Introduction

Boundary Concepts for Boundary Work Between Science and Technology Studies and International Relations: Special Issue Introduction

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Boundary Concepts in STS and Their Use in IR

This special issue builds on the cross-fertilization that results from (i) the growing conceptualization efforts made by science and technology studies (STS) from the 1980s to 2000s to better understand the science/policy interface and (ii) subsequent applications in international relations (IR), where several international institutions meant to be science/policy interfaces have been established. So far, STS boundary conceptualizations and international studies have been only cautiously studied together, with a few exceptions in security studies (for instance, Samimian-Darash, Henner-Shapira, & Daviko, 2016). There are, however, good reasons to believe in fertile hybridization outcomes for both academic disciplines, especially with regard to the analysis of international institutions.[1] This special issue builds on the added value that the use of STS concepts in IR, and more precisely in studies of international organizations, can contribute back to STS by producing enlightening analytical feedback loops.

Since the 1980s, constant conceptualization efforts in STS tried to better grasp and analyze the relations between science production and policy outcomes in local and national contexts. STS scholars have developed the concept of "boundary" to support these conceptualizations. The term was originally chosen for its reference to the unstable demarcations that were established and maintained to distinguish science from politics, ideology, religion, and pseudo-science (Gieryn, 1983). Over time, STS scholars further expanded this boundary concept into the three directions that we present here chronologically.

First, the concept of "boundary work" inspired by Callon and Latour appeared at the beginning of the 1980s. It recognized that actors involved in decision making on technical issues engage in various forms of knowledge brokering activities. This concept is still widely invoked in STS and knowledge brokering activities now

include informing, consulting, matchmaking, engaging, collaborating, and capacity building (Michaels, 2009). These activities, named "boundary work," help reduce the tensions that often arise between actors who do not share the same knowledge systems (distinguishing scientific vs. nonscientific knowledge). As a result, boundary work indicates that mutual understanding can be reached while preserving the boundaries that remain necessary to clarify each role.

Second, authors started to work on "boundary objects" (Star & Griesemer, 1989). This second direction aims at giving more flesh to a "boundary work" concept that was hard to operationalize. Boundary objects are defined as "scientific objects, which both inhabit several intersecting social worlds and satisfy the informational requirements of each of them. Their boundary nature is reflected by the fact that they are simultaneously concrete and abstract, specific and general, conventionalised and customised" (Star & Griesemer, 1989, p. 393). These boundary objects can be classifications, reports, constructions, or any concrete element that helps draw a boundary between scientific data and policy. Boundary objects have two defining features. First, with respect to boundary work, boundary objects have an architecture; meaning that they have a scale and a structure, for instance. Second, they operate at the boundary, providing flexibility of interpretation by a wide range of actors (Star, 2010).

Third, scholars later developed the concept of "boundary organizations" (Guston, 2001; Miller, 2001) that introduced another criterion: accountability. Like boundary objects, boundary organizations exist at the frontier of the two relatively different social worlds of politics and science. Like boundary objects, they are formalized as they represent organizations comprising experts. But in addition to these two elements, boundary organizations also have distinct lines of accountability to each of these social worlds. Not only do "boundary organizations" perform boundary work and produce boundary objects: they also provide forums where actors from all sides of the science/nonscience divide can interact. Such boundary organizations communicate and translate their respective knowledge and they build joint knowledge that has to be perceived as credible, legitimate, and salient (Cash et al., 2003; Guston, 2001). Boundary organizations distribute accountability across the boundaries, embodying an advanced formalization effort with respect to the first two dimensions.

While these three directions were initially mobilized to describe transformations that were happening at the local and national levels of policy making, international studies have recently and dynamically embraced these STS concepts to operationalize them at the international level. For instance, the Roundtable on Sustainable Palm Oil has been recently analyzed as performing boundary work by gathering experts from all actor groups concerned who discuss economic, environmental, and social scientific data on current markets and on their potential to make sustainable palm oil the norm (Offermans & Glasbergen, 2015). Boundary objects have appeared on the international scene in all categories, including classifications like the International Nuclear Event Scale of the International Atomic Energy Agency, reports like the United Nations Global Environmental Outlook, or constructions like a United Nations High Commissioner for Refugees refugee camp.

Boundary organizations have also flourished in international affairs where they have assumed a remarkable political role. Since the end of the 1980s, the need was

felt to manage effectively the interface between science and policy for enhanced global collective action. In 1988, governments created the International Panel on Climate Change (IPCC) to support and inform decision making regarding global warming. In 2012, they established the International Platform for Biodiversity and Ecosystem Services (IPBES) to review and assess knowledge generated by scientists, civil society groups, governments, and traditional communities. Progressively, international boundary organizations have expanded from the environmental domain and reached other issue areas, including among others health (see the contribution by Holzscheiter, 2017), food security (such as the World Committee on Food Security, see Brem-Wilson, 2015), and education (with the notable contribution of the OECD, see Grek, 2014). The idea to perform boundary work through boundary organizations in international affairs is, as a result, highly topical.

While the phenomena of boundary work, boundary objects and boundary organizations are growing in international affairs, there has clearly been a lack of scholarly reflection on what the exportation of STS concepts to IR means, both for IR and for STS. To be sure, other authors have recognized the range of benefits that could be drawn from using STS concepts in IR (Lidskog & Sundqvist, 2015; Miller, 2001). However, very few scholars have built on these benefits and there is still great room for putting STS and IR in perspective. First, insufficient studies have been conducted on boundary concepts in international affairs with respect to studies on boundary concepts in national contexts— at least outside the security realm. This is surprising when one considers the number of flourishing initiatives in other fields. Second, existing studies often take the STS conceptualizations for granted, referring to the time when the concepts were coined and first identified, with very little reflection on their evolution or on potential adjustments to be made. Third, the generalization of results on boundary concepts is difficult as there exist very few comparative endeavors looking at them in different policy fields.

This special issue precisely aims at filling these gaps. It revisits the potential cross-fertilization between the two academic disciplines, looking at concrete examples of boundary concepts at the international level outside security studies, and discussing the lessons that IR can bring for the STS discipline. All four contributions have been written by IR scholars who mobilized boundary concepts for their work, including in the fields of health issues, climate change, and Arctic governance. Looking at cross-fertilization between disciplines and issue areas helps advance academic thinking. It is important to analyze both how STS speaks to IR and how IR speaks back to STS. The following presents the core research lines on which the contributions gathered in this special issue have been developed and presents further research frontiers as well as policy considerations. These findings resonate outside the IR community as illustrated also by the contribution by Swedlow (2017) in this issue of the *Review of Policy Research*.

Step 1: When STS Speaks to IR

With their boundary concepts, the insights brought by STS to IR that interest the authors of this special issue are twofold. Both insights question the understanding of science that has so far dominated IR. In contrast to this dominant understanding, STS offers new perspectives on how science and policy nurture each other.

The study of boundary concepts in IR has followed developments at lower levels of policy making. The IR community has indeed been somehow hermetic toward the general conceptualization of co-production processes of knowledge involving exchange and combination of data and information from both science and politics and toward more specifically science/policy interfaces, due in part to dominantly opposite approaches and political considerations.

First, STS invites us to rethink the links between science and policy by deconstructing the linear model of science informing policy that has so far dominated in IR. In particular, the landmark concept of "epistemic communities" developed by Peter Haas (1992) is still very much prevalent in IR scholars' understanding of science/policy interactions. This conceptualization developed around two principles describing the relationship between science and policy: the principle of separation and the principle of consensus. According to the epistemic community literature, expertise is distinct from politics, and this distinction is the main warranty of experts' credibility. There is consensus between scientific expert networks on what science is, meaning that science is pure: "Haas and Stevens thus conclude that science must first develop truth and then speak to power" (Lidskog & Sundqvist, 2015, p. 5). To the contrary, the boundary perspective in STS takes a different stand by paying more attention to the complex and varied interrelations between scientists and policy practitioners. To "separation" and "consensus," STS answers "coproduction," "stage management," and "civic epistemology," this latter concept meaning that scientific findings and results should not be taken for granted but rather have to be explained (Morin, 2014).

Second, STS can bring to IR the argument that science, in the same way as policy, is diverse and can be negotiated. Just as there is no one single policy, there is no one single science. One explanation for the lack of consideration of the heterogeneity of science in IR is related to the complexity of decision making at the international level. Besides the initial disciplinary locking of IR around the epistemic community conceptualization, that some authors have tried to bypass by studying other important trends on the international scene like economic trends (Bernstein, 2001), a political locking inherent to the anarchical nature of IR has always been a sensitive issue in IR. The necessary intergovernmental nature of collaboration efforts at the international level means that governments are likely to hold up governance mechanisms that might become supranational and are less keen than in national contexts to provide a full space to processes of knowledge production. As an answer to these political deadlocks, STS has signaled that boundary concepts could open possibilities to develop varied cooperation equilibriums, as long as one could see that both science and policy had to be constructed collectively: "we must be aware that knowledge considered credible and usable in one context may not necessarily be so in another" (Lidskog & Sundqvist, 2015, p. 16).

All the authors of this special issue take these two insights developed by STS concepts into account while studying boundary concepts at the international level. By so doing, in light of the specific conditions characterizing IR (see below), they are likely to bring refinements to the boundary concepts in question.

Step 2: When IR Speaks Back to STS

What can STS learn in return from the way IR scholars have imported boundary concepts? By changing the level of analysis, IR scholars have been faced with challenges that bring new insights. These challenges have revolved around the question of the institutional design of boundary organizations, the heterogeneity of knowledge (and not just science) present at the international level, and the fragmented architecture of international affairs, with no hierarchy, no central government, and an increasing transnational participation in global politics.

First, the institutional design of boundary organizations in international affairs requires innovative mechanisms that could account for horizontal hierarchies. In such context, the success of a boundary organization lies in the legitimacy of the process of knowledge generation. As defined by Cash et al. (2003), "legitimacy reflects the perception that the production of information and technology has been respectful of stakeholders' divergent values and beliefs, unbiased in its conduct, and fair in its treatment of opposing views and interests" (p. 8086). Legitimacy within boundary organizations has usually been understood by STS in two complementary ways, that both look at the structure of organizations. First, scientists and policy makers should jointly participate and interact. This joint involvement is considered necessary so that science can build on politically arbitrated values, and politics can rely on scientifically arbitrated information (Jasanoff, 1996). Studies have found that the IPCC credibility crisis partly results from its conceptualization of policy makers as downstream clients, rather than upstream coproducers of knowledge (Beck, 2011; Lidskog & Sundqvist, 2015). Second, various disciplines should be represented in boundary organizations. Social sciences, in particular, can complement natural sciences by favoring a reflexive and self-critical process. This is likely to minimize the risks of groupthink and of overly confident claims (Lemos & Morehouse, 2005). Some argue that the IPCC social salience suffers from its bias in favor of natural sciences, meaning that its recommendations are rarely translated into concrete measures to be implemented by policy makers, and from its organization into disciplinary silos that again prevents it from developing potential synergies or joint actions across different domains like the economy, the environment or law (Bjurström & Polk, 2011).

IR studies bring interesting further insights on this aspect by indicating that other forms of legitimacy can be explored by looking at agents, with representativeness of these agents being considered as a key within boundary organizations. The international level brings an unforeseen plurality of realities, norms, values, and beliefs compared to the national level of policy making. In the parlance of social network analysis, a boundary organization that aspires to generate credible, legitimate, and salient knowledge requires both external "bridging ties," which connect it with various issue areas, scales, and epistemologies, as well as internal "bonding ties" (Coleman, 1988) to create a dense, balanced, and cohesive group. As a result, a third condition for a boundary organization to succeed, particularly salient at the international level, seems to be related to the social capital of its members, related to their professional and personal contacts, to their past professions, and their social networks (Morin, Louafi, Orsini, & Oubenal, 2017). Ideally, a boundary organization would include individuals from different functions and disciplines but

also with different types of social capital, and would work with the aim of giving them an equal chance to express their views. Tracing social capital would also help to avoid amalgams between the members of different boundary organizations. In their contribution to this special issue, using the IPCC as a case study, Hughes and Paterson (2017) warn against the danger of favoring experts with a strong social capital over time. Indeed, they demonstrate how experts involved in the IPCC over a long period of time have developed practices aimed at maintaining their reputation for climate expertise, by constantly referring to their work in IPCC reports. To put it more simply, Hughes and Paterson illustrate the risk that science becomes instrumentalized by policy with policy imperatives modifying the scientific agenda accordingly. Another challenge for the design of boundary organizations at the international level is the circulation of experts from one organization to the other, as illustrated in this special issue by the contribution of Holzscheiter (2017) on international health issues. Interfaces are not amalgamations, but in a context of multiple science/policy interfaces it sometimes becomes complicated to renew the assigned experts in that case, boundary organizations can perpetuate inequalities and gaps instead of resolving them. By pointing to individual trajectories, both contributions reintroduce agency into the boundary organization literature, in which discussions of credibility, salience, and legitimacy have tended to be disconnected from agents.

Second, using the boundary concepts at the international level provides insights on the question of knowledge heterogeneity. While STS is rather optimistic concerning the potential role of boundary concepts in solving local and national political issues, the absence of a common social, cultural, administrative, and political background makes it even harder than expected for actors' understandings to converge at the international level. The difficulty does not just lie in the nature of the scientific data to be used but revolves around the fact that there exists an incredibly wide range of understandings of what "science" is at the international level. Miller (2001) refers to hybrid management in respect of this plurality. The word "knowledge" is also probably more accurate than "science" at the international level, as it encompasses other understandings such as "traditional knowledge," "managerial knowledge," or "local practices" that are most of the time lost in translation. IR studies of boundary organizations indicate that knowledge can be produced and brought into the debates by actors other than scientists or policy makers. In her contribution to this special issue on boundary work performed by the Arctic Council, Spence (2017) clearly demonstrates this shift from a classical understanding of science to an effort to include other sorts of knowledge into the equation.

Third, the fragmented architecture of international affairs, compared to the more centralized governance architecture of national contexts, has changed the framework in which boundary concepts are performed. Fragmented architecture puts emphasis on the recent issue of institutional interactions and regime complexes at the international level that might create synergies but also overlap redundancies and incoherencies among different international institutions (Orsini, Morin, & Young, 2013). In IR, this means that several boundary objects or organizations are at the crossroads of different international regimes interacting on the same issue area. For instance, transboundary national parks are party to

international regimes of conservation, tourism, and intellectual property. The context in which boundary concepts are developed at the international level is already populated by an extensively broad range of norms, principles, and rules. In this fragmented architecture, boundary organizations could play a great role, by reducing tensions between international regimes when their members are representatives of different alternative understandings, like the IPBES in the biodiversity field (Morin et al., 2017). Partnerships are also promising forms of boundary structures (Gupta, Pistorius, & Vijge, 2016). In this special issue, Holzscheiter (2017) shows that public–private partnerships populate the field of polio eradication, creating synergies but also conflicts in the global management of this sensitive issue. She also clearly illustrates a sort of two-level game whereby external influences such as the competition for resources or the fragmentation of global health governance shape the internal structure of boundary organizations.

Research Frontiers and Policy Considerations

So far, IR studies have tended to rely on a unique model of science informing policy, the epistemic communities model that does not work properly at its level of analysis. For its part, STS has developed sophisticated accounts of the interface between science and policy for decision making but is slow in renewing and updating these conceptualizations. This special issue attempts to take both limitations into account by presenting up-to-date contributions on boundary concepts in current international affairs.

The contributions presented open at least three new research frontiers that could be further investigated in future research and that already lead to important policy considerations. First, IR introduces the idea to rethink STS conceptualizations in a context of horizontal, multiple, and diffuse hierarchies. Such a novel institutional context could call for new research methodologies to study boundary concepts. While STS scholars have favored single and detailed case studies accompanied by ethnographic fieldwork and extended interviews, the number of actors and interactions concerned at the international level limit the potential feasibility of such methods at this level of analysis. The contribution by Hughes and Paterson (2017) in this special issue introduces social network analysis as a promising research tool for boundary concepts in IR. Other quanti/quali methodologies could be used like surveys or statistical correlations of social capital coding. These studies would help identify the social dynamics of boundary objects and help design them as more representative. These new methodologies could be used as innovative instruments and benchmarks by international organizations and science/policy platforms to improve their current representativeness.

Second, boundary concepts have so far been undertheorized. Despite the early attempt by Cash et al. to systematize in 2003 the study of knowledge systems, there is no clear model of efficient boundary objects or boundary organizations available in the current literature. Such models would require further case studies and a further comparison effort across cases. As a starting point, the contribution by Compagnon and Bernstein (2017) to this special issue already indicates that boundary organizations might be helpful if they produce "usable knowledge" and social

learning conditions by better recognizing the politicization of science. Successful initiatives could be better highlighted and serve as examples to follow. To the contrary, difficulties should also be recognized so that they can be overcome. The diversity of the international scene also brings a diversity of situations that can inform each other.

The third challenge is the risk of the marginalization of boundary efforts due to external power pressures. While thinking about ways to design performing boundary objects and organizations is important, their interactions with other organizations and/or the too-high external pressures that they will encounter might undermine their relevance. The contribution by Holzscheiter (2017) unravels the potentially negative conflicts and redundancies that a proliferation of boundary concepts can create. The contribution by Spence (2017) also indicates a trade-off between boundary work and decision making: the more sophisticated boundary work an institution seems to perform, the less it will have decision-making power, as illustrated in the case of the Arctic Council. A balance between boundary work and decision-making functions has to be reached. Otherwise boundary work, even if highly elaborated, faces the risk of being sidelined and policy irrelevant.

Acknowledgments

Note

[1]This project is similar to two other projects combining this time the STS concept of translation with IR; see the 2013 *International Political Sociology* special issue on "Actor-Network Theory" and "International Relationality: Lost (and Found) in Translation," 3(7), and Barry (2013).

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