

Networks and Boundaries

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Since its establishment in the 1970ies sociological network theory is concerned with boundaries. This mostly implicit concern comes quite naturally because the very concept of network allows to bracket the boundary problem (Wellman 1988)—only to make it even more salient. Thinking relationally means facing the problem how distinct identities, bound social entities or delimited domains emerge out of networks of relations that just don't lend easily to any concept of boundary (Emirbayer 1997). The salience of the problem notwithstanding boundaries remained only the hidden theoretical agenda of network research. But in the meantime the search for solutions has been reinforced (Abbott 1995; Eigmüller and Vobruba 2006; Lamont and Molnár 2002; Tilly 2005; Zerubavel 1991).

In this paper I will focus on some distinguished theoretical ideas and statements of a few relational thinkers to come to grip with boundaries and their connection to networks. This connection might prove to be much closer than expected. Both rely on the same crucial distinction of coupling and decoupling which brings them about as meaning structures for analysts and natives alike. The collection of formal evidence that boundaries and networks are equivalent is challenging. To some it may simply sound counterintuitive. Therefore, my proceeding will be to trace back the theoretical trail that leads to this proposition. It is part of a research project that aims at yielding a sociological theory of boundaries and applying it to organizations. To this end I will offer a first simple formalism that can guide further research.

THREE RESTRICTIONS FOR THEORY

To be able to extract the main theoretical ideas out of the body of literature I will basically use three restrictions that will guide the selection. This proceeding has two further effects. It serves to keep some of the preoccupations of social boundary research at bay which only distract us from the main subject, that is, boundaries. Additionally it serves as a discription of my own boundaries with respect to boundary and network research (a paltry excuse though).

My first and main restriction is to pick up for discussion only propositions that focus on boundaries explicitly. This proves of value because sociological studies on boundaries are rather preoccupied with identity than with boundaries (cf. Tilly 2004: 213-14). Without any doubt identity formation is very close to boundary setting so that any presumed identity can serve as an indicator of some boundary. Nevertheless identities and boundaries are different simply because one boundary can bring about at least two identities. (Besides, we wouldn't need two terms to indicate something that is identical.) The second restriction is to preclude the boundary specification problems of survey research (Knoke and Yang 2008; Laumann, Marsden and Prensky 1983; Scott 2000; Wasserman and Faust 1994). For the sake of data collection researchers are forced to neglect that boundaries are highly context dependent, most of the time ephemeral and contingent on the observer observing them. In most cases it is simply assumed that boundaries delimit groups of individuals or persons. To be sure, if it is to conduct a survey this might be the only way to proceed. Yet it obscures the problem of how boundaries are specified and reproduced empirically. It furthermore decouples from network theory and even the concept of network itself. Starting with any preconceived knots— individuals or even persons—misses the point, since it is the tying and stringing of such knots that is to be explained (White 1992, 2008). The third restriction is intimately connected to the previous one. It's the concentration on assumptions that at least in principle allow for selfreference (cf. Luhmann 1995, 1997). Propositions of that kind remind us of the fact that boundary research is itself dependent on the setting, accepting, and even defending of boundaries. This brings us closer to the core of boundary processing for we don't look for specific boundaries of this or that group but for the self-similarity of societal boundaries (on self-similarity see Abbott 2001a). This does not preclude examining boundaries that aren't our own. But the latter is just unsuitable for setting out a theoretical argument on boundaries.

Equipped with these restrictions the number of respective accounts shrinks to a few. The main ideas we get out of this funneling serve as pillars for any relational theory of social boundaries.

BOUNDARIES AS EVENTS

Start with thinking of boundaries as events.¹ That is to say that any operation of demarcation basically does not have any duration.² Therefore most boundaries remain unrecognized in

¹ If the world is a world of events, as George Herbert Mead (2002) has convincingly argued some seventy years ago then this holds for boundaries, since they belong to this world, too. Recently this temporalized, event-based view on social structure has been put to the fore by Andrew Abbott (2001b) and even more radically by Niklas Luhmann (1995, 1997).

² The problem then is not how rigorous boundaries can be penetrated but how they are reproduced.

most situations unless conditions are set that reproduce and maintain them. It is such maintained and defended boundaries that become salient and that we usually come to call boundaries. However, I think we shouldn't confine boundary research to durable and apparent boundaries but rather refine our view of them. Some social limitation is present in every communication or action even if it shouldn't be apparent for the participants simply because of their being taken for granted. The seeming absence of boundaries is due to the fact that they are usually a part of the metacommunication accompanying any communication (Ruesch and Bateson 1987), that is, we don't have to signal them explicitly to communicate them. Boundaries belong, in other words, to the „shared agreement“ of ethnomethodology which is reported without being mentioned (Garfinkel 1967). The notion of boundaries as events stresses their constitution and usage on a microlevel insofar as „micro“ doesn't refer to individuals but to operations—i.e. events-in-relation—like communication and action. This allows to examine boundaries of micro and macro alike: boundaries of interactions, face, roles, status, occupations, professions, organizations, and markets or of domains like science, politics, economy or religion. Any boundary has to be actualized and instantiated in some moment. Therefore, to start with the assumption that boundaries are events results in scale-independence of inquiry and attentiveness to dynamism from the outset.

Some boundaries seem nonetheless much more stable than others. The distinction of symbolic and social boundaries as proposed by Michèle Lamont and Virág Molnár (2002) might help to clarify the point that we have eventful boundaries on the one hand and seemingly durable ones on the other. *Social boundaries* are directed towards the unequal access to and distribution of resources and opportunities. In this sense they are *durable* and seem to be more resistant to modification. Ethnic, gender, nation, class, or race boundaries for example seem, as it were, manifest and ossified. *Symbolic boundaries* in contrast appear to be rather airy. Nevertheless they are as consequential and real as social ones. Any conceptual distinction used for categorization or classification draws a symbolic boundary. Since any cognitive act depends on some implicit or explicit distinction this type of boundary is fundamental and, in our sense, *eventful* because such boundaries can be switched and connected rapidly—though not arbitrarily. Every situation deploys symbolic boundaries to get some idea of what's going on. In Lamont and Molnár's own words (2002: 168): „They are tools by which individuals and groups struggle over and come to agree upon definitions of reality.“ Since this struggle is a defining feature of any social situation, symbolic boundaries must be ephemeral, shifting, and, of course, *social* in character. At this point the distinction collapses. At least it cannot be the first distinction of boundary research. Yet to distinguish social and symbolic boundaries might be very useful in two important respects. First, it allows the observation of possible power relations involved in boundary setting, maintaining, and defending; there are contested boundaries. Second, it is suitable for historical and evolutionary problems. Only under specific circumstances do symbolic boundaries become so constraining for interaction as to be

termed social boundaries. Hence this distinction pushes one into the direction to look for different forms of transformation from symbolic to social boundaries and their interweaving relations in time. This amounts to an interest for the transformation of events into (durable) structure and the search for respective empirical mechanisms. However, any duration or stability needs to be reproduced in time by a conditioned sequence of events.

Although following a different rationale Charles Tilly's treatise on social boundary mechanisms also provides many cues with regard to the assumption that boundaries can be considered as events (Tilly 2004). His argument aims at identifying boundary *change* and its precipitating and constituting mechanisms. But a second glimpse reveals the wit of his argument: Boundary change isn't the exception but the rule. When a boundary is communicated then change, and thus volatility, of that boundary is built in automatically. In the next moment the same boundary looks different or is substituted for another one. Take a closer look at his mechanisms to get a better idea why this holds.³ Every mechanism Tilly identifies (i.e., encounter, imposition of boundaries by authorities, borrowing of boundaries from elsewhere, conversation, shift of boundary maintaining incentives, inscription and erasure of boundaries, activation and deactivation of boundaries, site transfer within a boundary and relocation of boundaries as combination of different mechanisms) describes an operation situated in time and space that first of all brings the boundary about that is to be changed. Where should a boundary have dwelled before anyway? In the end all these mechanisms can be boiled down to the operation of activation and deactivation of boundaries. This is a rapid and permanent process in social life. Boundaries, even the durable ones like gender and ethnicity, are always temporary and ephemeral. It depends on the observer and on context which ones are activated and which ones deactivated—for the time being.

How can we now account for such ephemeral and rapidly shifting boundaries of the social world that are inevitable for managing uncertainty and contingency and for any agreement upon „definitions of reality“ as Lamont and Molnár argue with respect to symbolic boundaries? To be sure, without boundaries and boundary signaling social organization wouldn't be there. It just couldn't sustain itself. Any recognition of regular patterns would be impossible. In this vein boundaries are essential for any social process to occur simply because we cannot do without drawing distinctions (Abbott 2007; Baecker 2005; Bourdieu 1979; Lamont and Fournier 1992; Luhmann 1997; Simmel 1989, Zerubavel 1991)⁴ which is

³ As already noticed he distinguishes mechanisms that precipitate from mechanisms that constitute boundary change. For the present purpose this distinction can be ignored for we don't look for causality but for evidence that boundaries are events.

⁴ Evidence for the fact that distinction is the basic cognitive operation is also provided by biological epistemology and second order cybernetics both of which are branches of cognitive science. See Bateson 2000, von Foerster 1981, Glanville 1990, Maturana 1981, Varela 1979. For a mathematical calculus of distinctions see Spencer Brown 1994.

tantamount to setting a boundary that separates two sides. The typologically used distinction (sic!) between social and symbolic boundaries surely helps to frame boundary research but it also introduces new problems. This distinction enables us to distinguish two types of boundaries but we still don't know much about how boundaries are brought forth or, so to speak, what boundaries *do*. Since social and symbolic boundaries are both boundaries we have to look for a distinction that enables us to identify *both* as boundaries independent of the question whether they are social or symbolic. This turns out to be the main problem that has to be approached before any other issues like different boundary types, institutionalization or permeability of boundaries should be tackled. It will need some theory to get things more clear in this respect—though the clarity I hope for may at first glance seem confusing because it demands to leave some of the beaten tracks behind.

BALD BOUNDARIES

The probably most radical treatise on boundaries is offered by Andrew Abbott (1995). Usually we start with things, objects or entities and ask for their boundaries or for the boundaries between them. Abbott proposes a reversal. The reason is quite simple: When we start with a view of social structure that is based on events, process, and relations then the problem of how entities emerge and dissolve becomes acute. Hence we have to examine boundaries first, without presuming any pre-existing entities. But how can we approach bald boundaries, that is, boundaries as a subject of its own without referring to anything else? Abbott chooses to employ algebraic topology to get some formal ideas how to proceed in this case. Without going into the details here the result of this excursion is that boundaries and entities are topologically equivalent. However, the determination of some point x as boundary point still has to resort to sets as preexisting entities. If boundaries come prior to entities, as Abbott is trying to show, a boundary definition is needed that works for itself—without any entity but as a precursor of any entity:

„To do this, I shall replace the concept of set membership with the more general notion of ‚difference of character‘. Thus, I shall define a point x as boundary point in space S if every neighborhood of x contains at least two points that differ in some respect ... (Note that the boundary point is defined ‚in a Space S ‘ rather than ‚of a set M .‘) In the simple case, this difference will be a single known property—color, gender, creed, education. In the more complicated (and more likely) case, it will be a combination of properties or dimensions of difference.“ (Abbott 1995: 862)

Andrew Abbott continues to show how such sites of difference are combined and connected to form a social entity, in his case social work as a profession in the late 19th century. But I rather want to highlight the theoretical idea on which his conjecture is based and exploit it further. If any social entity is a product of some site of difference and combinations of

different sites of difference respectively then we are in need to learn more about such sites of difference. At this point the theory of distinctions of mathematician George Spencer Brown (1994) comes in handy. What the latter calls „form of distinction“ is tantamount to what Abbott terms „site of difference“. Look at his notions of „distinction“ and „form of distinction“ respectively and compare it with the above given account of Abbott:

„Distinction is perfect continence. That is to say, a distinction is drawn by arranging a boundary with separate sides so that a point on one side cannot reach the other side without crossing the boundary. ... Call the space cloven by any distinction, together with the entire content of the space, the form of the distinction.“ (Spencer Brown 1994, 1-4; original emphasis)

The form of distinction obviously comprises Abbott’s idea and is thus an equally possible vantage point for a theory of boundaries. What makes Spencer Brown’s non-numerical mathematics furthermore attractive is the introduction of a notation for distinctions. Its consequences for sociological modeling have not yet been explored. However, some promising steps in this direction are undertaken by Dirk Baecker (2005, xxx). It seems worthwhile to follow this lead and look for further elaboration.

NOTATION FOR DISTINCTIONS

Notational systems aren’t simply a passive tool but their use actively delimits our mode of observation (Long 1999). They allow to perceive things that otherwise would remain unrecognized.⁵ Paradoxically speaking: a notation is a deliberately employed observational limitation for the purpose of observational extension. Although sociology is at its core about the drawing of distinctions that help to explain, understand or analyze the distinctions drawn in social systems we obviously lack a proper representation for distinctions (cf. Bateson 2000). Written language is very useful in transporting distinctions but it cannot grasp them. It is dependent upon sequential unfolding and needs copulae like „and“, „or“, „if...then“ or „between“ to indicate a distinction. But a distinction is completely indifferent with regard to such copulae. It just registers the neighborhood of two sides or states and leaves it to other distinctions to determine the relation in some direction or another. The inability of written language to indicate distinctions becomes even more salient when it is to indicate distinctions without there being any identities to be distinguished. The word „distinction“ itself may serve as a marker of course but this is rather unsatisfactory when it is to grasp the implications of drawing distinctions.

⁵ Think for example of written language that allowed to build artificial words and abstractions (most salient in the development of greek philosophy, see Havelock 1963), or recall the combinatorial possibilities discovered and invented by musical and mathematical notations.

Since we are, as our brief discussion of Abbott has shown, in need of a theory of distinctions and their accompanying boundaries we will use Spencer Brown's notation for distinctions in a sociological interpretation (Baecker 1999, 2005; Spencer Brown 1994). The intention is to achieve a proper formalization of the above and forthcoming conceptions of boundaries and to give way to an easier comparability of networks and boundaries. The theory of form behind this notation will be used as a foil to make these two phenomena comparable.

The notation is parsimonious. It consists only of the mark of distinction.



This mark is to be understood as marking an operation of distinction. It is, in other words, a token for distinctive events and is therefore suitable for a theory departing from events. Furthermore it fits with relational sociology because drawing a distinction means to separate to sides in order to relate them—independent of the question whether this happens explicitly and deliberately or not. If we start from relational events then the establishment of any relation in a specific moment brings forth the sides it is relating. In short: no relation without distinction. The following figure illustrates in detail how this mark is to be read and what it implies.

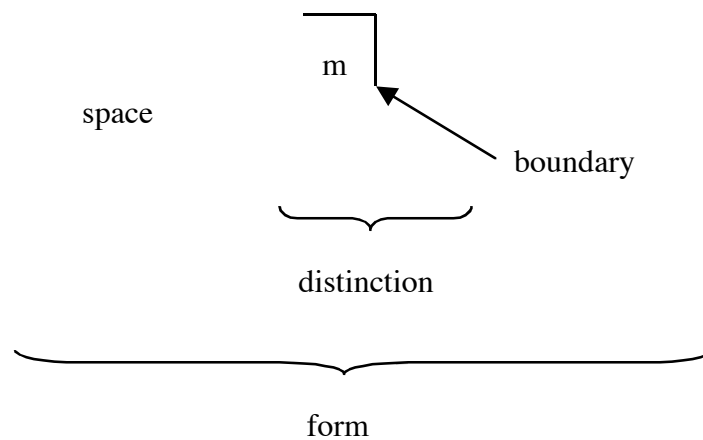


Figure 1: Observational components of the form of distinction

This figure shows the notational implementation of the definitions of distinction and form given above. It shows the setting of a boundary that simultaneously produces two sides: the marked side (the concave side of the mark, in this case additionally named *m*) and the unmarked side. Note that the unmarked (right) side of the mark pertains to the distinction as well. Observing the distinction together with the space that is thereby generated means observing the *form* of the distinction. The boundary of a distinction obviously separates the two sides but also relates them to each other. A boundary essentially amounts to both separation and connection. It is the element of a distinction responsible for perfect continence.

Turning now to sociological boundary research again it is interesting to see that Charles Tilly's definition of boundary is almost identical to the idea of boundary we get from Spencer Brown (Tilly 2004):

„We might ... define a social boundary minimally as any contiguous zone of contrasting density, rapid transition, or separation between internally connected clusters of population and/or activity.“

This definition can be curtailed when taking into account that boundaries, as Abbott argues, appear before any clusters can be distinguished and indicated. Furthermore separation and rapid transition do only double the issue of contrasting density. Therefore a social boundary can be defined even more minimally as any contiguous zone of contrasting density. Put on top of Spencer Brown's boundary of figure 1 we get figure 2.

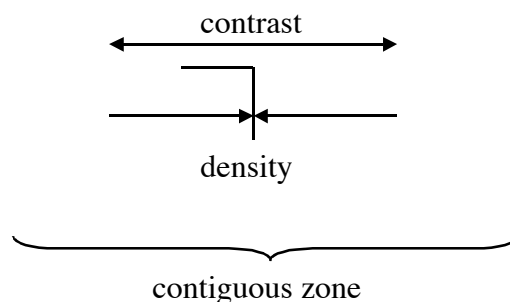


Figure 2: Tilly's boundary definition and Spencer Browns notation

Note that this token is not the mark of distinction which implies all the components shown in figure 1 but only the boundary component of figure 1 zoomed in, because we are trying to concentrate especially on boundaries and ask for *their* form. This figure demonstrates on the

one hand that Tilly presents a formally exact definition of boundary and on the other hand that we have a notation available that goes hand in hand with sociological definitions of boundary. But it needs further zooming if it is to lay out the contiguous zone in more detail. We will stick with Tilly because he actually has more to offer with respect to the relational complexity of boundaries. Our notation abbreviates the further line of argument and will be employed to slightly recast the boundary formalism he introduces.

THE RELATIONAL COMPLEXITY OF BOUNDARIES

Boundaries generate and organize relations. As Charles Tilly writes:

„In the operation of a social boundary, we expect to find 1. distinctive relations between sites on one side; 2. distinctive relations between sites on the other side; 3. distinctive relations across the zone between those two; and 4. on each side, shared representations of the zone itself.“ (2004, 214)

In a chapter entitled „Ties that Bind...and Bound“ he summarizes this four part complex that a boundary operation brings forth by the following figure:

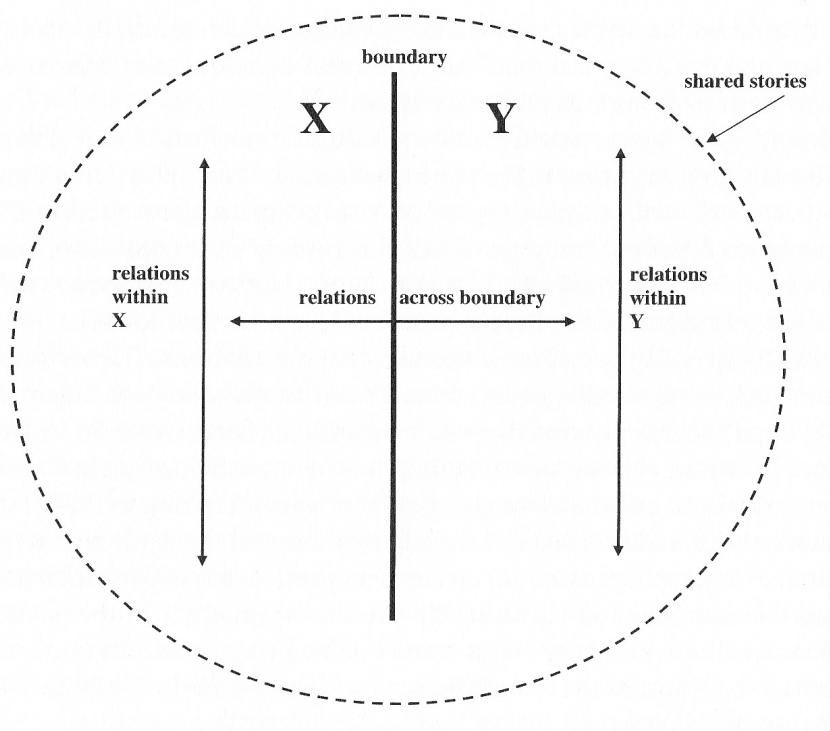
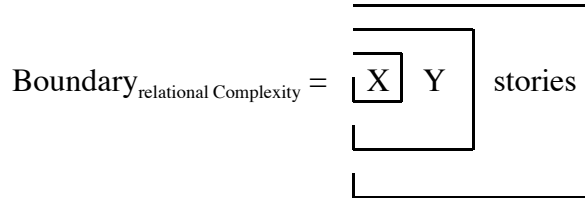


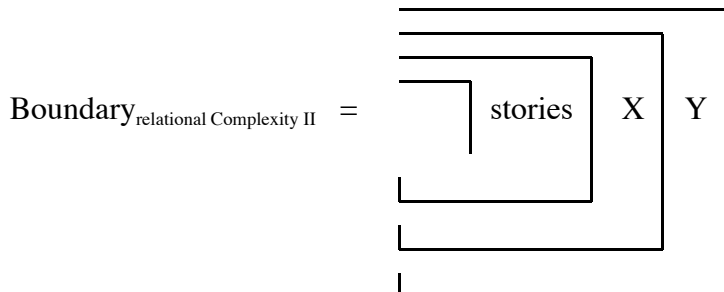
Figure 3: Tilly's Boundary Relations (Tilly 2005, 8)

Translating this figure into an equation using the above introduced notation we get:



The modification of the mark introduced here is called the re-entering mark. It simply indicates self-reference, that is, it indicates in this case that there are relations within X referring to relations within X. The same applies to Y, to the relations between X and Y, and to the stories told of this relation and of the relations within X and Y respectively. Note, that this intermeshing of relations notated in this form *is* the boundary. It is a notation of a contiguous zone of contrasting density. Remember once again that we zoomed in the boundary of figure 1. We now use the same notation to get to the distinctive form of a boundary. What we see here is a network of relations as the minimal form of boundary complexity. This corresponds to Ronald Breigers assumption that the boundary problem has to be made reflexive within relational analysis (Ronald Breiger in Emirbayer 1997). Boundaries of networks are themselves networks.

We could also notate the boundray differently when we integrate Andrew Abbott's proposition that boundaries come first. Then we get



This equation turns the former, as it were, inside out. It contends the same as above but makes visible that the identities X and Y and their respective closure are products of setting a

boundary and telling stories about it first. Recall the network theoretical insight of Harrison White that stories might be the only way in which we come to know anything about ties and their shape (type, strength, multiplexity, etc.) (White 1992). Where should X and Y, their internal relations and the relations to each other else come from if not from stories?

One important point has to be repeated here once again for it lends to misunderstandings easily. The above equations (and any equations that will follow using the re-entering mark) seem to be completely involuted but they aren't *because the unmarked (right) side of this arrangement of distinctions belongs to the form as well*. This unmarked side isn't determined here but refers to a determinable context which is mandatory for the understanding of the form and might become marked in a subsequent event. Therefore this notation does not only display involution but likewise co-dependence of the distinctions within the form and dependence of the form on context; and differentiation of the form in itself and from its neighboring forms. Different degrees of involution, dependence, and differentiation then have to be examined empirically which amounts to examining the *distinctions* that gradualize the decoupling and embedding of the form.

Our exploration of boundaries still hasn't come to an end yet. The unfoldment of the relational complexity of boundaries still leaves open what boundaries do. After looking at boundary complexity we now have to turn to ascertaining the form of boundary *operations*. What do boundaries do to generate this form of complexity that Tilly alludes to? Network theory proper may give some answers.

DECOUPLING AND COUPLING

The relation between networks and boundaries is rather clear: „Networks do not have boundaries.“ (White 1995: 1039) However, pay attention to the following conundrum. Social organization appears in two concurrent modes: blocking and getting action (White 1992). Both rely on networks. But this makes boundaries pervasive and directly linked to networks. What else than networks is blocking action and how should fresh action be possible without activating networks? How can we get action without being blocked in certain respects? How could it be able to suffer blockage without knowing that it is necessary for getting action?

However, I won't try to solve this conundrum. But it is important to face it if we want to see how boundaries and networks form a duality (Breiger 2008). The symmetry of this duality or distinction is broken differently by different observers and how this is done might be the crucial empirical question that has to be addressed in any application of the following simple formalism of boundary operations. In this last section I will therefore try to show that networks and boundaries amount to the same problem. Networks and boundaries are akin.

This can be shown by looking at some ideas from social boundary research on the one hand and compare it to network theoretical accounts on the other. It makes sense to approach these two areas separately to be better able to discern their intimate connection.

Boundaries have come into a general sociological focus only recently. In contrast organizational sociology has always been interested in boundaries. It forms a field of research that is concerned with boundaries almost traditionally because it is dealing with social entities that somehow manage to build up seemingly durable boundaries to society in which their operations nevertheless remain embedded. Many scholars have tried to create organizational boundary typologies (Adams 1980; Hernes 2004; Hirschhorn and Gilmore 1992; Oliver 1993; Santos and Eisenhardt 2005) but they aren't of so much interest because they mainly enumerate different boundary types or characteristics and lack substantial discussion of how boundaries operate, that is, what makes them boundaries at all. In return the accounts of organizational sociology dealing with boundary operations in particular exhibit a similarity that one hardly encounters in sociological research. We need not go here deeper into the different analyses. The presentation of the main distinction qualifying boundary operations will suffice to lay bare the crucial point. The classical work in this respect is James D. Thompson who determines boundary operations by the distinction of buffering and spanning (Thompson 1967, Yan and Louis 1999). Since then organizational sociology is basically varying this distinction when it comes to boundaries: separation and joining (Cooper 1986), segregation and blending (Hannan and Freeman 1989), or barrier and conduit (Arrow and McGrath 1995). The general theme of all these distinctions is decoupling and coupling. This distinction also serves the purpose of possible further generalization and summarization of these similar yet semantically different distinctions. Asking now once again the question of what boundaries do or how they operate we get the answer: they decouple in order to couple. Note that we deal with a *distinction*, that is to say, it is not about lumping some decoupling here and some coupling there together but to realize that setting boundaries means establishing an intimate relation between decoupling and coupling. They happen at the same time. Sequences (e.g. first decoupling and then coupling, like in work flow), spatial dispersion (e.g. decoupling here and coupling there, often realized by departmental differentiation), and role segmentation (e.g. one person decouples and the other couples, mostly realized by differentiating positions and tasks) are typical organizational forms of managing the paradox that every severance leads to connections elsewhere and vice versa. Since this distinction can easily be applied to boundaries in the social world in general⁶ we may note:

⁶ Evidence that boundary operation can be grasped by the distinction of decoupling and coupling is also found in anthropology (separation and articulation of groups; Barth 1969), in the functioning of boundary objects in sociology of science (enabling communication between domains otherwise separated; Star and Griesemer 1989), and in systems theory (articulating the operationally closed system with its environment; Luhmann 1995).

$$\text{Boundary} = \boxed{\begin{array}{|c|c|} \hline \text{decoupling} & \text{coupling} \\ \hline \end{array}}$$

Immersion into network theory now reveals that the core distinctions it employs to explain the decisive operation that is generating a network are not only similar but, as to the distinction employed, identical. I refer to a line of thought in Harrison White's work reaching from the early paper „Notes on Coupling-Decoupling“ (1966) until the just published revised edition of „Identity and Control“ (2008). Besides the many concepts he offers for heightening the possibility to observe social formations emerge it is exactly two distinctions on which his view of social process rests: coupling/decoupling (or equivalently embedding/decoupling) and identity/control. White argues that every social process leading to some form of social organization is fueled by the tension between identity and control—identities searching for control and control projects leading to the emergence of identities. Yet closer to networks proper (in difference to social organization in general) is the distinction of coupling and decoupling.⁷ To be sure these two distinctions do not match one on one but are rather perpendicular to each other. For example decoupling might induce fresh control or the formation of identity (or both) like any outsourcing of organizational departments can show.

Let us now note the distinctive operation of networks with our notation.

$$\text{Network} = \boxed{\begin{array}{|c|c|} \hline \text{coupling} & \text{decoupling} \\ \hline \end{array}}$$

This equation can be read as follows: A network is a continuous process of coupling and decoupling itself embedded and decoupled from an indeterminate yet during this process determinable context (indicated by the unmarked outside of the form). Any coupling can only be realized by decoupling from elsewhere and any decoupling presupposes couplings if it is to be viable and to make sense. The re-entry is, as it were, the uncertainty index of networks. It

⁷ Network research is mostly biased toward coupling: discussion of ties and embeddedness abound. Surely one reason for this bias is that decoupling is much more difficult to measure (though zero blocks may offer a solution; cf. White, Boorman and Breiger 1976).

indicates that it is and will always remain uncertain, ambiguous, and ambageous exactly what coupling any decoupling entails, which decoupling is involved when identities and control projects are coupled in specific ways, and last but not least if any of the couplings and decouplings will succeed at all or rather fail. The result, including successful and failed couplings/decouplings, is an uncertainty trade-off we call network.

When we now look at the two forms of boundaries and networks respectively we realize that they are, in their distinction, identical. But their respective *form* is slightly different. There is a small variation we have to account for. An observer observes networks rather than boundaries if he marks couplings (ties, embeddings) and looks for decouplings (in this case most probably: identities) while an observer observes boundaries by attending to events of decoupling (separation) that induce indeterminateness and thereby force him to look for possible couplings. Hence the observer is crucial when this notation is employed. The observer cannot be ruled out and provides the empirical footing needed because inquiry may proceed by asking under which conditions and circumstances some observers see boundaries where other see networks.

Before arriving at the conclusion I want to scratch on the surface of at least one further strand of ideas about the relation of boundaries and networks that deserves further elaboration. Against the background of the ideas presented here Harrison White's disciplines may get an additional meaning as boundary mechanisms of social organization. He himself proposes to think of interfaces as substitute for boundary (White 1982) and attributes clear boundaries to disciplines in general (White 1992, 66) and recently also for arena disciplines (White 2008, 64). Intriguing in this respect are his embedding ratios that allow to model the contextuality of disciplines. The ratio is implemented as embedding over decoupling (White 1992) and therefore turns out to be one possible application of our general boundary formalism which itself is indeterminate with regard to the exact relation of decoupling and coupling. I suppose that White's market plains (White 2002) are nothing but formal visualizations of contiguous zones of contrasting density, that is, dimensions of a boundary laid out on a plane.

CONCLUSION

It shouldn't require too much effort to acknowledge that boundaries are nothing but networks. But the obverse can also be proposed: Any network is a social boundary. I tried to show that this conjecture is warranted against the background of the theoretical ideas the literature on relational sociology has to offer. The notation I introduced incorporates these ideas and allows for a formal comparison between network theory and boundary research. The result is a fundamental similarity between our knowledge of boundaries and our knowledge about

networks. Therefore, to look for the boundaries of networks is misleading and withdraws our attention from important insights to the nature of the duality of boundaries and networks.

To be sure, the kind of boundary research I propose here resembles witchcraft. The medieval witch had the competence to sit on the fence and watch both sides, wilderness and civilization, simultaneously (Duerr 1985). Hence she didn't only know what happened on both sides of a boundary, but she furthermore knew how to distinguish and connect them. Actually her very presence brought them forward at all. But her sociologically maybe most intriguing competence was the knowledge of the fence itself on which she could wander around being able to explore it. Our problem is therefore the fence, not its accompanying identities on this or on that side of a boundary. Studies on social boundaries reveal that social „fences“ don't look like lines but more like networks and that they constitute their own topological space (Adams 1980; Aldrich 1971; Barth 1969; Leach 1976; Rumford 2006; Simmel 1992; Tilly 2005; Turner 1977; Walters 2006; Yan and Louis 1999). Boundaries are a relational phenomenon (Lamont and Molnàr 2002). They are necessary for building relations.

Among other things we now might be able to explain why network researchers always had and still have problems with a conceptualization of boundaries. If it is correct that networks are nothing but boundaries then dwelling in networks looking for boundaries will actually make it difficult to see some. In the end we have to account for the observer. Some see networks, some see boundaries. Consider for example a market interface. The terms of trade define a boundary for firms looking for market entrance. But once you belong to the clique of producers you observe a network of identities, control projects, opportunities, transactions, and risk.

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