Relativity Theory in Urban Space Design

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Abstract: *This paper aims to throw light on the complex relationship between relativity and urban identity. In other words, the paper focuses on a space between the human and the buildings, in which way finding signs create connections and meanings as they are used. Special relativity implies a wide range of consequences, which have been experimentally verified, including length contraction, time dilation, relativistic mass, mass–energy equivalence, a universal speed limit and relativity of simultaneity. This article presents how authors within **Past** and **Present** have studied space, place and scale. It emphasizes that spatial history can serve as methodology, approach and object. Suggesting that (bounded) places are fundamental in providing a sense of belonging for those who live in them, humanistic perspectives propose a definite but complex relationship between the character of specific places and the cultural identities of those who inhabit them. This results in compelling empirical evidence of a high level of regularity regarding time and spatial correlations in urban sprawl, unravelling patterns about the **inertia** in the growth of cities and their **interaction** with each other.*

Keywords: Relativity, Mass–Energy equivalence, Space-place-scale, Spatial correlation

1. Introduction

In physics, special relativity (SR, also known as the special theory of relativity or STR) is the generally accepted and experimentally well-confirmed physical theory regarding the relationship between space and time. In Albert Einstein's original pedagogical treatment, it is based on two postulates Special relativity implies a wide range of consequences, which have been experimentally verified, including length contraction, time dilation, relativistic mass, mass–energy equivalence, a universal speed limit and relativity of simultaneity. It has replaced the conventional notion of an absolute universal time with the notion of a time that is dependent on reference frame and spatial position. Rather than an invariant time interval between two events, there is an invariant space time interval. Combined with other laws of physics, the two postulates of special relativity predict the equivalence of mass and energy, as expressed in the mass–energy equivalence formula $E = mc^2$, where c is the speed of light in a vacuum.

The dimensions (e.g., length) of an object as measured by one observer may be smaller than the results of measurements of the same object made by another observer (e.g., the ladder paradox involves a long ladder traveling near the speed of light and being contained within a smaller garage). Similarly, suppose a measuring rod is at rest and aligned along the x-axis in the unprimed system S. In this system, the length of this rod is written as Δx. To measure the length of this rod in the system S', in which the rod is moving, the distances x' to the end points of the rod must be measured simultaneously in that system S'. In other words, the measurement is characterized by $\Delta t' = 0$, which can be combined with the fourth equation to find the relation between the lengths Δx and $\Delta x'$: for events satisfying, This shows that the length ($\Delta x'$) of the rod as measured in the frame in which it is moving (S'), is *shorter* than its length (Δx) in its own rest frame (S).

2. Spatial Theory and Religious Studies

Since ancient times space and religion have been intertwined in cosmologies and geographies. For instance, in *Geography*, the Greek geographer Strabo traces the topography of the ancient world using a religious imagination. In a similar fashion, the cosmology of the Judeo-Christian tradition grounds space in scripture. This tradition carried forward into the middle ages as Medieval scholars and theologians searched for and pronounced correlations between scripture and the natural world, assuming that the Bible accurately dictated spatial order. In the sixteenth and seventeenth centuries scholars began to attempt to harmonize scientific thought with scripture. This produced a new genre of geography, one that emphasized divine providence and a Christian teleology. Within this new genre, Gottlieb Kasche first coined the term "geography of religion" in his 1795 book, *Ideas about Religious Geography*. Kasche joined space to religious missionary interests to produce a comprehensive ecclesiastical geography.

By and large the study of space in twenty-first century religious studies has moved beyond studying the confines of sacred space. For instance, Lily Kong calls for an analysis of new religious geographies in her article, "Mapping 'New' Geographies of Religion: Politics and Poetics in Modernity" (2001) that encompass "global, national, regional, local" and bodily spaces differentiated according to gender, age, and social preference (p. 226). Kim Knott and Thomas Tweed have also called for an evaluation of space in religious studies beyond the sacred. In her book, *The Location of Religion: A Spatial Analysis* (2005), Knott offers a spatial methodology for examining religion in modernity. Through an investigation of secular places and objects Knott aims to offer a new perspective on the relationship between religion and the physical, social, and cultural arenas in which it is situated. More specifically, Knott highlights the role of the body in the experience and representation of space in a case study: the location of religion in the left hand. Similar to Knott, Thomas Tweed aims to reorient the study of religion according to spatial theory in his book, *Crossing and*

Dwelling: A Theory of Religion (2006). Tweed theorizes religion in relation to three themes: "movement, relation, and position" (p. 5). He also constructs a definition of religion according to spatial terms: "Religions are confluences of organic-cultural flows that intensify joy and confront suffering by drawing on human and supra-human forces to make homes and cross boundaries" (p. 54). Tweed's theoretical model allows us to consider religion as a spatial entity, to apply spatial concepts to the material, social, and cultural locations of religion. Henri Lefebvre (see also Edward Soja) says that (social) space is a (social) product, or a complex social construction (based on values, and the social production of meanings) which affects spatial practices and perceptions. He explains space embraces a multitude of intersection in his great book, "Production of Space". That means that we need to consider how the various modes of spatial production relate to each other.

He argues that there are three aspects to our spatial existence, which exist in a kind of triad:

1) First Space (Physical space/perceived space) "The spatial practice of a society secretes that society's space; it propounds and presupposes it, in a dialectical interaction; it produces it slowly and surely as it masters and appropriates it."
2) Second Space (Mental space/conceived space) "Conceptualized space, the space of scientists, planners, urbanists, technocratic subdividers and social engineers, as of a certain type of artist with a scientific bent -- all of whom identify what is lived and what is perceived with what is conceived."
3) Third Space (Social space/lived space) "Space as directly lived through its associated images and symbols."

3. Scale: The local and the global

The Committee on Support for thinking spatially (2006, p.12) (the Committee) defines spatial thinking as a constructive amalgam of three elements: concepts of space, tools of representation, and processes of reasoning." Spatial structures and spatial reasoning are essential to perception and cognition. Much day-to-day practical information is about what happens at certain spatial locations. Moreover, spatial representation is a powerful source of geometric intuitions that underlie general cognitive tasks. Constraining space within the bounds of a logical theory and using related formal reasoning tools must be performed with particular care. One cannot expect the move from space to formal theories of space to be complete. Human life and human behavior are always situated in a particular space and/ or place. Place often represents the "here and now of immediate perception" (Ford & Harding, 2004, p. 817). Space on the other hand generally represents a certain broadness of perception. Organizations are particular kinds of spaces, in the sense that they embrace human behavior.

These organizational spaces are designed with a purpose in mind. They succeed (or fail) to the extent that these 'spaces' evoke the desired behaviors from their 'members' necessary to achieve the organization's purpose (Liedtka & Parmar, 2012).

4. Urban and Architectural context

Lynch sought to define the 'image of the city' through identity, structure and meaning, with the concept of 'imageability: that quality in a physical object, which gives high probability of evoking a strong image in any given observer.' He based this on earlier ideas about the attributes of an artistic object. If looked at from the perspective of visual culture, with its strong emphasis on cultural identity and weaker sense of the visual that also considers social factors, the scope of objects that contribute towards understanding the city image is wide. These graphic images are explored and exposed in this paper as 'mesographic' messages, at the interface between a number of competing dualities: between a political party and its public; between large-scale urban development and local agriculture; between politics and religion; between petty bourgeoisie and peasantry; between employers and workers; between nationalisation and private enterprise; and between the present and (unpleasant) past. Forms and functions of urban graphic visual elements (wayfinding signage) and their interaction with urban space, culture and identity. It is argued that urban graphic visual elements do not only indicate or reflect urban culture and identity, but are one of the effective ways in which social beliefs, commercial values and cultural identities are created, reproduced and disseminated. Some examples of Beijing's current way finding signs will show how these signs relate to society and culture and are used to construct and communicate a definite urban identity or brand for Beijing – a world city with its own local characteristics.

More specifically, the traditional and the modern, the local and the global, are expected to be culturally linked in Beijing. Skyscrapers of the Central Business District (CBD), avant-garde urban sculptures, high-tech transportation and public infrastructure constitute the modern image of Beijing. In the meantime, the city remains the traditional cultural centre of China, an oriental ancient country, having preserved its many historical relics and traditional values and ideologies. Against this background, since 2001 Beijing's graphic wayfinding systems have been systematically organised and improved to increase urban circulation and transportation efficiency, enhance cultural experience, actualise city brand individuality and boost urban competitiveness.
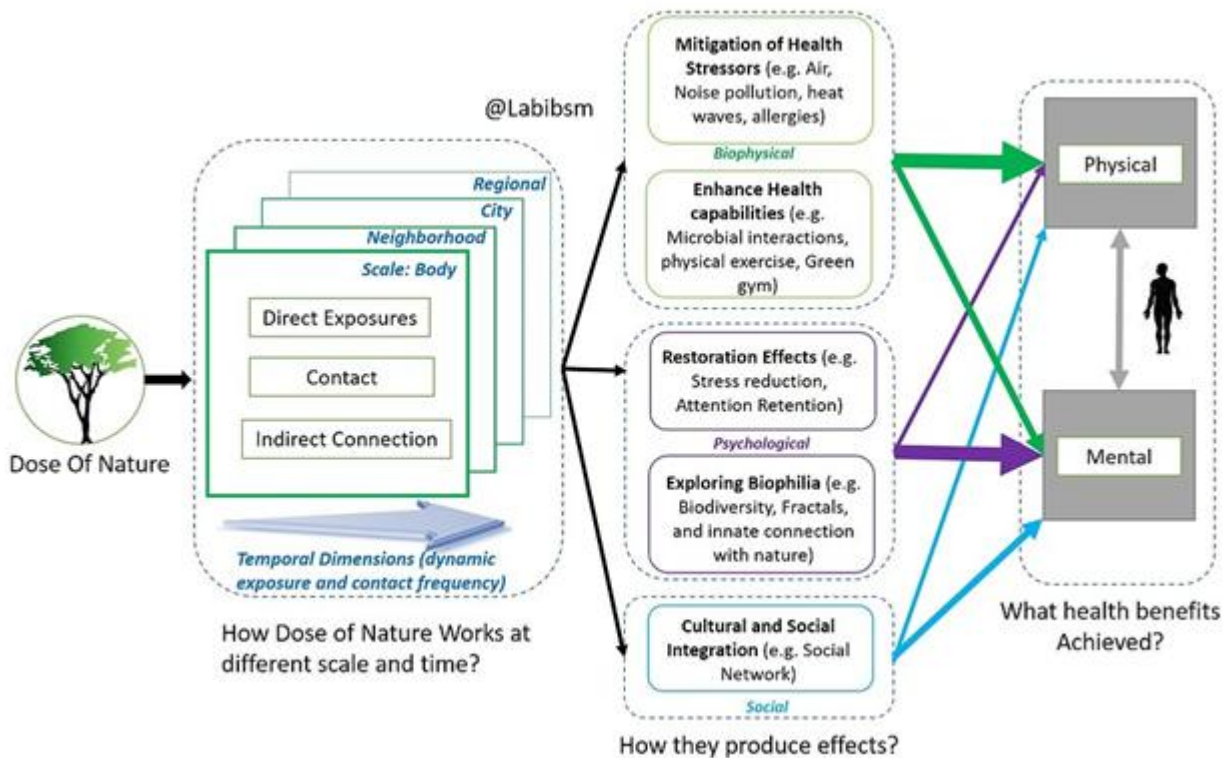
Figure 1: Conceptual model of space time relativity in human nature reaction at city level

Prototype mechanism for the creation of visual representations of cities aims to communicate their identity. The mechanism combines expression elements from urban design, cartography and painting.The term 'spatial image' implies that the embeddedness of the object in a spatial framework is central to its function as a site of resistance to the wiping clean of modern space. Local tradition calls attention to the site as having a connection to its collective past and frames it as a 'spatial image' that is read against the (otherwise anonymous) abstracting forces of urban transformation. The 'framing' is crucial, for it must not simply preserve the object, but also the mode of encounter.16 The 'spatial image' thus retains not only physical traces of the location, but also the traces of the mode of encountering that place; 'image' in this sense implies a network of relations rather than simply a visual object. In unpacking the spatial images of the past fifty years in Berlin, a visual culture approach which understands the image in this way is crucial to interrogating how a spatial image functions as place memory in a 'memory contest'. This is not a contest in the conventional sense, where there is a contest over the meanings and narratives to be attributed to a particular location.A landscape or indeed a cityscape is the product of an encounter between the viewer and an environment, so that an environment is not in and of itself a 'unique sight', as the position of the viewer is not the same each time. That encounter is also dependent on the position of the viewer vis-à-vis the object.

Spatial images need not only be site-specific installations, but can be produced in other forms of visual culture that involve an encounter with, and carrying over of, an indexical image of a particular site.Conceived space, on the other hand, indicates the way space is planned in abstract conceptualizations, an organizational prerogative of technocrats and urban planners, an instrumental space imagined through technical representations of space (e.g. maps, plans). For Lefebvre, this is "the dominant space in any society" (1991/1974: 39), so a powerful form of political control.

Lived space, which Lefebvre also calls representational space, is "the dominated space which the imagination seeks to change and appropriate" (Lefebvre, 1991/1974: 39). It is how we imagine the spaces we use, what such spaces mean to us. As a temporal and process-friendly reading puts it, lived space is "space as produced and modified over time and through its use, spaces invested with symbolism and meaning space as real-and-imagined" (Elden, 2004b: 190; see also Soja, 1996).The concept of well-being refers to the quality of people's lives which is regarded as "a dynamic process, emerging from the way in which people interact with the world around them" (Rees, Bradshaw, Haridhan, & Keung, 2010). Ben-Arieh et al. argued that "individual well-being is influenced not only by personal attributes, but also by the characteristics of the contextual factors emphasizing the significance of interactions among individuals, family, peers, schools, neighbourhood, the broader community, and society at large, the structure and processes of these contexts can facilitate or hinder access to social and material resources which is vital for a human's survival, development, protection and participation" (Ben-Arieh et al., 2001).

5. Conclusion

Special relativity implies a wide range of consequences, which have been experimentally verified, including length contraction, time dilation, relativistic mass, mass–energy equivalence, a universal speed limit and relativity of

simultaneity. Cities are unique in their connections, sizes and densities. These factors provide economic advantages for urban development starting historically with small networks of cities and then leading on to extensive urban development in traditional civilizations. Two major trajectories of historical urban development are described, the familiar "western" one and a more coherent eastern world. After the last two centuries of intense and unprecedented urbanization, we need a clear understanding of the ongoing trends of urban growth for a better insight of their possible future. Two main processes are analysed: first, the inter-urban concentration of population, with its consequence being a relative decline of the smallest towns; second, urban sprawl, including a shift of population density from the central part of cities towards their peripheries. Using recent data on population and employment in French urban functional areas, we show that the spatial and temporal framework in which urban growth is computed may considerably alter the results and their consecutive interpretation.

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