large scale concepts and datum that makes this possible.

Observing that London's urban environment is changing(in that we observe an increasing prevalence of mixed used/fuzzy typologies, highly dense and increasingly of privately interfaced in New London vs Old London) is not breaking news. However taken in context with our study's cognitive and AI exploratory framework there are two key points that we think might be worth highlighting. Firstly, that machine learning methods applied to aggregate data models can provide us with a novel way of visualizing and ultimately measuring the rates and degrees of change that we are faced with. Future Tools in Urban Design and Planning process and in the new media communication of this process may well look a bit like the tools we have touched upon so far.

Secondly, our exploration of AI as an Image Classification task applied to Urban Visual Artifacts has brought us into contact with the core idea of Visual Semantics. Earlier we highlighted the role of Vision in the development of Cognitive Science, and the milestone of Gibson's Ecological

Phenomenological approach in the progress toward embodied and representational theories of AI.

Do the strong taxonomic ambiguities that our CNN Analysis workflow encountered point to a quantifiable characteristic of the cognitive urban environment? Is a change to the Visual Grammar of our conditioning and developmental environment accompanied by change, in a Cognitive sense, on an equally fundamental and intrinsic Level?

These are questions that are presently being addressed in multi disciplinary field approaches such as the Leverhulme Doctoral Training Programme for the Ecological Study of the Brain which combines psychology, neuroscience, architecture, computer science, engineering, education and geography to measure behavior and brain activity in the Urban environment:

Understanding how humans operate in the real-world, the ecological niche in which the brain has evolved, is critical to explaining the richness of human experiences. Most scientific knowledge about brain and behaviour, however, comes from laboratory studies focusing on a single domain (e.g., language processing) and sacrifice real-world context to achieve experimental control (e.g., recognition of isolated words rather than face-to-face communication).

At the other end of the spectrum, scholars studying real-world phenomena often sacrifice experimental control in order to conduct studies in naturalistic settings. Laboratory experiments, however, often have limited external validity, while naturalistic approaches are descriptive, and therefore do not address causal relationships between brain, behaviour and the environment.

To explain the inherent richness of human experiences, a radical change in approach to brain and behavioural research is needed that enables future leaders to harness and further develop new methods and technologies - part of the digital revolution - to measure behaviour and brain activity in the wild (e.g., wearable devices and wireless electroencephalography), to bring real-world complexity into the lab (e.g., virtual and augmented reality, large-scale modifiable real-world facilities) and to analyse the wealth of data these methods produce (e.g., blind signal source separation, graph- theoretic analysis) (<https://ecologicalbrain.org>).

As regards the study's notion of the city as a developmental environment (upon which we train both our fledgling CNN Task and our nascent ML Workflow Inquiry into an Urban Setting) we reserve the last word to the ideas of Colin Ward.

In "The Child in the city" Ward explores the relationship between children and their urban environment. It asks whether it is true, as very many believe it to be true, that something has been lost in this relationship, and it speculates about the ways in which the link between city and child can be made more fruitful and enjoyable for both the child and the city. Specifically he points to the erosion of the child's freedom in the city by redevelopment for the benefit of property speculators and the out of town motorist.

The Urban “Child” can be seen to have taken the city within themselves, epitomizing the possibilities and pitfalls of an urban environment itself in a state of rapid becoming, and through their work and play acquiring an intimate knowledge of unfolding city spaces.

The quest for personal privacy and the sense of social isolation are not opposites in the experience of the urban child. The same child who is most deprived of a private and personal place is likely to be the child who is most isolated socially.

Colin Ward saw social change emerging from expanding social co-operation and mutual aid in everyday life. The work he did with the TCPA’s Education Unit exemplified in this most important work of his was, as Ken Worpole put in an obituary in 2010, ‘to get children out of school and into their communities, to talk to local people and to explore their neighborhood its amenities and utilities and understand how building streets, landscapes, and social life interact.

Ward theorized a 'pragmatist anarchism' that looked towards removing authoritarian forms of organization and governance in favor of informal and self-organized mechanisms based on non-hierarchical structures. Unlike other anarchists, Ward recognized that a wholly anarchist society was a theoretical impossibility, as universal consent was unlikely without the use of force or coercion. Ward's pragmatist anarchism thus strove for a freer society rather than a 'free society'.

Resonating with this for Ward was his feeling that utopia would be boring, and that in any case we would never get there. Instead of an instant utopia, it would be brought about through working on forms of human and social relationships in the here and now.

## 6 Conclusion

Our study's results, whilst not benefiting from the opportunity to fine tune and up scale our model using the most currently effective architectures(e.g. ResNet), were close but did not match the accuracy of the Kang et al building instance study on US and Canadian cities(>70%).

Possible reasons have been highlighted and may be related to the nature of the differing urban environments and differing socio economic approaches to the basic urban issue of urban density. In the process they open up possibilities regarding the secondary motivation of the study which was to determine whether a stylistic narrative could be effected though the application of Machine Learning techniques on an urban centric image classification exercise.

Further refinement of the adopted workflow would be required to feel confident on this point, however differences have been identified between geographic locales, the datasets that describe them and some of practical issues encountered in applying CNNs to real world Image Classification tasks explored.

This study has granted us an experience in applying AI to a real world challenge, specifically symbolic neural network based AI. In the study's exploration of building typology it has also allowed us to observe the role of semantics, both visual and conceptual and its impact on using connectivist tools to make sense of a human and urban environment.

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