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Urban spatial contexts of growing up

Delineating the spatial configurations of developmental ecologies with Space Syntax

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ABSTRACT

This paper seeks to demonstrate how Space Syntax analysis of urban spatial configurations can help to delineate and observe environmental systems of childhood development, based on Ecological Systems Theory, first devised by Urie Bronfenbrenner (1979). Ecological Systems Theory stems from an observation that children develop through interactions within social relationships at different levels of informational complexity. Bronfenbrenner identified how the complexity increases from 'micro-system' interactions of infants and primary caregivers to 'meso-system' interactions among children, homelife and institutions. The study described in this paper focuses on the flows of information apparent in the meso-system of children's growing awareness of their social situation in urban community contexts.

The focus on informational complexity in both Ecological Systems Theory and Space Syntax offers an epistemological bridge between these separate paradigms, formed around the notions of environmental affordance (Marcus, 2015), and of information morphogenesis (Hillier, 2016). We aim to elucidate the significance of these conceptual links between spatial and development systems via two areas of discussion: how spatial configurations shape flows of information in urban contexts; how children's interactions are influenced by urban spatial forms. The investigative potential in linking of spatial and developmental systems is tested by analysing two contrasting biographical histories of growing up in suburban English contexts (Joyce, 2021; Hanley, 2017).

In this paper, we seek to demonstrate how experiential accounts of child development can be contextualised spatially by applying Space Syntax analyses to the contemporary street layouts of their developmental environments. The overall aim is to test the possibility that Space Syntax and Ecological Systems Theory can be brought into contact effectively to create a normative methodology for studying child developmental contexts in urban settings.

KEYWORDS

Ecological Systems Theory, Space Syntax, child development, ecological psychology, urban history

1   INTRODUCTION

Our topic is a novel method to delineate and observe the urban spatial configurations in which child development often takes shape. This topic deepens theoretically our earlier work in applying Space Syntax to the analysis of movement infrastructures in young people's perceptions of their local community spaces (O'Brien, Garcia Velez & Austwick, 2017). In this current work, we aim to develop a method to study how these infrastructures play a fundamental role in children's growing up.

We draw inspiration from a 'constructivist' socio-cultural paradigm in child development research, which centres around children's everyday engagement with sign systems through which they learn and develop 'higher' functions of, for example, self-regulation, self-reflection, and complex sociality. We focus our research on child development in everyday spaces, as distinct to spatially segregated areas for children's play, which – though inarguably beneficial to children – do not afford the range of social and spatial differentiation that is involved in their higher functional development.

The research is built on an assemblage of several theoretical building blocks that are drawn from separate epistemologies, yet each relate in some way to the impact of the social environment on self-perception in relation to that environment. These include ecological psychology, a 'new history' of childhood, sociocultural theory, Space Syntax, and Ecological Systems Theory. These building blocks, which will be elaborated as part of this paper's review section, below, involve these notions:

- Developmental contexts are mutually constitutive of children and environments
- Perceptual differentiation depends on movement
- Transitioning between developmental settings creates perceptual 'content'
- Mental processes are created through semiotic mediations
- Configurational urban spaces comprise pervasive centralities
- Inter-linking centralities produce informational morphologies

Considered in different combinations, these building blocks support our research into the ways in which children's urban contexts for growing up become developmental settings. These settings are animated through urban movements by which children create perceptual content, involving the 'voices' of the others who also participate in that environment, so as to differentiate one social-spatial setting from another. By engaging in differentiating processes in urban spaces, children adopt the situational coordinates that affect self-perception and social practices throughout life. The following Review section draws on a range of sources to substantiate these building blocks, and lead to the questions and methods for research outlined in the Methodology section. In the Analysis section we

describe the primary research undertaken on biographical histories of growing up in inner and outer suburban contexts. The Discussion will extrapolate key findings of this research in terms of the review themes, while the Conclusion will formulate these findings with reference to the research questions, and propose some implications for research in this field of enquiry.

2   REVIEW

2.1   Developmental contexts are mutually constitutive of children and environments

Recent research into child development has placed emphasis on children's agency in shaping their 'repertoire of practices' in engaging with activities across a range of participatory settings (Rogoff et.al, 2015). The so-called 'new history of childhood' sheds light on the active role that children and adolescents play in shaping their own developmental settings, responding also to the instabilities of historical circumstances. Settings for childhood development are not, of course, even throughout history, and have been shaped by factors or forces not immediately of children's choosing or control.

Corsaro (2018, p. 73-86) has reviewed several histories of childhood that reveal children to have been the creators of spontaneous and autonomous 'play spaces' within workaday environments; to have been acutely aware and inclusive of adult social meanings in their role-play games; to have been just as industrious, opportunistic and organized as their adult counterparts in their employment situations. In contrast to the 'premodern' conditions of childhood in workaday settings, the 'modern' world of the 18th and 19th centuries regarded children as vulnerable and in need of special care at home or in school (Mintz 2004). The rise of these 'sheltered' settings for child development is perhaps more familiar to a western, affluent audience than that of children growing up among premodern workaday environments.

The 20th Century saw the introduction of protective measures from the hazards of the adult world, including the making of special spaces in the home (Mintz 2012). However, research has shown how adults in 'postmodern' societies are less likely to see their children as innocent as such: as being actively knowledgeable about adult worlds, and engaging in consumer cultures, and in need either of protection against or preparation for the hazards that these worlds present (ibid). Whatever the setting – workaday, street, institutional, home, consumerist – these histories of childhood bear testament to children's knowledge-building in relation to adult environments. They offer evidence for their active encountering of, and learning from, the adult social world from within their developmental spaces.

Our focus is on urban settings for childhood development. Yet there appears to be only circumstantial evidence for addressing the concerns of children with any degree of formality in urban planning and design. In the 19th century, the design of working- and middle-class houses was based alike around the principle of singular occupancy of the nuclear family, which was arguably reflective of the concern to

protect children from, or to prepare them for, hazards or stressors of the wider social environment. Urban planning in the 20th century put greater emphasis on the family home's requirements for privacy, community self-policing, and distancing from city traffic, among other factors that might benefit children (cf. Grannis, 2009). However, there is scant evidence for benefits to children's development as being deliberate considerations English urban planning in the modern era (beyond that of having their play activities spatially segregated)[1]. As a point of principle, even when protective benefits have been introduced through accidental effect – as in the example of subway as a play space, as described by Hanley (2017), outlined below – these 'sheltered' environments do not always keep children from harm.

2.2   Mental processes are created through semiotic mediations

Children grow up in environments that are not usually of their choosing, yet they create their individual psychologies through interactions within these environments. This is not to suggest that children simply internalize their external conditions. Vygotsky's foundational research into the relationships between environment and psychology asserted that mental processes are *created* as a result of the child's exposure to 'mature forms of cultural behaviour' (quoted in Wertsch 1985, p. 63). For Vygotsky, children's higher mental development, took shape within situational contexts through processes of mediated action; in other words, through the use of physical and semiotic tools within a task environment.

The key process in the creation of mental processes is in the child's emerging ability to decontextualise these actions from the specific situation in which they were learned, as in the example of transferring the rules of arithmetic to any numerical task (ibid p.33). This kind of decontextualization is also perhaps relevant to the transferences of syntactical spatial structures from one context to another. Once the hierarchical self-similarities of street layouts are apprehended as sign-systems for movement, so urban configurations in any urban spatial context becomes formally inhabitable. Moreover, the street layout as sign system is learned by children through movements *in* space, in contrast to learning through theoretical discourse *about* space.

Vygotsky argued – after his study with non-literate subjects – how the potential for the systemization of decontextualised sign-tools depends on the child's level of engagement within 'literate' learning environments. However, where formal schooling might affect ability with systemized thinking, later research highlighted the diverse nature of literacy, whereby children engage with different literacies of schooling and of homelife. Crucially, later research in this area revealed the complex relationship between verbally decontextualising a task and making literate use of decontextualized signs in

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[1]An arguable emblem for ineffective design inclusivity for children was London's North Peckham Estate, built between 1969 and 1975. In this case, the Borough architects intended for a series of grassed courtyards to offer spaces for 'younger members' of the community to play freely and safely. However, a contemporary design review of the estate reported how the courtyard areas were unadopted for play in favour of, problematically, the estate's pedestrian walkways. Cf. https://municipaldreams.wordpress.com/2016/10/11/the-five-estates-peckham-part-one/ [accessed April 2022]

practice (Scribner and Cole 1981). In short, children's literacies attend to decontextualised and contextualised sign systems alike, and these literacies are embedded through practice and work within their social worlds.

Vygotsky also drew attention to the contextual sign systems of speech, especially of dialogues, as it provides the semiotic potentials by which the inter-psychological ('world') plane is encountered through the intra-psychological ('person') plane. The role of dialogue – including of a person's internal dialogue – in the psychological construction of 'living reality' was theorised generally by Bakhtin (Wertsch 1985, pp.224-225). For Bakhtin, the voices within any dialogue constitute the coming into contact of indicated value systems (Bakhtin 1981, p. 304). Moreover, these individual voices are hybridised, reflecting multiple other voices derived from the social world. Hence, dialogue comprises a diversely informational sign system. It carries multiple and hybridised meanings and senses into the connecting of inter- and intra-psychological planes, and reflects the concrete, contextual values of their social environments (Bakhtin 1981, p. 229).

The perceiving mind is, in the ecological approach to its study, an extension of the body in action, and is mutually constitutive of its behavioural environment. The mutuality of person and environment forms the basis of Gibson's foundational theory of affordance, which proposes an implicate order among the animate and inanimate forms that make up an environment; as Gibson argued, "the niche implies a kind of animal, the animal implies a kind of niche" (ibid p.120). The human animal extends its mind into the environment by augmenting its body with tools – both mechanical and semiotic.

2.3   Perceptual differentiation depends on movement

A person perceives himself or herself as part of, and in terms of his or her situational environment. The potential to perceive the self in reference to the self's environment has been framed epistemologically within the ecological approach to perception (Neisser 1993, p. 6). This approach highlights the critical impact of information latent within the optical array (or of any phenomenal surface). Moreover, this information is animated for the purposes of differentiation through the person's movement in relation to the environment (Gibson 1979/2014, pp.108-109). For example, where some object blocks our view, we open our line of sight by moving in some way in relation to the occlusion. We move also to adjust our relative position in terms of navigational points in the environment (ibid p.190). Through movement we encounter the sensations, the semiotic potentials, of the people and things in our social environments.

2.4   Configurational urban spaces comprise pervasive centralities

Marcus (2015) presents a strong case for linking Space Syntax as a theory and method of urban morphology to ecological psychology. In analysing urban spatial forms in reference to the discrete units of axial geometry, we observe how we interact with relational points of reference to construct our sense of place in the urban environment (Conroy-Dalton et.al, 2005). Our observation of these

units in relation to one another is dependent on our movement in urban space; an insight that seems to be congruent with the ecological approach to perception.

The axial map that underpins Space Syntax analysis serves to break down urban spatial structures (paths, streets, roads) into the smallest set of lines that pass through their discrete positions in the urban network. The segment map, which extends the axial map to include proxies for pedestrian flows, provides a model of affordances for natural movement potential (Hillier et.al, 1993), and implies how functional centralities are pervasive and inter-connecting, rather than spatially fixed and discrete (Hillier, 2001). This pervasive centrality has the effect of, we argue, 'decentring' the observer: of placing him or her as a dynamic component of the environment, whose viewpoint is also a point of reference for other participants in that environment. Hence, considering the notion of affordance in terms of movement potential, we can observe how the urban environment is intrinsically and dependently social, in that its 'construction' (mechanical and semiotic) stems from our communicative – and, especially, dialogic – actions with reference to its material properties.

2.5   Inter-linking centralities produce informational morphologies

Hillier (2016) observed how urban spaces – cities in particular – serve to increase human contact for the production of practical and semantic knowledge. Cities have the effect of separating the means of knowledge production into foreground globalised networks, and background localised networks. This separation is observable in, for example, the commuter flows of the city's foreground, and the high-street flows of the city's background. Novel interactions among sections of foreground and background networks depend on the characteristics of sparsity (that is, weakly clustered), which compel the production of links between spatial actors, and afford informational flows between sections of the network. Dense clustering in the network has the effect of locking linkages into discrete sections, leading to informational redundancy. The network dynamics of cities afford flows of information in the production of knowledge that, to return to our main topic, come to shape environments in particular settings where children grow up.

The notion of affordance now offers an epistemological bridge between Space Syntax as a configurational theory of urban morphology, and ecological psychology as a constructive approach to child development. These separate paradigms view the person – the urban inhabitant, the child developing higher functions – as a dynamic and creative agent within their social-spatial environment. Space Syntax has shown how urban spatial environments bear pervasive centralities, compelling their inhabitants to move between distributed and variegated cores of network integration. This movement is crucial for the production of differentiation in phenomenal surfaces (including the line of sight along a street), and this differentiation is dependent on communication through dialogue, and the adoption of multiple 'voices' within dialogue, so as to stabilise and embed our common sense of place. In considering these themes, we present a model for ecological approaches to children's development within urban spatial contexts.

2.6   Transitioning between developmental settings creates perceptual 'content'

To fully consider children's development within an ecological, urban spatial perspective, we must consider the inequalities of children's development, including those relating to space and to time. Critically, the sense of place for children is constrained and fundamentally influenced by the circumstances in which they are growing up. Children make use of dialogic voices to construct their perceptual ecologies. However, their abilities to make use of multiple voices in a beneficial capacity might depend on factors of class, race, gender, access to education, or other learning contexts.

Children growing up in 'postmodern' milieu incorporate consumerist voices of advertising and entertainment; sometimes at intense informational frequencies. The nature of these voices changes rapidly over the few years of 'higher' childhood development, and marked by indications of morally sophisticated or compromised values; for example, relating to gender identities. Consider a situation, as described by Hanley (2006), in which a teacher vocally divides activities for girls and boys into hairdressing and car maintenance respectively. The children do not learn from education policy in a professional domain; they learn from the teacher's voice in the classroom environment. That voice brings the differentiation of a certain social-spatial perspective; the perspective by which children become bound economically and socially to specific kinds of place.

Observations of this kind – of the impacts of social-spatial interactions within developmental contexts – formed the basis of Bronfenbrenner's Ecological Systems Theory (ECT). ECT explores developmental ecologies as nested hierarchies of interactions within and between developmental settings. ECT encompasses cultural and historical contexts for development, and it attends to the 'micro-system' interactions of, for example, home or classroom environments. However, we limit our present focus to ecological meso-systems, which are built from transitions and interactions between micro-systems. Meso-systems might incorporate elements of the local built environment, such as street corners, bus shelters, crossing points, and involve movements that serve to animate perceptual differentiation: to create contrasts among the experiences of micro-system environments, and to learn from the social-spatial interactions that comprise the journey from one setting to another.

In summary, ECT was built initially on a basic principle of interconnectedness among the nested hierarchies of social-spatial interactions (Bronfenbrenner 1979, pp.7-8). As a theory of child 'development-in-context', ECT is distinctive as it attends to the *mutual* interactions of children and their social worlds, the interactions among agents that construct or monitor those worlds (parents, teachers, and the like), and crucially the *content* that comprises those interactions. ECT places emphasis on the dynamics of differentiation, not least the patterns of transition between different layers of complexity in the developmental ecology (ibid pp.21-27).

Bronfenbrenner's later developments of ECT sought a methodology that could observe the impact of *time* on proximal processes in child development (Bronfenbrenner, 1995). Time in this regard works on two levels: historical and life stage. In the first level, a person's life course is embedded in and

shaped by the historical circumstances in which they live. The specific impacts of historical contexts can be observed through comparisons with others not affected directly by those events. In the second level, the life stage at which a person makes a transition from one setting to another bears variable effects in later life stages.

3   METHODOLOGY

In this section, we seek to test the notion that Space Syntax analysis could help to delineate ecological, meso-system interactions in urban spatial contexts for child development. The analysis by way of case-studies will be applied to contemporary road-network maps pertaining to two biographical histories, described by Lynsey Hanley (2017) and Patrick Joyce (2021) respectively. These histories provide detailed descriptions of comparable English suburban settings, at distinctive historical periods, and in contrasting urban morphologies. The biographies each describe aspects of socio-cultural development in urban community settings, and place these in broader historical contexts of housing policy and town planning.

3.1   Questions for research

In analysing these biographical histories the investigation will respond to two questions:

- Can Space Syntax help to delineate spatial contexts of social encounters as ecological meso-systems for child development?
- Can Space Syntax be applied as a method of analysis for differentiating transitions between developmental settings?

3.2   Case studies

Hanley (2017) presents a biographical history of growing up in the 1980s on The Wood, a large council housing estate in the West Midlands region of England. This region experienced intensive industrialisation and urbanization in the 19th century, featuring inward migration from Wales and Ireland for economic and welfare opportunities, followed by deindustrialisation in the 20th century, and subsequently experiencing migration from south Asia and the Caribbean. Slum clearance in the mid 20th century led to the building of new public housing settlements at metropolitan peripheries, orientated to light manufacturing and service industries. The housing on these settlements was intended to meet, on affordable terms, the general needs of workers receiving low-to-average incomes. The 'mass' nature of building council estates to fulfil specific socio-economic objectives became reflected in self-similar (what Hanley saw as 'fractals') patterning in architecture and urban design (ibid p.42).

Hanley's The Wood estate was developed in the 1960s; claimed from green-belt woodland through local authority legislation, impelled by the Housing Act of 1949. The Wood's town plan was based on a Radburn Concept and responded partially in its design to extant ancient trackways. The masterplan

was intended to separate cars and pedestrians through a system of distributor roads and low-density residential cul-de-sacs, which were interconnected by ground-level, elevated and subterranean walkways. Hanley describes vividly the social and psychological impacts of this functional and aesthetic homogeneity in terms of 'the human mind caged by the rigid bars of class and learned incuriosity' (ibid p.7).

From Hanley's wide-ranging account, five discrete descriptions of social encounter have been highlighted for spatial analysis. These have been extracted exclusively from the textual evidence presented in her account, as well as from contemporary maps. The author's home is described as being on a 'boomerang-shaped crescent' on extreme south-eastern border (ibid p.23). Hanley describes the key feature of a subway that ran under a main road close to her home, forming a link to her grandmother's house and to primary school, where she played independently as an infant, (ibid p.45). The subways were 'places of refuges and escape routes, yet they also created a 'natural boundary beyond which we rarely ventured'. However, this ostensibly safer play-space also brought Hanley as an infant into contact with the 'ubiquitous feature' of pornography, in the form of torn and discarded magazine images, leaving the author with an impression of 'dirtiness and seediness [that] seemed to infiltrate everyday sights and exchanges' (Hanley 2016, pp.65-66).

Hanley describes the location of her grandmother's house as being near to her family home on a dedicated pedestrian walkway, which was typical of the urban layout in some areas of the estate. Similarly, her disabled aunt lived in a house on a walkway so closely arranged that, standing on the doorstep, she could touch the opposite neighbour's front door. Her aunt would keep her front door unlocked to allow ready access to her frequent visitors (Hanley 2017, p. 35). These walkways 'helped people to know one another' (ibid, p. 32). Close to Hanley's grandmother's house was the location of her primary school; its location among the walkways meant that 'great trains of children' could make their journey to school independently (Hanley 2016, p. 59). Hanley describes a pedestrian footbridge that traversed three roads to reach the shopping precinct, where many of her childhood memories were made (ibid p. 39), and brought her into contact with everyday activities of shopping for groceries, eating takeaway, reading at the library, petty gambling, and waiting for buses.

Joyce's biographical history (2021) includes a description of his childhood in London's Notting Dale, part of North Kensington. The area was developed during the late 19th century around previously agricultural land parcels, which were sold to commercial developers following improvements impelled by the Artisans' and Labourers' Dwellings Improvement Act of 1875. Streets were laid out among these land parcels along intersecting, rectilinear axes that supported high-density housing: the familiar Victorian English terraced street.

The area had been associated historically with agricultural and manufacturing industries, the centres of which came to be jammed between railway and canal infrastructures. The area's main Harrow Road followed an ancient trackway on an east-west axis, reaching from the outer countryside to the capital's

historical centre. Following a roughly adjacent path was the Grand Union Canal. The canal formed an internal barrier between different sections of the local area, yet could be traversed at a key crossing point, the Ha'penny Steps. Subsequently the urban layout surrounding these erstwhile industrial sites and ways, well established by the 1870s, followed a system of rectilinear and triangular grids, interlaced by rigidly perpendicular streets, comprising a set of interstitial residential zones.

The general urban layout of Joyce's childhood had changed very little since the late 19th Century. The area described by Joyce had experienced inward migration from Ireland and the Caribbean in the mid 20th Century. Joyce's family experience was characteristic as being strongly embedded in Irish customs and practices, and sought to recreate the traditional Irish family dwelling, centred around the hearth: 'the sun around which everything is set into motion' and which 'burns still in the centre of the mind'[2]. However, the centring of family life around the hearth was constrained by the Joyce family's circumstances of dwelling in a town house converted into apartments.

The Joyce family home was situated at 11 Ashmore Road, located within a 'notorious… slumlet', a 'whole festoon… of the sinisterest highways in our city'[3]. Yet the crossing point of the Ha'penny Steps was a 'magic place' where the author bought comics from a street vendor (ibid p.62). The steps were situated next to Wedlake Street Public Baths on the canal's south bank. Joyce describes his weekly trip to the baths for ablutions, passing a disabled veteran of the Second World War, begging and hawking at the foot of the canal-side steps, for whom he felt 'pity and fear'. The waiting room for the baths also put Joyce in touch with the 'working classes sharing our lot, keeping order, being ordered' (ibid p.64).

Ashmore Road led directly onto Harrow Road, a shopping high street that 'catered to almost every conceivable need', encountered by the author as a 'changeless succession of waystations', and representing a 'densely textured continuity', from the intimate needs of homelife to observations among the 'world of shops', including that of a cobbler 'always at his last, his fingers deformed by his trade', (ibid pp.62-63).

Joyce attended Cardinal Manning Secondary Modern on St Charles Square, the route to which led through Southam Street. As the Ha'penny Steps were the only means of crossing the canal, the route through Southam Street towards the Goldborne Road bridge was the only means of traversing the railway lines. This was unavoidably 'a street that stank' of 'dirt and decay', that put the author into contact with 'usual awfulness of the disrepair of buildings', with the 'sadness and destructiveness of the place', with the 'fraught arguments… conveying the sheer sense of people's helplessness' (ibid pp.66-68).

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[2] Quoting from Glassie, H. (1995) *Passing the Time in Ballymone: Culture and History in Ulster, reprint edition*. Bloomington, IN. Indiana University Press.

[3] Quoting from MacInnes, C. (1959/2011) *Absolute Beginners*. London: Allison & Busby Ltd.

3.3   Methods

The biographical locations highlighted in the Case studies section, above, were plotted over a digital tracing of the contemporary road network, processed using the core Space Syntax software, Depthmap[4]. The digital tracings were limited to the major roads that surrounded the core areas described in the authors' accounts. These limits may not align with formal boundaries, but they present bounded spatial continuities within the authors' biographical horizons.

The computational methods applied to the road network map were Integration and Choice, both normalized, at radii of 500m, 2000m, and global. Choice is associated with a road segment's level of affordance in traversing a space ('through-movements'), and Integration with its level of affordance as a point of origin or destination ('to-movements'). Integration analysis often reveals the key 'cores' or 'centres of gravity' for origin/destination movement potentials. A road segment can afford both through- and to-movements simultaneously, and at different radial scales. In this way Space Syntax allows us to separate and observe the diversity of movement potentials that converges on specific road segments.

In this section, we focus on two key syntactical metrics: Choice at a radial scale of 500m, and Integration at the global scale. The value ranges associated with these metrics is presented for each case study in Tables 1 and 2, below. The purpose of limiting the metrics for analysis is to observe how the through-movement potentials associated with highly local journeys intersect with the to-movement potentials across the sampled area as a whole. This anticipates how, in the present context, a child's journey from one developmental setting to another, such as from home to school, encounters the traffic of everyday life, which brings the possibility of enriching the quality of encounter within his or her urban community setting.

Table 1: Depthmap value ranges for 1980s 'The Wood'

Text descriptions	Normalised Choice (NACH), 500m	Normalised Integration (NAIN), global
Very low	0.000-0.762	0.459-0.599
Low	0.762-0.887	0.599-0.646
Low-to-moderate	0.887-0.961	0.646-0.689
Moderate	0.961-1.029	0.689-0.728
Moderate-to-high	1.029-1.109	0.728-0.771
High	1.109-1.226	0.771-0.833
Very high	1.226-2.197	0.833-3.719

Table 2: Depthmap value ranges for 1950s North Kensington

Text descriptions	Normalised Choice (NACH), 500m	Normalised Integration (NAIN), global
Very low	0.000-0.864	0.517-0.779
Low	0.864-0.982	0.779-0.870
Low-to-moderate	0.982-1.050	0.870-0.933
Moderate	1.050-1.130	0.933-1.026
Moderate-to-high	1.130-1.195	1.026-1.081

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[4] Available via https://varoudis.github.io/depthmapX/

| High | 1.195-1.316 | 1.081-1.168 |
| Very high | 1.316-1.529 | 1.168-1.467 |

4   ANALYSIS

Hanley's family home was situated on a crescent-shaped road at the estate's south-east edge, part of a discrete planning 'Zone 6' within the development (Figures 1 and 2). The zone is bounded by road segments featuring high-value to- and through-movement potentials (indicated by orange and red colour-codes in NACH r=500 and NAIN r=global). These high-value 'circulatory' segments contain sets of 'stagnatory' segments that are of lower-value movement potential. Hanley's grandmother's home was situated within one of these 'cells', which seems to have afforded close social contact between local residents. A pattern of circulatory bounding segments containing stagnatory inner segments was reproduced across the estate's town plan. This self-similarity is perhaps reflected in Hanley's description of the urban landscape's 'fractals'. Comparing the Space Syntax map with a current road-network map reveals that the circulatory routes are linearly complex, comprising central roadways and outer pathways. Hence, the moderate-to-high value through- and to-movement potentials are distinctive in that they promote non-roadway circulation within their cellular zones. This is reflective of Radburn planning principles – separating cars and people – within the movement infrastructure.

Biographical locations in "The Wood", West Midlands
Normalized choice r=500

Legend

FTB.......Footbridge
SBWY.....Subway
Sch.......Primary School
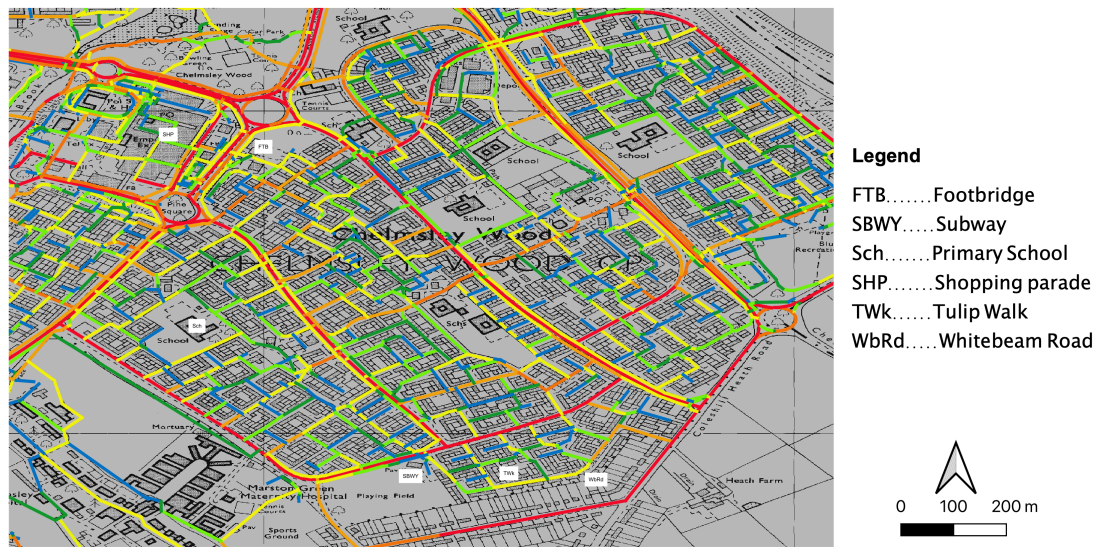SHP.......Shopping parade
TWk......Tulip Walk
WbRd.....Whitebeam Road

Figure 1: 'The Wood' 1980s layout with Space Syntax normalised choice r=500m

Hanley describes playing independently of adult supervision within a pedestrianized subway complex, situated on Helmswood Drive. The subway formed a functional bridge between one 'cell' and its neighbour, and was one instance of a feature common to the town plan as a whole[5]. While children made use of the subway as a play space, the complex remained a component of the areal integration

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[5] The estate's subways were infilled and replaced with pedestrian crossings, c.2010-11.

core (albeit a weak core), reflected in moderate to-movement values (indicated in yellow, NAIN r=global). Hence any children playing in the subway would have been put in contact with the everyday traffic of adults or adolescents.

Hanley's primary school was located within a large 'cell' to the estate's west and south. This cell presented overall low local through-movements (NACH r=500), with higher through-movement potentials along the segments perpendicular to high-value circulatory segments (NAIN r=global), perhaps promoting through-movement from the circulatory routes into the local walkways, but not distributing these flows within the walkways. This cellular patterning, which discretely contains movement potentials, meant that children could walk to school independently, without encountering car traffic along their regular routes.

Biographical locations in 'The Wood', West Midlands
Normalized integration r=global

Legend

FTB.......Footbridge
SBWY.....Subway
Sch.......Primary School
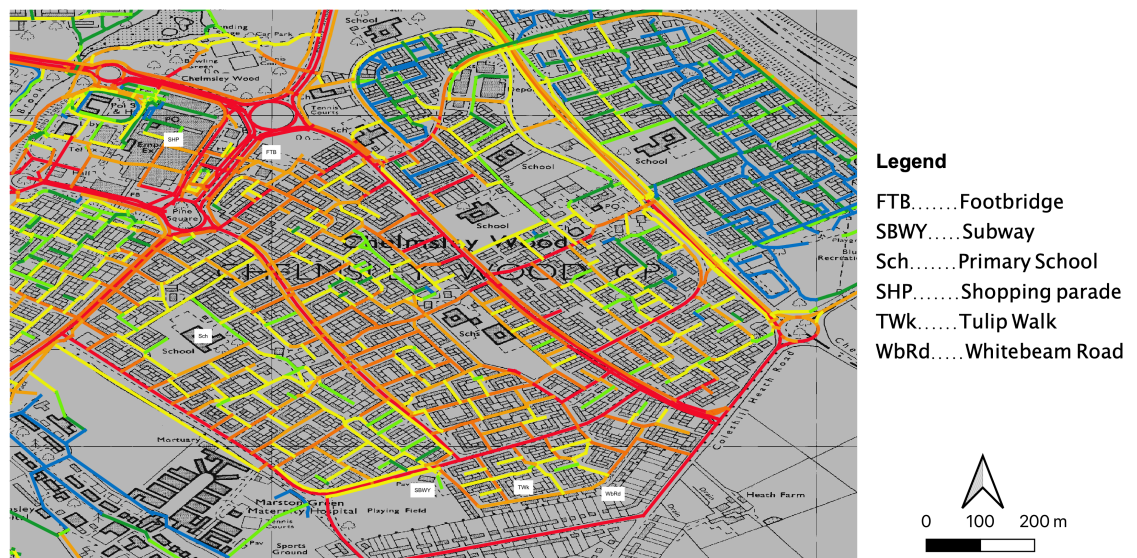SHP.......Shopping parade
TWk......Tulip Walk
WbRd.....Whitebeam Road

Figure 2: 'The Wood' 1980s layout with Space Syntax normalised integration r=global

Hanley describes the view from a footbridge over three roads, leading to the estate's main shopping centre. The bridge stems from network's main integration core (NAIN r=global), and traversed one of the major circulatory routes around the estate. Hanley's description of this view testifies to the segment's affordance for gaining perspective, to see how the circulatory routes serve to bind the stagnatory routes of the pedestrianised cells.

The adjoining shopping centre is situated within the estate's major integration core (indicated by red colour-codes; NAIN r=global). However, the internal shopping parade bears only moderate values for through-movement (indicated by yellow and green colour-codes; NACH r=500). The centre's rectilinear layout would not, according to Space Syntax theory on this matter, promote natural through-movement potentials within its local network (cf. Hillier, 2001). The shopping centre also follows the self-similar cellular form, of weaker local through-movement bounded by high-value to-

movements, possibly serving to enclose movement within the centre's spatial layout. The centre's position within the integration core foregrounds its function as a centre of gravity for the entire estate, and is perhaps reflective of this socially enclosing space. Hanley describes abundant social encounters stemming from time spent at the shopping centre that, while numerous, were arguably socially homogenous, and reflected the inwardly directed nature of movement potential within the estate.

Joyce's family home was situated close to the junction of Harrow Road high street, and the intersections of three tertiary roads to its perpendicular (NACH r=500; Figure 3). These linearities promoted high local through-movement potential (indicated on by orange colour-code). The family home lay beyond the northern limits of a pronounced integration core, centred to the southern edge of the map at the intersection of Ladbroke Grove – running along a straight north-south edge to the area's west – and Goldborne Road (NAIN r=global; Figure 4). Harrow Road itself presents very high local through-movement potential along its stretch (indicated by red colour-code), with only moderate to-movement (origin/destination) for the area as a whole. Compare this with the very high to-movement along Ladbroke Road, which appears to represent the area's major centre-of-gravity. Harrow Road's higher local through-movement and moderate areal to-movement affordances, considered in combination, are perhaps associated with the minor attraction of an 'enclave' high street.

The Harrow Road thoroughfare would have formed the major component of Joyce's regular routes to Wedlake Street Baths and to secondary school, which were situated on the southern side of the Grand Union Canal. The canal presented a firm barrier for community life, in terms of both physical infrastructure and the olfactory nature of the industrial waterway. We have already noted that the only means of crossing the canal was via the Ha'Penny Steps, shown on the map as integrating the steps, bridge and pathway. The steps present high local through-movement potential (NACH r=500, indicated in orange), which is unusual for a segment of relatively short metric length, and of only moderate degree connectivity within the local road network. The Ha'Penny Steps complex functioned as a bridge between the northern and southern sub-networks. However, the moderate to-movement potentials for the area as a whole (NAIN r=global), is perhaps suggestive of a structure that promoted primarily local movements.
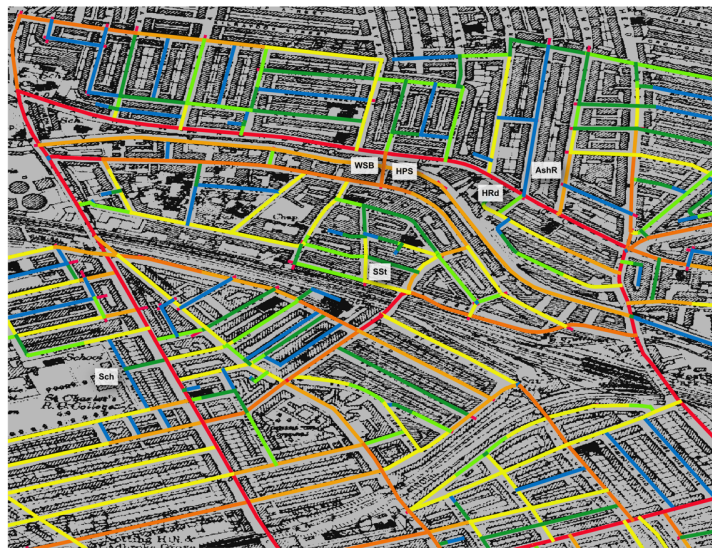
Biographical locations in Notting Dale, London
Normalized choice r=500

Legend
AshR....11 Ashmore Road
HRd.....Harrow Road high street
HPS.....HaPenny Steps
Sch ..... Cardinal Manning School
SSt.....South Street corner
WSB....Wedlake Street Baths

0   100   200 m

Figure 3: Notting Dale 1950s layout with Space Syntax normalised choice r=500m

The Wedlake Street Baths building was situated similarly on a segment of relatively high local through-movement potential (NACH r=500) and moderate areal to- movement (NAIN r-global), and interconnected very high-value segments (high streets) to the west and east, including the bounding thoroughfare of Ladbroke Grove. The Baths building appears to be situated to the fore of a natural-movement centrality within the local network, reflected in Joyce's description of its socially homogenous clientele.

Joyce's route to school was compelled towards Goldborne Road's railway bridge, the only means of crossing the tracks, which presents a very high-value segment for local through-movements and areal to-movements. Joyce reached the railway bridge by passing through Southam Street, which he describes in terms of extreme squalor and social distress. The street presents moderate local through- and to-movement potential (indicated by yellows and greens), and appears to comprise part of a sub-network of 'laddered' streets presenting overall weak affordances for movement. As such, this sub-network appears to be spatially segregated from the wider road network. The remainder of Joyce's route to school made use of relatively high-value through- and to-movement segments associated with its proximity to the major centrality formed around the junction of Ladbroke Grove and Goldborne Road.

Biographical locations in Notting Dale, London
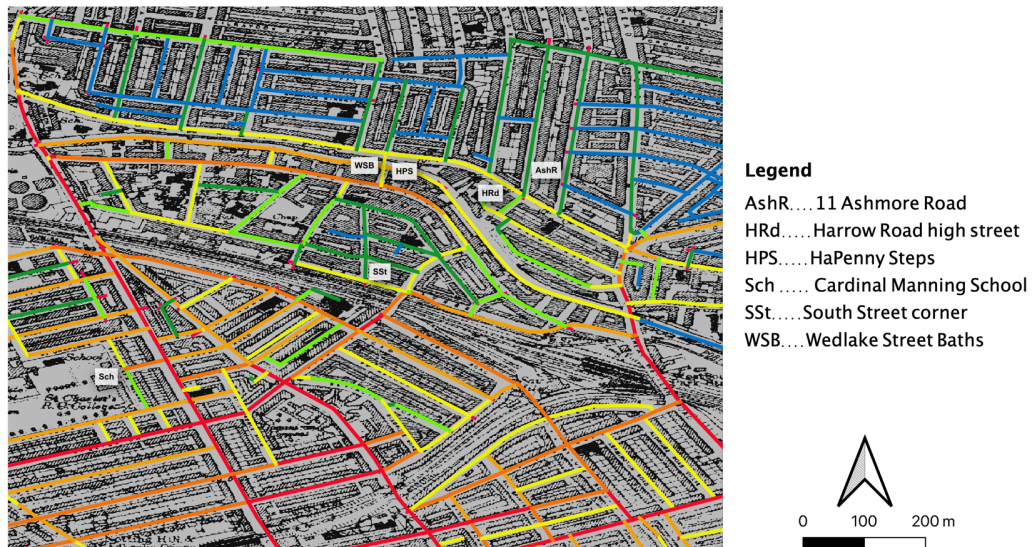**Normalized integration r=global**

Figure 4: Notting Dale 1950s layout with Space Syntax normalised integration r=global

5   DISCUSSION

The Review section of this paper, above, was organised as set of building blocks to form an epistemological bridge between the fields of ecological child development and spatial analysis with Space Syntax. We considered how the notion of affordance in urban environments stems from the animation of differentiation, a critical component of ecological perception that occurs as part of movement between developmental settings. We noted how differentiating transitions form meso-systems in child-developmental ecologies. We also noted how Space Syntax offers a model of movement potential – the affordance for movement – based on the inter-relatedness of discrete road-network segments. Children growing up in urban spatial circumstances build their knowledge of the world from social encounters that are underpinned spatially by these inter-related structures. In this Discussion section, we attend to spatial contexts of these social encounters, with reference to our topical review themes and to the findings presented in the Analysis section, above.

Movement within urban community contexts was a feature of the bibliographical histories we analysed. Each author has described experiences of journeys to shops and schools, crossing key points along their routes – such as Joyce's Ha'Penny Steps and Hanley's subway. These movements also served to differentiate their experiences of developmental settings. Joyce notes the 'positive' differentiation (in the sense that the difference has been experienced) of comparing his home with those of squalid conditions on Southam Street, or with the decrepitude of the hawking veteran by the Ha'Penny Steps, or the work-deformed hands of the cobbler on Harrow Road. Joyce also notes the 'negative' differentiation (in the sense of experiencing a lack of difference) involved in reinforcing his social identity among the working-class clientele of Wedlake Street Baths. Hanley describes how the subway near her home was a regular component of her route to school, and also a place for playing.

The subway was part of the regular route for many residents, and not a space that was set aside or protected for children's activities. Children's and adults' movements converged on this space, bringing Hanley into contact with discarded pornographic images. The subway became a space of positive differentiation, as Hanley encountered this torn-up imagery and traces of behaviours as being distinctively beyond the home environment. Hanley also describes crossing the footbridge from the walkway complex, over three main roads, towards the estate's shopping centre. She positively differentiates the infrastructures for her own pedestrian movements, against those of others' automotive movements.

The common feature of a walkway as a key point of traversal over infrastructure is coincidental in Joyce's and Hanley's biographical landscapes. Our analysis showed how these walkways served to channel the movements of different sections of the local populations, and brought both Joyce and Hanley into contact with differentiated social realities. These social encounters catalysed the creation of perceptual content associated with 'higher' mental functions (after Vygotsky's model, described above). The development of self-perception, for example, depends on exposure to the phenomena of other selves: with appearances of others' faces and hands, sounds and odours, behaviours and customs, with their signs of distress. By moving through community spaces, and by encountering traces of others' movements in those spaces, Joyce learned of the embodied and emotional impacts of war, and Hanley of the obscenities of sexual exploitation. The authors learned in childhood of what they would come to consider as being *classed* social realities – revolving around consumption habits along the high-street or shopping parade, or else at the public baths.

We observed in the Review section how constructivist approaches to child development tend to focus on notions of mutual constitution of person and world. As such, the developing mind extends into the world, working with information, building knowledge, shaping its own sense of place, through sign systems embedded in dialogue and normative customs. Joyce and Hanley both describe ways in which their actions around spatial forms within their biographical landscapes functioned to create sign-systems for their developing self-perception. In an earlier paper we outlined the notions of discursive and non-discursive agencies in reference to relational complexities of community spaces in urban contexts (O'Brien and Psarra 2015). Discursive agency refers to the activation of linguistic signs to conceptualise those spatial structures that serve as intermediaries to community relationships. For example, Hanley states that she lived with her family in Area 6 of The Wood. The author and her community appropriated this technical label from the estate's planning phase, and imbued it with local significance to distinguish one section of the estate from another. In her biographical history, the author seems to offer this place name on multivalent terms, reflecting its technical and cultural aspects, perhaps pointing the reader towards the experience of developing social meanings within The Wood's arguably 'programmatic' layout.

Non-discursive agency activates 'relational complexes' of physical and conceptual artefacts. As with discursive, or dialogical, agencies, non-discursive agencies also shape the inhabitant's sense of place

and identity. For example, Hanley's label of Area 6 was attached to a physically bounded reality, the 'cell' structure formed around circulatory roads and stagnatory walkways. Non-discursive agencies are evident in the elements that mark out barriers between sections of the communities, formed around, for example, a pedestrian subway or bridge, among other semantically potentiated complexes.

Both Joyce and Hanley describe sets of non-discursive agencies in their biographical landscapes, and take note of how these agencies shaped their sense of place within these developmental settings. Hanley describes the subway-as-playspace in terms of its being a 'place of refuge', 'escape route' and 'natural boundary'. For Joyce, the traditional' Irish household hearth, or else the kitchen, was an animating element, around which 'everything is set into motion'. The shops along Harrow Road's high-street become 'waystations' that compelled the author and his mother to pause on their shopping trip and, incidentally, to observe the phenomena of others' experiences.

Hanley and Joyce each recount the boundedness of their settings for growing up. Hanley describes the spatial structures of walkways and planning zones, and Joyce describes how the canal formed both a physical barrier and a malodours repellent. He also describes his encounter with the odour on the corner of Southam Street, which he associated with others' social distress. For each author, movement was shaped around the impact on perception of the phenomenal surfaces within their horizons of encounter.

Certain crossing points, waystations and intersections brought each author into contact with the traces of others' activities, and compelled discontinuities in their movements, with the effect of their gathering enriched information within these proximal settings. In this way, the spatial settings for social life afford movements that regulate flows of information from which developmental knowledge is created. Each author's sense of place and identity in adulthood was contextualised by the agencies of bounded spaces, self-similar layouts, phenomenal surfaces, and patterns of spatial centrality. While the non-discursive agencies of child development were animated in the authors' specific developmental contexts, they each came to be decontextualised for inclusion in a 'palette' for spatial description as part of their biographical histories.

6   CONCLUSIONS

In this concluding section we attend to the main research questions with reference to the topical themes of pervasive centrality and information morphogenesis. We set out to understand how Space Syntax might help to delineate the spatial contexts of growing up. The case studies served to highlight the impact of pervasive centrality on the urban movements that underpin developmental ecologies. This pervasiveness depends on the dynamic inter-relatedness of an integration core and its 'background' periphery. Hence, the variegated nature of centrality allows for the spatial integration of distributed peripheries, meaning that urban movements from different sections of the network – or, at least, traces of these movements – are compelled to interface at certain segments within the network.

Pervasive centrality can, in the context of child developmental, be seen as a governing affordance in urban spatial meso-systems. That is, the inter-dynamics of spatial centres and peripheries bring children into contact with the phenomena of others, albeit with positive and negative consequences.

We sought to consider how Space Syntax offers a method for observing transitions between developmental settings, following the meso-system model set out by Bronfenbrenner (1979). A strength of Space Syntax lies in its normative presentation of movement potential, which allows us to delineate the configurational affordances for movement from relationships among spatial structures at different radial scales: for example, how local movement potentials converge with city-wide movement potentials. This formal normativity also allows Space Syntax models to the placed within phenomenal contexts, including biographical histories or psycho-geographies, as the work outlined in the Analysis section, above, has demonstrated.

While Space Syntax alone cannot account for the phenomenal realities of social encounters – be they with people, artefacts, or surfaces – its theory and method serve to delineate the spatial mechanics by which these encounters occur. Moreover, the syntactical nature of these mechanics – featuring, that is, regular hierarchical relationships among road segments – allows us to decontextualise the spatial settings of development, and to draw comparative analysis of these settings, as our Analysis has shown. For example, where Joyce and Hanley each describe the impacts of shopping centres on their growing awareness of the world at large, our application of Space Syntax has been able to shed light on how the spatial configurations of these settings served to contain movement within their socially classed enclaves. Working with Space Syntax in this way offers a wide-angle viewpoint on the spatial contexts for the authors' childhood experiences.

Our analysis was based on a limited set of metrics, Choice r=500m and Integration r=global. This helped us to observe how affordance for localised through-movements might intersect those for wider-scale to-movements. In other words, to look for evidence in the Space Syntax models for any patterns that afford the day-to-day journeys described by the authors, which involved encounters with others, their phenomena or their traces, from across the biographical landscapes. This overlaying in the model of different kinds of movement potentials at different radial scales provided opportunities to observe the 'dialectical' nature of urban realities, in the sense that these emerge from interactions among divergent socio-spatial entities, including those of scale, proximity, or temporality. Hence, the spatial configuration that brought Joyce to the corner of Southam Street consisted of the author's integrative through-movement, part of his journey to school, interacting with the segregated origin/destination movements of the Southam Street area. The spatial configuration that involved qualitatively distinctive movement potentials, at divergent radial scales, afforded the author's encounter with that street's sensory surfaces – the smell of dirt, the sounds of arguing, the sight of dilapidation – that became powerful signifiers of otherness in a state of social distress.

In conclusion, in this paper we have deepened our theoretical knowledge of developmental ecologies and used Space Syntax to analyse spatial settings for child development. We have shown how syntactical spatial configurations can be analysed as sign systems for movement, providing both contextualized affordances and decontextualized relationalities for mediating movements. Urban movements in child development serve to differentiate the developing 'self' from the encountered 'other' as a primary mode of knowledge-building. The selected biographical histories have provided reflective descriptions of urban movements in child development. However, Space Syntax's methodological independence makes it available to analysis in a wider range of child-development domains; for example, based on evidence from geographic, mobilities or public health data. As such, Space Syntax offers a flexible and context-independent theory and method for delineating the urban spatial contexts of child development.

ACKNOWLEDGEMENTS

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