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Revealing the Spatiality of Crises: Lessons from Failures of Boundary Work in a Cross-Border Crisis

Nour Kanaan[1]* and Julie C. Mayer[2]

[1]Lumen (ULR 4999) – Axe SOIE, IAE Lille, Université de Lille, Lille, France
[2]Centre de Recherche en Gestion (CRG-i3), Management de l'innovation et Entrepreneuriat (MIE), École Polytechnique, Palaiseau, France

Abstract

Our societies are facing the rise of cross-border crises, which transcend established territorial demarcations. Managing cross-border crises raises challenges of spatiality, as actors need to coordinate within an unexpected, temporary space of action, shaped by multiple overlapping boundaries. However, little is known about how actors deal with the spatial ambiguity of cross-border crises. To answer this question, this article builds on a qualitative case study of the 1999 Mont-Blanc Tunnel fire. It adopts a boundary work perspective, focusing on the intentional shaping of boundaries, as an antecedent to coordination. We introduce a conceptual distinction between the notions of 'borders' and 'boundaries' to better account for the multiscalar nature of cross-border boundary work. By unfolding the spatiality of the crisis process, our analysis highlights the failures of boundary work in the Mont-Blanc Tunnel fire case. We find that boundary work cannot happen until borders and boundaries are explicitly revealed and acknowledged. Our study contributes to cross-border crises literature in both management and public administration fields by revealing the interdependencies of borders and boundaries as an implicit driver of the crisis process. We also extend the boundary work perspective by introducing 'boundary revelation' as a condition to unfold boundary work in a crisis situation.

Keywords: *Cross-border crisis; Boundary work; Boundaries; Borders; Spatiality*

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We are witnessing the rise of cross-border crises (Boin et al., 2014; Noordegraaf et al., 2017), which transcend established territorial demarcations (Ansell et al., 2010; Ayton & Rao-Nicholson, 2018; Söderbaum, 2018), such as the European migratory controversy (Ibrahim & Howarth, 2018), COVID-19 pandemic, and conflict between Russia and Ukraine. When such crises happen, they suddenly compel the encounter of multiple actors at all levels of intervention (Ansell et al., 2010) (e.g., international agencies, governments, security forces, civilians, private operators), as well as distinct jurisdictions, cultures, languages, and material conditions. It is now well known that managing crises and extreme situations requires coordination (Hällgren et al., 2018; Wolbers et al., 2018). Yet, cross-border crises generate an unexpected, temporary space of action, where ambiguity caused by multiple overlapping boundaries may severely impede coordination (Ansell et al., 2010; Boin & Lodge, 2016), and wherein actors on the field may mobilize different repertoires of problems and solutions, depending on which boundaries they focus on. Thus, answering 'where is the crisis?' becomes an essential antecedent to coordination.

Although spatial ambiguity (Jessop, 2016) is acknowledged as inherent to cross-border crises, it remains overlooked by both the management and public administration literature. On the one hand, crisis management studies have mainly focused on the crisis process and on how coordination emerges *in situ*. This literature has focused on situations where spatiality can be delineated within the same organization (Hermann, 1963) or on interorganizational configurations where organizational demarcations are made clear and explicit (Beck & Plowman, 2014). On the other hand, public administration studies have focused on the establishment of national protocols and governance, explaining how one specific territorial demarcation is reshaped at an institutional level (Boin & Rhinard, 2008).

***Corresponding author:** Nour Kanaan, Email: nour.kanaan@univ-lille.fr

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To further explore how actors deal with spatial ambiguities in cross-border crises, we adopt a boundary work perspective which emphasizes how actors purposefully shape social, symbolic, material, and temporal demarcations that affect their actions (Langley et al., 2019). We enrich this perspective by introducing a conceptual distinction between 'borders' and 'boundaries'. While borders reflect relatively stable demarcations that are pre-existent and independent of unfolding actions, boundaries reflect dynamic, temporary, and relatively permeable dualities that emerge from the situated action. We argue that this distinction is important to capture how actors can really handle boundary work during a cross-border crisis. We thus address this research question: *how do actors cope with spatial ambiguity of a cross-border crisis that emerges from the overlapping of borders and boundaries?*

To empirically address this question, we build on a qualitative case study of the Mont-Blanc Tunnel fire in 1999. As this tunnel is located at the border between France and Italy, the incident involved a plethora of actors at each territorial side of the tunnel. From a unique set of data collected from archives and interviews, we reconstitute the crisis by unfolding both its temporality (i.e., the crisis response phase) and its spatiality (i.e., the set of overlapping borders and boundaries that shaped the crisis response). We stress that the spatiality of the Mont-Blanc Tunnel's management was implicitly structured by an overlapping of cultural, topological, normative, and administrative-political borders. When the fire occurred in the middle of the tunnel, French and Italian actors struggled with this spatial ambiguity, and coordination was still difficult to achieve even after 53 h of fire. In the meantime, even though collective action was oriented towards the same goal, it was divided by three boundaries (relational, cognitive, and material), causing operational mistakes, delays, *status quo*, and contradictory reactions. Our findings stress that boundary work only started in the aftermath of the fire when actors acknowledged the overlap between borders and boundaries, ultimately leading to restructuring the tunnel management's borders.

Our findings enrich the literature on cross-border crisis management by revealing the interdependencies of borders and boundaries as an implicit driver of the crisis process. Our study suggests that actors located in cross-border spaces should build an awareness of the multiscalar spatiality to enhance their ability to collectively tackle crises. This article also extends the boundary work perspective by showing that revealing implicit boundaries is a key condition for unfolding boundary work during a crisis (Faraj & Yan, 2009; Langley et al., 2019). Finally, we discuss the limitations of our study and derive some empirical implications.

Theoretical background

Cross-border crisis as a situation of spatial ambiguity

In the management literature, a crisis is understood as 'a phenomenon that (1) threatens high-priority values of the organization, (2) presents a restricted amount of time in which a response can be made, and (3) is unexpected or unanticipated by the organization' (Hermann, 1963, p. 64). A crisis refers to a disruptive situation with damaging consequences, resulting from a complex set of causes, including external hazards, technological dysfunctions, human misconduct, or organizational weaknesses (Forgues, 1993; Mason et al., 2011; Pauchant & Mitroff, 1990; Reason, 1997; Rodríguez et al., 2007; Shrivastava et al., 1988; Vaughan, 1999). A prominent corpus of studies has unfolded the temporality of crises as a sequence of events and actions, covering the 'incubation' period (Turner, 1978), triggering incident, crisis response, resolution, recovery, and post-crisis learning (Roux-Dufort, 2003).

This emphasis on the processual nature of crisis (Williams et al., 2017) has provided a significant body of knowledge on how to manage crises by implementing measures of anticipation, preparation, mitigation, recovering, post-learning, or adaptation (Rodríguez et al., 2007). While acknowledging their different levels of uncertainty, urgency, stress, and danger, the literature converges on the need for coordination between actors at all stages of the crisis process. Studies highlight several ways of allowing coordination during a crisis: defining an incident command system (Bigley & Roberts, 2001; Moynihan, 2009), improvisation and bricolage (Adrot & Garreau, 2010), open communication between emergency managers and elected officials (Kapucu, 2008), and prevention by planning and networking ('t Hart & Sundelius, 2013). While these forms of action enable coordination within a unified crisis management system, less is known about how coordination emerges when numerous, heterogeneous, and unfamiliar perimeters are simultaneously involved (Beck & Plowman, 2014), such as in cross-border crises.

'Cross-border' crises refer to a particular empirical situation in which either the causes or consequences of a crisis transcend territorial borders (Christensen et al., 2015): a natural hazard damaging several geographical zones, the collapse of international financial markets, a worldwide pandemic, a refugee crisis, and so on (Ansell et al., 2010; Boin et al., 2014; Kornberger et al., 2019; Olsson et al., 2015). Cross-border crises are increasingly attracting scholarship interest due to their growing frequency and stakes (Bapuji et al., 2020). They are characterized by their spatiality, which is particularly constraining for coordination. They involve at least two territories, in which multiple organizations may intervene or be impacted if a crisis occurs. Consequently, considering official administrative demarcations between the two sides of borders is not enough to account for spatiality of cross-border spaces. Indeed, as

Jessop (2016) recalls, space also comprises 'socially produced grids and horizons of social action that divide and organize the material, social, and imaginary world(s) and also orient actions in the light of such divisions' (p. 10). Thus, a cross-border space transcends stable territorial demarcations, wherein *in situ* action is delimited by multiple material, social, and symbolic arrangements that are not limited to those established between two territories. These spaces are not fixed, but rather 'often constructed by a variety of state and non-state actors both within and outside formal regional institutional arrangements, and at various scales' (Söderbaum, 2018, p. 43). In that regard, cross-border spaces are destabilizing, as they emphasize overlapping domains and dual sovereignty over a single territory (Longo, 2017). This implies multiple, intertwined, and potentially incompatible horizons of action, in terms of 'inside', 'outside', 'cross', and 'liminal' that configure the possible connections between actors (Jessop, 2016; Koch, 2019).

Even though spatial ambiguity is inherent to cross-border crises, it has been overlooked by management scholarship (Ayton & Rao-Nicholson, 2018; Perkmann, 2003; Söderbaum, 2018). The existence of multiple and heterogeneous boundaries is often treated implicitly (Faraj & Xiao, 2006; Wolbers et al., 2018). This is particularly problematic for coordinating while responding to a crisis (Comfort & Kapucu, 2006), when the unexpected occurrence of an incident impels the encounter of different systems of command, administrative structures, and operational agents that are not used to connect and adapt their respective modes of action (Comfort & Kapucu, 2006; Hermann & Dayton, 2009; Moynihan, 2009): actors should be capable of rapidly adapting to circumstances and reorganizing courses of action (Olsson et al., 2015). However, a potentially dangerous urgent situation may also limit actors' ability to elucidate the question of 'who should do what' (James et al., 2011; Noordegraaf et al., 2017; Williams et al., 2017). By aggravating the delay or inconsistency in decisions and actions, spatial ambiguity can be lethal in the crisis response process (Christensen et al., 2015; Quarantelli, 1988). The lack of coordinated actions between the two sides of a border may exacerbate stress and confusion on the field (Boin & 't Hart, 2010) or generate a procedural or political *status quo* in decision-making (Head, 2008).

In this study, we argue that a condition for the emergence of cross-border crisis coordination lies in the ability to navigate through multiple heterogeneous boundaries (Beckman & Stanko, 2020). We thus turn to the theoretical perspective of 'boundary work' as a conceptual lens to further explore how actors deal with spatial ambiguity.

Dealing with spatial ambiguity: Boundary work

Boundary work can be defined as the 'purposeful individual and collective effort to influence the social, symbolic, material, or temporal boundaries, demarcations, and distinctions affecting groups, occupations, and organizations' (Langley et al., 2019, p. 2). It focuses on practices through which actors bridge, change, or reinforce boundaries to define a new frame of action. Boundary work unfolds in multiple forms, including the embodiment of dualities in discourses or artifacts (Dar, 2018), inclusive/exclusive interactions between individuals and groups (Carlile, 2002), and intermediation between distinct spheres of actors operating at different levels and in different contexts (Schotter et al., 2017). Furthermore, boundary work defines and reshapes organizational areas of activity, legitimacy, knowledge, roles, and power (Ashforth et al., 2000; Kislov et al., 2017; Lifshitz-Assaf, 2018). In the context of cross-border crises, boundary work can thus help reduce spatial ambiguity by creating, maintaining, erasing, or changing established boundaries (Langley et al., 2019) to redefine more effective sociospatial foundations for a joint action across the two sides. This may involve many organizations, institutions, or states willing to collaborate to solve common problems by sharing resources or addressing common policy challenges (Nadalutti & Kallscheuer, 2018).

Boundary work, however, implies an ambivalent view on whether coordination results from *reinforcing* or *bridging* established boundaries (Bruns, 2013; Harrison & Rouse, 2014; Kellogg et al., 2006; Majchrzak et al., 2012; Wolbers et al., 2018). Different categories of boundary work emerge from this dimensioning question (Faraj & Yan, 2009). In an integrative view, Langley et al. (2019) differentiate collaborative (aligning boundaries to collaborate), competitive (reinforcing boundaries to dominate the external side), and configurational boundary work (explicitly delimiting domains of joint and separated actions). Engaging in one form rather than another depends on the need to bridge *versus* reinforce boundaries, to achieve a coordinated collective performance (Langley et al., 2019; Wolbers et al., 2018). On this matter, scholarship has been striving to reach a consensus. On the one hand, some argue that bridging temporarily established professional, institutional, or organizational boundaries is useful to reach a unified action between the two sides usually operating with different systems (Meier, 2015; Noordegraaf et al., 2017). On the other hand, some scholars warn against deviances that could result from neglecting established delimitations, as boundaries are important guidelines to manage safety and prevent failures (Farjoun & Starbuck, 2007; Oliver et al., 2017). Bypassing boundaries could generate political conflicts and authorities clashes (Kalkman et al., 2018), a misunderstanding of roles and responsibilities (Kendra & Wachtendrof, 2003; Olsson et al., 2015), or an overlap of authorities (Ansell et al., 2010; Boin & Lodge, 2016).

Nonetheless, there is no clear evidence of how boundary work unfolds in a situation of spatial ambiguity (Oscarsson, 2019), as the perspective of boundary work suffers from several conceptual weaknesses to fully address this question. First, existing theorizations neither address the overlap of multiple

demarcations nor their interconnectedness; they generally describe how actors influence one boundary at a time (Gulati & Puranam, 2009; Langley et al., 2019). However, some boundaries may be easier to remove or ignore than others, depending on their degree of institutionalization and permeability (Dumez & Jeunemaître, 2010; Hernes, 2004). Second, empirical studies unfold boundaries as if they were already revealed and conscientized by actors engaged in boundary work. Nonetheless, beyond obvious and tangible demarcations (e.g., topology), cross-border spaces embody more intangible and implicit boundaries (e.g., routines and social norms). Consequently, we still need to understand how actors arbitrate *in situ* between those different injunctions (Langley et al., 2019; 't Hart & Sundelius, 2013). One explanation of those conceptual weaknesses lies in the confusion between different spatial realities, 'boundaries', and 'borders'.

Borders versus boundaries

In the literature, borders and boundaries are often mentioned as similar or even interchangeable notions (Ansell et al., 2010; Comfort & Kapucu, 2006). Implicitly, organization studies put the locus on practices at an operational level, while public administration studies focus on decisions at an institutional level. As those two theoretical perspectives do not engage in dialogue, the resulting segmented corpus of studies on cross-border crises bears a conceptual limit in clearly understanding the nature and role of the spatiality of a crisis (Ansell et al., 2010). Although both notions refer to dualities that spatially delimit actions, borders, and boundaries, they reflect different levels of reality. To clarify this conceptual distinction, we turn to studies from disciplines such as public administration and geography. They acknowledge different visions of cross-border spaces: either as (1) tangible 'loci' (i.e., location that may share specific sociocultural and economic features) that lead to consolidating 'natural economic territory' (Perkmann, 2003; Perkmann & Sum, 2002) or as (2) spaces in the making constructed with 'a more or less explicit strategic objective pursued by various social forces within and across border regions' (Jessop, 2002, p. 30).

This distinction suggests two interpretations of the spatiality of a crisis. On the one hand, action occurs within a relatively stable 'setting', independent of the situated action. We call this level of spatiality *borders*, defined as pre-existent and established duality that characterizes *a priori* the territoriality of a cross-border crisis and compels actors. Borders encompass demarcations such as natural topological delimitations, administrative perimeters, and cultural differences deeply embedded between two territories (Ansell et al., 2010; Dumez & Jeunemaître, 2010; Eydieux et al., 2016; Longo, 2017). On the other hand, *boundaries* can be defined as dynamic, temporary, and relatively permeable dualities that emerge from social practices unfolded *in situ* (Hernes, 2004). Boundaries can be materialized by areas and flows of behaviors, norms, and knowledge that actors mobilize *in situ* (Wolbers et al., 2018). These boundaries may also reflect changing geosocialities by revealing different 'ways that people in specific localities describe, imagine, use, suffer from, and make sense of the geophysical environment in which they live' (Nadalutti & Kallscheuer, 2018, p. 10). For example, Flitner et al. (2018) have emphasized that coastal erosion in south-eastern Ghana has created new social demarcations between vulnerable coastal people and others, questioning the predominance of structural national demarcations. Consequently, borders and boundaries may not necessarily reflect the same dualities.

We argue that this conceptual distinction helps to understand how boundary work unfolds in a cross-border crisis. Drawing on a metaphor where a crisis would unfold as a 'theater play', borders would represent a relatively stable 'decor' in which the play is running, while boundaries would reflect the demarcations of the action 'played' by the actors in real time. Depicting the spatiality of a crisis requires accounting for those two levels of spatiality, which are interdependent but distinct. This acknowledges that boundary work concerns both levels of boundaries and borders, with different implications. First, for organizational studies, it may reveal how individuals collectively achieve or reconfigure a sense of 'here' and 'there' (Tillement & Journé, 2016), while accounting for established perimeters and routines institutionalized at a supra level. In turn, it would allow understanding how the new frames of 'here' and 'there' can be maintained and institutionalized over time (Boin et al., 2009).

Second, bridging those two literatures thus offers the possibility to enrich the understanding of the boundary work, both at the micro and macro levels. Public administration studies focus on the institutional level to reveal how administrators shape borders to prevent or deal with a crisis through political negotiation, laws, and transnational protocol elaboration. Yet, some authors claim for frameworks that 'help public administrators to make sense of their daily practice' (Elías, 2022, p. 1635). They argue that governments and supranational organizations will always face an insufficient response repertoire while dealing with a crisis (Boin & Rhinard, 2008), and that they may find adapted answers in the understanding of crises at a more operational level. The conceptual bridging between borders and boundaries induces a multiscalar analysis of a crisis by emphasizing how borders and boundaries interact; 'there are multilevel network approaches that focus on regions by considering their social/multiscalar and multi/agent dimensions that transcend fixed states boundaries' (Nadalutti & Kallscheuer, 2018, p. 6). This is important, as states and supranational organizations are facing an increasing number of transboundary threats (Boin & Rhinard, 2008), involving complex relations between levels of governance and command (Jessop, 2016).

Thus, by adopting the lens of boundary work, refined with the conceptual distinction between borders and boundaries, we intend to address this research question: *how do actors cope with spatial ambiguity of a cross-border crisis that emerges from the overlapping of borders and boundaries?*

Methods

Mont-Blanc Tunnel fire case

This study examines the case of a fire in the Mont-Blanc Tunnel, located at the French and Italian border, which occurred on March 24, 1999 when a truck caught fire on the French side of the tunnel. The ensuing violent fire lasted nearly 53 h, causing the death of 39 people and closure of the tunnel for 3 years (1999–2002) for rehabilitation and (organizational and structural) modernization.

The Mont-Blanc Tunnel fire is one of the most emblematic crises experienced at European borders. We argue that it is a case with high 'revelatory potential' (Gioia et al., 2013) for our research question, as it allows learning from a past crisis to better consider organizational phenomena (see Weick and the Mann Gulch disaster; Weick, 1993).

First, the Mont-Blanc Tunnel is a unique infrastructure project that crosses the Alps and links France to Italy. Following its inauguration in 1965, several agreements were made to manage the tunnel's operations and safety: the specialized emergency plan in 1994 in France and the Plano de emergenza traforo del Monte Bianco in 1995 in Italy. Therefore, organizations simultaneously operating in the tunnel faced differences in terms of cultures and administrative or legal jurisdictions that could impact their responses. Organizations potentially involved in any tunnel-related situation are duplicated on each side of the national border: a French tunnel operator on one half of the tunnel concession, an Italian tunnel operator on the other, the Chamonix, Courmayeur, and Swiss fire brigades, hospitals, Aosta barracks, Chamonix Municipality, Haute-Savoie prefecture, and so on (see Appendix 1). These organizations used different protocols and routines and belonged to different sectors (e.g., the French and Italian concessions are public and private organizations, respectively). Therefore, this case offers the possibility to examine a crisis involving different types and levels of demarcations, within a delimited crisis space.

Second, this case is also interesting because it occurred in an area in which it was difficult to define, in real time, which side of the border was in charge. The tunnel is 11.6 km long; more than half (7.6 km) is in French territory, and roughly 4 km is in Italy. The tunnel concession was assigned equally to two companies in 1999 (with responsibility over 18 shelters each). Thus, concession demarcations do not reproduce the territorial borders of France and Italy (see the Results section). The tunnel fire started exactly where the designation of responsibilities was the most unclear. After the truck caught fire, the driver had to stop on a plot close to shelter 21, located in French territory, but under the Italian concession's responsibility. One common explanation at that time suggested that the magnitude of the crisis simply resulted from a lack of communication and collaboration across French and Italian borders because of cultural differences. Yet, this trivial explanation neither explains the difficulty in defining accountability of actors in real time nor why institutional and operational adjustments were made to enhance the tunnel security's management in the aftermath of the crisis.

Finally, as the Mont-Blanc Tunnel fire is a historical case with significant legal impacts and media coverage (e.g., a famous trial in France and a large process of security reforms in European tunnels), it provides detailed data from various sources and time periods (see the Data collection section), which allowed us to build a rich understanding of the case.

Data collection

The Mont-Blanc Tunnel fire offered the possibility to dig into archives and past experiences of a cross-border crisis that has been little explored in crisis research. To understand past events, a historical perspective that involves finding, using, and analyzing archival information is appropriate (Mills & Mills, 2018). Archival research is mainly valuable in social science because it offers new insights to understand a phenomenon *a posteriori* and allows for substantial contributions by making connections with other fields and methodologies (Bensadon, 2019; Decker, 2013).

Collecting archival material requires a strict methodology and results in specific challenges of scarcity, overabundance, or both (Decker, 2013). Accessing archives can be very time-consuming and difficult, especially when the data cannot be recreated somehow through interviews or observations. Of the people who were there in 1999, some chose to remain silent about the trauma they experienced and did not agree to discuss it with us. In addition, because the event involved several countries, we had to gather all potential sources from available archives (national, local, and international). In this case, we collected many archived documents (both Italian and French), especially from French libraries (at a local level in Chamonix, at a departmental level, but mainly in national archives centralized in Paris). National, departmental, and communal data often provided information on topological, institutional, and administrative challenges encountered by specific actors at their own level of responsibility (strategic or institutional actors).

However, due to the dynamic of centralization in France, most important documents were collected from the national archives and were obtained under specific authorizations. To gather these sensitive data, a series of derogations had to be obtained from numerous ministries in France (e.g., Ministries of

the Interior and of Ecological Transition, General Inspection of the Administration, and technical advisor to the Prime Minister's Office) (see Appendix 2 for sources of archives provided). At the national level, this process started in November 2017 and took 18 months, from the first letter asking for a file consultation to the answers provided by authorities. As the data are highly confidential, we only broadly mention the name institutional archival sources without specifically describing the nature of the reports and which content was collected from which department.

This corpus of archives relates the evolution of the Mont-Blanc Tunnel crisis before, during, and after the incident. Related to the crisis itself, we selected 3,503 pages comprising legal, administrative, or legislative reports; correspondence between governments; biographies and testimonies of relief teams; minutes of meetings between private and public organizations involved; operational progress reports; national representatives' communications in intergovernmental commissions; press releases in public events; and the lawsuit report. We further complemented these data with internal documents provided by the binational structure, which has been operating in the Mont-Blanc Tunnel since the reopening of the tunnel accident in 2002.

Among these documents, 418 pages of official press (official journals, bulletins, notices) and newspapers (daily newspapers, weekly press, professional journals) were included in the corpus. Finally, we also consulted audio-visual archives (Descamps, 2005), collecting two videos (2 h 12 min and 55 min, respectively) retracing in detail what happened and transcribing interviews with some main actors about the socioinstitutional context of the tunnel at that time.

To drive our archival research and confirm our results, we conducted 11 interviews (approximately 1–2 h each) with actors who were either present during the fire in 1999 or who started functioning in the reconstruction period (1999–2002) and were well aware of the crisis challenges at the time.

The interviewees' roles were representative of the heterogeneity of organizations involved in the crisis process (e.g., president of the Mont-Blanc Tunnel non-profit organization in charge of helping the victims' families, members of the intergovernmental commission, French and Italian directors of the tunnel, a managing director of the European operating company created months after the fire, actors in charge of the Mont-Blanc protection site organization, representatives involved in the Mont-Blanc trial, Italian and French colonel firefighters present during the crisis, operational firefighters or medical professionals involved in the medical center set up at the entrance of the tunnel). The number of interviews was limited because, as the crisis occurred in 1999, some of the people we contacted were unable to communicate (either disabled or dead); furthermore, some people were traumatized by the event (e.g., one person refused to recount what he experienced that day). However, the heterogeneity of the data collected allowed us to triangulate these sources to answer our research question (see Table 1).

Table 1. Data triangulation

Data source	Material collected
National, departmental, communal archives	3,503 pages
Audio archives	3 h and 7 min
Press	418 pages
Interviews	Roughly 17 h (11 interviews)

Data analysis

Table 2 explains the steps and codes we used to holistically capture *what happened where* during the Mont-Blanc crisis. To understand how these data served our analytical strategy, Table 2 also articulates these codes with the data presented in the previous subsection.

First, we started by building a general 'narrative' of the case by broadly tracing the chronology of events (processual view of the cross-border crisis) (Langley et al., 1999). We obtained an overview of the crisis temporality, which helped us organize our empirical material (e.g., classifying archives, interviews, and authors' notes).

Second, we analyzed the Mont-Blanc Tunnel's space by identifying and characterizing the borders that pre-existed before the crisis. We established a simplified geographical map of the tunnel. We then operated an open coding from our narrative of the crisis to spot the borders that appeared in the narrative. We identified four categories of borders (topological, normative, cultural, and administrative-political), which we transcribed on our map of the tunnel. We also indicated the localization of the main events (i.e., truck fire) and tunnel's resources mobilized during the crisis (e.g., tollgates). By doing so, the overlapping of borders clearly appeared.

Third, we used coding dimensions derived from our framework on crisis spatiality (borders vs. boundaries, boundary work; see Table 2 for details). We reviewed the data by addressing the question 'what happened where?'. We considered the 'where' as broadly designating any delimitation that divided actions oriented towards the same goal. This step allowed us to identify boundaries that unfolded during the crisis. We used recorded communications between operators, which testified regarding the distribution of actions, discussions about perimeters of responsibility, interactions between French and Italian organizations, and the use of formal safety procedures and devices (e.g., procedures, organigrams, infrastructures, monitoring tools). We operated an inductive coding of identified boundaries, leading to dividing them into three categories (material, cognitive, and relational). We then

Table 2. Analytical stages and data collected

Analytical stages/codes	Data collected	What information is obtained from the data?
1. Narrative of the case and actors involved in the process	Daily newspapers, weekly press, professional journals retracing the chronology of the crisis, exploratory interviews (e.g., biographies and testimonies of relief teams)	Processual/temporal analysis of the crisis: chronology of the fire (Appendixes 1 and 2)
2. Crisis spatiality with a focus on the structural mapping of the tunnel	Archives under derogation (mainly national from several ministries; e.g., legal, administrative, or legislative reports; correspondence between governments; national representatives' communications in intergovernmental commissions)	Addressing the spatiality of the crisis around different categories of borders Understanding which structures and administrations have been involved in the tunnel
3. Crisis spatiality: what happened where?	Interviews and archives; audios; technical and administrative reports addressing responsibilities and casualties of the crisis	Different categories of boundaries Analyzing the actions undertaken by actors operating in the tunnel and their profiles (which standards and profiles they relied on) and their interactions with their cross-border counterparts
4. Boundary work	Interviews and archives; audios; technical and administrative reports addressing responsibilities and casualties of the crisis	Problems identified in the crisis response
5. What comes next?	Interviews and archives; audios; technical and administrative reports addressing responsibilities and casualties of the crisis	Epilogue and boundary work unfolding in the aftermath of the crisis

reconstituted the crisis process by coding each as an interplay of multiple demarcations. We examined the (in)congruency between boundaries and borders, and the related consequences on actions.

Finally, we used thematic coding to analyze the boundary work. However, when we tried to identify existing theoretical categories of boundary work in our data, we found that none of them happened during the 53 h of fire, but rather in the aftermath of the crisis. We therefore went back to our empirical material to reconstitute the period after the crisis, to examine how problems that arose from the overlapping of borders and boundaries during the crisis were addressed through the enhancement and clarification of the tunnel's management (see the Epilogue subsection of the Results section). By doing so, we found that the crisis led actors to progressively acknowledge dualities that shaped actions or interpretations during the drama. We interpret this 'revelation' of borders and boundaries as a condition for boundary work, which we further demonstrate in the Results section.

Results: Revealing the spatiality of the cross-border crisis

First, we describe the Mont-Blanc Tunnel as a space divided into four types of overlapping borders (topological, cultural, normative, and political-administrative) and identify the ambiguity stemming from them. Second, we unfold the 53-h crisis process by emphasizing both the influence of boundaries in generating uncoordinated action and actors' incapacity to engage in boundary work. Third, we present an 'epilogue' to analyze the late emergence of boundary work in the aftermath of the crisis. We conclude that the revelation of boundaries and borders is a key condition to allow boundary work in a cross-border crisis.

Mont-Blanc Tunnel: A space of overlapping borders

The Mont-Blanc Tunnel crosses the national border between France and Italy. There was no doubt, before the incident, that it constituted a cross-border space; the tunnel security's management was handled by the two sides of the border within their respective perimeter, delimited by an administrative demarcation. However, on March 24, 1999, when a truck caught fire, it stopped at the position of the shelter 21, which was at the intersection of three other borders – topological, cultural, and normative – each type of border bounding actors' perimeters of action in a different way. This created an ambiguity for the actors located at the interface of those borders:

> We think differently. So, it was clear that everything that happened in the tunnel at that time was under the control of each tunnel concession. So, we each had only half of the tunnel to manage. But the rights and civil penal responsibilities belong to each nation-state's territory. The problem is that from shelter 18 to shelter 25 *it is French territory* but it is part of the *Italian concession*. (A director in the tunnel)

Figure 1 illustrates the overlapping of borders made salient by the crisis. We then describe them by showing how they bounded actions in their own specific way.

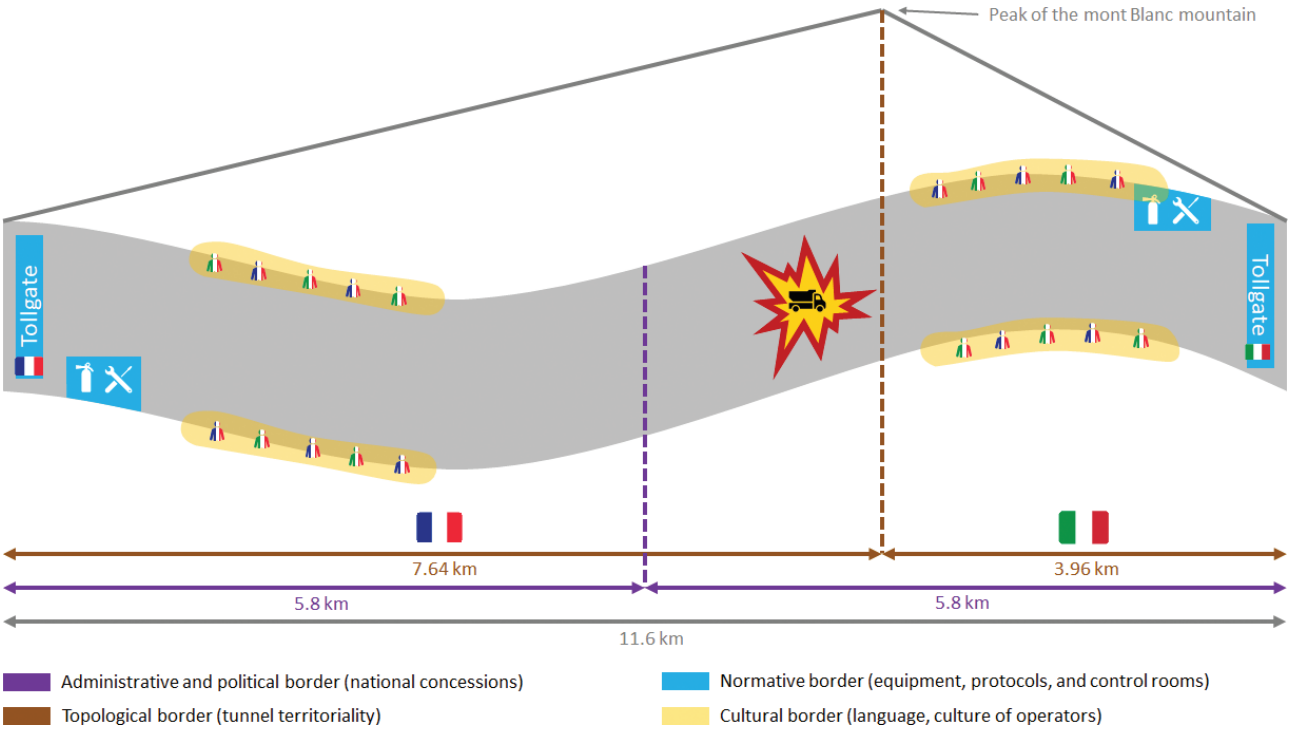

Figure 1. Borders in the Mont-Blanc Tunnel space.

Topological border

This demarcation is associated with the territorial delimitation between the French and Italian nation-states in the tunnel, separated by the peak of the Mont Blanc, just above the tunnel's infrastructure. Accordingly, within the 11.6 km length of the tunnel, 7.64 km fall in the French territory, whereas the rest belongs to the Italian side. This means that any incident or request happening on one specific territorial area of the tunnel normally falls into the management of the territory where it is geographically occurring. For example, repairing the shelter located at a distance of 4 km from the French entrance will be done under the supervision and management of the French concession of the tunnel. Consequently, according to this topological border, the fire started at the level of shelter 21, which is on the French territory (see Figure 1):

> The mountain is there; it is not symmetrical. The tunnel is there and the border is on the freight line and the part on the French side is not the same as on the other side [he creates a drawing]. As you can see, this is the French side and the Italian side. The French-Italian border is on the peak and the French territory in the tunnel is wider on the French side. Normally, there is a principle at the level of territory which is that of the integrity or the indivisibility of the territory, so what happens in our territory is our field of action. (Interview with an actor involved in the fire trial investigation)

Administrative and political border

This demarcation is associated with the demarcation of authorities and their own perimeter of accountability. Regarding this border, the administrative and political demarcation is made equally under a 50/50 concession regime inside the tunnel. Accordingly, both French and Italian governments entrusted the operation and administration of the tunnel equally to one French public operating company and to one private Italian company. The French and Italian operating companies have been anonymized as companies 'Alpha' and 'Beta', respectively. Each of these two organizations is administratively in charge of half the tunnel. This regime had established a two-headed system for the tunnel's governance (e.g., one Italian director and one French director). Each of these two concessions bears a political dimension because the tunnel embodies vital stakes for both nation-states (e.g., economic rent of situation, strategic traffic point between European countries). Therefore, governments are careful to ensure that highly placed individuals are selected to run these structures, entrusting these positions to political personalities close to the government (e.g., honorary positions, previous ministers, relatives). Regarding this border, the fire started at shelter 21, under the authority of the *Italian concession* (company Beta).

> Because there are two countries, each country has its own agreements, national jurisdictions, and institutions in charge. Before

> 1999, the management of the tunnel was oriented towards two juxtaposed administrations with an Italian and a French concession manager. This was a very well-paid honorary position given to people close to the government. For instance, [Mr. X] was in charge for a moment and; he was one of our ministers and also a good personal friend of one of our former presidents. (Institutional actor related to the tunnel)

As a matter of fact, we can see at this point that the administrative demarcation is subtly different from the topological border. The fire occurred indeed on a French territory (topological border), but that territory falls under the responsibility of Italian actors (political border).

Normative border

This demarcation is associated with the operational delimitation between organizations operating in the tunnel (concessions, French or Italian firefighters) regarding their protocols, security response procedures, and technical qualifications (e.g., security accreditation among French and Italian tunnel operators). Indeed, the tunnel security's management involves several professional perimeters with their own standards at each side of the national border (e.g., firemen, civil protection, tunnel's private security teams). This border also reflects the delimitation between two operating companies, which operate following their own cycle of investment and agenda. Consequently, the structures of equipment and procedures differed inside the tunnel:

> Companies in 1999 were different in many things such as equipment or standards […]. Investments were often made by each company at different dates and with different technical contents. These differences affected many things such as ventilation, smoke extraction, automatic incident detection, and automatic access closure. Companies also have their own way of working and may have procedures and ways of doing things that are not necessarily the same. The standards have been different between Italy and France for a long time. For instance, this was the case with the breathing apparatus, which is essential when you intervene in a tunnel. In France, there was a standard, the French standard, and in Italy it was the Dyne standard, the German standard. The team members working in the Mont-Blanc Tunnel under the supervision of the two operating companies had a standard, the nuclear standard. So, there were three different standards for the same thing. (A safety officer)

Cultural border

This demarcation reflects cultural differences (languages, habits, traditions) between France and Italy, deeply institutionalized and rooted in managerial routines. For instance, because of national differences, firefighters' functions differed between France and Italy. An Italian firefighter is responsible for reporting violations during interventions, while it is the judicial police who are responsible for this in France, not firefighters.

> It is not always easy to work with Italians and for Italians to work with the French because it needs energy when you are culturally different. You don't speak the same language and you can have different national identities and history. (An operator of the joint structure operating since 2002)

Considering the overlapping of those four borders, the Mont-Blanc Tunnel appears as a space where spatial ambiguity only revealed itself when the fire occurred at the intersection of those borders, thus forcing their encounter. Before the fire, problem-solving remained within one clear perimeter. In contrast, the truck required the mobilization of all actors at the same time, summoning a plethora of different modes of action, structured by multiple boundaries.

Failures in dealing with borders and boundaries during the crisis

The Mont-Blanc Tunnel crisis exemplifies the escalation of a fire incident into a cross-border crisis. The crisis unfolded through six main stages of intervention, each characterized by actions, which, despite being oriented towards the same goals (i.e., extinguishing the fire and rescuing the victims), were marked by clear dualities. Those dualities generate incongruent actions, mistakes, or *status quo*. By analyzing dualities of action, we emphasize the emergence of three boundaries (material, relational, and cognitive), which were not intentionally addressed until the end of the fire (see Figure 2 below). 'Material boundaries' refer to differences in the way actors mobilized material resources, protocols, and infrastructures. 'Relational boundaries' refer to hermetic interactions across several groups (mainly between professions). 'Cognitive boundaries' refer to differences of interpretations between two actors, which were explicitly transcribed in archives. In this section, we unfold each stage of the crisis by emphasizing how those boundaries influenced the crisis response.

Tunnel warning and entrance blocking (10:52 a.m.–10:58 a.m.)

The fire started at 10:52 a.m. on March 24, 1999 in a truck that entered the French side of the tunnel. The smoke spread very quickly between shelters 14 and 18, until the driver ultimately had to stop at the end of the French tunnel perimeter. French operators in the French control rooms directly detected the smoke and high temperatures within seconds of the vehicle stopping. Smoke and high temperatures also triggered alarms connected to French control rooms, while a few seconds later, Italian operators were directly called by a user blocked in a shelter on the Italian side of the tunnel. This delay and difference in information regarding the situation partly resulted from cultural differences in the way of detecting incidents between the French and Italians:

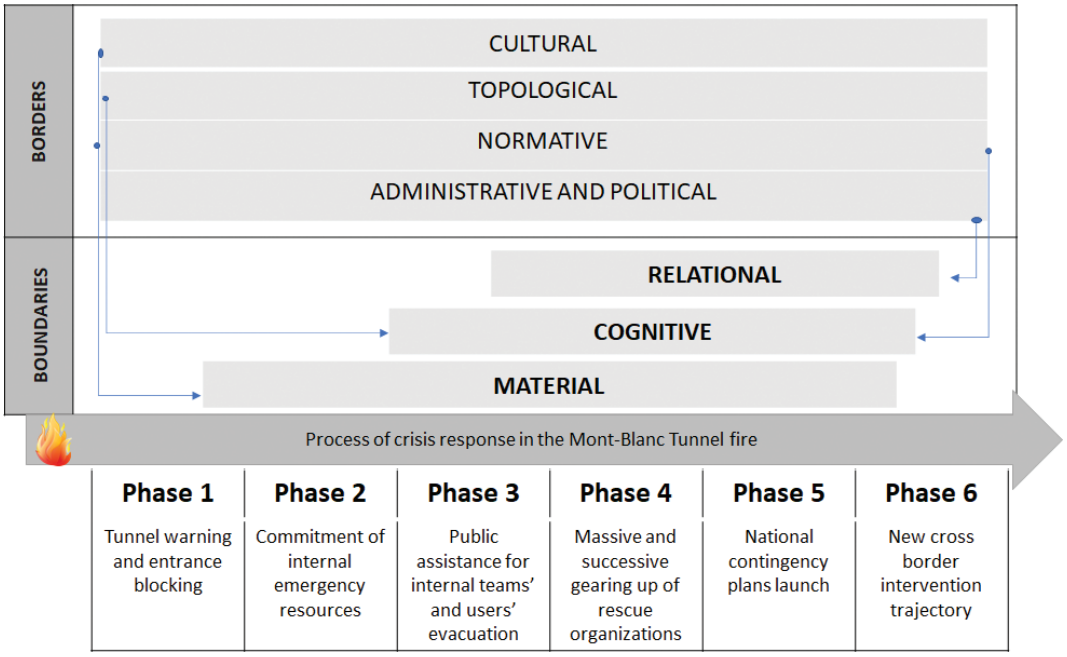

Figure 2. Revealing the spatiality of the crisis: an articulation of borders and boundaries in the Mont-Blanc Tunnel fire.

> The French fire detection system measures temperatures and detects overheating at sensors located every 8 meters. French operators did not generate any alert during the truck's travel, which is not abnormal, but they detected the temperature increases afterwards. The Italian fire detection system is based on a different principle (the heating of a gas in tubes 70 m to 80 m long). According to the information provided by the Italians, it was malfunctioning. Some sections had security failures from the day before and did not, therefore, provide any information at the beginning of the fire. (Official French investigation report on the crisis made public, 13 April 1999)

However, a few minutes later, each of the two control room regulators decided, for security matters, to close the tunnel entrances at each country's side. They immediately reached out to each other and made a common decision that, at that moment, fell into one particular and simple perimeter of actions. Then, the actors took quite simple and intuitive decisions, such as closing gates and (later) calling for public emergency support. Meanwhile, some users trapped in shelter 22, on the Italian side, were calling for help and trying to slow down the fire's spread by using a fire extinguisher.

Commitment of internal emergency resources (10:57 a.m.–11:05 a.m.)

Ten minutes after the alert and the tunnel closing, the two operating companies (anonymized as companies 'Alpha' and 'Beta') sent out operators and internal tunnel resources to monitor the situation and obtain further information. As the direction of the wind was more favorable to a penetration from the Italian entrance, only one of the vehicles managed to exit from the Italian side, ultimately saving travelers (including the driver of the truck). All other vehicles present in the tunnel were trapped, and travelers were forced to escape through shelters.

This stage shows how 'material boundaries' structured *in situ* action. Actors from each side worked independently using their own equipment (emergency vehicles and motorcycles with their very own fire pipes) and relying on their own infrastructures' standards (e.g., different junction plugs of French and Italian breathing apparatus). These material boundaries emerged from the pre-existent cultural and normative borders, as the use of equipment reflected national traditions and established standards. Those material dualities impeded synergies between operating companies' respective resources. They could not rely on each other's resources, as they did not know how to use their counterpart's equipment:

> At that time, in the tunnel, the fire pipes were not connected to the Italian plugs and conversely, the Italian plugs were not connected to the French poles. So, it was our territoriality that counted in actions. On the French side, the poles were established according to the French standard, while in Italy, it was the Italian standard. Same for the insulating breathing apparatus that allowed us to go in the smoke. The junction plugs were not the same, so everyone went in with their own equipment. […] So, we couldn't help each other. We couldn't pass a bottle to each other … so, it was a hellish situation. Same thing for the radios. (A colonel chief of firefighters)

Public assistance for the evacuation of operating internal teams and users (11:00 a.m.–onwards)

The fire spread in a short period of time, impeding any intervention within the infrastructure. In addition, internal operators were also trapped with travelers, reducing their chance to provide support elsewhere in the tunnel. Consequently, the situation escalated quickly. To handle the fire, the two sides had to choose between two options: an 'extracting mode' to push the smoke out of the tunnel or a 'blowing mode' to hold the smoke within the tunnel. Following the French tunnels safety regulation (no. 81.109-1981), the French regulator gave the instruction for smoke extraction from the French side. This activated an 'extracting mode' of ventilation, resulting in pushing the smoke out of the tunnel. However, the Italian regulator considered the use of 'blowing mode' necessary to facilitate people evacuation, resulting, on the contrary, in pushing the smoke inside the tunnel. These contradictory operations aggravated the fire propagation:

> A specialized emergency plan in the fire department existed; I don't know the exact name, but it was just on the French side; it was just for French firefighters. In the tunnel, French actors followed the prescription of smoke removal from the circular number 81.109 of December 29, 1981 related to safety in the tunnels that briefly mentioned measures of ventilation in case of an emergency. At an institutional level, I don't think we had emergency protocols or procedures, so the door was open to interpretation. And, there was obviously no coordinated plan with the firefighters in the Valle d'Aosta region (Italy). So, such contradictions are inevitable… Everything was in place for the disaster to happen. (A director involved in the tunnel safety)

This stage shows the manifestation of a 'cognitive boundary'. Aware of the fire's magnitude, each regulator had its own interpretation of what the best choice was, leading to contradictory instructions and actions on the field. This boundary was rooted in the pre-existence of normative and topological borders. The differences in norms and standards as well as the geographical distance associated to the existence of a mountain did not support a joint interpretation of the situation, as actors were geographically dispersed with no means of communicating or physical capacity to reach one another in the tunnel.

Massive gearing up of rescue organizations in the tunnel (11:05 a.m.–12:55 p.m.)

Starting from 11:10 a.m., several fire brigades successively arrived at each national border. At the national level, the magnitude of the crisis put French and Italian administrations in a situation of intense international exposure. Focused on handling this political challenge, administrations on each side planned initiatives and actions independently. At the national level, those political borders expressed themselves through political tensions (later, they even indulged in blame games during the trial) and diplomatic maneuvers. On the field, this political duality impacted action by pushing each concession to work in isolation, without informing their counterpart of the actions undertaken.

In addition, multiple professionals intervening on the field also worked in isolation using their own modus operandi within their zone of expertise. With the rush, and as they considered that they did not have to receive orders from private actors, firefighters ignored national command rooms' authority and did not stop to get the latest updates from operating companies before entering the tunnel. However, as they were not used to intervening in confined spaces, the firefighters missed critical information to make use of a few opportunities of evacuation or rescue (see Vignette 1). Consequently, they were not aware of the obligation to individually hold a breathing apparatus (including for agents inside the vehicle) that is essential to breathe in a confined area such as the tunnel. The commander of the French operations who entered the tunnel without a breathing apparatus died a few hours later. At this point, the situation started getting out of control, as rescue organizations and internal support teams were trapped with no means of communication or counting devices that would

Vignette 1. Evidence of the lack of communication between firefighters and national command rooms

There were four open-circuit breathing apparatus (SCBA) on board the vehicle. This regulatory armament can only be valid for a 'normal' fire where the driver and the fire chief will not enter the smoke-filled zone. But this is not the case in a tunnel fire where the vehicle and the entire crew will enter and work in a hostile environment. Moreover, *the first van of French public firefighters did not stop (as it should have done) at the control station before entering the tunnel, to seek prior information and take its orders from safety managers of the French operating company.* When entering at 11:11 a.m., the van was stopped at 300 m from the entrance by a tunnel team leader (from the French operating company) who indicated the presence of dense smoke and the need to wear a breathing apparatus, but the van continued its journey. Four firefighters (anonymized by the authors) equipped themselves with the breathing apparatus, but the team leader and the driver of the van were not equipped with it. This turned out to be tragic a short time later. (Administrative and technical investigation on the Mont-Blanc Tunnel fire ordered by the French Ministry of Transport and the Ministry of the Interior, April 1999, p. 18; online accessible archives)

Evidence 2: On the other side of the border, we had to go through the safety manager because he was the one who had the connections and he didn't let us speak on the phone when he coordinated with his teams. So, we had no connection with our cross-border colleagues. […] He even voluntarily spoke a language we did not understand. (Interview intentionally anonymized with a rescue worker)

have allowed national authorities and internal regulators to estimate the number of people inside (users, operators, and public rescue actors).

This stage shows the manifestation of several 'relational boundaries', both between countries or within professions, which led to a hermetic communication between different responders. National institutions and professional organizations discontinuously attempted to take over command of fire management without really questioning which leadership they should follow.

National contingency plans launch (starting 1:04 p.m.)

Witnessing the dramatic crisis, national authorities in France decided to trigger two national emergency plans at 1:04 p.m. and 1:35 p.m., respectively. This upsurge in France was carried out by the prefect who led the establishment of a command unit in the prefecture of Haute-Savoie. At this stage, the activation of national plans only occurred in France, with no proof of institutional coordination with Italian authorities:

> Despite contradictory information, it seems that the activation of the Italian emergency plan (*piano di emergenza*) by the President of the Region of Valle d'Aosta was not carried out; this authority probably considered that the fire took place on French territory and that the implementation of French emergency plans was sufficient. (41 proposals of the joint French and Italian administrative report on the Mont-Blanc Tunnel disaster of March 24, 1999, p. 16; online accessible archives)

Italian authorities said afterwards they did not launch any plan because the fire had occurred on the French side, and therefore the French authorities were territorially responsible for dealing with the crisis. However, French authorities argued that the tunnel is an infrastructure under a joint national responsibility. Consequently, the Italian administration could be held accountable for not contributing to the crisis management. French civil security actors called for a massive support from emergency organizations all over their country. They essentially relied on national support from French fire brigades (Marseille, Bouches-du-Rhône, and Var) which used the same equipment and operated with similar standards, unlike resources used by Italian brigades (material boundaries). This shows further evidence of 'material', 'cognitive', and 'relational' boundaries that demarcated *in situ* action in the crisis.

Implementation of a new cross-border intervention trajectory (March 25)

The next day, Thursday, March 25, the fire could still not be extinguished despite the mobilization of nearly 90 firefighters from Haute-Savoie, 10 people from SAMU (*service d'aide médicale urgente*, French medical organization), civil security helicopters (which could not cross the mountain by air because of the smoke), 15 firefighters from Geneva, Marseille, Bouches-du-Rhône, and Var fire brigades. During that day, roughly 34 people were presumed dead in the tunnel and 45 were still missing.

Yet, the only way to enter was from the Italian side. Therefore, French authorities decided to transfer their resources to reach the Italian entrance. However, gaining access this way was difficult, as they needed to cross Mont Blanc and tackle serious smoke, which prevented the use of airways and helicopters. Firefighters, thus, used land routes extensively increasing their travel time. French firefighters ultimately entered from the Italian side at 6 a.m. the following day. From this moment, a joint cross-border intervention was possible to stop the fire after 53 h of continuous propagation. At this time, the chances of saving potential victims were non-existent. Considering the magnitude of the fire, which made any penetration irrelevant, and the time that had passed, the fire extinguished on its own, once there was not much left to burn. Subsequently, the tunnel was closed and remained so for 3 years. Italy and France then entered a long phase of negotiation about infrastructure reconstruction and rehabilitation.

Epilogue: From cross-border crisis failures to boundary work in the aftermath of the Mont-Blanc crisis

The Mont-Blanc trial and successive institutional reports in the aftermath of the crisis all pointed out the boundary challenges that the crisis had dramatically emphasized. After the crisis, the Mont-Blanc Tunnel was not reopened until 2002. Starting May 1999, a series of negotiations and discussions to address what went wrong during the crisis were initiated between France and Italy. In particular, the crisis trauma raised awareness about the overlapping of borders and problems associated with each boundary. Reports, trials, and crisis feedback led to identifying problems associated with the overlap of borders and boundaries. In other words, borders and boundaries were 'revealed'. This revelation led to defining coordination improvements, including joint exercises between the two sides, institutionalization of a rotation in command rooms, and creation of common instances (joint binational structure). Table 3 stresses how the problems of boundaries led to those solutions and specifies the nature of the boundary work involved based on Langley et al.'s (2019) categories.

Material boundaries, acknowledged as the incompatibility of resources between the two sides of the tunnel, have been solved by 'bridging' boundaries. Bridging boundary work occurred through standardizing the equipment in the tunnel (technical centralization of all screens and systems of both

Table 3. Problems of boundaries and boundary work in the aftermath of the crisis

Boundaries	Problems associated with boundaries	Boundary work in the aftermath of the crisis	Consequences on borders
Material: differences in the way actors mobilized material resources, protocols and infrastructures	Incompatibility of resources provided	Boundary work bridging: exercises; command and control room rotation	Downplaying cultural borders
Cognitive: differences of interpretations between two actors that were explicitly transcribed in archives	Inconsistency of actions	Boundary work reinforcement: Convention de Lucques	Consolidating normative and topological borders
Relational: hermetic interactions across several groups (i.e., professions)	Discontinuity of actions	Configurational boundary work: binational European structure	Arranging administrative and topological borders

French and Italian control rooms) and by establishing five exercises per year (four with all French and Italian private and public rescue organizations and one additionally with the French and Italian administrations and the official elected). Today, these exercises are an administrative obligation, which is a significant step forward in preventing problems of incompatibility such as those revealed during the 1999 crisis. During these exercises, private relief organizations (Vigili del Fuego in Italy and Departmental Fire and Rescue Service in France), private relief teams from operating companies, and health actors (Italian civil protection and SAMU in France) are invited to simulate an intervention in the tunnel in both the French and Italian concessions and territories. These exercises do not strictly standardize ways of working or erase territorial intervention demarcation in the tunnel; rather, they offer opportunities to downplay some differences and solve incompatibilities such differences may induce. In turn, this boundary work enhanced the consciousness of cultural borders on the field. Moreover, to solve incompatibilities and avoid retention of information, operators in each command and control rooms are now necessarily both French and Italian. Operators' mobility has then been introduced: this means that operators from the two operating companies always rotate to work either on the Italian or French platform. Consequently, at any time, French and Italian operators are jointly accountable for managing any crisis occurring in the tunnel.

Cognitive boundaries, acknowledged as inconsistencies of actions and interpretations, were addressed by reinforcing boundaries. Reinforcement boundary work occurred more specifically on November 24, 2006 by the signing of the Lucques agreement, a cross-border agreement between Italian and French authorities. This agreement clarifies the attributions and responsibilities of tunnel actors to avoid ambiguous situations and harmonize security knowledge. This boundary work led to the consolidation of normative and topological borders. Article 12 of the Lucques convention clearly reasserts the territorial demarcation between France and Italy in the tunnel (mountain peak) and assigns the responsibilities to actors for the management of any event (Article 4 gives primacy to the state legislation of the territory on which the event or the needs have been expressed).

Relational boundaries were addressed by reconfiguring boundaries. This configurational boundary work occurred through the negotiation between French and Italian governments, ultimately pushing for the creation of a joint infrastructure that would operate in the tunnel. This led to the creation of the joint (binational) operating structure of the Mont Blanc in 2002. The binational structure exclusively manages and operates the whole Mont-Blanc Tunnel on behalf of the two French and Italian operating companies. This reconfiguration of relational boundaries has occurred by gathering French and Italian operators under the same exploitation. However, common exploitation does not mean the end of the legal existence of the French and Italian concessions because each operator officially has a national contract with the operating company that hires them, but works under a common infrastructure equally mixing French and Italian operators. The binational structure then needs to conciliate contractual and administrative differences in its daily activities. This has led to the introduction of a two-headed model with a French tunnel manager and an Italian tunnel manager, as well as a third operating manager, who is alternatively French and Italian (rotation every 18 months).

Discussion

This study examined the spatiality of the Mont-Blanc fire crisis to reveal how boundary work, as an antecedent for coordination, unfolded at both the scales of borders and boundaries. Our findings stress that when a crisis reveals the overlapping of multiple borders, boundary work is necessary to allow coordination. However, this work does not occur until actors acknowledge the multiple borders and boundaries they are dealing with.

This study has several theoretical and practical implications. We first present theoretical contributions to the literature on cross-border crisis management and on

boundary work. Then, we discuss the limitations and scope for future research. We conclude with some practical implications.

Theoretical contributions

First, our findings enrich the literature on cross-border crisis management. On the one hand, studies from management literature have overlooked the spatiality of crises (Brinks & Ibert, 2020). Our study reveals the interdependencies of borders and boundaries as an implicit driver of the crisis process. We show that a cross-border crisis compels actors to join a temporary 'common space', both material and symbolic, in which they must collectively face danger. In this common space, the emergence of boundaries plays a central role in the construction of the crisis response. Our findings invite scholars to further explore how actors become aware of those latent boundaries and their interdependencies with borders. Sociocognitive theories such as sensemaking (Maitlis & Sonenshein, 2010; Weick, 1993) could help reveal how actors collectively deconstruct and reconstruct their interpretation of 'where the crisis is happening'. Unpacking the learning processes (van Laere & Lindblom, 2019) that underpin the revelation of boundaries can also be a promising research avenue. Our data show, as mentioned in the epilogue, that the revelation of borders and boundaries occurred when trials and reports pointed out the incongruencies of actions and failures of coordination. However, it also suggests that different forms of boundary work that followed, such as joint training exercises, also contributed to enhancing actors' awareness of the dualities that existed in the tunnel's management.

On the other hand, studies in the field of public administration are calling for a better understanding of solutions to the challenges posed by crises and disasters (Boin & Van Eeten, 2013; Christensen & Lægreid, 2020). Previous literature has indeed often pointed out the cultural and political differences that generate a lack of cooperation in extreme cross-border situations (Ansell et al., 2010; Dahles & van Hees, 2004). Failures during the Mont-Blanc Tunnel's fire certainly reflect problems underpinned by cultural differences. Nevertheless, the crisis response process was essentially weakened by the lack of awareness of multiple demarcations (associated with both borders and boundaries) that were at stake. In addition, our work answers recent calls for building a framework that helps administrators enhance their awareness of daily practices at the operational level (Elías, 2022). Highlighting the interrelation between borders and boundaries during a crisis, as we did *a posteriori* in the Mont-Blanc case, can help public administrators build a more adapted repertoire of responses to the crisis (Boin & Rhinard, 2008).

Our conceptual distinction between borders and boundaries further allows bridging the two fields of management and public administration. By doing so, it provides conceptual insights for integrated, multiscalar theorizing of cross-border crises (Söderbaum, 2018). As Jessop (2016) noted, theories tend to operate a reification of distinct levels of action at borders. We suggest that further theorizing of the revelation of boundaries and borders, as the capacity to build a collective awareness of a multilevel spatiality can contribute to enhancing cross-border response at all scales of crisis management.

Second, our study also extends the perspective on boundary work (Faraj & Yan, 2009; Langley et al., 2019). Our study enriches previous studies, which tended to consider boundary work on one boundary at a time and at one level of analysis at a time. By distinguishing borders from boundaries, we introduce the idea that boundary work involves navigating between different levels of demarcations that can overlap. This distinction can be an interesting avenue to overcome current debates on boundary bridging *versus* reinforcement (Kellogg et al., 2006; Majchrzak et al., 2012; Wolbers et al., 2018). Our findings suggest that depending on the problems associated with boundaries and borders' overlapping, actors fell back on different forms of boundary work. As a matter of fact, the new tunnel management system resulted from mixing bridging, reinforcement, and configurational boundary work. This observation echoes with studies in less extreme contexts, showing that bridging boundaries between actors is not always necessary to achieve coordination, as long as boundaries remain visible (Kellogg et al., 2006). Our single case study does not provide enough evidence to generalize the nature of problems and their link with specific forms of boundary work. However, multiple case studies on crises in different contexts may help build a contingent approach on boundary work. Furthermore, this article also challenges the existing literature on boundary work by introducing boundaries' revelation as a key condition to unfold boundary work in a crisis. It challenges this implicit assumption that boundary work emerges spontaneously. Therefore, future research on boundary work should consider opening the black box of 'how' purposeful individual and collective efforts emerge. This question is even more critical in the context of extreme stress and urgency, such as crises, in which arbitrating between several boundaries can be particularly challenging.

Limitations and future research directions

In addition to previous comments, we wish to underline some additional limitations of this study. First, we focused on

the specific context of a cross-border crisis between two neighboring countries. Other crisis contexts, with less clear spatiality, such as the Eurozone crisis (Ayton & Rao-Nicholson, 2018), may reveal other dynamics and conditions of boundary work. Moreover, we focused on real-time work at the interface of boundaries. Future research could, for instance, study a more longitudinal dynamic of boundary work to explore how transboundary work evolves over time. Finally, our analysis relies mainly on archives and a limited number of interviews and thus does not generally consider cognitive processes that play an important role in crisis situations (Taarup-Esbensen, 2019; Weick, 1993). Future studies could explore how actors collectively make sense of organizational boundaries while addressing a transboundary crisis. The 'long-dated' data we collected made it difficult to identify precise triggers for each practice. Therefore, research based on an *in situ* observation of crisis could help to understand why specific practices of transboundary work emerge, remain, or disappear at particular moments. For instance, the number of organizations involved in the crisis appeared to be a potential trigger for boundary endorsing and negotiating. Changes in boundary saliency can also trigger a switch from one practice to another.

Practical implications

Finally, our study also highlights ways of improving cross-border crisis management for practitioners. Distinguishing how institutionalized borders interfere with *in situ* boundaries can help detect vulnerabilities in cross-border management systems. While some inconsistencies, 'holes in the racket', or overlaps do not appear problematic in a routine situation, they could hinder effective action in a crisis. Joint exercises, common instances, even when routines seem smooth, can shed light on *ex ante* incoherencies and incompatibilities that could be avoided during a crisis. Furthermore, revealing how dualities interact across different scales serves as a reminder that 'what takes place at the micro-regional level inevitably influences what occurs at higher level of scales and vice versa' (Nadalutti & Kallscheuer, 2018, p. 4). Acknowledging such interactions can help clarify which scale is the most effective or competent for coping with crises (Boin et al., 2013; Brinks & Ibert, 2020).

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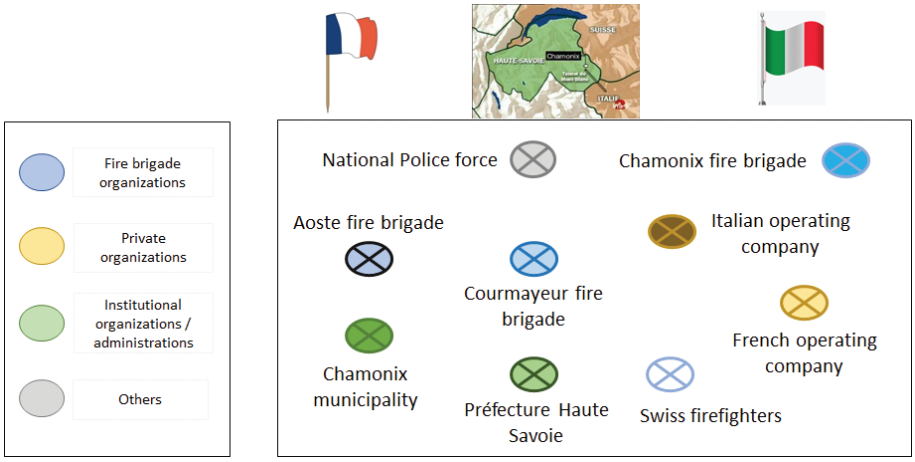
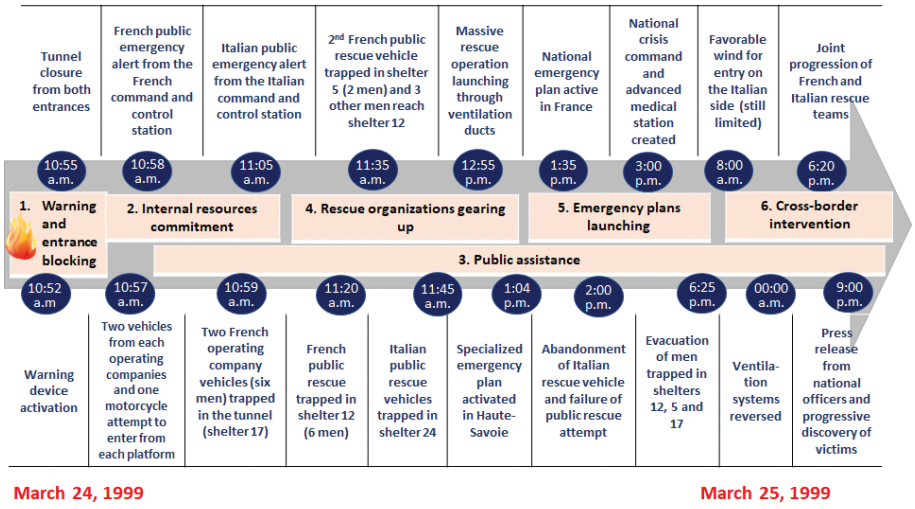
Appendixes



Appendix 1. Mont-Blanc Tunnel fire: main actors

Appendix 2. Archival sources collected

Archival sources	Number of files relevant to the analysis	Acceptance date (delay between first request and its acceptance)
Department of Equipment and Transport	31	01/10/2018 (11 months)
Technical office – Department of Equipment and Transport	77	01/10/2018 (11 months)
Secretary of State Overseas office	8	04/10/2018 (11 months)
Office of the Minister of Equipment & Transport	77	04/10/2018 (11 months)
Official Mont-Blanc trial report	Personal source	December 2017 (1 month)
Technical advisor – Office of the Prime Minister	26	04/10/2018 (11 months)
Office of the Department of Justice	3	01/10/2018 (11 months)
Secretary of State for Victims' rights	5	04/10/2018 (11 months)
Department of Ecological Transition	3	14/11/2019 (24 months)
Communal archives	1	December 2017 (1 month)
Local, departmental, national press (public sources)	418 pages	December 2017 (1 month)



Appendix 3. Temporal chronology of the crisis.