

Networks

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Glossary

Actor-Network Theory (ANT) This material-semiotic approach focuses on practices of mobilizing networks and conceives networks as hybrid collectifs of human and nonhuman actors.

Embeddedness This notion primarily counters idealized perceptions of markets as anonymous exchange and stresses the role of network relations (relational embeddedness) and social structure (structural embeddedness) for economic behavior.

Governance Approach Rather than with the formal configuration of networks and network positions of individual actors, this approach explores processes through which networks are initiated, coordinated, recombined, and terminated.

Social Network Analysis Behavior and social processes are interpreted with reference to the configuration of networks and the position of actors within networks rather than by the individual attributes of actors.

Structural Equivalence This notion of social network analysis refers to actors who occupy similar positions in a network by having identical ties with other members and predicts that structurally equivalent actors will use each other as a frame of reference.

Structural Holes This concept of social network analysis denotes the separation between nonredundant contacts (i.e., disconnected clusters) that is expected to yield behavioral opportunities (*tertius gaudens*).

Translation In ANT this notion refers to the four processes (problematization, interressement, enrolement, and mobilization) through which relationships between human actors, projects, interests, and naturally occurring entities are proposed and enacted.

Networks have turned into an almost universal principle of social organizing. In our current 'network society' they form the social grid of deterritorialized flows of information, capital, goods, symbols, and people; businesses are transformed from isolated organizations into nodes within networks of associated suppliers, competitors, and collaborators; technical networks such as those of the

Internet surround us within an ever-extending ecology of information and communication technologies; the increasing interpenetration of technical and social relations is predominantly conceived as an actor network. Networks, then, are not simply a theoretical concept. They have become metaphor, paradigm, method, and social practice alike.

The rather complex genealogy of networks can be traced back to Georg Simmel's formal sociology and his concern for relational structures. For much of the second half of the twentieth century, research on networks was driven by the fields of sociology, social psychology, and anthropology. These fields produced a considerable corpus of research on the role of networks in mobilizing social support or reproducing social exclusion, and the key role of networks in the diffusion of information among others.

The enormous upsurge of theoretical interest in networks in the economy during the last few decades was mainly catalyzed by Mark Granovetter's notion of the social embeddedness of economic action. By stressing the fundamental role of concrete personal relations and the networks of such relations, he provided a key concept for the study of institutional mechanisms by which networks are initiated, coordinated, monitored, recombined, and terminated. The particular Granovetterian understanding of embeddedness in fact turned into a key concept in the human geography of the so-called 'cultural turn'.

This contribution seeks to trace the selective engagement of human geography with three dominant network notions. The paper sets off by depicting the prevailing understanding of the network governance approach. Founded on Granovetter's relational conception of embeddedness, this approach branches off into the study of different network forms with strategic, informal, and regional networks that are most relevant within human geography.

The paper subsequently briefly ventures into the terrain of the social network approach that so far remained largely uncharted by geography. This strand of network research attempts to explain behavior, rather than by attributes of actors like age, gender, or class, by their position within a network and the particular configuration of networks.

By moving way beyond the two dominant network traditions, the article in the final section moves on to the

post-structuralist approach of actor-network theory (ANT). Although ANT has not reached the status of an alternative to the network governance approach dominant in geography, it has been employed as a conceptual pivot to shift beyond the established dualisms of structure/agency, subject/object, and human/nonhuman.

The Network Governance Approach

Governance, Embeddedness, and Network Forms

The governance approach is chiefly concerned with the institutional and organizational forms that govern exchange relations. Rather than with the formal structure of network configurations, the governance approach more specifically is interested in the institutional mechanisms through which networks are initiated, stabilized, and terminated. The goal of this line of inquiry is to account for the heterogeneity of organizational and institutional arrangements in contemporary economies – ranging from anonymous spot markets to long-term collaborative agreements, from informal credit rotating schemes in ethnic enclaves to multinational banks, from tightly knit clusters to elaborate global franchise systems.

The stage for the more recent debate on the governance of exchange relations was set by Oliver Williamson's transaction-cost framework in 1985. Williamson asked under what circumstances economic functions are performed within the boundaries of hierarchical firms rather than by market exchanges that cross these boundaries. His answer was that transactions involving high uncertainty about their outcome, that recur frequently, and require substantial 'transaction-specific investments' – of money, time, or energy – are likely to take place within hierarchically organized firms. Exchanges that are straightforward and nonrepetitive, requiring few transaction-specific investments, should take place across a market interface. This dichotomous view of firms as islands of hierarchical control in a sea of market relations attracted both followers and critiques.

The first most authoritative challenge of this framework was launched when Granovetter addressed the *Problem of Embeddedness*. In the transaction-cost approach, under- and oversocialized concepts of economic action complement one another. On the one hand, the market resembles the 'undersocialized' conception of an atomized and anonymous exchange, which neglects the role of social relations and local cultures that can provide order in economic life. On the other hand, an 'oversocialized' perception of hierarchical power within firms disregards the role of informal horizontal ties that often transcend vertical lines of hierarchy. In practice, Granovetter categorically stated, economic exchanges are embedded in personal relations and networks that are generating trust

and malfeasance. From the early 1990s onwards, this fundamental understanding of the imbrication of the economy within personal relations and social structure was also increasingly taken up in economic geographic reasoning.

The second major line of critique on Williamson focused on the dichotomous view of markets and hierarchies. By conceiving of markets and hierarchies as 'pure' forms, the rapidly expanding spectrum of intermediate network forms ranging from complex multiparty alliances in high tech industries over elaborate subcontracting relations to vague mutual obligations or illegal informal agreements, were initially reduced to 'mongrel hybrids'. More and more, though, networks have come to be seen as a specific mode of governance in the ever-extending range between the alleged 'ideal types'.

An approach to systematize networks in the governance tradition is to differentiate between their duration and governance. Different temporal dimensions have important consequences for the types of regulation of network relations. Long-term networks, for example, are shaped by reciprocal ties of past experience and expectations emerging from the 'shadow of the future'. The governance of networks spans a broad spectrum from more hierarchical to more heterarchical. In hierarchical networks, like in the supplier pyramid of a car manufacturer, control is exerted by an identifiable center that regulates network practices and rules, such as the selection of network members, the allocation of resources, and the maintenance of network boundaries. In heterarchical networks, like regional networks, for example, the regulation of interactions and relations in contrast is distributed and associative and authority is decentralized. Within this relational space defined by governance on the one hand, duration of networks on the other, informal, strategic, and regional networks represent the most relevant network forms within human geography.

Strategic Networks

Strategic networks are more tightly orchestrated than either informal or regional networks with regard to the selection of network members, the allocation of resources and distribution of revenues, and definition of network boundaries. Ties in strategic networks are forged – in a much more distinct and manifest fashion than in other forms – by power. Strategic networks evolve both horizontally as inter-organizational relations among competitors as well as vertically through the interpenetration of intra- and inter-organizational networks of global corporations.

By focusing on the inter-organizational ties between large vertically disintegrating corporations and their suppliers, an earlier debate evolved around the different governance modes of supplier networks. The spectrum of

the governance modes of supplier networks ranges from market-driven adversarial transactions to collaborative ties of mutual learning. Cross-country comparisons, in fact, have revealed that opportunism and trust are highly variable and dependent on specific national and regional institutional settings.

The global commodity chain framework of Gereffi and Korzeniewicz brought multiple geographical scales to the forefront of the analysis. At a time when geographical interest had turned to the study of localized production networks, this line of reasoning on commodity chains found its way into geography through Peter Dicken's *Global Shift*. Dicken's seminal piece paved the way for a strand of literature that began to explore the interdependencies between internal and external ties of global corporations and their host economies in more conceptual terms.

This literature increasingly crystallizes around the notion of the global production network that combines insights from the global value/commodity chain analysis with ideas derived from ANT and varieties of capitalism approaches. By drawing on these diverse antecedents, the global production network approach aims to push the conceptualization of territoriality beyond the highly aggregated distinction of core and periphery rooted in Immanuel Wallerstein's world-system framework and to appreciate more systematically the particular institutional conditions shaping (regional) development.

While global production networks primarily evolve around vertical ties, strategic alliances typically are confined to horizontal interfirm relations. Over the last two decades joint ventures have increasingly been replaced by nonequity partnerships, such as R&D pacts and joint development agreements that involve a lower degree of organizational dependence and shorter time-horizon. Presumably due to their nonlocal and ephemeral character, strategic alliances have hardly appeared in the focus of geographic analysis.

Informal Networks

Membership in an informal network is typically based on shared experience or the thick bonds of kinship and ethnicity that draw participants together. Given that such relationships emerge out of repeated exchanges, informal networks symptomatically involve long time-horizons. Research on informal networks has portrayed this type of networks rather ambivalently. Whereas one strand of research pays tribute to the compensatory role and 'lubricating' effects of informal ties, a less prominent line of inquiry is primarily interested in exposing the potentials of informal networks to disrupt markets and obstruct hierarchies.

The compensatory role of informal networks has been demonstrated in settings that appear to operate

like purely price driven markets, such as the financial markets of the Wall Street or the City of London, for example. Yet, traders in these market settings often establish continuing relationships based on reciprocity to validate information and exchange rumors and gossip. Human geography has significantly contributed to this line of reasoning, both conceptually and empirically.

Presumably, the most vivid contrast to the sterile image of spot-contracting in pure market settings has been revealed in research on ethnic networks that provide the social infrastructure of enclaves and ethnic economies. Ethnic ties provide solidarity and trust that can be enforced in relatively closed networks. The amalgamation of these collective assets in the notion of 'social capital' subsequently tended to privilege the enabling attributes of informal networks. This focus on the short-term benefits of social capital glanced over earlier accounts that illuminated how informal networks might turn into mobility traps over time.

Despite the imminent spatiality of ethnic networks and enclaves the geographical community initially has been less involved in the relevant conceptual debates. The more lively cross-disciplinary exchange in recent times has moved beyond the emblematic genres of geography such as the idiosyncratic portrayals of the place-based nature of local enclaves and ethnic economies to explore the transnational character of migration and 'transmigrants', ethnic networks, or global elite networks.

Informal networks, however, are also particularly well suited for practices ranging from conspiracy to organized crime in violent Mafia-type networks or terrorist networks. In fact, the risks associated with crime make trust far more necessary among criminals than among businessmen. Geography largely remained absent from this strand of research and once more narrowed the focus to the more benevolent and functional dimensions of informality.

Like in market environments, informal ties in hierarchical contexts fulfill multiple roles. On the one hand, informal networks can be mobilized to organize resistance against hierarchical rule. On the other hand, they can compensate for the structural weaknesses of hierarchies when they, for example, constitute 'communities of practice' that provide decentralized means of learning. The notion of communities of practice has rather rapidly migrated into a broad range of disciplinary contexts and, in the wake of the intertwined debates on the knowledge-economy and learning, has been increasingly employed in economic geography.

Regional Networks

Regional networks typically evolve over even longer time periods but share the multiplex features of informal

networks. They are, in other words, connected through a variety of intertwined heterarchical social and economic relations that make up their embeddedness. The early accounts on the amalgamation of family, community, polity, and business within tightly knit localities in the Third Italy provided most vivid embodiments of the notion of embeddedness. Although the Italian industrial districts, due to their dense familial and political bonds, represent an atypical case of collective governance, they provided an emblematic point of reference for the unexpected success of regional networks. These small firm networks obviously held the promise to combine economic imperatives of efficiency, innovativeness, and resilience with a sense of economic democracy and social fairness.

Subsequently, other thriving regions, most notably Baden-Württemberg and Silicon Valley, were regarded as empirical proof that resilient regional networks can be based on a variety of mechanisms and relational configurations that foster reciprocal forms of exchange. Networks, however, were rarely theorized in an explicit fashion, but rather, envisioned mainly in a rather generic sense as a shorthand for all sorts of lasting ties that did not adhere to a straightforward market logic. Moreover, the reification of regional networks in a plethora of case-studies tended to adhere to 'overterritorialized views on embeddedness'. Initially productive conceptions of territorial innovation models like innovative milieus, learning regions, regional innovation systems, and, above all, the cluster that had branched out from the district debate more and more seemed to constrict the view on regions to isolated 'islands of innovation'.

More recently, however, earlier attempts to break out of what increasingly appeared as the straitjacket imposed by Marshallian analysis gained momentum. The extent to which regional networks are integrated into global exchange relations has profound impacts on their internal governance, as well as their ability to tap into wider pools of information and relational resources. Trans-regional relations, moreover, have been identified as rather robust pivots against the self-reinforcing dynamics of closure and lock-in.

The current reaffirmation of nonlocal ties has been mainly phrased in the conceptual terms drawn from Owen-Smith and Powell's instructive distinction between 'local broadcasting' and 'global pipelines'. This conceptual step from the local into the nonlocal appears long overdue, yet it still seems rather distant from a topological understanding of space that allows an understanding of individual sites "as a place of trans-scalar and non-linear connections, and as a relay point of circulating knowledges that cannot be territorially attributed with any measure of certainty or fixity." (Amin and Cohendet 2004: 154). Most recent attempts, however, have begun to push beyond the static and problematic local-global

duality in which different spatial scales are associated with distinct social relations, behavioral attitudes, and types of knowledge. Local ties, in other words, are no longer necessarily regarded as socially embedded relations bound up with tacit knowledge surrounded by a sparse array of disembedded ties confined to the exchange of explicit knowledge.

Some of the structural limitations of the regional network debate, above all its privileging of cohesion and benevolent trust-based ties, reflect the willing engagement of economic geography with the governance approach. Human geographic imaginations of networks hardly appreciated the second, in fact older, tradition of social network analysis in a more systematic fashion. Presumably, human geography was deterred from venturing more deeply into this terrain by the austere and formalistic style of the social network approach that appeared to clash with the predilection for qualitative approaches of the 'cultural turn'.

Social Network Analysis

The hallmark of social network analysis is to account for "the behavior of network elements (i.e., the nodes) and of the system as a whole by appeal to specific features of the interconnections among the elements" (Laumann 1979: 349). The austere style of theorizing in social network analysis is deliberate and reflects the chief strategy to avoid the 'traps' of categorical thinking. Social network theory attempts to institute a relational mode of analysis and to challenge the unexamined construct of the person as an entity characterized by the typical list of variables of interest in social science – age, race, class, gender, etc. – that are conceived as sole causal factors of behavior.

Resonating with Simmel's program of a formal sociology of relations, networks represent sets of actors linked through specific types of connections. As a most basic representation of such affiliations, the formal language of the nodes and lines of the 'sociogram' became an emblematic representation of social network analysis. Over the last decades, the basic formal language of the sociogram or 'graph' has been translated into software-tools (e.g., Inflow, KrackPlot, Pajek, UCINET) to analyze and depict features of relationships. In human geography, only a few elements of the conceptual toolkit of social network analysis have been employed while the explanatory power of others is yet to be more critically gauged.

Strength of Ties

The strength of ties is presumably the most frequently adopted concept of social network analysis within human geography. Granovetter's elegant simplicity of the 'strength of weak ties', in particular, has consistently been referred

to in human geography and currently seems to attract some renewed interest. Put simply, this principle states that whatever is to be diffused can reach a larger number of network members, and traverse greater social distance (i.e., path length), when passed through weak rather than strong ties. Conversely, the information received in strong-tie networks is likely to be stale information, already received from other members of their own social group. Weak ties, in Granovetter's understanding, score rather low with regard to the amount of time, emotional intensity, intimacy (mutual confidence), and reciprocal services which characterize those relationships.

In exploring the significance of weak ties, Granovetter also refers to 'marginal' actors and 'outsiders' who seem to play a crucial role in the first phases of the diffusion of information and innovation. It seems to take only a small analytical step from Granovetter's sociological notion of the 'outsider' to Park's iconic 'marginal man' or Simmel's emblematic 'stranger'. These personifications of urbanity hardly played a noticeable role in the accounts of successful regional networks. The local has rather been portrayed in terms of the social cohesion of a village than of the diversity of a city. Rephrased in Ferdinand Tönnies' terms, locality is seen as *Gemeinschaft* (community) rather than as *Gesellschaft* (society).

More recently, the strength of network ties appeared in the focus of economic geographic inquiry in the reappraisal of translocal ties. Although this appreciation of weak ties took geographic theorizing a crucial step forward, the straightforward association of weak ties with the local scale has also caused severe objections that deny causality between spatial scale and density of ties.

Structural Equivalence

Although the notion of structural equivalence hardly has been employed explicitly in human geography, it resonates with more recent debates on innovation in economic geography. The idea of structural equivalence challenges the more familiar line of reasoning that perceives the adoption of innovation as a result of frequent interactions and emphatic communication between network members. Structural equivalence, broadly conceived, occurs when two actors occupy similar positions in a social system by having identical ties with other network members.

Structural equivalence predicts that actors identically positioned in the flow of communication will use each other as a frame of reference even if they have no direct communication with each other. In other words, it is not through intense exchange between network members but rather through the perception of the proper action for an occupant of a specific network position that diffusion is primarily driven. Innovation in this perspective, in other words, is stimulated primarily by mimetic pressures of mutual comparison.

By revolving around dense webs of local linkages, geographical innovation models apparently tend to overemphasize the dynamics of cohesion at the expense of structural equivalence. More recently, a critical line of reasoning that resonates with the structural equivalence argument has been voiced pointing to the crucial role of mutual awareness and observation in stimulating regional innovation. Among the pioneers that explored this particular path in economic geography, Malmberg and Maskell in 2002 pointed to the relevance of observation and imitation more generally.

Tertius Gaudens and Structural Holes

A further key principle in social network analysis alerts to the vital importance of the network position of individual actors for understanding entrepreneurial behavior. An actor that is positioned between two unconnected actors can leverage off a stable entrepreneurial decision as the *tertius gaudens* (the third who benefits) by divulging and brokering contradictions and tensions between previously unconnected actors. Burt in 1982 has further built on this classical strategy of 'divide and rule' in his discussion of how actors who connect two others previously unknown to each other bridge a 'structural hole'. These bridges represent unique, nonredundant ties between networks that otherwise would remain separated. By bridging a structural hole, an actor is able to look at a wider information screen and for that very reason becomes an even more attractive network contact to other actors thus providing new opportunities to expand network contacts.

This understanding of entrepreneurship that flows from exploiting ambivalence is radically different from the incarnation of the Schumpeterian entrepreneur prevailing in current economic geographic debates. While networks in economic geographic narratives are predominantly portrayed as webs of trustful ties to curb opportunism and to engender cooperation and innovation, networks emerge from the *tertius gaudens*-argument rather as vehicles to pursue opportunistic behavior and to produce competition. The iconographic economic geographic accounts are preoccupied with sharing, trust, and mutual learning; the *tertius gaudens*-viewpoint focuses on dividing, arbitrage, and strategic games. Only few accounts so far have begun to conceptualize the intermingling of diverse social rationalities such as family, friendship, firm, church community, etc., within network relations.

Burt's interpretation of structural holes is presumably the most widely cited notion of social network analysis in human geography and, in fact, is regarded as the emblematic representation of this network tradition. Social network analysis, however, encompasses a diverse range of approaches that has advanced beyond 'structuralist

determinism' to address agency in network structures. More significant steps beyond deterministic perceptions of network structure have been taken by Harrison White's seminal writings on identity, temporality, and narrative. Formerly a leading exponent of structural determinism, White began to push towards a reconceptualization of the interrelation between network structures, culture, and agency.

Actor-Network Theory

From Network to Rhizome

Notwithstanding these major steps beyond determinism undertaken by 'structural constructivists' like White, this strand of social network analysis still continues along a structuralist tradition. A fundamentally different ontology rooted in post-structuralism is offered by ANT. ANT is a material-semiotic approach developed by Michel Callon and Bruno Latour in Paris in collaboration with John Law and others in the context of science and technology studies.

Both the network governance as well as the social network analysis adhere to a network construal rooted in a generic topographic imagination of social relationships that connect social actors. This grid of ties-and-nodes is contrasted in (later contributions to) ANT with the trope of the rhizome. The rhizome offers an alternative trope that perceives networks as multiple, intertwined, and branching roots with no central axis, no unified point of origin, and no given direction of growth. The botanical associations indeed seem intended: The metaphor of the rhizome foregrounds the transformative and processual dimension of networks; it deliberately departs from the static views of 'transport without transformation' in the dominant network approaches.

Relationality and Translation

This perception of multiple entanglements in ANT is intended to subvert our habitual juxtapositions of structure/agency, subject/object, and human/nonhuman. In the ontology of ANT, actor and network are inextricably enmeshed. An actor network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform the constituent elements of which it is made of. The capacity to act and give meaning to action is neither solely embodied in human actors nor localized in norms, values, and institutions that make up our familiar registers of 'social embeddedness'. In this perspective, we do not live in a society but in 'hybrid collectifs' that entangle human actors as well as nonhuman actors in multiple ways.

The point here is not to anthropomorphize insentient beings and things but to appreciate their particular role

in collectifs: they stabilize. Whilst fixed in one sense, 'immutable mobiles' such as maps, texts, algorithms, organization charts or ships, canon balls, and navigation instruments are also re-combinable. Recombination and alignment is achieved through the process of 'translation' that is a process in which sets of relationships between human actors, projects, tools, and naturally occurring entities are proposed and enacted. As Callon in 1986 elaborated, translation is achieved in four moments. Problematization involves the interdefinition of actors and the attempts of actors to establish 'obligatory passage points' in order to become indispensable network elements; *intéressement* confirms the validity of the problematization and the alliances it implies; *enrolment* describes the negotiations, trials, and tricks that enable enrolment to succeed; mobilization of allies, eventually, turns enrolment into active support.

ANT in Human Geography

Although the rhizome-metaphor up to now has not diffused into human geography on a similarly broad front as the tie-and-node imagery, it nevertheless exerts increasing influence on human geographic imaginations of networks and space. First and more generally, ANT perforates the analytical distinction between practice and its scientific representation. The relational webs that constitute the economy, for example, not only comprise of the familiar catalogue of nodes such as firms, consumers, and various institutions – but also of the economists who contribute through calculative practices and conceptual tools to the performance of the reality they describe: The economy is embedded in economics.

Second, the governance approach offered to human geography a model for conceiving (or at least implicitly assuming) the fabrics of socioeconomic life that could be assorted neatly onto different scalar levels (from local through regional to global); geographical notions of space themselves, though, remained largely untouched by this network metaphor. ANT radically breaks away from the Euclidean scalar understanding to a genuine relational perception of space as topological stratifications. This approach "opens up space-time to the coexistence of multiple cross-cutting networks of varied length and durability" (Whatmore and Thorne 1997: 302). ANT, in other words, follows the pleas against essentialist understandings of space and time. A topological geography interweaves time and space with a heterogeneous network of actors that has been differentiated, for example, into regions, networks, and fluid spaces.

Third, the methodological strategy of ANT helps to identify and embody the agents and networks of the global economy in a way that undermines the image of the "faceless juggernaut of globalization" (Dicken 2001: 106). By appreciating the multiplicity of interrelated

processes in the constitution, stabilization, and reshaping of relational ties, ANT challenges the perception of a seamless and lucid global chain that links producer and consumers in a straightforward fashion. In contrast to the more functionalist understandings of global commodity chains, ANT inspired perspectives foreground the fibrous links that have no linear or bounded character and that continually evolve into new constellations in unforeseen ways. Instead of conceiving individuals, firms, industries, or nation states as coherent and unitary actors, ANT directs the focus to their constitution and reshaping via tracing their engagement within an array of actor networks. Studying a different type of global networks though from a similar point of view, Whatmore and Thorne in 1997 used ANT to guide their research on the making of durable 'fair trade' actor networks that link buyers in the North with producers in the South.

Fourth, the perception of networks that challenge the established demarcations between human/nonhuman opened up novel avenues to delve into 'hybrid geographies', in which nature, for example, is no longer perceived as the traditional passive object but rather ascribed an acting role. ANT thus can perforate analytical demarcations that have become 'naturalized' in our prevailing lines of reasoning in a productive fashion.

For this very reason, however, the underlying imagery of the rhizome can also turn into a trap when all too arbitrarily transplanted in any context. ANT-inspired studies tend to privilege the relational dimensions of the web at the expense of considerations of the actors themselves. ANT seems to offer an invitation to glance past the differences between distinct types of actors in different domains and thereby also conceals uneven power relations. Although power (in its Foucauldian understanding) is by no means an alien concept to ANT in principle, in practice ANT misses that hierarchies are real.

Conclusion

This paper set out at tracing the engagement of human geography with the three most relevant network conceptions of the network governance approach, social network analysis, and the post-structuralist ideas of ANT.

Human geography, first and foremost, embarked primarily on the route paved by the network governance approach. Far from being exhausted, the governance approach can carry human geographic reasoning on networks farther on. This seems a particularly fertile ground for cross-disciplinary exchange with adjacent social sciences. With the increasing spatial awareness in the social sciences, as manifest in the debates on the resilience of national institutions, the '(re-)discovery' of local clusters or the importance of micro-geographies for learning in laboratories, the conditions, in principle, seem

favorable. However, instead of confining the role of geography to attaching the proper spatial scale (along the familiar scale of local to global) to network structures, human geography might champion more challenging problematizations of space into the social sciences.

Second, apart from fairly loose interpretations of the strength of network ties and structural holes, human geography hardly engaged in the systematic inquiry of network structures and positions. In particular, more recent approaches of the structuralist constructivists like Harrison White have not (yet) been critically interrogated by human geography. Unlike in structuralist determinism, networks in the constructivist perspective afford opportunities for action, though are but one antecedent of action. In this sense, human geography might benefit from examining the potentials of social network analysis. Human geography is strong on processuality and contingency but weak on structure; social network analysis is strong on structure and, apparently, increasingly sensitive to processuality and contingency.

Third, human geography has already ventured into the terrain of the post-structuralist strand of ANT. For human geography the proposition that action takes place in 'hybrid collectives' could imply, among others, to more systematically appreciate materiality of the social and the "diverse props ... that sustain people's actions" (Strathren 1996: 523). Studies of financial markets, for example, have exemplified the entanglements of actors with tools, instruments, and algorithms in an instructive fashion. Computer monitors that are used to 'screen' the markets are the very locations of markets on which trading is performed. Geography with its tradition in studying the material world seems in a privileged position to contribute to a 'science of associations'.

See also: Commodity Chains; Embeddedness; Ethnic Economies; Food Networks; Global Production Networks; Industrial Districts; Poststructuralism/Poststructuralist Geographies; Regional Production Networks; Relational Economic Geography.

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