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Space

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Leibniz Association

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Contents

Despite its constitutive significance for spatial development and spatial planning, the term ‘space’ used in these areas varies considerably as to its meaning. This corresponds with the diversity of the semantics of space in the space-related sciences. In addition to the everyday notion of space, this article will differentiate between and examine seven concepts of space ranging from philosophy to the social sciences.

1 Introduction

The constitutive significance of space for spatial research and ▷ *Spatial planning (Raumplanung)* contrasts with the often imprecise use of the term 'space' in those disciplines. While philosophy, geography and the natural sciences have grappled intensely with the term 'space' for quite some time (Jammer 1960; Dünne/Günzel 2006), from the 1990s the notion of space was newly discovered by the fields of social sciences and cultural studies in the course of the *spatial turn*. However, this rediscovery did little to achieve greater terminological precision, as the term *space* is often used in a diffuse, colloquial sense, as well as in diverse metaphorical expressions (Döring/Thielmann 2008; Lossau 2012). Based on a typology of concepts of space, the following will attempt to summarise the most significant approaches in various disciplines in regard to their significance for ▷ *Spatial sciences* and spatial planning.

2 The everyday notion of space

Space 1: Physical space

An elementary starting point for the scientific conception of the term is the notion of space in everyday life as an expanse and the structural arrangement of material objects. As a result, the self perceives space as a specific, physical space, yet the term 'space' is generally not abstracted from the actual experience of space. The everyday notion of space is always socially defined. The individual's experience of space is embedded in the collective interpretation of space by one's family, group, ethnicity, etc., which is imparted through communication (early childhood socialisation, media) and through myths, religion, education and other cultural institutions.

3 Scientific concepts of space

Space 2: Absolute space, the container theory of space

This concept of space is linked to the everyday notion of space. It was decisively formulated by I. Newton, who assumed space to be infinite, homogeneous and independent of matter. As such, space formed the basis for classic mechanics: the first law of motion relies on an absolute spatial reference system. Absolute space can be illustrated by the idea of a box or container, the walls of which can be (conceptually) pushed out infinitely. According to this view, space exists independently from the objects which fill it, enabling the assumption of an ontologically independent 'empty' space (Jammer 1960).

While the perception of absolute space was largely abandoned by the natural sciences from the 19th century, the container theory of space is still very much alive in many aspects of current thinking. Expressions such as 'economy in space' or 'space and society' rely on being able to abstract space from objects or its contents. The hypostatisation of space goes one step further by attributing to space its own effective force or the function of an independent variable in the sense of a dependency on space.

Space 3: Relational space

Contrary to I. Newton, G.W. Leibniz believed that space did not have its own existence but was a system of positional relations of simultaneously existing material objects, an order of coexistence, an *ordo coexistendi*. According to this view, the assumption of an absolute space amounts to an impermissible hypostatisation of the term 'space'. In physics, however, Leibniz's concept of relational space initially failed to gain much traction. A shift away from the concept of absolute space, which could not be empirically proven, occurred only towards the end of the 19th century, when the definition of absolute space was replaced in classic mechanics by the concept of the inertial system. In the theory of relativity, the term 'space' lost its previous conceptual autonomy; it is now subsumed under the term 'field' and understood as a subordinate term in a general space-time-matter concept. Hence, the notion that space exists independently from the material world was finally abandoned. A. Einstein describes this space as 'the storage quality of the material world'[1] (Einstein 1960: XIII).

Space 4: Space as a form of intuition

The third philosophical concept of space goes back to Immanuel Kant. According to Kant, space itself cannot be perceived by the senses, as it is neither an object nor a property of objects. Space is also not an empirical concept, as it is an infinite dimension and, as such, cannot be subsumed under any other definition. Space, just like time, is an a priori existing and necessary prerequisite for sensory perception, a form of intuition on the part of the recognising subject, which serves to structure perceptions. This transcendental, philosophical concept of space greatly influenced how 19th-century idealist philosophy and the psychology of perception conceived of space. The immediate impact on the natural and social sciences remained fairly limited; however, Kant's concept of space amounted to a Copernican Revolution in that the question of the nature of space is not a question of the nature of the world, but rather a question of the nature of knowledge and thus of the observer, because there can be no spatiality of reality independent of the subject experiencing it. This laid the foundations for modern concepts of space as a function of the subject and for constructivist concepts of space (Space 7).

Space 5: Space as terrestrial space and the natural environment of humankind

The notion of (terrestrial) space as the natural or physical environment dates back to 19th-century geography, which understood space as the earth's surface filled with objects and matter and which thematised the relationship between (natural) space and humankind. The relationship between humankind and space was interpreted in particular by F. Ratzel, under the influence of Darwinism, as the dependency of humankind on space (geodeterminism). This view was reversed around the turn of the century by cultural geographers, such as P. Vidal de la Blache, who examined the impact of human activity on space and accordingly focused on the ▷ *Cultural landscape* created by humankind from a natural landscape. While geodeterminism has thus been largely discarded in academic geography, geodeterministic concepts survived into the interwar period and played an ignominious role in the geopolitics of that period.

The insight that modern civilisation has increasingly emancipated itself from its natural environment sounded the death knell for geodeterminism. Inverting the perspective on the human-space relationship opened up new possibilities for research into space as it is used

1 "Lagerungs-Qualität der Körperwelt"

and shaped by humankind. Three strands of research on the term 'space', each with a different emphasis, can be distinguished:

1) Space as a network in which natural and anthropogenic factors interact (ecological landscape approach)
2) Space as the result of historical, landscape-shaping processes (cultural landscape-genetic approach)
3) Space as a process field of human activities; landscape as a 'registration plate' (W. Hartke) of social processes (socio-geographical approach)

The geographic paradigm of (terrestrial) space shaped by humankind (cultural landscape) in principle lent itself well to the elaboration of scientific bases for ▷ *Spatial planning (Raumordnung)*, all the more since its heyday largely coincided with the emergence and institutionalisation of supra-local spatial planning. The change of perspective from geodeterminism to a space shaped by humankind at the same time focused attention on the ambivalence of the human impact on the natural environment: on the one hand, humans shape space into a cultural landscape, and on the other, they exploit and pollute nature with varying degrees of intensity, even to the point of destroying it at times.

From this perspective, space appears as a material concretisation of the natural conditions of human life. In the wake of the founding of modern ecology by E. Haeckel and plant ecologist A.G. Tansley, geographer C. Troll conceived modern landscape ecology as the science of the spatial differentiation and structuring of the earth's surface in accordance with the system of interactions between individual elements of the landscape (climate, soil, flora and fauna). According to E. Neef (1967), space is to be understood as a field of integration within the geosphere, i.e. as a section of the earth's surface, the nature of which is characterised by the integration of the inorganic, organic and social spheres.

Space 6: Space as a formal systematic structure

In modern spatial sciences, a concept of space largely prevailed in the 1970s and 1980s, which is partly based on the absolute and partly on the relational definition of space. Space in this sense is understood to be a two- or three-dimensional, metric structural framework of objects that can be localised on the earth's surface (formal regulated area). Points in space, lines and areas can be depicted by coordinate systems, such as the earth's grid system of parallels and meridians and in maps or media similar to maps. D. Bartels (1968) attempted, based on the logic of classes, to render this concept of space more precise and to develop a consistent system of terminology with the inclusion of more specific terms such as area, region and field. His designation of this concept of space as a choric space refers to the earth's surface (Greek: *chora* = country, place, region).

The notion of a formal regulated area is at the core of the many attempts to develop a formal theory of space through spatial analysis, in particular through economics and geography. This includes the classic economic location theories, as well as the New Economic Geography (P. Krugman) and the modelling of 'spatial behaviour' in the social sciences. Key aspects of this concept of space are location, positional relationships and distances. The distance relations and resulting transport costs in particular are often given a key role in approaches to developing formal models of space (Gatrell 1983).

The generalisation of the concept of space which initially related only to the earth's surface means connotes the construction of three-dimensional thematic surfaces (e.g. spatial distribution of population density). A long as only the geospatial variation of a variable is considered, the surface of the earth can be represented on a map, e.g. through isolines. The use of alternative dimensions of distance, particularly cost and time relations, goes one step further, for example, to describe and analyse spatial goods and information flows as well as transport systems (transport costs, time distances). These 'thematic spaces' are two-dimensional only in trivial cases; as a rule, they can only be projected onto the two-dimensional surface of the earth and thus represented on a map with a more or less considerable loss of information. For the analysis of 'thematic spaces' of higher dimensionality or with non-Euclidean metrics, mathematics offers suitable instruments; however, these constructs of space suffer not only from a lack of clarity, but also have a merely indirect relationship to the choric space of the earth's surface. The same applies to the numerous approaches to describing and analysing the virtual spaces created through technical communication media and the internet (information spaces, cyberspace) (Janelle/Hodge 2000).

Space 7: Space as a function of the subject: Conceived space, 'living space', Space of action

In contrast to the objective definitions of space considered above, concepts of space have been developed in philosophy, cultural anthropology, environmental psychology and social geography, which focus on the perception and interpretation of space by humankind and the significance of space for human activity. In so doing, the term 'space' underwent an epistemological shift from physical, real space to its mental representation in thought and action.

N. Hartmann distinguishes three concepts of space in his natural philosophical ontology: (a) ideal space (the geometric space of mathematics), (b) real space (the three-dimensional space of the earth's surface), (c) conceived space (space as it is perceived, imagined and experienced). Unlike the first two concepts of space in mathematics and the natural sciences, conceived space centres around the subject and is inhomogeneous, finite and limited in its expansion. The concept of space as a function of the subject has been discussed systematically in existentialist philosophy and philosophical phenomenology. The term 'lived space' *('espace vécu')* means space as it is subjectively experienced and conceived, which exists in the inner world of thought and contrasts with the intersubjective structure of objective space. This concept was further developed in phenomenology-oriented philosophy (Bollnow 1963). This view holds that 'lived space', unlike the abstract space of mathematics and the objective space of the natural sciences, has its own subject-related core, its own axial system, a thematic structure, discontinuities and boundaries, and meanings ascribed through subjective and/or social connotations.

These approaches to space in the humanities were taken up and further elaborated in psychology (Kruse 1974). The space of perception and action (▷ *Action space*) is understood to be the subject's sphere of action and manipulation *('Handhabungsbereich')* of different ranges; it is perceived to have different valences, i.e. values for the different intentions that motivate actions. These do not amount to genuine properties of the physical space; they are meanings ascribed by humankind, which furnishes the material living environment with symbolic meanings. As a result, individual elements of space become the bearers of symbols, thus creating a semiotics of space.

While spaces in the sense of places have a material substrate, they have been created and interpreted by humankind, which acts under certain economic, social and cultural circumstances, although not, as a rule, ones they have chosen themselves. Spaces can be 'read', which means that problems of cultural representation arise, and space can be understood as a cultural system of signs, which refer to ascribed meanings.

Space in Anglo-American social anthropology and environmental psychology was thematised with a somewhat different emphasis. According to this viewpoint, space is understood predominantly as the physical environment of humankind – however, not in its material quality but in its significance for human behaviour. The term 'territory' was initially derived from animal ethology. Space, sometimes also referred to as 'ethological space', when generalised to human behaviour, designates a space which is used or claimed by an individual or a group as a living space or habitat and defended as such against others. Departing from the consideration that territoriality is a fundamental category of human life (Sack 1980), social anthropology examines the spatial implications of human behaviour, for example the impact of spatial constraints on shared living space (crowding). In this tradition, E.T. Hall (1976), in his work "Anthropology of Space" describes space as an element of the organisation of daily life. Based on an analysis of interpersonal distances in different types of social communication, he developed the concept of 'personal space'. In environmental psychology, R.G. Barker's concept of 'behavioural setting' (1968) gained attention. It describes behavioural regulation which arises from spatial (material and social) environmental conditions and leads to invariants, i.e. typical behavioural patterns that are independent of individuals (e.g. going to a restaurant or attending a church service).

Extensive research on environmental perception developed particularly in Anglo-American countries. Working in tandem with psychologists, its socio-geographical branch frequently focused on 'mental maps', i.e. with cognitive representations of spaces. These 'cognitive maps' are the result of sometimes life-long learning processes and are thus essentially determined by society and culture. They include not only topographical representations (places, distances, buildings, etc.), but also the ascription of spatial values (positive or negative images).

In the more recent theoretical debate in geography, the relationship between space and human activity has been discussed from a variety of angles – for example, through the concept of activity-focused social geography by B. Werlen (e.g. 1996). The epistemological shift in the term 'space' from a physical, real space to a conceived space and space of action is explicit in action theory-based human geography. Spaces are not spaces on the earth filled with objects, but have significance for an acting human population as subjective and social spatial constructs: firstly, as a limiting and enabling but always contingent context of action, and secondly, as a mental representation of space of various types in specific situations of activity (Miggelbrink 2002). As these representations of space are essentially socially determined, they can also be understood as social space.

Space 8: Social space

As with space as a function of the subject, 'social space' (as an umbrella term for social and economic concepts of space) is not primarily structured in a terrestrial-material manner; it is rather an aspect of the social construction of reality. However, as a rule, social structures, such as states, organisations, the economy, etc., usually have a terrestrial-material substrate (artefacts, terrestrial structures of use, etc.), which makes the concept of a social space possible in the first

place. It only becomes a social space, however, due to its significance for the social world – for example, as a political-administrative territory, as an economic space, as a cultural space or as a space of social identification. To this extent, space is not an absolute framework or container which is independent of social space, but an inherent aspect of the social world and societal practice.

Sociologist Martina Löw (2001) considers space to be an essential sociological category because it designates the organisation of co-existence[2] in the sense of relational space. She objects to a division of space into social and material space and bases her analysis on a social space characterised by material and symbolic components[3] (Löw 2001: 13). According to her, the key objective is to examine the constitutive processes of space: What is being regulated (things, events)? Who is responsible for regulating them (with what legitimacy, power, etc.)? How are spaces created, how do they change? Spatial configurations concern social goods, i.e. material bodies and symbolic goods, but people as well. Spaces are understood as configurations and ensembles of social goods, including people.

However, proponents of the tradition of the theory of social systems according to N. Luhmann advocate for a strict ontological division between material space, on the one hand, and the semantics of space in social communication on the other. Research in the social sciences should not focus on the analysis of material space, but instead on the use of the semantics of space in social discourses in the sense of a second-order observation, for example in the form of geopolitical figures of thought (Redepenning 2006).

In economic theory, space played a significant role up to the end of the 19th century, for example as a natural resource (land as the basis for agriculture) in classic theory and in terms of the container theory of space of economic cycles (city, territory, nation state) in the historical school of economics. J.H. von Thünen used the abstract concept of an isotropic, homogenous space for modelling the economic interdependencies between agrarian land use, market prices and transport costs. Neoclassical theory, on the other hand, largely excludes spatial differentiations in an attempt to formulate a pure economic theory; in this view, macroeconomics was principally a space-less 'point economy' *(Punkt-Ökonomie)*. Only spatial economic theory, which was developed in the 1940s, and especially the New Economic Geography (Krugman), which has been rapidly evolving since the 1990s, expanded the neoclassical general equilibrium models by including the spatial dimension, primarily through the explicit consideration of distances; after translating them into transport costs, they can then be included in the economic models as monetary variables.

In sociology, the critical analysis of space essentially goes back to G. Simmel and E. Durkheim; however, this was subsequently abandoned in favour of pursuing a purely social theory (Konau 1977). Only the theoretical strands of Dutch sociography, which developed from the 1920s, and North American social ecology retained a focus on how social problems relate to space. The central theorem of social ecology is the principle of synomorphy, which postulates a correlation between spatial and social distance. It gained considerable relevance for practice on account of its strong empirical orientation, specifically in the field of ▷ *Urban planning*.

For the past three decades, the social sciences (sociology, economics, human geography, etc.) have been engaged in a broad but heterogeneous discussion on economic and social concepts of

2 "die Organisation des Nebeneinanders bezeichnet"

3 "einem sozialen Raum aus, der gekennzeichnet ist durch materielle und symbolische Komponenten"

space. Social space can thus be characterised by a number of shared features:

- It is a space of average geographic scale, as neither the 'micro space' of atomic physics nor the 'macro space' of astrophysics is relevant for the social world.
- As an aspect of the social world, it must be differentiated analytically from the physical (terrestrial) space. Aspects of the material structure of space are not relevant here; instead, the focus is on the social function of space as a contingent condition, medium and consequence of human activity and for the establishment of social structures.
- In contrast to the term 'space' in mathematics and the natural sciences, space is differentiated and structured in many different ways; at the same time, there are links to the concepts of space that prevail in those disciplines, as in the case of abstract modelling.
- Its significance within the social world is manifold. Instead of a uniform 'social space theory', which is scarcely even feasible, a large number of socio-spatial aspects and concepts of social space must be taken into account.

A typological classification of social spaces can be based, for example, on the following scale: a) micro-space (the corporeality of people, the personal 'space of experience'), b) meso-space (city, region as a spatial web of work and life), c) macro-space (nation state, global economy).

Another typology differentiates concepts of social space according to the underlying theoretical approaches:

a) *Symbolic space*. The role of spaces (more precisely of artefacts, such as buildings, monuments, landscapes, etc.) is expressed as a medium of symbols and signs which convey meaning and identifications (semiotics of space). These include the more or less unrealistic 'images of space', such as are propagated in tourism marketing and ▷ *Urban and regional marketing*.

b) *Organisational and political space (territory)*. A shared feature of this type of space is the significance of space as a referential framework and medium to exercise and control power, to exert influence or to take effective ownership of organisations and other social systems; the most prominent example is the national territory.

c) *Relational economic space*. Four basic factors, in particular, are responsible for the spatial differentiation and structuring of the economy (von Böventer 1979): the cost of (regional) mobility (transport costs; ▷ *Costs for bridging spatial distances*), market competition in space, the competition between locations or places in space (▷ *Choice of location*), agglomeration effects (▷ *Agglomeration, agglomeration area*). In more recent thinking in economics and economic geography, moreover, particular attention is paid to the institutional relationships between stakeholders.

d) *Space as an economic force field*. Polarisation theory stands in contrast to the neoclassical notion of balance. For F. Perroux, space is an abstract economic force field in which 'driving entities' (larger sole proprietorships or industrial complexes) are located, which generate 'knock-on effects' (e.g. input and output relationships, innovation effects). J.R. Boudeville has transferred this approach to geographical space.

e) *Space as an economic milieu*. In this context, space appears as a field of social interactions (which is also culturally determined), and the configuration of its values, preferences,

communication patterns and networks of interaction (▷ *Networks, social and organisational*) forms a region-specific economic ▷ *Milieu*. If social interactions between the relevant stakeholders lead to interpersonal synergies and collective actions, this creates the capacity for innovation, which in turn creates an innovative milieu (▷ *Innovation, innovation policy*).

f) *'Matrix space' as a socio-economic space*. D. Läpple (1991) proposed the term 'matrix space' to describe a concept of space which includes social, economic and cultural aspects. It is based on 'spatiality' as an inherent aspect of social practice. The term 'space' is conceptualised in a similar way in recent regional research in the social sciences (Belina 2013). Space in this context is construed not as an external effect, but rather as an expression and part of social practice.

In the debate about social concepts of space, the confrontation between the structuralist and the action-theory approach has played a key role. Today, however, a middle line is gaining importance. The more recent action theory in the social sciences emphasises the embedding of the stakeholders and their actions in upstream social situations, which restrict and enable action in a contingent way, but usually do not determine it. The effects resulting from actions, which are partly intended and partly unintentional, must also be considered. Social situations and social impacts generally include spatial situations and spatial impacts, which include both physical space as well as subjective and social space. The spatial effects of actions can be traced back to the intentions of the action only to a minor extent; they develop their own dynamic, as exemplified by the ecological effects of human activity on anthropogenic climate change.

4 Space in spatial planning

The constitutive significance of the term 'space' for the emergence and development of spatial planning, especially in German-speaking countries, is based on two factors. On the one hand, the term 'space' became a buzzword in political debate in the first decades of the 20th century despite, or perhaps even because of its scintillating semantics. On the other hand, the term 'space' seemed to lend conceptual unity and the professional identity of an academic discipline to the new political-administrative field of spatial planning.

Closer observation shows, however, that the diversity of concepts of space are also reflected in the language used in spatial planning. At times, the term 'space' is used there in the everyday sense of physical space, while at other times, depending on the discipline and the theoretical context, more scientific concepts of space are invoked. In so doing, the concepts of space in philosophy and the natural sciences (Space 2 to Space 4) remain rather in the background, as the term used in spatial planning largely vacillates between that of Space 5 and Space 8. The principal problem is that concepts are frequently unclear in whether they refer to the physical space of the earth's surface, whether they are based on subjective or social concepts of space, or whether the scintillating term 'space' implies an interdependence of whatever nature between epistemological levels.

For example, the Federal Spatial Planning Act *(Raumordnungsgesetz, ROG)* of 1998 refers to various definitions of space, especially to those of Space 5 and Space 8. Physical, terrestrial space

(Space 5) is referenced by the guiding principle of 'safeguarding natural living conditions' through the reference to open space, free space and green space, as well as the concept of 'measures with spatial significance', i.e. those which 'make a claim on or use up space'. Social space (Space 8) is meant when reference is made to 'spatial imbalances', 'living and economic spaces', 'structurally weak areas', etc. Finally, references to 'uses of space', as well as the 'statements on the development, structuring and safeguarding of space', imply a correlation between physical and social space.

The development of the different definitions of space used in spatial planning must not be understood as a simple historical sequence of the spatial concepts outlined above; rather, these definitions coexist. In the older literature on spatial planning, the term is mostly used in the sense of physical space with little analytical reflection. This corresponds to the notion of reality prevalent in older spatial planning, whereby every object virtually has its own natural place. The study of spatial economics and the normative theory of best practice in 'space planning' are based on the concept of a formal regulated area, which is in turn based on the container theory of space: the model space of the isotropic surface in neoclassical location theory can be compared to the empty space of Newton. On the other hand, references can also be drawn to the relational space of G.W. Leibniz, because location theory does not require an absolute reference point; relative systems of description are sufficient.

The concept of space as a function of the subject (Space 7) was largely ignored in spatial planning for quite some time as it had no place in expert planners' understanding of their role. Only with the development of civic participation in participatory planning, which included the perception of (natural) risks, as well as with the increasing consideration of symbolic places for city design did the focus of ▷ *Planning* shift towards the normative perception of space by citizens (Altrock/Huning/Kuder 2010). Thus, the multidimensionality and ambiguity of the term 'space' remain a problem not only for disciplines concerned with space, but also for spatial planning, all the more so as it is deeply embedded in its language, discourses and practice (legal bases, plans and programmes).

This corresponds to a current trend of debate in the international ▷ *Theory of planning*. The semantic plurality and multidimensionality of the term space and its associated terms, such as 'place', give cause to reformulate the object of spatial planning in an expanded, multidimensional sense, and to derive the demand for an expanded, dynamic approach to planning (Madanipour 2001). The plurality of the perspectives on space should be acknowledged and taken seriously, without becoming lost in pointless relativism. The fact should not be overlooked that in practice, planning is always at the intersection of different perspectives (physical-material, economic, political, aesthetic, those relating to the living environment, etc.).

5 Concluding remarks

As with the plurality of academic concepts of space, the term 'space' in spatial planning varies to a very great extent. These span from urban planning, primarily relating to land use, up to ▷ *Federal spatial planning (Bundesraumordnung)*, which focuses on the development of the entire territory of the Federal Republic of Germany and the spatial structure of different types of area. The use of the term 'space' thus oscillates between a specific, material section of the earth's surface on the one hand and concepts from the social sciences on the other. The

elaboration of a comprehensive, closed theory of space for the purposes of planning is not in sight and is most likely scarcely even feasible. For spatial planning and federal state spatial planning (▷ *Federal state spatial planning, federal state development*), the challenge remains to do justice to the multidimensionality of space in theory and practice in a constructive manner.

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