

Vulnerability and Resilience in a Socio-Spatial Perspective

A Social-Scientific Approach

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Abstract This paper argues that the conceptions of “vulnerability” and “resilience”, which have been strongly influenced by ecology and natural hazards research, have been widely used in an essentialist manner. Thus, vulnerability is treated as the factual susceptibility and resilience as the factual adaptive capacity of systems, which are measurable by certain indicators. Although in the meantime social dimensions have received greater consideration than previously and although both notions have been transferred to a wider field of phenomena ranging from technology to economy and society, the conception of vulnerability and resilience still lacks the dimension of the social construction of reality that implies that actors may develop different perceptions of potential threats and of the precautionary measures that are to be adopted—even though the nature of an endangerment seems clear and proven. In this contribution we identify major conceptual desiderata and suggest a social science based conception of vulnerability and resilience addressing them. We take up ideas from social constructivism in the form pointed out in actor-network theory. We dissolve the tired dichotomy between social and material entities and instead emphasise that all kinds of entities have the same ontological status and thus interact directly with one another on the same level (‘flat ontology’). Against the background of a generic definition of governance, questions of agency in networks will be addressed. Based on a relational understanding of space, a

spatial research perspective will be developed also taking into account the dimension of time. Finally the conception comprises an empirical strategy for investigating vulnerability and resilience.

Keywords Vulnerability · Resilience · Knowledge · Social constructivism · Nature-culture dichotomy · Actor-network theory

Vulnerabilität und Resilienz in sozio-räumlicher Perspektive

Versuch einer sozialwissenschaftlichen Fundierung

Zusammenfassung In diesem Beitrag wird argumentiert, dass die von der Naturrisikoforschung und der (Human-) Ökologie geprägten Begriffe der Vulnerabilität und Resilienz, auch wenn sie inzwischen soziale Dimensionen aufgenommen haben und auf unterschiedliche Bereiche wie Technik, Ökonomie oder Soziales bezogen werden, insofern einseitig konzipiert sind, als Vulnerabilität und Resilienz immer noch als objektiv gegebene Tatbestände bzw. Eigenschaften von Systemen betrachtet werden. Vulnerabilität *ist* danach eine faktische Anfälligkeit und Resilienz *ist* eine faktische Anpassungsfähigkeit von Systemen, die sogar aufgrund bestimmter Indikatoren messbar ist. Diesen Begriffskonzeptionen fehlt die Dimension der sozialen Konstruktion, die besagt, dass Akteure – selbst bei nachweisbaren Gefährdungen – ganz unterschiedliche Wahrnehmungen von einer möglichen Bedrohung und von zu ergreifenden Schutzmaßnahmen entwickeln können. Der Beitrag entwickelt eine begriffliche Konzeption von Vulnerabilität und Resilienz, die insofern sozialwissenschaftlich ausgerichtet ist, als sie von (sozial)konstruktivistischen

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Annahmen im Sinne des „Actor-network“-Ansatzes ausgeht. Dadurch wird die weit verbreitete Dichotomisierung zwischen sozialen und materiellen Entitäten aufgehoben. Stattdessen interagieren jegliche Entitäten, auch wenn sie ganz unterschiedliche Eigenschaften besitzen, auf derselben Ebene miteinander (*flat ontology*). Vor dem Hintergrund eines generisch gefassten *Governance*-Begriffes adressiert der Beitrag Fragen der Handlungskoordination und auf der Basis eines relationalen Raumverständnisses entwickelt er eine raumwissenschaftliche Perspektive, die auch die Dimension der Zeit einschließt. Nicht zuletzt beinhaltet die Konzeption einen Vorschlag für eine empirische Strategie zur Untersuchung von Vulnerabilität und Resilienz.

Schlüsselwörter Vulnerabilität · Resilienz · Wissen · Sozialkonstruktivismus · Natur-Kultur-Dichotomie · Actor-network-Theorie

1 Introduction

Perceiving and dealing with endangerments form part of the history of human society. People have always tried to protect themselves from the dangers they perceive. In relation to dealing with dangers, however, it is possible to identify spatial, social and temporal differences. Thus, for instance, neighbouring coastal regions can differ from one another in the way in which they deal with the threat of storm flooding at a particular time, even though they are exposed to very similar physical environments. In addition, in the same coastal region forms of perception and action related to dangers can change over time.

In modern societies awareness of endangerments seems to have increased. The notion that it is possible to prevent endangerment has also developed greatly. The notions uncertainty, risk and the risk society (see e.g. Beck 1986), but also sustainable acting and sustainable development play a prominent role, and have even entered everyday language. The terms vulnerability and resilience, in contrast, are so far less widespread. However, most recently they seem to have been experiencing increased popularity in scientific discussions (see e.g. Bohle/Downing/Watts 1994; Adger 2000; Bohle 2002; Folke 2006; Janssen/Ostrom 2006; Brand/Jax 2007; Birkmann 2008). The terms describe ways of dealing with endangerments, but in some ways differ considerably from the concepts of risk and the concept of sustainability.

To date the terminological concepts of vulnerability and resilience have been greatly influenced by the context of (human) ecology and natural hazards research (see Holling 1973; Felgentreff/Glade 2008), even though they have their origins in medicine (see Pfeiffer 1929) and (social) psychology (see Werner 1995). We assume that they can just as

well be applied to endangerments that arise in the technical, economic and social fields. A look at the research literature shows that the concepts have indeed already been applied in this way. However this more comprehensive use of the terms has usually occurred without the necessary fundamental conceptual adjustments. The aim of this paper is to find a more generic definition of these terms that makes them suitable as analytical instruments for a broader spectrum of empirical fields within which we currently witness an increase in uncertainty about future expectations. This includes, for instance, the susceptibility of critical infrastructure to breakdown, natural events, terrorist attacks, the side-effects of human intervention in complex systems (ranging from the financial markets to ecological systems to cultural landscapes), new volatile markets in a globalised knowledge economy or media intensified stigmatisation processes affecting (sub-)spaces.

We further argue that vulnerability and resilience are not objectively given. Rather, we assume that the ways in which people or entire societies perceive and anticipate endangerments, increase public awareness of them as well as collectively perform counter-strategies to increase resilience usually vary between social groups, different regions and different times in history. Against this background we develop a social-scientific approach that focuses on the socially constructed nature of vulnerability and resilience from a spatial perspective and that also includes the dimension of time. In this paper we use social constructivism, actor-network theory and a relational understanding of space as sources of inspiration to conceptually frame analyses of social practices of constructing vulnerability and resilience.

In the following, we first critically review previous research and identify established concepts of vulnerability and resilience in order to derive some central conceptual desiderata (Sect. 2). Section 3 discusses some propositions offered by actor-network theory to solve the desiderata elaborated upon above. From this basis we then develop our own approach and suggest a social-scientific definition of vulnerability and resilience that clearly differs from previous ones (Sect. 4). By integrating ideas from a relational theory of space, we anchor our understanding of vulnerability and resilience in the spatial sciences. In addition, we propose an empirical strategy for the research of vulnerability and resilience (Sect. 5). A conclusion rounds up the paper (Sect. 6).¹

¹ We thank Heiderose Kilper and Timothy Moss for the valuable ideas and comments that date back to our joint work on a more comprehensive working paper on vulnerability and resilience and with which they supported us in the drawing up of this paper (see Christmann/Ibert/Moss et al. 2011). Thanks are also due to Jörn Birkmann for his suggestions on the working paper that also had consequences for the present paper.

2 State of Research, Previous Terminological Concepts and Desiderata

The terms vulnerability and resilience are today not any longer used for analysing only ecosystemic dysfunctions or so-called natural hazards. Rather, they have increasingly been expanded on empirical fields in which endangerment is the result of a wide range of constellations of interacting social, economic, institutional and ecological factors.²

Human ecology and developmental geography so far have mainly been concerned with vulnerability and resilience. Thereby human ecology traditionally focuses on the reactions of societies to natural hazards and disasters like earthquakes or floods (see e.g. Adger 2006; Dietz 2006). Examined from this perspective, vulnerability represents a potential or actual impairment of social systems and ways of life, whereas resilience means a successful adaptation of societies to anticipated natural hazards which allows either the avoidance of damages and impairments caused by natural disasters or a quick recovery after having suffered from disasters. Research on developing countries understands problems of poverty and the life circumstances of disadvantaged population groups in developing countries as an expression of a structural vulnerability (see e.g. Watts/Bohle 1993; Blaikie/Cannon/Davis et al. 1994; Bohle/Downing/Watts 1994; Bohle 2002; Prowse 2003; Deffner 2007), with a focus on resilience as a strategy to provide broader access for all societal groups to (often natural) resources necessary for existence such as food, clean water or income.

Social-scientific spatial research concerned with questions of vulnerability and resilience, most noticeably geography, the planning disciplines and regional policy research, remains today strongly influenced by this understanding of vulnerability and resilience (see Greiving 2002; Birkmann 2008). As in human ecology and developmental studies, the term vulnerability refers to the susceptibility shown by human-environment systems in cities and regions to natural hazards and environmental changes (like, for instance, climate change), while the term resilience is understood as a strategy of adaptation that these systems develop (see Pelling 2003; Stock/Kropp/Walkenhorst 2009: 98). Furthermore, in urban research issues of security, particularly the threat posed by terrorism (see Coaffee/Wood 2006) and criminality, play an additional role. The same aspects of vulnerability and resilience are also of major relevance in the research on megacities in developing countries (see Kraas/Mertins 2008).

Vulnerability and resilience analysis is also carried out in the fields of socialisation research and psychotherapy (see

e.g. Werner 1995; Wustmann 2004; Obrist 2006; Welter-Enderlin/Hildenbrand 2008; Zander 2009), although rather disconnected from the discourses mentioned thus far. Here investigation focuses, among other things, on the conditions under which individuals are willing and able to recognise their own psycho-social vulnerability and as a precondition for their ability to create resilience. Although this research is related to individuals (in the psychological sense) it provides valuable impulses for socio-spatial research on vulnerability and resilience because of its strict orientation on action theory. Vulnerability and resilience are not primarily understood in relation to threats caused by external forces such as natural phenomena or terrorists. Rather both are mainly results of social action and are viewed in close association with social interaction.

Overall various disciplines have adopted the terms vulnerability and resilience, whereby different foci can be identified in different disciplinary contexts (see Anderies/Janssen/Ostrom 2004; Janssen/Ostrom 2006; Brand/Jax 2007; Birkmann 2008). Birkmann/Böhm/Buchholz et al. (2011) earn recognition for having proffered definitions of vulnerability and resilience that also integrate various theoretical approaches.

According to them *vulnerability* encompasses “situations and processes that determine the exposure, susceptibility and also reaction capacities of a system or object with regard to dealing with dangers Here physical, social, economic and environmental factors play a role” (Birkmann/Böhm/Buchholz et al. 2011: 25). In this wording, not only external natural hazards such as the effects of climate change are regarded as responsible for a particular vulnerability, but also internal factors, the reaction capacities of a society, seem to deserve the same degree of attention (see also Voss 2008: 47 f.). The integration of reaction capacities in the definition of vulnerability is an expression of the authors’ intention to capture the extent of vulnerability not only in terms of exposure towards external factors (such as natural hazards), but also in terms of how the system itself structures its perceptions of its own endangerment. Thus vulnerability may turn out to be low even with a high level of exposure, provided the reaction capacities are simultaneously high.

Moreover, according to Birkmann/Böhm/Buchholz et al. (2011: 8 f.), the term vulnerability is not to be equated with the terms *danger* and *endangerment*. Rather, danger means “the state of an objective threat through a possible damaging event that occurs under certain conditions or demonstrates a certain probability of occurrence” (Birkmann/Böhm/Buchholz et al. 2011: 8). Endangerment refers here to external threats and thus is part of vulnerability. However, it lacks the idea that societal actors might have different internal capabilities of coping with these threats and thus might

² Bürkner (2010) and Christmann/Ibert/Moss et al. (2011) provide a more comprehensive review of the literature on vulnerability and resilience and related concepts like risk, uncertainty and sustainability.

come to divergent conclusions about the effects of their factual exposure.

The term *resilience* describes the ability of a system “to absorb shocks and disruptions and to continue to exist with the least damage possible” (Birkmann/Böhm/Buchholz et al. 2011: 17). Three dimensions of resilience have been identified so far in the literature: First, the ability of a system to withstand certain actual shocks or internal changes; second, the capacity to restore the original state relatively quickly; and, third, the ability of a system to learn and to continually adapt itself to the changing conditions. In line with this third point, Folke (2006), in particular, suggests seeing resilience not as a state but as a process, which includes continuous observation of the system’s environment and pertinent adaptation, learning and innovation processes.

A great deal of effort has gone into these terminological concepts, making them far-sighted and integrating various dimensions. However it is nonetheless noticeable that the conceptions are rarely theoretically rooted. In addition, they all share an essentialist perspective, as they understand vulnerability as factual exposure or susceptibility and resilience as the factual coping ability of systems. Despite the awareness that vulnerability and resilience can vary from society to society, from region to region and from time to time, both concepts are still viewed as if they denote quasi objective states of affairs. From this perspective a system *is* in a specific way vulnerable or resilient due to specific factors that can be objectively identified. This understanding is not only widespread within the natural sciences but also among social-scientific approaches. Not least owing to experiences gathered in research in developing countries, analyses of vulnerability and resilience also consider aspects of social differentiation and there is agreement that not all actors in a specific situation are equally vulnerable or equally able to develop resilience. The basic assumption is made that social inequality in terms of factors like economic situation, age or gender is reflected in different vulnerabilities and forms of resilience, which is why the term *social* vulnerability is also used (see e.g. Bohle/Downing/Watts 1994; Bohle 2002; Wisner/Blaikie/Cannon et al. 2004; Bohle 2005; Birkmann 2007; Birkmann 2008; Birkmann/Fernando 2008; Cutter/Finch 2008; Morrow 2008; Kusenbach/Simms/Tobin 2010). Morrow (2008: 4) comments in this context: “Social vulnerability is a catchall phrase that has become part of the discussion related to how social and cultural conditions place some at higher risk to environmental impacts such as climate change or natural hazards. Simply stated, social vulnerability occurs when unequal exposure to risk is coupled with unequal access to resources”. This is often illustrated by presenting empirical evidence that demonstrates that usually social groups with little economic capital live in districts threatened by specific natural hazards more often

than wealthier groups, thus rendering them more vulnerable than others. Furthermore, disadvantaged groups are even often simultaneously exposed to multiple interacting endangerments. Finally, they often have neither the economic nor the cultural and/or social capital to change anything about the situation, i.e. to raise their resilience by moving away, insuring themselves against possible damages or repairing damages that have occurred. However, these accounts of social vulnerability still tend to conceive vulnerability and resilience in an essentialist manner as both the various forms of exposure of social groups and their different abilities to cope with endangerments are treated as matters of fact.

Such conceptions are without question legitimate, especially as experience to date shows that potential endangerments are not purely fictitious but that there are specific indicators for specific endangerments actually occurring, that some endangerments also really do occur and that they are, when they have occurred, of substantial or even existential nature, resulting then in material (and also immaterial) damages.

However, this perspective lacks one important dimension: that of the *social construction* of vulnerability and resilience, which should not be confused with that of social inequality (see Berger/Luckmann 1969). Voss (2008) presents similar arguments, when he draws attention to the fact that the reaction capacity of a system also depends on the way in which this system is able to perceive problems and the extent to which it is able to manage the related (public) communication in a way that affords its adaptability. Social construction of vulnerability means, roughly outlined (see also Sect. 4), that people, cities, regions, firms or entire societies—when confronted with certain events—can at a specific time in a specific way and to a specific extent perceive themselves as being threatened. Following this logic, vulnerability is not simply an objectively given exposure, but rather a commonly shared *assumption* about the possibility of being exposed or endangered. In this sense it is a result of social construction work when, for instance, based on the observation of frequent, quite different extreme weather events, members of a society draw the conclusion that their society is exposed to results of an ongoing climate change. Moreover, social construction also means organising widely shared anticipations about possible future endangerments for themselves and their goods and, in addition, deducing from this the necessity of certain action or certain precautionary measures. Consensus about which precautionary measures can be seen as appropriate (and which not) is indispensable for the formation of resilience and should at the same time be understood as the result of collective construction work. The dominant perceptions of vulnerability form the basis for ways of perceiving possible forms of resilience. As the anticipation of endangerments

is always to an extent uncertain,³ it is possible that actors do not perceive (or take seriously) potential threats despite the fact that scientifically uncontested measurements clearly indicate these dangers.

The situation becomes even more complex when aspects of cultural differentiation and social inequality are also taken into consideration. Basically, against the background of different socio-cultural knowledge, people, cities, regions or whole societies can differ with respect to the ways they construct vulnerability and eventually also actions to improve resilience. It is possible that the perceptual horizons of certain individuals or groups do not include possible endangerments (e.g. by natural events) in a/their space. Thus they exclude threats that other groups would rank high from their group-specific constructions of vulnerability. It is unnecessary to emphasise that these different constructions have consequences for coordinated action, for instance in governance processes, and are therefore particularly worthy of attention.

Despite all efforts that have been made to integrate social aspects into social-scientific research the following desiderata remain that will be further addressed in the following (Sect. 3, 4 and 5). These are, as already indicated:

- *Lack of consideration of the social construction of vulnerability and resilience.* All of the above definitions lack—at least explicitly—recognition of the fact that the vulnerability of a person, a household, a firm or a city should not be considered independently of people's interpretation of the endangerment. Janssen/Ostrom (2006) identified this as a central open question that requires further research. There are now notable initial empirical studies, the results of which indicate that different people affected by natural hazards have differing perceptions of vulnerability (see, for instance, O'Brian/Eriksen/Nygaard et al. 2007; Bankoff 2007; Heijmans

2007; Delica-Willison/Willison 2007; Voss 2008; Voss 2010). For instance, Heijmans' (2007) study of wild fires in Indonesia shows that the perceptions of fire-related vulnerability differ significantly among policy actors and the wider population. Due to their ignorance of the population's perceptions of vulnerability the responsible policy actors cause additional vulnerabilities among the population owing to the proposed measures. Even though the authors explicitly uncover these different perceptions they do not draw conceptual consequences from their findings.

- *Insufficient linkage between non-social and social, material and immaterial or nature and culture in connection with vulnerability and resilience.* This desideratum arises at least partly if not wholly from our taking social construction work more seriously. If immaterial and culturally imbued entities such as perceptions or shared beliefs are brought into connection with vulnerability and resilience, then the relation between the social and the non-social, culture and nature or the material and the immaterial needs to be clarified anew (see also Oliver-Smith 2007: 12 ff.). There are social theory approaches that attempt to overcome the dichotomy of materiality-immateriality (see Görg 1999). Most of them understand the nature-culture relationship as a hybrid one and offer ideas about how these spheres might interact: for instance in the form of a metabolism, through "action setting", as a socio-ecological system, or through structural coupling (see e.g. Fischer-Kowalski/Erb 2003; Weichhart 2003; Berkes/Colding/Folke 2003; Walker/Gunderson/Kinzig et al. 2006; Brand/Jax 2007). Quite similarly, early work on socio-technical systems investigates the co-evolutionary processes of technology development and societal change (see Hughes 1983; Summerton 1994; Star 1999; Melosi 2000). These works reiterate the idea of two distinct spheres (nature and culture) that 'interact' with another. Although all these approaches aim at a dissolution of the dissociation of nature and culture they have in common that—paradoxically—they tend to even accentuate this division. They thus always return back to the fundamental problem that was the starting point of theorisation.⁴ The "actor-network" theory offers a promising approach to this problem (see Sect. 3).
- *Inadequate consideration of the governance dimensions of vulnerability and resilience.* Janssen and Ostrom (2006: 238) identify particular challenges for future research: "to incorporate governance research on the mechanisms that mediate vulnerability and promote adaptive action and resilience" (see also Young 2010). So far there has been no systematic investigation about the consequences of divergent perceptions of vulnerability for

³ Fundamental and terminologically consistent social-scientific conceptions of risk and uncertainty can be found in Luhmann's (1991) social-scientific system theory and in Knight's (1921) decision-theoretical approach. The latter describes risk as a measurable uncertainty whereby the probability of the possible consequences of alternative actions can either be determined *a priori* through mathematical operations or *ex post* by evaluating past experiences. Luhmann (1991) in contrast sees danger as the counterpart to risk. Decisive here is the attribution of unwished consequences of action: are they attributed to the decision-making system itself (risk: I'm moving next door to a nuclear energy plant) or are they attributed to the environment of the system (danger: a nuclear energy plant is being built next to my house)? In this way a system cannot avoid producing risks for itself and dangers for its environment in the course of decision processes. Both approaches, however, have in common a view that the consequences of actions and decisions are fundamentally uncertain. Uncertainty is then, to a certain degree, the standard situation. Social action thus never occurs under fully determined conditions. An important criterium for social action should be seen in minimising contingences and dealing constructively with uncertainty (see further Böhle/Wehrich 2009).

⁴ Discussion of this is found in Christmann/Ibert/Moss et al. (2011).

consistent governance processes. Above all, the question about how the term “governance” is to be understood when aspects of the social *and* the non-social are to be considered remains unanswered (often even unasked) (see Sect. 3). It is necessary to have further knowledge about governance forms that, on the one hand, emerge in reaction to crises or endangerments (see Schott 2010) and, on the other hand, are developed in anticipation of possible endangerments (“governance of preparedness”, Medd/Marvin 2005). Also worthy of particular attention in the future are the interests, power relations and conflicts that are linked to different problem definitions (see as a starting point Eriksen 2004). However, it is outside the scope of this paper to systematically discuss these issues.

Other research desiderata are:

- *Inadequate consideration of the spatial dimensions of vulnerability and resilience.* Apart from Birkmann’s (2008: 1) criticism that spatial planning in Germany concerned itself primarily with physical sources of vulnerability, further more broadly expressed spatial terms and spatial relations have so far attracted little attention in the literature. This includes the double perspective on physical and social space as well as their linkage (see Sect. 5.1).
- *Inadequate consideration of the dimension of time in terms of vulnerability and resilience.* The factor time is also missing in most definitions of terminology—apart from the general understanding of resilience as a process of adaption. First, the temporal implications of spatial categories have to be considered more systematically. Second, construction practices of vulnerability and resilience themselves have an inherent temporality and are situated in historical time. This means, for instance, that the content of constructs of vulnerability and resilience are likely to change over time. As Whittle/Medd/Deeming et al. (2010) show in their analysis of the flood disaster in the city of Hull (UK), ideas about urban resilience against floods changed during, immediately after and long after the floods (see Sect. 5.1).
- Not least, *the normative way in which the terminology of vulnerability and resilience is often used is noticeable.* Research has been criticised for taking for granted the categories of the acting subjects being observed without reflecting their normative connotations. A specific empirical strategy needs to be developed that differentiates between the constructions of the actors and those of academia (see Sect. 5.2). Contrary to a conventional reading it is, for example, not necessary that vulnerability is always negatively valued and resilience positively. The collapse of some vulnerable systems, which actors

at the time of the event find dramatic, can be seen from a more distanced standpoint and taking a long-term historical perspective as triggers for important developmental leaps (see Walker/Holling/Carpenter et al. 2004; Schott 2010). Furthermore, forms of resilience are not unequivocally good, as they can have unintended side-effects that can then give rise to new problems (see Coaffee/Wood/Rogers 2008; Hodson/Marvin 2008).

3 Impulses from Actor-Network Theory for a Social-Scientific Based Understanding of Vulnerability and Resilience

In this section we draw on “actor-network” theory, an approach that has so far received little attention within the discourse on vulnerability and resilience, and search for impulses to resolve the desiderata discussed above. We identified this approach as a promising one particularly because it inspires ideas about how to overcome the traditional dichotomy between the social and the non-social, culture and nature,⁵ and how to open up and focus on the construction work that underlies calculations of vulnerability and resilience. Finally it also allows vulnerability and resilience to be conceived as being part of governance processes.

3.1 Sociology of Associations: Relations Between Social and Non-Social Elements in Actor-Network Theory

The “actor-network” theory belongs to the larger family of theoretical approaches that build upon a “flat ontology” (Delanda 2005: 58). In contrast to a hierarchical ontology that locates empirical phenomena on different levels and in so doing differentiates between general principles and particular cases (e.g. a specific organism belongs to a general genus), in a flat ontology all phenomena are positioned on the same level and thus always interact directly with one another. Entities may have different positions and expanses in time and space, but they do not differ in their ontological quality (see Delanda 2005). Within a flat ontology the assumption of a fundamental difference between the social and the physical, natural and cultural makes no sense anymore.

⁵ With regard to the dichotomy between social and non-social, “actor-network” theory formulates a pointed critique on the fundamental stance taken by all social-scientific approaches so far and proposes a radical rethink (see on this point the research desiderata discussed in Sect. 2). It is not in vain that actor-network theory with its relational and action-oriented understanding of social and other “actors” has had a significant influence on various relevant strands of debate—such as the transformation of socio-technical systems—, as recent literature shows (see Hommels 2005; Coutard/Hanley/Zimmerman 2005).

The “actor-network” theory is an approach in which thinking in a flat ontology is most pronounced. In his 2005 monograph “Reassembling the Social” Bruno Latour for the first time attempted to comprehensively present the analytical approach that had previously been fragmented across manifold separate papers (see e.g. Callon 1986; Law 1986; Latour 1987; Law 1992; Law 2002). Somewhat polemically, he described the traditional sociology as a “sociology of the social” (Latour 2005: 9). In the course of efforts to establish a distinctive academic discipline and to define a distinctive object for the discipline, he argued, sociologists had developed an attitude that regarded the social as a characteristic feature of the research object of sociology. From this perspective the world appears to be divided into social phenomena, for which sociology feels responsible, on the one hand, and non-social phenomena, for which other disciplines are responsible, on the other hand. Social and non-social objects are seen here as being located on different ontological levels, whereby, of course, for traditional sociologists non-social entities, like for instance objects, nature, machines or artefacts, are granted only subordinate rankings in the ontological hierarchy. Latour sees this as the main reason why sociology has either completely ignored material objects or, if not, has simply understood them as the antitheses of social phenomena. In the latter case the idea that the social and the material might interact or even merge with one another has been conceived as interactions or hybridities.

As an alternative project to a sociology of the social Latour puts forward a “sociology of associations” (Latour 2005: 9). According to this, sociology should be concerned with the work that is necessary to form associations or to change existing associations between non-social entities. The social does not come to light as a separate domain of objects but rather exposes itself in the dynamic of the production of all kinds of associations. Social dynamics connect heterogeneous and incommensurable (i.e. of differing nature or quality) entities that are not compatible but nonetheless interact with one another on the same level. Social relations do thus not only exist between humans, but can also emerge between humans and machines or even find expression in the interaction of objects.

3.2 On the Concept of Construction in Actor-Network Theory

In contrast to the way in which it is presented today, the sociology of associations approach did not emerge as a social-scientific programme, but from sociological investigation of the production of scientific facts and observation of scientific practice in laboratories (see Latour/Woolgar 1979; Knorr-Cetina 1981). These pieces of work have demon-

strated empirically that scientific facts are to a great degree artificially constructed. They exist in the form of actively produced, artificial and unstable associations. For example, a scientific statement in the field of linguistics can be understood as a network of associations between scientists, actual completed acts of speech, their technical representation in the form of audiotapes and transcripts, and numerous relations to the existing literature of the discipline. Actor-network theory thus understands science as acts of heterogeneous engineering “in which bits and pieces from the social, the technical, the conceptual and the textual are fitted together, and so converted (or translated) into a set of equally heterogeneous scientific products” (Law 1992: 381). Knowledge is thus seen not as an independently existing *a priori* that is just waiting to be discovered or unveiled by gifted scientists, but on the contrary as something actively constructed that exists only as long as the underlying, unstable associations persist.

The actor-network approach can be seen as consistently constructionist. However, the nature of the construction is developed here in explicit contrast to what, following Latour, is usually seen as “socially constructed”, that is the assumption that social actors attribute meaning to objects and by so doing construct their symbolic content. The act of attributing meaning remains one-sided. The objects fade to such an extent that they do not exist in their own right, but only to the extent to which they are perceived by a social actor, addressed in social speech acts and social interaction. This traditional understanding of social construction involves a hierarchisation between social actors and material objects and thus strengthens the tired dichotomy between culture and nature, social and material, subject and object.

Construction in the sense of “actor-network” theory, in contrast, emphasises that knowledge emerges from artificially created or consciously changed associations between non-social entities. Construction expresses itself in the work that is necessary to connect elements that would be unconnected without social work. John Law shows, for instance, how the colonial influence of the Portuguese empire was only able to reach across the thousands of nautical miles separating Portugal from India due to the interrelationship of large, seaworthy sailing vessels, astronomical maps of the southern hemisphere and simple manageable navigation instruments with ships armour, weapon technology and drilled soldiers (Law 1986). The economic exploitation of the subcontinent by a small European country and the exercise of political control over such a great distance were only possible by forming and stabilising these in no way “naturally” occurring linkages between heterogeneous elements.

3.3 Agency and Governance in Actor-Network Theory

For “actor-network” theory agency is of central importance, which makes the approach compatible with the idea of governance. We understand governance as “the ways in which disparate but interdependent agencies are coordinated and/or seek to coordinate themselves through different forms of self-organisation to achieve specific common objectives in situations of complex reciprocal interdependency” (Jessop/Ngai-Ling 2006: 255; see also Mayntz 2010). Further, “actor-network” theory can also be linked to the topics of “proto-governance” (Christmann 2010) and self-organisation. Finally, actor-network theory is suggestive of a greater conceptual valuation of objects in processes of coordinated action.

In the “actor-network” approach agency is viewed as a distributed competence. Thereby interest is directed first at the associational work necessary to form groups and thus to assemble the agency distributed among many agents. It is, for instance, possible to concretely observe the representation of a group by a spokesperson or the process of definition by which a group creates itself and, at the same time, separates itself from others (Latour 2005: 27 ff.). In addition, the terms “enrolment” and “translation” are used to denote processes of mobilising support for an idea (Latour 1987). The *enrolment*, that is the mobilisation of additional entities in support of an idea, is often accompanied by a reformulation, i.e. a translation of the central idea. If it is possible to redefine the central concerns of a group so that further interests are represented, then the mobilisation of additional actors and their resources is achieved. These accounts of construction works strongly overlap with the idea of “proto-governance” (Christmann 2010), which highlights that the construction of shared perceptions usually precedes coordinated action and is hardly dispensable for the self-organisation of coordinated action.

In contrast to the classical approaches, in the “actor-network” approach it is not only the acting social actors with their interests, motivations, intentions and skills that generate action. Rather, action is understood as arising in constellations in which dispositions of individuals and opportunities for action match in concrete situations, contexts or constellations. Agency is thus located not only with the social actors but is usually “distributed” in a complex fashion within a network of relations that also includes objects and artefacts. Their existence and availability can suggest, make possible, promote or even provoke specific actions. Furthermore, “actor-network” theory also ascribes agency to objects. To the extent that they participate in the course of actions, “objects too have agency” (Latour 2005: 63 ff.). While sociology has so far had little interest in material objects and has—at most—considered such objects as neutrally passive and subject to human will, the actor-net-

work approach attempts to capture more precisely which functions objects and artefacts take on in the course of actions and which effect they have on the course of the action.

If the existence of a principal difference between social and material actants is rejected, this is of course not to say that objects “themselves” can act or even feel or are motivated or anything similar. The purpose of the “actor-network” approach is explicitly not to humanise objects, but rather to understand more precisely than so far, what difference the presence of objects makes for the course of actions. If there is a difference, then the respective object participates in the action. In this case, the task of the social scientist is to precisely describe how this participation is constituted. For example, a loaded weapon within reach of someone who is potentially violent makes a crime possible, but the weapon does not carry out the crime.

The prominent and explicit position that is ascribed to objects and material contexts in the “actor-network” approach calls for an understanding of governance, in which the coordinated assembly of collective agency is firmly understood as interaction between social and non-social elements, like in the socio-technical research on the co-evolution of city and infrastructure. This becomes particularly clear with the example of the governance of infrastructure systems such as the energy system, where governance is not only about the mediation of interests and management of conflicts, but also about the taken-for-granted definitions of problems and the reality manifested in existing infrastructures (Star 1999), the resources invested into the system and the constraints created by technical interdependencies (Moss 2009). On the one hand specific forms of governance (and their transformation) influence the organisation of infrastructure systems (see Mayntz 1993), on the other hand new technologies can afford the adaptation of existing institutions (see Dolata/Werle 2007).

4 Proposal for a Social-Scientific Foundation for Vulnerability and Resilience

It has thus far been argued that the “actor-network” approach could offer promising answers for central desiderata in the understanding of vulnerability and resilience. In concrete terms, it provides an opportunity to focus on the constructionist character of vulnerability and resilience without further overtaxing the dichotomies between natural and cultural, material and social phenomena. At the same time it is possible to conceptualise governance processes, even though this requires a reorientation of understandings of governance in relation to the participation of objects in coordinated actions. However, no explicit statements on vulnerability and resilience have thus far been made within

the frame of the “actor-network” approach; this we will do in the following discussion.

We conceive of vulnerability as a concept which, in the context of social action under conditions of uncertainty, denotes practices of collectively assessing and negotiating situations of endangerment. In more specific terms, this is based on a construction process that involves any kind of entity—be it a subject, a group, an organisation, a technical or ecological system or a territory—which is defined (and thereby also delimited), identified as valuable and thus worthy of being preserved and set at the centre of an analysis. This entity is placed in the centre of a relational network to other entities, whereby the interdependence between the central entity and the other elements of the relational network are observed in terms of their impairing effects for the central entity. This interdependence can take many forms and encompass multiple dimensions at the same time. It can, for instance, be produced through technical interactions or economic exchange, it can be contractually specified or can become effective through habitual repetition.

All of the three central parameters in a vulnerability analysis, the centrally placed entity, the relations identified as important to other elements, and the levels on which the associations are observed, are in no way *quasi* naturally given. Rather they are actively and selectively perceived and—as in an actor-network—constructively brought into a causal association. In this construction process, all elements are located on the same level and affect one another directly. Material objects (e.g. the tendons and bones of one’s own body) and immaterial regulations (such as health insurance) can be equally constitutive elements in this process of construction.

Resilience, on the other hand, emphasises the possibilities of action and reaction within the relational network that has been conceived in specific perceptions of vulnerability. The intention is to implement more or less far reaching changes within the relational web in order to reduce the vulnerability of the centrally placed entity by protecting its vital functions and ensure its overall integrity. In general, the following “re-arrangement” operations are logically possible.

First, the attempt can be made to change the position of the centrally placed entity in the relational web. This can involve an increase in distance from or proximity to certain other entities. Increasing distance can reduce the degree of exposure against threatening effects and increasing proximity can intensify protective effects of the respective entities. The perception of the endangerment of a house by flooding can, for instance, be countered by the removal of the household into a territory that is considered to be less prone or not at all prone to flooding. Furthermore, the centrally placed entity can be changed in its internal structure so that it is better able to compensate for actual dama-

ges. One example is if a city threatened by stigmatisation attempts to regain sovereignty of interpretation over the discourse by professionalising its public relations activities. In both examples, the relational network that was perceived as threatening is changed through the re-positioning of the focal entity.

Second, elements in the relational network can be manipulated in such a way that they emanate a lessened endangerment for the focal element or indeed none at all. For example, an appropriate reaction to a perceived endangerment for one’s own household through water damage can be to install a “Water-Stop” appliance on one’s washing machine. Furthermore, also the protective effect of elements seen to avert dangers can be strengthened, such as increasing the height of dykes or topping up a health insurance policy.

Third, elements can be completely removed from the relational web so that their threatening effects defuse. For instance, the demolition of a steep flight of steps or a rusty bridge by an urban administration is based on preceding constructions in which possible injuries to passersby are anticipated using these traffic infrastructures.

Fourth, elements which have the effect of reducing the exposure of the centrally placed entity to sources of endangerment can be added to the relational web. Taking out fire insurance for the first time brings an element into the relational framework that makes a difference in the vulnerability calculations surrounding the endangerment of a house fire.

Fifth, the kind and/or the intensity of relationships to entities outside the framework can be altered. For instance, the recognition of vulnerability on the job market can lead to friends being increasingly seen as strategic contacts or to a previously superficial acquaintanceship being more intensively pursued.

Sixth, the level on which vulnerability is analysed can be questioned and shifted. This enables elements to be perceived in a different light, other elements can suddenly seem unimportant, and new elements can show up and present themselves as important. For example, an individual can in relation to his/her employment reduce the relative importance of income and security of status so that other values like “fulfilment through work” or “healthy stress levels” gain significance. This revaluation changes the assessment of the entire situation.

Generally speaking resilience constructions are usually not limited to single individual operations. Rather, the distinctions above are mainly undertaken for analytical reasons. In empirically observable practices we expect many of these possible approaches to work in combination and interaction with one another (see Evers/Nowotny 1987).

5 Vulnerability and Resilience and Their Positions in the Spatial Sciences and Empirical Social Research

Our proposed social-scientific based understanding of vulnerability and resilience offers answers to research desiderata that have long been discussed. In particular, the construction character of vulnerability and resilience is emphasised. The interaction of the material and the social is placed on a new basis that does without further overtaxing of tired dichotomies. Moreover, the topic of governance can be integrated in the way briefly sketched. However, this new conception also raises new questions; these are to be discussed in this section. Of particular note are questions about how this conception can be made productive for the spatial sciences and about how empirical analysis might be undertaken. These questions demand the integration of ideas from relational understandings of space (see Bathelt/Glückler 2003; Massey 2005; Yeung 2005) on the one hand and of concepts of second order constructions (Schütz 1953) on the other hand.

5.1 Vulnerability and Resilience as Spatial-Scientific Categories: The Roles of Space and Time

“Actor-network” theory is not primarily interested in questions related to spatial science. Nonetheless there are several inspiring applications of this theory to the field of spatial sciences that show that a transfer is not only in general possible, but can also offer fresh views. These include works that investigate the interaction of different spatial concepts (see Mol/Law 1994; Law/Mol 2001), and works on questions about the global effects of local work contexts (see Latour 1987; Latour 2005) and on long-distance control (see Law 1986; Murdoch 1998). However, detailed discussion is required of how the spatial relations of a foundation for vulnerability and resilience could appear. In order to achieve this, it is necessary to integrate some elements of a relational theory of space.

If, namely, vulnerability calculations and resilience constructions are understood as a network of heterogeneous elements and as associations of non-social entities (see Latour 2005), then spatiality is inherent to these constructs. This spatiality can be made explicit if—as in the relational approach in geography—space is understood not as a research object but as a research *perspective* (Bathelt/Glückler 2003: 123 ff.). In the course of the construction of relational webs it is impossible to avoid making spatial assertions. A spatial perspective has then the function of making explicit the spatiality in these arrangements, a spatiality that is otherwise often only implicitly assumed (Yeung 2005: 38 ff.). Thus the construction of relational frameworks includes, whether intentionally or not, both decisions about the positioning and extent in physical space of the entities in question, their mobility or immobility and also the spatial reach of their

damaging or protective effects. For instance, the perceived endangerment caused by a flood held back only by waterlogged dykes can implicitly or explicitly bring with it the following:

- positioning of the central entities in physical space (like the positions of place of residence, dyke and coastline),
- the issue of the mobility of important entities (an individual can retreat in the face of a flood peak expected in three days’ time, for a house the situation is different),
- the spatial extent of the relative phenomena (which territories are judged as threatened by flooding, which as safe), and
- the extent of effects (a flood is initially seen as a locally delimited natural event, in contrast the epidemics that often follow threaten to cross larger distances).

The construction of relational networks also takes into consideration the overlapping of different types of space and their possible interaction (Mol/Law 1994). When, for instance, a fire station is very close to a thatched house (that is endangered by fire) but is responsible only for the territory of the neighbouring municipality, then a tension emerges between good accessibility in physical space on the one hand and the lack of responsibility in institutional space on the other hand.

The temporal relation of these terminologies is produced in three ways: through the temporality inscribed in spatial categories, the temporality of construction practice and the temporality of assessment.

First, time is inscribed in the relational networks of perceived endangerments. Positioning, mobilities, extents or ranges are spatial categories whose meaning is not without a temporal component. Mobility means the ability to move in relation to time scales, territories have an extent the meaning of which cannot be measured independently of time scales, good or poor accessibility always also implies the possible temporal proximity of an event. Transforming active safety measures into passive ones implies, for instance, a rearrangement of possible time-spatial encounters between entities that threaten one another. For instance, at a level railway crossing the interaction of traffic lights and signals, gates and people at control desks is used to actively separate street and railway traffic in time or space while a railway tunnel arranges trains, cars, cyclists and pedestrians in such a way that the two groups of transport users can no longer encounter one another at the same time *and* in the same place.

Second, we see constructions in the course of vulnerability calculations and resilience practices as being situated in practice. Hence this construction work shares much in common with what Rittel and Webber (1973: 160 ff.) have discussed as “wicked problems”. In contrast to “tame problems” that are fully solvable as they have clear boundaries and are clearly delineated by a limited number of variables,

“wicked problems” prove to be intricate. They are involved in infinitely branching causal webs, can therefore not be isolated and thus always remain diffuse. This type of problem dominates when, as in the case of vulnerability and resilience, solutions are sought that are not only technical but also concern the social sphere. “Wicked problems” locate problem solvers in a specific time regime in several ways. They can only be dealt with in active contestation with the environment because the complexity of the causal interconnections cannot be simulated anywhere. It follows that increasing resilience must also be understood as a “one-shot-operation” (Rittel/Webber 1973: 163). There is no laboratory in which measures intended to increase resilience can be tested without the consequences of these measures having to be borne. It is rather the case that every attempt counts and every attempt has consequences that cannot be simply eradicated from the world. Furthermore problem solvers intervene in dynamic systems with multiple feedback loops. Other problem solvers are probably also active in intervening in the nexus of connections in question, sometimes without being aware of it, sometimes operating for different interests. There are feedback loops because each intervention that occurs has consequences for future processes of construction and must in future be considered in terms of its consequences, both anticipated and unanticipated ones. The situatedness of vulnerability and resilience in practical action implies that problem analysis always takes place in real time. It is thus to be expected that facts are changing during analysis or during the implementation of measures. The analysis is also never independent of action. Time and money that have been invested in the analysis of the problem can no longer be mobilised to solve the problem.

Third, a further characteristic of “wicked problems” indicates the temporal transience of assessments in the context of vulnerability calculations and the resilience strategies based upon them. The assessment of both threats and of implemented countermeasures often changes in the long-term. For instance in 2009/2010 swine flu was initially discussed in the German public sphere as being extremely threatening. Under this impression policy makers felt forced to order vaccines in high quantities. Once state investment running into billions had been made, then assessments of the threat changed and in the end large amounts of the serum were not even needed. Resilience strategies that were consistently criticised as insufficient were shortly afterwards reassessed and seen as ridiculous panicking overreactions. Events that were initially experienced as catastrophic have often been revealed with historical hindsight as favourable opportunities for new developments (Schott 2010).

5.2 Empirical Strategies for the Investigation of Vulnerability and Resilience

Throughout this paper we treat vulnerability and resilience as an indivisible pair of terms. The term vulnerability emphasises the aspect of constructive perception, while resilience highlights the aspect of constructive manipulation, but both terms are meaningfully interrelated and share the perspective towards action. Perceiving a threatening situation almost automatically suggests a direction for action or reaction: “The process of formulating the problem and of conceiving a solution (or re-solution) are *identical*, since every specification of the problem is a specification of the direction in which a treatment is considered” (Rittel/Webber 1973: 161; our italics).

The situatedness of vulnerability and resilience in practice forms the starting point for a strategy for their empirical investigation. Hereby the practice of the construction of vulnerability and resilience can be conceived as a “first-order construction”, drawing on the work of Alfred Schütz (1953), that is, as a construction that can be understood as part of social practice. The social-scientific analysis of vulnerability and resilience, in contrast, is based on “second-order constructions”, i.e. social actors are observed as they themselves observe their environment (see also Japp 1996). This second-order level of construction can, for instance, be attained if in the course of qualitative interviews actors are encouraged to present their perceptions of vulnerability and to explain what activities they are considering or have actually carried out in order to increase their resilience. A further possibility exists in discourse analysis. Publically made statements on vulnerability and resilience can be classified as first-order constructions, while the discourse analysis that lays open these constructs constitutes a second-order construction.

These strategies for empirical investigation additionally afford a productive way of dealing with the frequently criticised normative content of the terms vulnerability and resilience. The second-order construction offers the analytical distance necessary to tease out of the first-order constructions the normative orientations of the actors, without necessarily sharing them. The relationship between normative orientations and preferences in terms of certain resilience strategies is thus also made empirically tangible and accessible to critical analysis.

Nonetheless, the challenge remains as to how the agency of objects can be empirically and analytically captured. It will doubtless be necessary to widen the linguistic and conceptual repertoire of social-scientific spatial analysis so that it is possible to precisely capture and convey the share that objects have in the occurrence of actions of all kinds. It is important to restrain from analysing the participation of objects in collective actions with the vocabulary that has

proved appropriate for human actants. For instance, objects do not pursue “interests” and have no independent motivation for action. Nonetheless socially defined interests and motives are incorporated in them and in the contexts in which they are situated—which requires exact description and a new language of analysis. A ditch filled with water does not, for instance, separate a prisoner from freedom, however within the framework of an entire regime of imprisonment measures (i.e. in combination with walls, bars, guards and weapons, surveillance cameras and centres) it can fulfil a separating function and thus can contribute to the prisoner not achieving freedom. When analysing the agency of objects there will then often be discussion of which actions the objects facilitate, make possible, perhaps even suggest, and which other actions are made more difficult or are even completely precluded by them.

6 Conclusion

The aim of this paper has been to contribute to a social-scientific foundation for the terms vulnerability and resilience from a socio-spatial perspective. Going beyond other approaches so far, we draw attention to the dimension of the social construction of vulnerability and resilience, because endangerments and possibilities for forming resilience—even when there are indicators of them—are not necessarily perceived as such by those potentially affected. Actors can develop different forms of perception of potential endangerments and required precautionary measures, which has consequences for coordinated action in governance processes. Indication of the significance of immaterial factors such as constructions of reality should not, however, be misunderstood as implying a neglect of material factors. Rather it is the case that both aspects should be combined. The social-scientific approach of “actor-network” theory offers important impulses here, for various reasons. It attempts to capture the function of material objects and artefacts in the course of actions and their effects on the course of action. With its approach as a sociology of associations, it permits the integration of knowledge and forms of perception, and it formulates a constructionist perspective. Further, the “actor-network” approach proves itself particularly applicable because it conceptualises a new perspective on the materiality of social dynamics without further fostering the dichotomy between culture and nature, the material and the social. Using this basis it has been possible to present a conception of vulnerability and resilience that is to be understood not in dissociation from previous terminological definitions, but rather as an extension to them.

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