The Role of Uncertainty in the Policy Process: An Extension to the Multiple Streams Framework

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ABSTRACT

A core assumption of the Multiple Streams Framework proposes that agenda and policy change is more probable when a policy proposal worked out as a viable alternative in the policy stream is coupled with the political and/or problem stream in an open policy window. In this article, we argue that this perspective hinges on a too narrow understanding of the concept of ambiguity, which ignores situations of high epistemic uncertainty in which worked-out solutions are not readily available in the policy streams, but policy action still occurs. For instance, when a policy window has been opened in the problem stream due to the presence of a focusing event. Building on the literature on how decisions under uncertainty are taken, we propose that policy-makers will utilize "ad-hoc solutions" as satisficing strategies, such as the precautionary principle, which will then guide political decisions. Which heuristics are available may depend on different factors, such as the basic normative values of a decision-maker herself, national cultures of a country, or situation-specific characteristics.

1 | Introduction

The Multiple Streams Framework has developed into one of the most prominent theoretical perspectives in policy research and aims at explaining agenda and, relatedly, policy change (for the most recent update of the framework, see Herweg et al. 2023). The basic logic of the approach involves five elements: the famous three streams (problem, political, and policy stream), the policy entrepreneur, and the policy window. In a nutshell, the MSF suggests that policy change is more likely if the three streams are coupled in an open policy window by a skilled policy entrepreneur who either succeeds in attaching a worked-out policy solution to a situation perceived as problematic by policy-makers ("consequential coupling"); or who seizes the opportunity of a certain political moment (e.g., a change in government) to sell her favorite policy proposal to policy-makers, pushing it on the agenda ("doctrinal coupling") (Zahariadis 2003). Over the years, numerous conceptual and empirical advances have considerably increased our knowledge on how policy processes can be interpreted through the lens of the MSF (for overviews, see Jones et al. 2016; Zahariadis et al. 2023). This is not only true for certain steps of the policy process, such as decision-making (Herweg et al. 2015; Zahariadis 2003), policy implementation (Fowler 2019, 2022), or termination (Geva-May 2004; Wenzelburger and Hartmann 2021), but also for certain important elements of the MSF which have been refined, such as the role of focusing events (Birkland and Warnement 2016), the policy entrepreneur (Mintrom and Norman 2009), political institutions (Zohlnhöfer et al. 2016), or the coupling process (Blum 2018; Dolan 2021).

While these efforts in theory building through refinements and additions to Kingdon's initial model have advanced our understanding of the policy process and the MSF substantially, we argue in this article that the foundations of the MSF, namely the "garbage-can"-perspective of the framework, have not been scrutinized in similar depth. More precisely, we hold that we could gain additional analytical leverage in understanding the policy process if we reflected more specifically on the context in which certain

decisions are taken, that is by specifying more clearly what is often described as a "situation of ambiguity" without further explanation. In this research note, we therefore draw on the academic literature about concepts of uncertainty and ambiguity, and analyze *how different types of uncertainty and related ambiguity may affect the interpretation of the policy process through the lens of the MSF.*

Our core argument suggests that there is a crucial difference between political decisions that are taken in situations of *interpretative* ambiguity, when policy actors are confronted with several interpretations of a situation and multiple policy solutions, which makes them unsure about what to do, and situations of profound *epistemic* ambiguity, when a lack of knowledge and information fosters ambiguity about whether to tackle an issue and how. Applying this differentiation to the MSF, we argue that the crucial difference concerns mainly the problem and the policy stream. Whereas in interpretative ambiguous situations, the problem and policy stream may be overwhelmed with problem definitions and possible solutions (window overload, Dolan and Blum 2023, 92), epistemic ambiguous situations may lead to policymaking in the context of unspecified problem definitions and a policy stream without any readily available policy solution. We argue that in these cases, heuristics such as the precautionary principle will guide policy decisions and that the choice of policy solution through heuristics depends on easily available information, such as the basic normative values of a decision-maker herself, national cultures of a country, or situation-specific characteristics. Thinking more deeply about the differentiation between types of ambiguity seems not only important for advancing the MSF as one of the leading frameworks in policy analysis but also because in times like these, in which the very notion of "knowledge" has been disputable, disentangling different types of non-knowledge and how they arise and affect the policy process can advance our understanding of policy making.

The remainder of the paper is structured as follows. In the next section, we will present basic insights about how different types of uncertainty can be conceptualized and how they relate to ambiguity as a basic feature of the MSF. Based on this, we will then discuss how the dynamics laid out in the MSF may vary depending on the uncertainty context in which decision-making is embedded. The last section discusses the implications of our theoretical argument by deducing testable hypotheses and proposing ways forward on how to analyze MSF across different environments of uncertainty.

2 | Uncertainty and Ambiguity in the Context of the Multiple Streams Framework

2.1 | The Treatment of Knowledge and Uncertainty in the MSF

Knowledge and information are widely regarded as essential elements of policymaking (Nutley et al. 2007; Head 2010; Cairney 2016), supporting policymakers to understand complex issues, weigh potential outcomes, and make informed decisions. Evidence-Based Policymaking (EBPM) posits that better knowledge leads to more informed and effective policies (Nutley et al. 2007; Head 2013). Yet in practice, policymakers frequently

operate under conditions characterized by limited, contested, or rapidly changing information (Koppenjan and Klijn 2004). The availability of knowledge is rarely complete, nor does it have a direct effect on policy outcomes (Boswell 2009). As policymakers face time constraints (Zohlnhöfer and Rüb 2016), institutional pressures, and cognitive limitations (Simon 2000), they must navigate not only what is known but also what remains unknown or is only partially understood. The MSF models policymaking in such ambiguous contexts where problems and solutions are unclear and where, in contrast to uncertainty, even more information would not help to deal with the situation (Kingdon 2011). Ambiguity is conceptualized to arise from the interpretative nature of issues and information in the policy process. As any phenomenon could potentially be perceived to present a problem or not, attributed to various distinctive policy areas and coupled to different policy solutions, problem brokers who frame specific conditions as policy problems and policy entrepreneurs who present solutions to framed problems are crucial actors in this problem definition contest (Knaggård 2014, 2015). Consequently, the MSF assumes that empirical knowledge only gains policy relevance if it is specifically used to frame a problem or corresponding solution. The core assumption of the MSF concerning the environment of ambiguity could thus be summarized to form a non-linear relationship between empirical knowledge and policy output that rests on interpretation, argumentation, and deliberation by various stakeholders. The crucial characteristic of this type of ambiguity, however, lies in the availability of too much information and multiple ways of interpreting it. As Kingdon notes in his original account (Kingdon 2011, 79):

> The ability of human beings to process information is more limited than such a comprehensive approach [rationally matching solutions to problems, the authors] would prescribe. We are unable to canvass many alternatives, keep them simultaneously in our heads, and compare them systematically.

Yet, while this type of ambiguity—arising from interpretative conflicts on problem definition and policy solutions due to an overload of information—is undeniably an integral feature of policymaking and describes many or even most empirical cases, limiting the analysis to it downplays situations that are characterized by a different type of ambiguity, namely one arising from a lack of information, caused by epistemic uncertainty. Kingdon's conceptualization of ambiguity crucially rests on competing ways of how information is processed and interpreted, and the resulting cognitive overload of choosing from a wide range of possible solutions—specifically dependent on the way the information or phenomenon is processed. Yet, it remains unclear on how much information is necessary for the mechanisms described to be applicable, and conversely what happens if this degree of information is unavailable.

2.2 | Two Faces of Uncertainty and Their Relationship to Ambiguity

Uncertainty and ambiguity are related but distinct concepts often used interchangeably, as both describe conditions in which
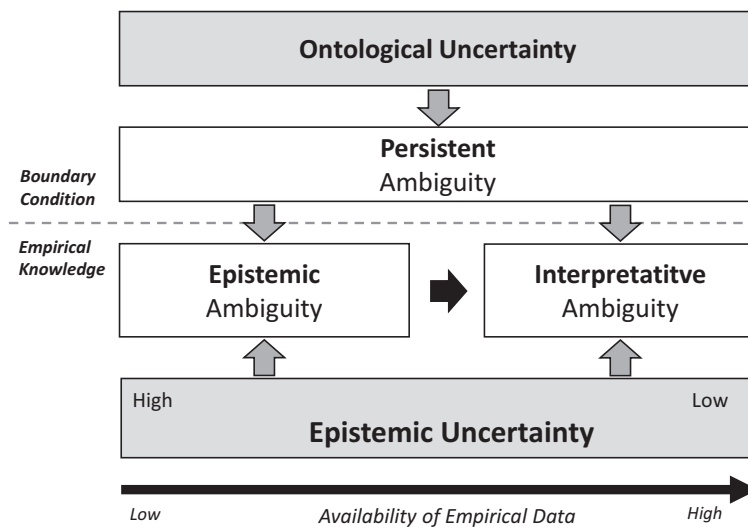
FIGURE 1 | The relationship between uncertainty and ambiguity.

decision-making is characterized by cognitive limitations. However, both concepts differ in important ways. *Uncertainty* refers to situations where the outcomes of decisions are either unknown or cannot be quantified, meaning specific outcomes cannot be predicted accurately—unless more information becomes available (Zahariadis 2014; Knight 1921). *Ambiguity*, on the other hand, arises when the information itself is unclear or open to multiple interpretations, often described as the presence of many ways to think about the same circumstance or phenomenon (Zahariadis 2014; Herweg et al. 2023). While uncertainty subsequently relates to problems arising from a lack of information or issues in data gathering (i.e., not *knowing* enough), ambiguity relates to the interpretation of information and sensemaking (i.e., what information/lack thereof *means*).

The large body of literature on various types and natures of uncertainty (e.g., Dewulf and Biesbroek 2018; Walker et al. 2003; Nair and Howlett 2020; Stirling 2010; Knight 1921; Funtowicz and Ravetz 1993; King and Kay 2020) can be largely summarized in differentiating between two distinctive forms: (1) *epistemic* uncertainty, rooted in incomplete or imperfect knowledge, and (2) *ontological* uncertainty, resulting from the complexity of systemic processes and the inability to reliably predict all future states of the system (sometimes referred to as "radical" or "deep" uncertainty, King and Kay 2020; Nair and Howlett 2020). Epistemic uncertainty relates to gaps in available knowledge or imperfect data, and can in principle be reduced through additional research, better models, or improved measurement. Ontological uncertainty, in contrast, reflects the inherent unpredictability of complex and evolving systems. It cannot be eliminated through better knowledge, since it results from the very nature of complex systems and our epistemological limitations. While predictive models and information can improve predictive accuracy for simplified states of the system, ontological uncertainty itself is not reduced, but remains a boundary condition. There will always remain aspects of system behavior (counterfactuals) that escape even the best predictive models—since any model requires abstraction and simplification. Because of that, more knowledge can lead to the emergence of competing, and equally accepted models of reality, and knowledge utilization is dependent on interpretations attached to it (e.g., Keynesian economics

vs. neoclassical economics). While increased knowledge thus permits a better approximation of reality, it, however, remains a form of heuristic for sensemaking because of epistemological limits and is dependent on the initial assumptions in data collection and its alignment with existing narratives (see Figure 1). This results in any action or decision made to occur in a general state of ambiguity (i.e., bounded rationality), either because (a) no epistemic knowledge is available to reduce complexity, and it is ambiguous where to even start looking for information, (b) any model that does exist necessarily ignores other characteristics of the system and it is ambiguous to what extent the assumptions of the model hold (Nair and Howlett 2020; Head 2008; Byrne and Callaghan 2022), or (c) multiple competing models or interpretations exist, referring to the situation of information overload as conceptualized by Kingdon. The degree of epistemic knowledge available thus leads to distinctive types of ambiguity actors face.

Epistemic ambiguity arises from particularly high epistemic uncertainty, where even the most basic question of how to determine the appropriate research angle, which data to collect, and which indicators to use and which to ignore (Stirling 2010) are unclear. Once a research angle has been chosen, and more information becomes available, epistemic ambiguity on how to approach the phenomenon decreases, by supporting consensus finding alongside simplified data (Wynne 1992). However, this simplification of reality is based on the ignorance of other aspects of reality (Stirling 2010; Wynne 1992), because the ambiguous choice of which data to collect and what type of model to use, results in other types of data or mechanisms being left unexplored. Given that no model can capture the entirety of processes of the system, and choices under epistemic ambiguity are guided by individual or collective heuristics, over time, competing models and/or interpretations will emerge. This conflict between different interpretations of existing knowledge (e.g., alongside overarching narratives), then induces *interpretative* ambiguity.

Interpretative ambiguity results from knowledge being inconclusive or contested (Sarewitz 2004), or when previously unexplored characteristics of a phenomenon manifest empirically over time—for example, because prior methodological

considerations are called into question (Beck 1998), or the normative assumptions used for data collection stand in contrast to other narratives. In those cases, more knowledge may both create or reinforce conflicting frames (e.g., alongside normative lines), instead of resolving them—and lead to the situation of information overload described in the MSF. Hence, once sufficient and reliable knowledge is available, and several working policy solutions potentially exist, *epistemic ambiguity* and the attempt to resolve it are replaced by *interpretative ambiguity* caused by previously ignored aspects, or potential value and distributive conflicts of the conclusions drawn in relation to other now existing models of reality (Majone 1989; Stone 2012; Cairney 2016; Kingdon 2011; Boswell 2009).

To give a more intuitive example of the argument outlined, consider the following case: Imagine a coastal city deciding on how to respond to a sudden sea-level rise. Initially, *epistemic ambiguity* dominates as decision-makers lack any data on whether this change is temporary or permanent, which neighborhoods are affected, or what caused this rise in the first place. And because of the complexity of the environment, many potential causes may explain the phenomenon. Thus, to tackle the issue, a decision must be made on what to model, which indicators matter, and how to collect data. These decisions are shaped by simplifying heuristics and institutional biases. As first data becomes available, epistemic ambiguity on the sea level rise may decrease, as the initial data collection could, for example, point to one specific neighborhood being most likely affected, or indicate that the change would only be temporary. However, the newly gathered evidence is likewise open to competing interpretations: some stakeholders may question the way the data were collected, distrust the conclusions drawn because they run contrary to their interests, or question the objectivity of data collection. Is it better to build sea walls or restrict housing in certain areas because the flooding may come back? Or is the collected evidence sufficient to make a decision in the first place? Those competing interpretations exemplify what we call *interpretative ambiguity*—and are situations which are very well modeled by the MSF.

2.3 | The Effect of Different Levels of Uncertainty on the Policy Process

The implications from these different types of ambiguity for the policy process are straightforward. While framing contests and contestation between problems and solutions define situations of interpretative ambiguity, because data and interpretations of the issue at stake exist, the context of epistemic ambiguity differs starkly. Here, due to the lack of data and interpretations, simplified models and heuristics dominate, and policy-making is vulnerable to new findings (Table 1). Persistent ambiguity arising from the ontological unpredictability of systems forms a boundary condition for the policy process and persists across varying levels of epistemic uncertainty. The required response is similar to conditions of high epistemic uncertainty and requires simplification of reality by the use of heuristics (King and Kay 2020; Vis 2024).

Once a satisfactory problem definition has been identified, and inferences on potential mechanisms to engage with a phenomenon can be made, epistemic ambiguity on how to approach the phenomenon regresses and is gradually replaced by interpretative ambiguity, leading to framing contests but also permitting sensemaking and consensus-finding between actors. However, any potential consensus reached at this point is fragile, not only because inferences can be interpreted differently, but also because the simplified sensemaking is based on the ignorance of other potential characteristics of the phenomenon, which can be emphasized by other actors trying to re-define the problem. Likewise, over time other models based on other characteristics may permit different inferences on causal relationships, which may be connected to different overarching narratives. The resulting interpretative ambiguity on how to frame and solve a specific issue presents the classical type of ambiguity conceptualized by the MSF, and intensifies alongside normative and distributive conflict lines, the more robust and reliable empirical data becomes.

3 | Implications of Different Forms of Ambiguity for the Multiple Streams Framework

As the last sections have shown, distinguishing different contexts of ambiguity can help us to draw a more refined picture of the policy process. Such a perspective takes into account that situations of ambiguity can be created in different ways—by information overload (interpretative ambiguity) as well as a lack of empirical data (epistemic ambiguity). As the MSF has been mainly built on the assumption of interpretative ambiguity (i.e., information overload), this section discusses how the lack of information may change the dynamics laid out in the MSF standard model. We do so by focusing on the main components of the framework, namely the three streams and the coupling.

3.1 | Problem Stream

The MSF assumes that the policy relevance of conditions is shaped by problem brokers who frame indicators, focusing events, or feedback as political problems (Herweg et al. 2023). Drawing on scientific, bureaucratic, or local knowledge, problem brokers construct narratives that integrate empirical evidence with normative and emotional appeals, mobilizing political resources to define issues and catalyze policy action (Knaggård 2015). Thus, under conditions of epistemic ambiguity when only very little empirical data is available to define a problem, problem definition is most likely confined to epistemic communities. Consequently, unless the issue gets highly salient (due to problem brokering or a focusing event), it will not gain enough political traction for making the problem stream ready for coupling.

In contrast, if a focusing event draws public attention to a certain issue, the definition of which is unclear due to a lack of empirical data, problem brokers are likely to emerge from the epistemic communities and engage in framing (Boin et al. 2008; Boin 2005; Birkland 1997), even when the empirical foundation remains thin. This is not least due to the fact that policymakers feel under pressure due to the increased public attention and demand expertise from the policy community given that the phenomenon is not well understood. In fact, one could expect that a focusing event draws attention to the high levels of

TABLE 1 | Levels of uncertainty, their relationship with ambiguity, and implications for the policy process.

Level of uncertainty	Description	Relationship with ambiguity			Implications for the policy process
Low Epistemic uncertainty	Phenomenon sufficiently explored, robust and reliable data exists	Value and distributional conflicts, stronger the more phenomenon becomes embedded in established narratives	↑ Increase	*Interpretative* Ambiguity	Framing contests and contestation between competing problem definitions and solutions (within/between phenomena)
Medium Epistemic uncertainty	Phenomenon can be conceptually isolated. Some information on consequences and solutions available.	Sensemaking based on preliminary data may foster shared consensus if not yet captured by competing frames of interpretation	↓ Decrease	*Epistemic* Ambiguity	Supports policy consensus if shared sensemaking present. Knowledge highly volatile to contradictory findings, fosters different interpretations based on competing interests
High Epistemic uncertainty	Presence of novel phenomenon. Little to no empirical data available.	Question how to approach issue, which data to collect and which indicators to use	↑ Increase		No worked-out solutions, Decision-making marked by heuristics
Ontological uncertainty	Inability to reliably predict states of complex system, modeling entails simplification	↑ Persistent ambiguity Unpredictability of systemic interactions, and individual actors' perceptions and behavior at future points in time. Established knowledge on aggregate mechanisms volatile to influence of previously unexplored characteristics of phenomenon.			Boundary condition, induces bounded rationality, present across levels of epistemic uncertainty

epistemic ambiguity itself, which makes the unforeseen nature of the focusing event—and thus ontological uncertainty—salient. Consequently, the demand for expertise to provide heuristic guidance (Birkland 1997) on whether to ignore or engage (Vis 2024) with the problem increases even more. However, the demand for expertise puts problem brokers in a difficult situation. Since epistemic ambiguity entails the unavailability of information and causal inferences on the scope and consequences of the problem cannot be derived, they need to resort to normative and emotional appeals and judgments, and easily comprehensible frames succeed.

In the absence of a focusing event that increases attention to the issue, problem definition will hinge on the ability of a problem broker to frame unexplainable changes in indicators or feedback in a way that mobilizes attention and generates salience of the uncertainty arising from the issue. This is most likely to succeed if the problem broker is able to frame the phenomenon as a potential threat to established values or evokes emotional responses (Maor 2024). In some areas (e.g., environmental policy of the EU) this may entail the connection of a phenomenon to institutionalized norms of precaution—restrictive regulation until evidence clearly indicates that the phenomenon poses no threat—in other areas framing the ambiguity arising from the phenomenon itself as endangering established values. Goyal et al. (2021), for example, argue that EU agenda-setting for the GDPR was not triggered by the focusing event of the "Snowden-revelations," which nevertheless contributed to public attention and ultimate coupling, but by normative concerns over a lack of harmonization between member states.

While the logic of the MSF assumes problem brokers to clarify and define problems (Knaggård 2015), conditions of epistemic ambiguity may induce the opposite effect, where problem brokers argue that even without robust knowledge, uncertainty is too dangerous to ignore, and waiting is riskier than acting (e.g., GMO regulation). Because no competing factual information to confirm or contradict the evaluations exists, the issue may, in such cases, also become salient and gain political traction if the emotional or normative framing of the problem broker resonates with a large enough share of the public. Thus, we would argue that under conditions of epistemic uncertainty and when the phenomenon poses a potential threat to established norms and values, quite counterintuitively, the heightened demand for expertise and public demand for problem definition makes problem brokers more visible and increases their chances to successfully frame the problem, even though they have *less* empirical content to back up the argument, traditionally viewed as essential to problem framing (Knaggård 2015; Cairney 2016).

Which kind of problem do brokers become relevant when empirical information is lacking? Drawing on Knaggård (2015), we can expect that brokers who are seen as trusted experts, that is, who have a certain institutional or personal reputation and authority (Chaiken and Maheswaran 1994), can compensate for the scarcity of data by lending provisional legitimacy to their interpretations. Framing research has shown that source credibility matters for framing effects (Druckman 2001; Hovland and Weiss 1951) and should be particularly strong when information is scarce. For the two mechanisms described, this means

that, depending on the policy at hand, (a) either a recognized expert in the field provides an interpretation of a focusing event as to whether the phenomenon presents a problem and whether action is required or not, or (b) a respected individual, representative of specific norms or values, increases the salience of uncertainty in the absence of contradictory data (e.g., the pope framing specific developments as endangering Christian values). Either being present, this should have a strong influence on whether a policy window opens in the problem stream or not.

At any rate, once epistemic uncertainty recedes, the available knowledge transforms epistemic ambiguity into interpretative ambiguity. At this stage, the dynamics of problem framing shift and align with those conceptualized in the MSF (Kingdon 2011; Knaggård 2015). The availability of knowledge enables a factual understanding of the phenomenon, and the construction of more robust and stable problem frames, as they now combine factual, emotional, and normative elements (Knaggård 2014; Aarøe 2011; Giorgi 2017; Morris et al. 2019). While this allows the issue to be connected to broader policy debates and narratives which might aid in consensus finding, it opens the door for competing interpretations and normative evaluations (Chong and Druckman 2007), questioning the legitimacy of the original problem frame (e.g., does a specific risk that can now be quantified constitute a problem or not). Further, because the inferences made to construct the problem frame in early stages of data collection involve high degrees of ignorance, it is likely that subsequent research uncovers additional mechanisms, characteristics, or outcomes previously left unexplored. This allows individual aspects of the phenomenon to be attached to different narratives, which intensifies contestation, leads toward their entrenchment (Pierson 2000) among overarching narratives on the distribution of risks and benefits, reinforcing interpretative ambiguity.

3.2 | Policy Stream

The policy stream is conceptualized to be populated by a diverse community of policy experts, for xample, civil servants, academics, consultants, interest groups, who contribute ideas to what Kingdon (2011, 116) famously terms the "primeval soup." Once ideas emerge in the policy community, they undergo a "softening-up" process—informal discussions, modifications, and recombination—that eventually lead to a few viable alternatives. Specifically, policy alternatives are subjected to filtering based on criteria of survival, such as technical feasibility, value acceptability, public acquiescence, and financial viability (Kingdon 2011; Herweg et al. 2023). When at least one viable policy alternative exists that aligns with these criteria, the policy stream is ready for coupling. Key is the "emerging consensus" (Kingdon 2011, 139) among actors and within or between policy communities, leading toward the "softening-up" of viable alternatives.

Conditions of epistemic ambiguity will strongly affect dynamics in the policy stream, as the discussion of viable alternatives among actors is difficult when empirical information about whether a policy fulfills the criteria of survival is scarce. If epistemic communities can barely evaluate whether a policy would be normatively acceptable in the long run, for

instance because a certain technology has just emerged and downstream consequences can hardly be assessed, actors will barely be able to "sell" their ideas to policy-makers as viable alternatives. In other cases, policy communities may not be ready to identify a viable solution because a phenomenon is totally new to them. Which policy to propose as a viable alternative fitting technical and financial feasibility criteria in case of a new virus the mortality of which cannot be defined can be a nightmare (as studies on the very early phase of the COVID-19 pandemic have shown "when experts scrambled to find better ways of enacting the disease" trying to "find ways to use the limited information available about what was happening, 'on the ground' and use it to predict what was to come" [Olofsson 2025, 9]).

Instead, in such cases, the policy stream is rather empty of viable alternatives that emerged from the softening-up process, and policy entrepreneurs will have a hard time finding a *viable* alternative to present to the political decision-makers.

That is not to say that the policy stream is empty of *any* alternatives, as solutions are developed independently of problems. But the lack of empirical evidence on causal mechanisms connecting potential solutions to specific phenomena prevents solutions from emerging from the softening-up process, in order to present a "worked-out" alternative tailored to any such phenomenon. As Kingdon notes (Kingdon 2010, 139), the selection process contains a temporal element, where ideas are formulated and reformulated, and survival depends on the consensus reached within policy communities. But this process presupposes at least some knowledge of the specific issue any policy is aiming to tackle, in order to evaluate its impact on said criteria—for example, how the specific circumstances of a phenomenon may affect the technical feasibility or financial viability of this policy. Take the recent developments surrounding the Russian invasion of Ukraine, as well as the deterioration of US–NATO relations as an example. While without a doubt, different policy proposals existed to strengthen European defense and independence, the policy response rather consists of a patchwork of policies that only become technically feasible or financially viable because of the newly emergent circumstances. And while policy solutions may indeed be developed independent of problems and in anticipation of hypothetical scenarios, ontological uncertainty and applied heuristics limit the range of scenarios that can be logically perceived. Thus, any solution being developed that may present a viable solution to a newly emerged problem is limited to chance, while for most cases, the softening-up of specific solutions to uncertain phenomena will be rather the result of than independent of problem definitions. As a result, under epistemic ambiguity, the type of policy solutions available is limited to more general or "stopgap" measures that may have been found to reduce uncertainty in other fields, but that are more general and far-reaching in nature than policies that underwent a traditional softening-up process and provide specific cause and effect relationships. In addition, as indicated above, the lack of evidence also limits the overall availability of policy solutions because assessing the criteria of survival is difficult under these conditions.

Therefore, we argue that under epistemic ambiguity, the policy stream is likely to operate in a more fluid and experimental mode, in which the generation and softening-up of policy ideas will need to rely heavily on heuristic judgments rather than well-established empirical criteria. Inferences might, for example, be made by drawing on other policy areas or contexts, increasing policy diffusion (Capano et al. 2020) and policy emulation (Shipan and Volden 2008). Building on policies in other contexts can make policy alternatives become available (Meseguer 2005; Marsh and Sharman 2009), and help define criteria for evaluation (Stone 2004). As with problem definition, framing by policy entrepreneurs will occur in the policy stream to advance a certain "solution" as being particularly viable (Kingdon 2011); but, again, under epistemic ambiguity, the relative importance of the criteria of survival should change. Whereas technical feasibility cannot easily be assessed when empirical information is scarce, normative acceptance and anticipated support with the larger public are likely to remain important. The policy debate will subsequently revolve around the overarching question of whether satisficing strategies to manage potential risks associated with the phenomenon should be applied—by isolating the phenomenon applying the precautionary principle (Tosun 2013), or focusing on specific elements of the phenomenon applying the maximin rule (Sunstein 2024) and symbolic policies (Edelman 1985; Boussaguet and Faucher 2020; Rempel and Dobbin 2024)—or whether engaging with the problem should be postponed until more knowledge becomes available (Vis 2024).

Which strategy is applied will likely depend on the policy debate, which under conditions when knowledge to form substantive arguments is not available, will be dominated by "non-knowledge" (Knaggård et al. 2019), for example, emotional appeals, or normative and ideological demands (Hall 1993; Blyth 2003; Cairney 2016). This is not to say that the availability of knowledge would in turn lead to a rational debate. Policy actors might always base their arguments on either type of appeal using evidence selectively (Weiss 1980). But it means that higher degrees of epistemic ambiguity shift the discourse toward arguments based on non-knowledge (Cairney 2016). Thus, the fluid nature of the policy stream under epistemic ambiguity leads to a broader array of innovative or experimental proposals—which is met by policy-makers attention (Eady and Rasmussen 2024), but makes it impossible to definitively assess technical feasibility, resulting in any viable alternative being a satisficing "ad-hoc solution."

As with the problem stream, the situation changes once more knowledge becomes available. Because the accumulation of evidence reinforces the credibility of particular alternatives, institutionalizes criteria for evaluation, consolidates emerging consensus within policy communities, and leads to increased integration of policy communities, the way policy alternatives are communicated and refined results in sets of viable policy solutions becoming entrenched in normative and ideological narratives (Pierson 2000; Henry 2011). As empirical evidence accumulates, the surviving alternatives become institutionalized by increased integration (e.g., research programs, evaluation criteria), previous ideas are no longer feasible, which creates path dependencies and the alignment of specific aspects of the phenomenon with established narratives. This will probably result in policy communities to debate alongside established normative or distributional conflict lines, the emergence of a

resilient "policy image" (Mondou et al. 2014) and the formation of clear advocacy coalitions (Sabatier and Weible 2007). Thus, more robust knowledge and lower degrees of uncertainty induce higher levels of interpretative ambiguity, since competing solutions and narratives will exist, focusing on different aspects of the phenomenon. Unless full consensus on proven solutions exists, more knowledge will lead to higher contestation, leading to more interpretative ambiguity (Boswell 2009; Hoppe 2010). Accordingly, more far-reaching, innovative policies become less viable in the long term, whereas incremental changes, aligned with existing narratives are more likely to survive, as the effect of issue frames in the problem stream decreases with increased information (Gramacho et al. 2025). Comparable to the dynamics in the problem stream, these entrenched policy alternatives are at risk of being exposed by underlying ignorance. The failure of established policy solutions then paves the way for renewed contestation among policy options, or more far-reaching policy solutions.

3.3 | Political Stream

The political stream is characterized by the interplay of the national mood, interest group campaigns, and changes in government or leadership that shape the political environment in which policy change is possible (Kingdon 2011; Herweg et al. 2023). The political stream becomes ready for coupling when conditions align in a way that facilitates the attachment of policy solutions to problems, which may even not be seen as particularly pressing (doctrinal coupling). A classic example is that of government change: With a new executive coming into office, new worked-out policies may move on the governmental agenda for ideological reasons and without a specific focusing event or deteriorating indicators pointing to a specific need for action. At the same time, a policy window in the political stream also opens if the public is generally supportive of a policy change or if influential interest groups campaign in favor of the policy.

How would a situation of high epistemic ambiguity affect the political stream? On the one hand, the scarcity of information may generally hinder the political stream from being ready for coupling, because the heuristic choices available under epistemic uncertainty make issue engagement risky (Tversky and Kahneman 1981; Bromley-Trujillo and Karch 2021). Policymakers are hesitant to invest time and resources in addressing something that is poorly defined or contested and are unwilling to support a cause if there is a high risk of failure or backlash (Linde and Vis 2017; Vis 2011). Hence, even in the case of government change, for instance, it is improbable that a new executive would embark on taking up an issue on the governmental agenda for which empirical information is scarce.[1] Similarly, interest groups should not be particularly likely to embark on campaigning on an issue if they do not have enough visibility about what the issue actually is about.

On the other hand, and under specific conditions, the national mood might foster a "climate of uncertainty" (Kingdon 2011, 148) that pressures policymakers to bring an issue to the agenda, even if empirical information is not available, simply in order to ease public sentiment. This is the case when epistemic ambiguity does not originate from the presence of a focusing event that triggers consequential coupling in the problem stream, but from the presence of a novel phenomenon that (a) collides with ideological beliefs and (b) potentially presents a substantial danger, for example, to human health or the environment. Policymakers may see such circumstances as a possibility to signal their engagement with the epistemically ambiguous situation and propose some policy that signals protection (Albertson and Gadarian 2015). From illustrative evidence, we would expect that such responses often involve a precautionary approach: for instance, numerous cases exist where governments adopted a precautionary approach to novel technologies to respond to public concerns, even if concrete evidence on problems and solutions was unavailable and the salience of the issue in the problem stream was not particularly high. Examples include the EC moratorium on GMO (Lieberman and Gray 2006), or the regulation of nanotechnology (Bowman and Hodge 2007).

Likewise, interest groups might capitalize on uncertainty, utilizing increased access to policymakers in times of crisis (Eady and Rasmussen 2024), to push for policy change in other areas. While this might allow for doctrinal coupling, it is debatable whether such situation would attest to the opening of a policy window in the political stream, or rather amounts to policy bandwagons (Baumgartner and Leech 2001) resulting from the opening of a policy window in the problem stream.

3.4 | Policy Entrepreneurs and Coupling Mechanisms

Policy entrepreneurs play a central role in catalyzing policy change by strategically exploiting open policy windows to couple the otherwise independent streams of problems, policies, and politics (Kingdon 2011). Policy entrepreneurs strategically deploy and frame knowledge about problems and solutions to strengthen selected narratives or undermine competing interpretations (Mintrom and Norman 2009), serving as vendors of information (Anderson et al. 2020). By leveraging political capital, expert knowledge, and symbolic legitimacy, policy entrepreneurs actively reconfigure policy debates by deliberate framing that utilizes the inherent ambiguity of policymaking to favor their preferred initiatives (Kingdon 2011; Zahariadis 2003).

While problem brokers and policy entrepreneurs follow distinctive strategies (Knaggård 2015; Mintrom 2019)—the former framing public problems into accessible frames without advocating specific policy alternatives, and the latter actively coupling the defined problems with preferred solutions—especially the role of policy entrepreneurs is likely to differ from the traditional understanding in the MSF if we consider conditions of high epistemic ambiguity: Since no worked-out policy solutions are available in the policy stream—as discussed above—policy entrepreneurs will have a hard time selling particular policies pointing out their technical feasibility or financial soundness. Thus, their role is therefore mainly to construct narratives that emphasize normative acceptance or point to anticipated support by the public. If the problem stream is not ready for coupling, policy entrepreneurs most likely refrain from coupling initiatives due to the lack of solutions and the lack of salience of the uncertain phenomenon (Green-Pedersen and Mortensen 2015). Even if doctrinal coupling would be possible, for example, if a

window opens due to government change, it is unlikely that heuristics are used to come up with a policy without a problem to which it can be convincingly attached. Overall, under these conditions, strategies such as issue linking, networking, coalition building, and venue shopping (Brouwer and Huitema 2018) are most likely to be chosen to lay the foundation for future entrepreneurial action (e.g., constructing overarching narratives for precautionary regulation in a specific policy field).

When a policy window opens in the problem stream, policy entrepreneurs face a strategic choice. To gain legitimacy for their policy proposals, they will need to attach themselves to established problem brokers who credibly define and frame uncertainty as a policy issue. However, this alignment is an inherently risky endeavor, given that it is dependent on the continued credibility of the problem broker. Conversely, as the pressure to provide a solution is very high, policy entrepreneurs who can provide ad-hoc solutions that may be normatively acceptable, and to which support by the public may be anticipated based on simple heuristic judgment, will have a high chance of successful coupling. Whether policy entrepreneurs become active or downplay uncertainty (Vis 2024) thus most likely depends on their perception of anticipated benefits and whether they are elected officials. Either by seeing the opportunity for anticipatory credit-claiming and the demonstration of leadership in uncertain circumstances (Boin et al. 2009)—or the attempt to shift blame to incumbents, or when the uncertainty is indicative of specific policy goals of the individual actor. The latter may reflect situations where uncertainty arises in policy areas, where individual actors or interest groups have a general interest in precautionary regulation, and try to capitalize on uncertainty to promote more far-reaching policy change. Examples are right-wing demands for stricter anti-immigration laws following terrorist attacks, or environmental groups pushing for precautionary regulation of GMOs.

4 | Synthesis and Extension of the MSF

The previous sections have shown that refining the general treatment of ambiguity within the MSF by distinguishing distinctive types can help us to clarify how policy processes work depending on the respective conditions. While persistent ambiguity forms a boundary condition that is inherent to the policy process, we have primarily argued that differentiating between *epistemic ambiguity* caused by high epistemic uncertainty and *interpretative ambiguity*, which sets in when the availability of evidence leads to information overload—a situation that resembles the interpretation of ambiguity of the textbook MSF. We have further argued that epistemic ambiguity induces heuristic judgments as well as emotional and normative framing for problem definition and formulating policy alternatives. This creates a situation in which viable solutions are often tentative, and policy-makers rely on heuristic mechanisms such as the precautionary principle to bridge the gap between insufficient data if they consider that there is an urgent need for action. Instead, if an issue is neither epistemically ambiguous nor salient, policy stability is the most probable outcome. As epistemic ambiguity is gradually reduced through data collection and improved knowledge, it gives way to interpretative ambiguity. The increased availability of data does not resolve ambiguity; instead,

it intensifies normative and distributive conflicts as actors draw on and organize around competing interpretations and emerging policy frames, or preliminary findings may be called into question.

The availability of knowledge and the type of ambiguity present subsequently have distinctive effects on the policy process. Methodologically, this requires taking the level of uncertainty present into account when conducting empirical case studies and focusing on the distinctive dynamics each form of ambiguity present entails. This could, for example, be measured via proxies such as expert disagreement, lack of scientific data or consensus, the presence of uncertainty references in media discourse, or the newness of a phenomenon.

Building on this argument, we propose amendments (Table 2) to selected existing hypotheses (Herweg et al. 2023) in order to account for situations of epistemic ambiguity. These modifications allow us to also cover situations of epistemic ambiguity and are necessary because several of the original hypotheses—at least implicitly—only relate to situations of interpretative ambiguity and information overload and assume the existence of empirical knowledge within the problem and policy streams.

First, on the problem stream hypothesis, we argue that although the framing of the various problem sources by problem brokers likewise occurs under epistemic ambiguity, it is important to clarify that the absence of clear indicators or empirically measurable feedback necessitates a stronger emphasis on normative and emotional framing of uncertainty itself. This additional mechanism accounts for the fact that emotional and normative appeals can partially compensate for the absence of empirical knowledge, and that under those conditions, a problem broker increasing the salience of uncertainty becomes crucial (Maor 2024).

Second, the selection criteria in the policy stream, which for the formal softening-up process to occur depend strongly on empirical knowledge about proposed solutions and causal mechanisms, change in situations of epistemic ambiguity. Under such circumstances, robust technical feasibility is difficult or impossible to assess—or may only occur once preliminary knowledge can be incorporated in the analysis—restricting the applicability of this hypothesis to this context. Hence, we amend the policy hypothesis by acknowledging that under epistemic ambiguity, policy proposals may still gain agenda status if they provide ad-hoc solutions aimed at reducing uncertainty, even if they did not emerge from a formal softening-up process, or did emerge from a softening-up process but are applied as a form of policy diffusion or emulation.

Third, since engaging in agenda setting under epistemic ambiguity is risky, actors will only do so if signaling precaution is perceived as a lower risk than ignoring an issue, and if proposals are perceived to mitigate a climate of uncertainty. As described above, we propose two distinctive mechanisms by which the problem stream may be ready for coupling under those circumstances: (1) a problem broker is not able to mitigate concerns arising from a focusing event and recommends precautionary action,[2] or (2) a problem broker is able to normatively or emotionally frame any uncertain phenomenon as

TABLE 2 | Proposed amendments to MSF Hypotheses (Herweg et al. 2023) to account for agenda change under epistemic ambiguity. Changes highlighted.

Element of the multiple streams framework	Revised hypotheses
Problem stream	A problem broker is likely to be more successful framing a condition as a problem the more an indicator changes to the negative, the more harmful a focusing event is, the more definitely a government program does not work as expected, *or the more a credible broker succeeds in normative and emotional framing of uncertainty as an issue.*
Policy stream	If a policy proposal does not fulfill the selection criteria, the likelihood of gaining agenda status, and thus being coupled, decreases significantly, *unless the proposal provides an ad-hoc solution under epistemic ambiguity.* As the integration of policy communities decreases, it becomes more likely that entirely new ideas can become viable policy alternatives.
Policy window	The policy window opens in the problem stream as a result of at least one of the following changes: change of indicators, focusing events, feedback, *or heightened salience of uncertainty.*

demanding policy action, making uncertainty itself a salient issue. While the first mechanism described is in line with the current hypothesis, we complement the policy window hypothesis accordingly for situations where coupling may occur due to the increased salience of uncertainty itself—as a bottom-up increase in salience.

5 | Conclusion

Despite numerous theoretical advancements over the past decades, some key assumptions of the Multiple Streams Framework still lack critical scrutiny and clarification. In this paper, we argued for the analytical value gained by differentiating more clearly between epistemic and interpretative ambiguity, serving as distinctive conditions under which policy making occurs. While interpretative ambiguity arises from an overload of competing information, policies, and narratives, epistemic ambiguity emerges when scarce empirical evidence leaves policy actors without worked-out solutions in the policy stream, and problem definition hinges on heuristic interpretation. In its current reading, the MSF does not explicitly model such situations, which leaves researchers with an underspecified model and hypotheses that do not really fit the context at hand. Building on the literature on uncertainty and types of ambiguity, we complement existing MSF hypotheses in order to take situations of epistemic ambiguity into account—situations when agenda change may occur despite the policy stream not being ready for coupling. More specifically, we argue that policy change occurs under these circumstances if political actors perceive high salience of an epistemically uncertain issue and resort to trustworthy policy entrepreneurs, who come up with what we term "ad-hoc solutions." These policies are born out of epistemic ambiguity, as they are temporary, heuristic-based proposals that arise specifically to provide a response under conditions of epistemic uncertainty. Moreover, we argue that policy entrepreneurs and problem brokers leverage emotional and normative appeals to push uncertainty itself onto the policy agenda, challenging the traditional expectation that problem framing necessarily entails problem specification and isolation.

Our modifications to the MSF hypotheses emphasize that under epistemic ambiguity, the policy stream may be void of policy alternatives that emerged through a softening up process, yet political action still succeeds. This raises not only a new conceptual understanding of "ad-hoc solutions," the types of which demand further theoretical and empirical investigation, but also suggests that some degree of interplay and substitution is likely to exist between empirical knowledge, emotions, and normative considerations. The empirical examples referenced in this contribution clearly indicate that policies following the precautionary principle seem to be a particularly probable outcome in such contexts, as they provide protection from an uncertain threat, can be linked to emotions and normative considerations, and are an "ad-hoc solution" that can be emulated from the past.

While we argue that our arguments help clarify the concept of ambiguity inherent in policymaking, several limitations remain. First, the proposed mechanisms and revised hypotheses, although drawing on selective evidence, ultimately remain primarily argumentative in nature and require empirical testing. Hence, reviewing existing case studies using the MSF clarifying the type of ambiguity or conducting additional studies on situations where epistemic ambiguity can be found would help us see the empirical relevance of our hypotheses more clearly. Second, future research should explore the conditions under which epistemic ambiguity transitions into interpretative ambiguity, which might aid in the further refinement of the working mechanisms in each form of ambiguity. It is in these cases where we should see the shift in the dynamics both in the problem stream and the policy stream most starkly. Third, it would be useful to expand the conceptual differentiation that we propose here to the analysis of implementation, evaluation, and termination of policies. While Fowler (2021) has already provided first insights about how actors cope with uncertainty and ambiguity in policy implementation, future analyzes could explicitly model how situations of interpretative and epistemic ambiguity differ, drawing on our proposal. Fourth, more research is needed on the role of different actors, as well as the specific political environment, and how this may further influence the mechanisms described. This could, for example, relate to the question of which actors utilize which

strategy under epistemic ambiguity, but also the role of party politics, given that the party structure most likely has a strong influence on contestation between different policy frames. Finally, considering the importance of emotional and normative appeals under conditions of epistemic ambiguity, the MSF would further benefit from increased attention on the interplay between knowledge, emotions, and normative appeals, and to what extent they may substitute for one another under interpretative ambiguity. This may help answer questions such as whether interpretative ambiguity is primarily driven by different factual interpretations, by the collision of factual and normative or emotional frames, or by conflicts between entrenched narratives and lingering ignorance. The complemented hypotheses developed above are therefore an important but only preliminary step toward a more profound understanding of how different types of ambiguity may change the dynamics proposed in the MSF.

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Conflicts of Interest

The authors declare no conflicts of interest.

Endnotes

[1] This is may be particularly the case if a government faces pressure from interest groups, and if influential stakeholders signal their doubts on the necessity of policy change or warn about unintended consequences of policy action.

[2] The problem broker thus mediates the effect of a focusing event. Whether a focusing event opens a policy window in the problem stream under epistemic ambiguity depends on whether a problem broker is able to mitigate concerns arising from the uncertainty associated with said event, or on the contrary supports the call for precautionary action.

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