

Towards an Epistemology of Boundary Work: Producing Interdisciplinarity From Teams to Communities

Agustin Mauro

Universidad Nacional de Córdoba, Argentina

A. Nicolás Venturelli

Universidad Nacional de Córdoba, Argentina

Although today the importance of interdisciplinarity is widely recognized and the associated philosophical reflection is consolidating into an autonomous field of research, there is still no adequate understanding of what interdisciplinary projects consist of, nor are there clear agreements on how to execute them. Here we propose that the concept of boundary work, carefully adapted to the different contexts of scientific work, can shed light on how disciplinary structures are produced and therefore how interdisciplinary practices intervene in these processes. Along this line, we claim that a philosophy of interdisciplinarity must include an epistemology of boundary work, which allows for establishing criteria on the necessity and conditions of disciplinary integration for different pragmatic contexts: Scientific conferences and journals, educational programs, and research teams are considered. Additionally, we focus on how the concept of interdisciplinarity is used to loosen boundaries, and how researchers should be able to adapt their boundaries to different contexts and moments to avoid stagnation or loss of rigor. In order to illustrate our arguments, we take the interdisciplinary area of the National System of Researchers in Mexico as a case of a flexible boundary, and the Argentine Society of Neurochemistry as a case of a rigid boundary.

Keywords: pragmatic contexts, scientific practices, flexible boundaries, rigid boundaries, scientific collaboration, boundary crossing

Introduction

The concept of interdisciplinarity (ID) has evolved since it acquired relevance in the 1960s and 1970s (Apostel et al., 1972; Pombo, 2023) to counteract the reactionary tendencies enabled by rigid disciplinary formations in academia.

Since then, it has taken on an increasingly prominent role in scientific production, dissemination, and education, particularly in relation to complex problems that were considered too challenging to be addressed from the perspective of a single discipline (Schmidt, 2022, p. 75; Reijula et al., 2023). This growth has been centrifugal and diversified, leading the concept to be used in increasingly diverse contexts and under disparate meanings. Although today the importance of carrying out interdisciplinary projects is recognized, and there is a serious need to address how to carry them out, there is still no adequate understanding of what they consist of, nor are there clear agreements on how to execute them. Beyond the recurring complaints about light uses of the concept, the problem of a marked polysemy persists, which hinders communication both among working scientists and among theoretical approaches centered on the concept. Depending on the chosen unit of analysis, things as diverse as the following can be considered interdisciplinary: a specific case of research in which some kind of triangulation or complementarity occurs, for example, between studies of brain lesions and studies of recordings from individual neurons (Bechtel, 2002); a research group that coordinates different research methodologies (Smulski, 2019); a specialty that involves the integration of subfields or other specialties (Gerson, 2013); a research institute in which different groups representing different research programs are coordinated to produce knowledge on a topic (Goñi Mazzitelli et al, 2018); an institute in a university (Cruz et al., 2012); and broader scientific practices such as collaboration (Sonnenwald, 2007) or evaluation (Huutoniemi & Rafols, 2017), among others.

We believe that the concept of boundary work, carefully adapted to the different contexts of scientific work, can shed light on how disciplinary structures are produced, and thus how interdisciplinary practices intervene in this process to generate such a diverse set of interdisciplinary units. In this article, we argue that a philosophy of ID must include an epistemology of boundary work that will allow the establishing of criteria for the necessity and conditions of disciplinary integration for different contexts. By philosophy of ID, we mean a philosophical reflection on ID that draws on the rich tradition of philosophical thought to rethink interdisciplinary research along its epistemological or ethical dimensions, among other relevant aspects (Frodeman, 2014; Schmidt, 2022). In the first section, we introduce the conceptual landscape of ID, after which we present some of our main working assumptions in the second section. In the third section, we introduce the concept of boundary work proposed by Gieryn (1983) and some subsequent uses and reinterpretations. We then show how the concept of ID is used to do boundary work, leading to more flexible boundaries in different contexts, and finally we demonstrate the need for an epistemology of boundary work.

The Elusive Definition of ID

The diversity of units of analysis available for the study of ID makes conceptualization challenging. Klein (2017) has attempted to organize the discussion by establishing distinctions and subcategories, creating elaborate taxonomies of ID and its related concepts, multidisciplinary and transdisciplinarity (see also Jantsch, 1970). However, we argue that, instead of clarifying the semantic landscape, these frameworks can have the troublesome effect of multiplying categories in an attempt to be exhaustive, deepening a common tendency in the philosophical literature to disconnect from the specific contexts in which interdisciplinary practices take place. While these taxonomies may characterize various aspects of scientific research, they ultimately do not advance our understanding of ID itself. Accordingly, they fail to provide a comprehensive theory of ID, that is, a broader conceptualization that would make such taxonomies meaningful. Concepts such as integrated ID or cooperative ID may describe a type of interdisciplinary work, its goals, or its scope, but they do not explain how it occurs in practice, what processes shape its evolution, or what is critical to forming the interdisciplinary nexus, such as the unit of analysis considered interdisciplinary.

To address this issue, we believe it is necessary to identify a robust category that can distinguish between different types of ID work and serve as an organizing principle. Efforts to clarify the concept of ID from a philosophical perspective have often relied on the concept of integration, which is perhaps the most commonly used to define ID (Klein, 2021; Menken & Keestra, 2016; O'Rourke et al., 2016; Siedlok & Hibbert, 2014; Bammer, 2013). Nevertheless, we find it insufficient for a philosophy of ID. First, the pursuit of integration alone does not adequately guide interdisciplinary research. Many types of research can be integrated, which leads us to ask: For what purpose and for whom? As Frodeman (2013) notes, "what we choose to mix is a matter of interest and audience" (p. 36). Similarly, Schmidt (2022, p. 18) suggests that we should move toward a critically reflexive practice of interdisciplinary research that questions the purpose and goals of integration rather than simply seeking it. Integration is also limited because the amalgamation of data, methods, concepts, researchers, communities, or entire approaches may or may not occur at different stages of these processes and in different senses depending on the unit of analysis—ranging from a single researcher to entire disciplines. Moreover, integration is an inappropriate concept for designing policies and interventions that promote ID, because the elements to be integrated (concepts, data, theories, methods, instruments, etc.) depend on the specialized knowledge of each researcher and cannot be managed from the top down. Thus, thinking of ID solely in terms of integration limits the potential of the term.

An optimistic perspective on the irreducible polysemy of the term “interdisciplinarity” is offered by Vienni Baptista (2023), who argues that this polysemy reflects the absence of a singular way of doing ID. Ultimately, it suggests the acceptance of no fixed interdisciplinary regime for organizing knowledge. While we sympathize with this view, we believe it is necessary to develop a concept that encompasses various relevant units of analysis in order to identify specific practices of interdisciplinary research, paying close attention to the pragmatic contexts that shape them. While we recognize the deep heterogeneity, as highlighted by Klein (2005) and Vienni Baptista et al. (2020), this recognition does not compel us to reject the existence of interdisciplinary regimes for organizing knowledge that can be suitably distinguished to philosophically characterize types of ID. Such regimes can enhance our understanding of different forms of interdisciplinary practice without ignoring contextual factors. Achieving this would mark a substantial advance beyond simply acknowledging the plurality of conceptions that accompany “interdisciplinary collaborations [which] occur in countless ways, offering a broad range of approaches to intersections of culture, society, and environment” (Vienni Baptista, 2023, p. 69).

Some Preliminary Considerations

Prior to developing our argument, we consider it important to make some assumptions and positions explicit. Theoretically, this article aligns with the philosophy of scientific practices. From this perspective, we believe that the epistemologist’s approach to scientific inquiry should be based on the study of the set of practices that scientists engage in to produce knowledge, such as experimentation or modeling, as opposed to a philosophy of science centered on theories. Likewise, we consider it essential to focus on the processes of knowledge production and problem solving, as therein lies the richness of scientific research, rather than on the logical structure of the results. This article also follows this tradition methodologically, so the core of the contribution lies in the argumentative proposal. We will draw on exemplary cases to illustrate the various arguments. That is, the cases are not original research, but the contrast between them and the arguments made is. Finally, the intended contribution is mainly of an analytical-descriptive nature (which does not prevent it from providing a source of possible future heuristics for the relevant sectors).

In relation to the unit of analysis in this research, the philosophical literature has highlighted the potential of different units for ID. In the philosophical treatment of ID, many have already emphasized the importance of defining a unit of analysis that can be used as a prism to study the type of ID under consideration. For example, O’Rourke et al. (2016) review the literature

focused on the concept of cross-disciplinary integration, including studies on ID and philosophy of science (especially biology), and emphasize how the concept varies substantially as the focus of analysis changes, from considerations on how two large disciplinary fields connect to very specific scientific practices, such as implementing strategies to compare very disparate sets of data (O'Malley & Soyer, 2012). These are all cases of cross-disciplinary integration but point to very different classes of activities. Once again, following the bulk of the literature, what will determine the nature of interdisciplinary linkage is the specific context in which it occurs. We prefer to use the practices of boundary work and pragmatic contexts as units of analysis, in line with Chang's (2014) idea of systems of practices, which refers to the interweaving of epistemic activities guided by different objectives that are their cohesive factor: In this sense, we can think, along with Chang, that any relevant activity in a scientific research context can be seen as an action or practice, from the most concrete to the most abstract.

Additionally, we adopt a framework in which the concept of discipline and its derivatives functions as both an epistemic and a social unit, a framework sometimes associated with the work of Kuhn (1962). In practice, these aspects are inseparable. A discipline encompasses a community of practitioners, technicians, and experts with similar training and skills, as well as a collection of epistemic resources focused on related problems and objectives. This dual nature of disciplines—as both social and epistemic entities—forms the basis of our understanding of interdisciplinary practices and their contexts. In this sense, it is argued that epistemic transformations can have consequences for the organization of scientific work (a new theoretical framework can give rise to a new scientific community) and vice versa (collaboration between different disciplines changes properties of knowledge such as its robustness or relevance). This framework is objected to, for example, by Andersen (2016), who explicitly distances from the viewpoint. The problem for her is that “we cannot identify a unique structural level at which the relation between scientific community and cognitive resources can be unequivocally defined” (p. 2). In this regard, she mentions several factors why cognitive resources are neither homogeneous nor evenly distributed within a scientific community, such as the development of new resources, the presence of sub-specialisations, and finally, cross-disciplinary activities that are largely unaccounted for in the philosophical literature. We believe that the points Andersen raises are valid, and to some extent we share them, but we do not see them as justifying the abandonment of this bipartite framework. Continuing to understand disciplines as both epistemic and social units is not only appropriate, but particularly relevant to the goals of a philosophy of ID, and, as will be claimed, the practice of boundary work contributes to show how these dimensions are deeply interrelated.

Boundaries and Boundary Work

Although ID defies a strict definition with necessary and sufficient conditions, it remains a widely understood and useful term. Its widespread adoption reflects the ability of different actors to appropriate it, to characterize their scientific practices and to define scientific projects. In order to understand this phenomenon, we propose an analytical approach that sheds light on the use of the term. Examining the referent of “interdisciplinarity” reveals highly diverse interpretations, with doing ID signifying vastly different things across varied contexts. We suggest a Wittgensteinian turn: Temporarily setting aside the referent of doing ID and instead considering the concept of “interdisciplinarity” as a tool and its use as a practice. This distinction illuminates that the concept is deeply embedded in practices of boundary work. To better grasp this idea, it is essential to first explore the concept of boundary work itself. This exploration will provide the foundation for understanding how “interdisciplinarity” functions as a tool in academic discourse and practice.

The concept of boundary work was coined by Thomas Gieryn (1983) when addressing the classic demarcation problem, typical of 20th century philosophy of science, from a sociological perspective. It refers to the process of defining and establishing boundaries between science and non-science, as well as within different disciplines or specialties. In his analysis, he considers that the demarcation between science and non-science, religion or pseudoscience is a practical problem that is routinely addressed in various areas of scientific research. This process is driven by the need to distinguish scientific knowledge and activities from those considered non-scientific, in order to secure professional advantages and protect the autonomy of scientific research.

For example, in early 19th century Scotland, anatomists sought to exclude phrenologists from the scientific community, and to do so, they successfully drew the boundaries of science as a rigorous activity, emphasizing the verifiability of hypotheses (Gieryn, 1983, p. 787). This prevented phrenologists from obtaining positions in university chairs or the Royal Society of Edinburgh, among others. Boundary practices therefore allow for the delimitation of academic territories, the allocation of expert privileges and responsibilities, and the claiming of resources within the scientific community. From this perspective, it is important to emphasize that boundary work is first and foremost a scholarly practice. Like any other practice, it is situated, taking place in a specific context with multiple specific demands, and is therefore often contradictory. “The boundaries of science are ambiguous, flexible, historically changing, contextually variable, internally inconsistent, and sometimes disputed . . . the ambiguity results from the simultaneous pursuit of separate professional goals, each requiring the construction of a boundary in different ways” (Gieryn, 1983, p. 792). Boundary work extends beyond the science/non-science divide; it is also evident within disciplinary demarcations.

Following later interpretations (Klein, 2021, p. 7), we can generalize boundary work as a framework for characterizing the practices, criteria, and institutional structures that define, uphold, challenge, and reshape boundaries between different knowledge domains. Evaluation serves as a prime example of boundary work in action. The practice of defining and demarcating what constitutes valid knowledge for various contexts, such as journals, conferences, or funding agencies, is a clear-cut practice of boundary work. But, as we will see later, defining the curriculum of a programme involves boundary work in determining what content is relevant and necessary from what is peripheral or redundant. It is particularly important to note that, according to this definition, boundary work takes place not only when boundaries are defined, but also when they are reformulated (for example, when they are made more flexible or rigid, as we will show below); in the end, they remain practices of constructing boundaries, only different.

As research in the sociology of science and social epistemology has shown, the practice of boundary work is fundamental to the formation and maintenance of academic disciplines (Fuller, 1991; Hammarfelt, 2019; Lemaine et al., 1976). According to Fuller (1991, p. 304), the importance given by philosophers of science to the problem of demarcation, and the variety of criteria used, indicates that boundary work is an important function that must be performed regularly in order to maintain the social order. Boundary work involves processes such as classification, segmentation, and the allocation of privilege and disadvantage within the scientific field. It determines not only who can participate and contribute to knowledge, but also what types of methodologies and approaches are considered legitimate and valuable. That is, boundary work is a scientific practice where the cognitive and methodological aspects of research meet the organizational and institutional ones. Through boundary work, scholars translate cognitive demands into organizational structures; conversely, boundary work is also a way in which institutional structures shape the cognitive aspects of research. For example, the stabilization of a new research methodology can be used as a criterion for boundary work to create a new organizational structure (e.g. a new conference), while institutional boundary work can help to define the appropriate methodologies for a given research. Following a Foucaultian view, it can be seen that these practices prescribe social orders, delimit competences, and allocate resources, as well as belonging and exclusion. Boundary work thus also functions as a power mechanism that regulates and controls the production of knowledge, shapes institutional structures within science, and produces, among other things, disciplinary structures. Finally, boundary work is also closely related to the division of labor and the establishment of disciplinary competences; it is thus an important practice in problem decomposition during complex problem solving (Reijula et al., 2023). As scientific disciplines emerge from a set of boundary work practices in different contexts, ID follows these practices

giving rise to a variety of types of interdisciplinary work (as will be further developed in the next section).

Subsequent studies have differentiated between types of boundary work. A complete reconstruction of the different types of boundary work is beyond the scope of this article, but it seems important to mention some significant types for a study of ID. From a temporal perspective, Root (2005) distinguishes three interrelated processes: The establishment of boundaries, the maintenance of boundaries and the expansion of boundaries. The establishment of disciplinary boundaries occurs primarily in the early stages of a science's development. This is the time when scientists market their discipline to other sciences and to the rest of society. As a discipline matures, scientists focus more on maintaining the boundaries of their discipline through professionalization and institutionalization in order to maintain their acquired credibility and material resources. Maintenance also involves adapting disciplinary boundaries to changing conditions, such as a change in another discipline that forces scientists to redefine their boundaries, or a changing social landscape that creates new opportunities. Lastly, expansion involves venturing into new territory, such as researching topics or seeking funding from a source not typically sought in other fields. Kinchy and Kleinman (2003) also distinguish between strategic boundary work, which advances targeted interests, and routine boundary work, which tends to be a longer-term endeavor on a larger scale compared to the former. Quick and Feldman (2014), on the other hand, propose a conception of borders as dynamic rather than stable, and not only as sites of separation but also as sites of connection.

"Interdisciplinarity" as Boundary Work

The link between boundary work and interdisciplinary practices has been discussed for some time within philosophical reflections on ID. ID is sometimes associated with the breaking of disciplinary boundaries (Frodeman, 2014, p. 3). It is also associated with boundary-crossing practices (Klein, 1996), that is, the practices of crossing the various barriers imposed by disciplines, be they epistemological, cultural, methodological, or institutional (Bruun et al., 2005). These practices define a type of researcher, the boundary crosser or go-between, who plays a key role in interdisciplinary projects by acting as a transporter of concepts and tools, and as a mediator in border zones (Raj, 2016). However, as relevant as the concept of boundary crossing is, framing the problem in these terms is potentially reductive, as the concept of boundary work is richer. Schmidt (2022, p. 25) emphasizes that thinking about boundaries and boundary work is central to the philosophy of ID, as ID presupposes two premises: First, that there are boundaries present, and second, that there are options to transcend or transgress those boundaries through interdisciplinary

research. Thus, Schmidt (2022) argues that the concept of “interdisciplinarity” creates a “boundary paradox” by simultaneously seeking to maintain and dissolve disciplinary boundaries.

Recently, Smulski (2019) discussed the use of the concept of “interdisciplinarity” to do boundary work and acquire prestige, as a way for a group of neuroscience researchers to differentiate themselves from other neuroscience researchers who they considered reductionist. Pombo (2023) also points to the importance of observing the use of the term “interdisciplinarity” in order to understand it; she focuses not on boundary work, but on how it changes between contexts: in particular, how the term has been appropriated in the contexts of academic research, journals and conferences, universities, schools, industry and business, and the media. We intend to complement these positions by further developing the use of the concept of “interdisciplinarity” to do boundary work. We will then show how the different sites where boundary work is done (and thus sites where disciplines are defined) are also sites where the concept of “interdisciplinarity” is used to change boundaries. In this way, we will also show how boundary work depends on the pragmatic context at stake.

In the context of scientific communities, for example, we can consider boundary work in academic events or journals. This activity mainly concerns the acceptance or rejection of articles based on their relevance and suitability to certain disciplinary standards. What is “neuroscience” at a neuroscience conference? And what is “philosophy” in a philosophy journal? The label “interdisciplinarity” allows for the flexibilization or reduction of the boundaries of the academic event or journal. To say that it is an “interdisciplinary” journal on a particular topic allows for the flexibilization of disciplinary standards and the setting of new ones, be they more open or stricter. It also means having a more heterogeneous evaluation committee that is able to make specific connections between works (Andersen, 2016). It involves a communication strategy that is attentive to this proposal and seeks to reach different communities, as opposed to disciplinary communication, which has a very predefined audience.

In the context of designing educational programmes, boundary work involves constructing areas of competence for trainees and determining which subjects or disciplines to include or exclude. Consider, for example, the process of defining the content of a “philosophy” degree: What should such a degree include? The challenge becomes even more complex when researchers attempt to create an “interdisciplinary degree in neuroscience.” In this educational context, the label “interdisciplinary” aims to make boundaries flexible, albeit in a distinct way. It involves integrating different disciplinary traditions, making meaningful connections between disciplines rather than simply assembling subjects from different fields, and encouraging students to cross disciplinary boundaries during their studies. These practices explain

the emergence of “interdisciplinary disciplines” or interdisciplines (Repko & Szostak, 2017, p. 45). While this concept may initially seem contradictory, it becomes coherent when viewed through the lens of boundary work.

Finally, in the context of research groups and scientific collaboration, as in the other cases, boundary work involves a dynamic of inclusion/rejection (which, if too flexible, may become a problem). However, the core of boundary work often lies in the dynamic of delimiting competences in order to establish scientific collaboration and solve complex problems. This implies defining the competences, that is, the tasks, of each participant in the research group. In an interdisciplinary research group, it is necessary to define what corresponds to a “neuroscientist” and what corresponds to a “computer scientist.” These practices of boundary work are particularly subject to epistemic dependence between researchers (Andersen, 2016). Epistemic dependence refers to the extent to which the resolution of one’s own tasks affects the tasks of another collaborator. The lower the epistemic dependence, the easier it is to share the epistemic work. The higher the epistemic dependence, the more difficult it is to divide the tasks into independent modules (“modularization” of the project), and therefore interdisciplinary work becomes more important (Reijula et al., 2023). That is, boundary work in this context is associated with a process of decomposition and modularization of research problems, and the establishment of a division of labour in a research project. Problems where a high degree of interdependence between components makes decomposition difficult require interdisciplinary research groups (Reijula et al., 2023).

All of these practices constitute boundary work and thus produce disciplinary structures. Moreover, in each of these contexts one can speak of doing ID. Thus we find interdisciplinary conferences, careers, and research groups. Boundary work practices contribute to the formation of disciplines as epistemic organizations in different contexts. Since the concept of “interdisciplinary” is used in these same contexts, this dynamics explains the ubiquity and heterogeneity of the concept of ID. In these situations, the concept is used to establish new boundaries, broader or narrower, although the consequences can be very different. ID thus answers the question of how to establish boundaries and how to interact with those who have different epistemological backgrounds. The answer is to seek interaction and/or integration rather than indifference or rejection. The consequences of having new boundaries are different in each case, and may result in different scientific collaborations or educational programs.

Epistemology of Boundary Work

As we mentioned above, some of the literature on ID places too much emphasis on integration, assuming that integration is always positive and desirable, and

that making boundaries flexible is always productive. On the contrary, we will argue that a boundary that is too flexible can be a problem, and that researchers need to engage in strategic boundary work that can adapt to the context and the moment. That is, we argue that a philosophy of ID should include an epistemology of boundary work that allows us to establish criteria for the necessity and conditions of disciplinary integration. Such an epistemology proposes practices, criteria, institutional structures, and processes through which boundaries between units of knowledge are constructed, maintained, and reformulated, with the aim of guiding how these boundaries influence the processes of knowledge production, circulation, and use.

Researchers have emphasized the existence of more porous and flexible disciplinary boundaries as opposed to more impermeable and rigid ones. Becher and Trowler (2001) distinguish two types of boundaries: Impermeable boundaries, are usually associated with closed disciplines, which they take as an indicator of the stability and coherence of an intellectual field, using economics as an example; porous boundaries, on the other hand, are associated with dispersed communities that are less stable and have more open epistemic structures, using psychology as an example of this type of discipline. Abbott (1995) discusses the difference between rigid and flexible boundaries using professional boundaries as an example. He presents actuaries as a tightly organized, rigidly controlled community whose tasks are tightly structured, and contrasts them with accountants “whose ‘profession’ is porous to the point of absurdity” (p. 878), so that their careers can go in very different directions and their tasks are also undefined and can accommodate different demands. Becher and Trowler (2001) analyze the types of boundaries in relation to the coherence of a discipline, but do not discuss in detail the consequences of this type of boundary. Abbott, on the other hand, analyzes the consequences in terms of the duration of the community, arguing that rigidity provides short-term security but long-term vulnerability, while the more flexible boundaries support the resilience of the discipline through greater adaptability. None, however, has proposed an epistemology of boundary work. To this end, we will present cases of overly rigid and overly flexible boundaries, and attempt to highlight the epistemic and social consequences of these practices. By rigid/flexible boundaries we mean a set of practices and criteria that limit/expand the scope of appropriate contributions to a body of knowledge. All boundary work practices determine inclusion/rejection: Rigid boundaries will in general choose rejection, whereas flexible boundaries will tend towards acceptance.

Overly Flexible Boundaries and Communities

In academic communities, if boundaries are too flexible, a given community can fall into eclecticism, where approaches and methodologies are adopted

indiscriminately without a solid or coherent foundation. This can lead to a lack of rigor, where theories and methods are not applied consistently or appropriately. Furthermore, the loss of a clear purpose and the dispersion of expertise can dilute the identity and cohesion of the academic community, making it difficult to build a solid and meaningful body of knowledge.

A case that adequately illustrates the consequences of overly flexible boundaries is the interdisciplinary field of the committees of the National System of Researchers of Mexico (Soto & Graf, 2023). The National System of Researchers (Sistema Nacional de Investigadores, SNI) is a government agency that promotes and evaluates professional research in Mexico; it is one of the most important recognition and incentive programs for scientific research in the country. It operates by including outstanding researchers, who are periodically evaluated based on their productivity and can advance in rank according to their achievements. The SNI is divided into research areas, which are responsible for evaluating researchers, determining their membership in the system, and promoting their advancement in rank. The current fields of knowledge are 1) Physical, Mathematical and Earth Sciences; 2) Biological and Chemical Sciences; 3) Medical and Health Sciences; 4) Behavioral and Educational Sciences; 5) Humanities; 6) Social Sciences; 7) Agricultural, Livestock, Forestry and Ecosystem Sciences; 8) Engineering and Technology Development; and 9) Interdisciplinary. The “interdisciplinary area” was established in 2019 with the aim of promoting multi-, inter-, and transdisciplinary research that does not fit neatly into any of the existing research areas.

Since its inception, the interdisciplinary field has struggled to establish criteria of relevance and inclusion (Soto & Graf, 2023). The regulations of the interdisciplinary area, in its 2019 version, emphasized the solution of complex problems through the integration of elements from different disciplines, without necessarily leading to the integration of disciplines in the sense of new hybrid fields of knowledge. On the other hand, the new regulations, after a reform in 2021, emphasize integration and work in hybrid fields of research. However, all definitions lead to very broad criteria and an “indiscriminate use of the term ‘interdisciplinary’” (Soto & Graf, 2023, p. 152). This lack of criteria has resulted in the committee being composed of a very heterogeneous group of researchers who have no common background and do not collaborate on their research: researchers in fields such as engineering, chemistry, management, computer science, biology, medicine, history, social anthropology, and education. This has led critics, supported by Soto and Graf, to point out that the commission is not fully capable of evaluating the projects it receives.

From the inception of the Interdisciplinary Area, applicants had to present their project to the Interdisciplinary Committee and choose another area of knowledge (from the remaining eight) related to the research. With the 2021 reform, it is now necessary to choose two areas of research. Thus, despite the creation of interdisciplinary committees, in practice the evaluation criteria

applied are those established by the traditional SNI fields. In the end, to the extent that the evaluation is disciplinary, the working methods and results do not differ significantly from disciplinary research (Soto & Graf, 2023). For example, a chemistry research project that claimed to be interested in solving problems in the medical sciences ended up being a regular chemistry research project. Furthermore, Soto and Graf (2023) point out that the field has been hijacked by engineering researchers, who represent the highest percentage within the committee, much higher than their global representation in the SNI.

In conclusion, the construction of an academic space that is too flexible, without clear criteria of inclusion and exclusion, and that also manages economic and prestige resources, tends to favor disciplinary research practices and can end up being appropriated by a community with greater relative power.

Overly Rigid Boundaries and Communities

In contrast to overly flexible boundaries, overly rigid boundaries can lead to isolation and stagnation. Communities that maintain strict boundaries tend to repeat and recycle the same approaches and theories, which can limit the growth and evolution of knowledge. We are not referring to normal science as described by Kuhn (1962), where researchers work within a paradigm on tasks of low relative novelty, repeating concepts, methods, problem-solving strategies, etc., but to a lack of openness to new ideas and methods that can lead to intellectual isolation.

A case that illustrates the consequences of overly rigid boundaries is the evolution of the Argentine Society of Neurochemistry (Mauro, 2024; SAN, 2024). The Argentine Society of Neurochemistry (Sociedad Argentina de Neuroquímica, SAN) was founded in 1986. This society sought to bring together researchers studying the chemistry of the nervous system: for example, Eduardo de Robertis, who used electron microscopy techniques to study neurons at the cellular and molecular levels and was a Nobel Prize candidate for the discovery of synaptic vesicles, explaining the discrete nature of neurotransmission; or Ranwell Caputto, who sought to determine the biochemical properties of glycolipids in the brain through centrifugation and subcellular fractionation. The SAN was fundamental in bringing together diverse communities in Argentina with common interests, especially those related to medicine and the exact sciences, and facilitated various congresses that united these communities (Mauro, 2024).

By the end of the 1990s, the new generations felt limited by this space. There were methods, techniques, questions, and lines of research that were not considered appropriate in the context of neurochemistry, but that graduate students were beginning to learn and integrate into their research: For example, research in electrophysiology and behavioral experiments in rats,

questions about the relationship between brain and behavior, and new techniques in computation and data analysis (Mauro, 2024). Faced with this situation, SAN researchers established rigid boundaries and were reluctant to allow these topics to be included in regular SAN meetings. This epistemic rigidity was accompanied by social rigidity, relationships among researchers were too hierarchical, and young researchers did not feel included in the society's discussions (SAN, 2024).

For this reason, in 1998, a group of young researchers decided to create the "Taller Argentino de Neurociencias" (Argentine Neuroscience Workshop). It was a space that sought to loosen the boundaries of accepted topics and methodologies, and to create a more relaxed atmosphere for interaction. The change of name from "Neurochemistry" to "Neuroscience" is significant because the workshop began to create new links between researchers from different laboratories, disciplines and lines of research; the change from "Congress" to "Workshop" implies a change in the formality of the space (Mauro, 2024). That is to say, the name change illustrates a shift in boundary work. It also reflects the consolidation of a new area of scientific research, "neuroscience", characterized by greater epistemic heterogeneity. Over the years, topics related to cognition, behavior, and memory were included; topics that could not plausibly be addressed in the context of neurochemistry (Mauro, 2024).

Gradually, the workshops became a more dynamic and relevant space for researchers, while the SAN congresses were increasingly empty of researchers. Faced with this situation, and after several tensions and disputes, they decided to merge and change the name of the Argentine Society of Neurochemistry to the Argentine Society of Neuroscientific Research, continuing to use the acronym SAN (SAN, 2024).

The case allows us to observe the consequences of overly rigid boundary work for a scientific community. By not being able to incorporate new concepts, methodologies, questions, and thus establish new connections with other researchers, the scientific community stagnates. In this case, it is clear how the need for interdisciplinary spaces becomes urgent and is effectively implemented by some means.

With these cases we try to show that both excessive rigidity and extreme flexibility in disciplinary boundaries can have negative consequences. An epistemology of boundary work must help researchers identify the context and moment when each type of boundary work is required. Finding the right balance is critical to fostering innovation, academic rigor, and effective collaboration in academic groups and communities. Of course, the epistemology of boundary work is not limited to cognitive elements. There are a variety of relevant criteria at work in these practices. Just as a critical philosophy of ID is necessary (Schmidt, 2022), so too is a critical epistemology of boundary work. As we mentioned earlier, boundary work practices are deeply political and cannot be guided by cognitive criteria alone.

Conclusion

In this article we argued that a philosophy of ID must include an epistemology of boundary work. The importance historically given by philosophers of science to the problem of demarcation highlights the importance of boundary work practices, and we argued that this importance extends to ID. As a complementary account of the conditions for integration, we proposed using the lens of boundary work to better understand the heterogeneity of interdisciplinary practices and the conditions for good interdisciplinary research. In particular, we showed how boundary work practices produce disciplinary structures in different contexts, how the concept of ID is used to change boundaries, and how researchers must be able to adapt their boundaries to different contexts and moments to avoid stagnation or loss of rigor. In essence, an epistemology of boundary work provides a framework for understanding how knowledge is compartmentalized and consolidated, how these processes affect the development of science and scholarship, and how they can be managed to solve complex problems and foster collaboration while maintaining rigor and quality. Future research should focus on deepening our knowledge of this kind of scientific practice. While there are many studies that distinguish different types of boundary work, there are not as many studies that focus on its consequences, especially for the production, circulation, and use of knowledge.

We believe that the concept of boundary work reveals what is common to different types of interdisciplinary practice. We argue, furthermore, that the concept of integration shifts significantly depending on the unit of integration. Thus, rather than considering ID as a fixed concept or practice, we focus on its use within boundary work practices, particularly in redefining established boundaries. As we have shown, boundary work can be applied effectively in different contexts while maintaining coherence. In this way, we find unity in diversity. Through this lens, ID is not just a call for integration: It is an invitation to rethink our boundary work practices, considering what, how and with whom we integrate, for what purpose, and to what recipient. This perspective forces us to ask: What is the purpose and recipient of our research? Who is included and who is excluded? Boundary work, then, is both a cognitive and a political practice, and an epistemology of boundary work takes both aspects into account.

We consider this change of perspective to be particularly useful for decision-makers seeking to promote and support ID. Focusing solely on the integration of concepts and methodologies makes it difficult to develop effective scientific and academic policies for ID, as these decisions often depend on the specific projects of individual researchers, which require extensive and detailed knowledge. As demonstrated by other researchers, a scientific policy that simply seeks to “integrate” heterogeneous researchers is bound to fail

(Callard & Fitzgerald, 2015). Such a policy would be inadequate because it could bring together researchers from different disciplines without producing meaningful results. In contrast, a boundary-work-centered perspective offers a new framework for rethinking science policy. Scientific policy continuously engages with boundaries—whether directly or indirectly, such as in the evaluation practices used to assess research. An epistemology of boundary work can inform these practices by identifying perspectives, criteria, and needs for successful boundary work. From our perspective, science policy and management should focus on rethinking disciplinary boundaries, ensuring that they evolve as needed, facilitating the movement of researchers (i.e., boundary-crossing practices), and encouraging collaboration.

Biographical Notes

Agustín Mauro, is a PhD Candidate in Philosophy at the National University of Córdoba in Argentina, working on Science and Technology Studies. His primary research projects explore the interdisciplinary practices in neuroscience and the tension with established disciplinary research structures in Argentina. He is particularly interested in the interplay of epistemic, organizational, institutional, and economic factors that influence scientific collaborations and how these can be enhanced for better integration and local relevance. To address these issues, he employs a diverse range of methodologies, including philosophical analysis, qualitative research (interviews and document analysis), and quantitative approaches (bibliometrics and social network analysis). He may be reached at agustin.mauro@mi.unc.edu.ar.

Alfonso Nicolás Venturelli holds a PhD in Philosophy from the National University of Córdoba, where he is also a senior lecturer at the School of Psychology. He is an Adjunct Researcher at CONICET (IDH), and has published in numerous journals, such as *Minds and Machines*, *International Studies in the Philosophy of Science* and *Studies in Psychology*. His research revolves around experimental practices in contemporary cognitive neurosciences. He may be reached at nventurelli@unc.edu.ar.

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