

# Focusing Events, Ambiguity, and Time<sup>1</sup>

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## Abstract

Birkland's studies of focusing events have greatly narrowed Kingdon's definition of focusing events to encompass those events that happen in a particular *place* at a particular *time*. This depiction of focusing events suggests that the mere fact that an event happened in a place and a time reduces, to some extent, the ambiguity that surrounds the putative causes of the problems "triggered" by the event and reduces the range of potential solutions to these problems. In this paper, I challenge this notion that a focusing event that is time- and place-bound is any less ambiguous than the rapid uptake of symbols. Indeed, I argue that large events transition from the realm of "event," with a clear place in space in time, to the realm of symbol. The transition to symbol means that participants in policy debates can imbue the event with the sorts of meanings that work best for actors' and groups' policy goals.

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In the thirty-four years since the publication of *Agendas, Alternatives, and Public Policy*, John Kingdon's effort to explain policy-making processes in the United States Congress has evolved into one of the most-followed approaches to the study of the policy process, as evidenced by its routine inclusion in textbooks (e.g. Herweg, Zahariadis, and Zohlnhofer 2017), scholarly compendia (Rüb and Zohlnhöfer 2016) and the special journal issues or sections devoted to it (see for example, the issue that contains Weible and Schlager 2016; and Jones et al. 2016; as well as Béland and Howlett 2016 and the following articles in this issue). It has spawned a community of researchers that spans the globe, and its researchers have made significant contributions to our understanding of the ways in which participants in the policy process couple problems with potential solutions and harness the inherent ambiguity of politics to advance arguments in favor of or in opposition to policy changes.

One of the terms that caught on in Kingdon's original explanation of the policy process is the idea of "focusing events." Kingdon (2011, 94 ff) used this term to describe the sudden uptake of issues on the agenda. The idea of a focusing event might suggest that what was once blurry comes into focus: that the ambiguity around public issues is reduced by these events, as

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the event provides advocates for particular sorts of policy change with the rhetorical devices they need to make arguments that are more effective.

This idea that events might reduce ambiguity and therefore hasten the adoption of policies that address the “real” problems raised by focusing events is appealing but deserves careful consideration. In this paper

1. I argue that Kingdon’s original depiction of a focusing event was too broad, and that policy literature has only partially adopted Kingdon’s definition of a focusing event—the definition that suggests a sudden event that is unpredictable and that “bowls over everything on the agenda.”
2. I argue that this narrower definition of focusing events bring MSA notions of events into line with other theories’ conception of such events, which is beneficial to the development of all policy theories.
3. I argue that my original, rather mechanistic theory of the working of focusing events, which implicitly (Birkland 1997) or explicitly (Birkland 2006) suggests that focusing events trigger greater learning about the “real” problems highlighted by events, is at best incomplete, and that the effects of focusing events are much more contingent than I have explicitly outlined.
4. Time is an important consideration in understanding focusing event politics, because
  - a. An event can move issues from the parallel-processing world of the policy subsystem to the serial-processing world of the macropolitical system.
  - b. There is no guarantee that the event will yield any policy change, nor is there any guarantee that the event will yield any change at all.
  - c. Focusing events can, among other things, create the conditions under which deadlocks are broken, or existing trends accelerated. But they do not by themselves create new politics and policies. As Kingdon said, they need an accompaniment.

## Kingdon’s original conception of focusing events

In writing *Agendas, Alternatives, and Public Policies*, Kingdon (2011) sought to understand and explain how certain issues gain prominence and advance on the agenda, while others fail to advance to active consideration and deliberation over potential policy changes. In broad terms, Kingdon, borrowing from Cohen, March, and Olsen’s “garbage can model” decision making in “organized anarchies”(Cohen, March, and Olsen 1972), argues that the policy making process can be described in three streams: the problem, policy, and politics streams. Policy making is characterized by “fluid participation” in the process by actors that are reasonably free to enter and exit the process, and by unclear technologies, which means that all participants’ understanding of the effects of policy are, at best, characterized by bounded rationality. The development of policy ideas (Beland and Cox 2010)—that is, about what government should do about a claimed public problem—is advanced by policy entrepreneurs who seek to create or exploit the conditions under which the streams can be joined in a window of opportunity. The window of opportunity represents the increase in attention to an issue by a formal political

institution and, as such, is an opportunity for policy change, because greater attention to a policy issue is often characterized by greater negative attention, which breaks down the policy monopoly that long dominated policy making, usually in favor of maintaining the status quo (Baumgartner and Jones 2009). The window of opportunity opens when it is possible to join a problem with an available policy solution during a period in which the political environment—the political stream—is favorably inclined toward the consideration of particular policy ideas.

Kingdon argues that issues can be elevated on the agenda—that is, windows can open—in two broad ways. First, changes in the level of indicators of public problem, such as the unemployment rate, crime rates, changes in critical health statistics, and the like, can lead to claims that a problem exists for which some solution should be adopted. Second, these windows can be opened by a sudden, unexpected “focusing event” that focuses attention to issues and potential problems.

Like much of the MSA, Kingdon’s defines “focusing event” inductively, rather than with an eye to deductive hypothesis testing. Kingdon, we might recall, developed his theory of agenda setting and alternative selection from interviewing a range of policy actors in the health care and transportation domains. He begins his discussion of focusing events by noting that

problems are often not self-evident by the indicators. They need a little push to get the attention of people in and around government. That push is sometimes provided by a focusing event like a crisis or disaster that comes along to call attention to the problem, a powerful symbol that catches on, or the personal experiences of a policy maker. (Kingdon 2011, 94-95)

Here, we see that, to Kingdon, a focusing event can be thought of in three different ways: a crisis or a disaster of the sort that, as Kingdon puts it, “bowl things over” on the agenda, the sudden uptake of a symbol, or the personal experiences of policy makers.

Of these three definitions, only one of these—the thing that bowl things over—can be considered an *event* in the sense that such an event happens *in a time and place*. A place might refer to a geographic location, or it could refer to an organization, or a country or a subnational unit. The “place” may depend on whether we are dealing with a disaster, which is often an externally generated event, or a crisis, which is often created in an organization.

An event will gain attention if a *prima facie* case can be made by important participants in the policy process that the event reveals something bad. In most cases, this is not difficult to do; a natural disaster, a massive shooting, an industrial accident, and events like these have obvious bad effects, and if they are particularly dramatic, with vivid imagery and highly tangible and sympathetic victims, the news media can be counted on to prominently present such events, because they fulfill journalistic norms around newsworthiness. And, as noted earlier, Baumgartner and Jones note that increased attention to any public problem is increased negative attention, which is usually associated with a change in the issue’s position on the agenda. This negative attention can beget negative attention in a form of feedback into the policy process.

Aside from the most obvious manifestation of the effects of an event, some policy actors are likely to frame the event as evidence of policy failure, and to couple that particular “failure frame” with a policy solution that would remedy the policy failure. Indeed, the argument will often be made that, for want of the policy solution being suggested, the event itself would either not have happened or not have been as harmful.

Many students of the politics of natural disasters, crises, or accidents have adopted the focusing event concept, often uncritically. Much of this literature cites either Kingdon, Birkland, or a combination of the two. Birkland, and most of the literature, have adopted the “bowling over” definition of focusing event as the key example of such events.

With this in mind and keeping in mind that the MSA has moved well beyond its original source—that is, Kingdon’s book—I propose that we abandon this three-part definition of focusing events. The sudden uptake of symbols and the personal experience of policy makers are different phenomena: they do not occur in an easily definable time and place. Furthermore, the development and propagation of symbols—or, more precisely, the development of narratives that rely on the adoption of symbols—is a constant activity undertaken by participants in policymaking. And the personal experience of policymakers is well known as motivation for policy entrepreneurial activity on the part of decisionmakers or is a feature of a decision maker that can be exploited by other savvy policy entrepreneurs.

Often, Kingdon says, symbol can suddenly gain attention. It does so, he argues because the issue is *already* in people’s minds. In the example that Kingdon provides in his book, the advent of the CAT scanner became a symbol of cost inflation in medicine because of the adoption of high-tech medical devices. Kingdon goes on to say that these kinds of symbols act “as reinforcement for something already taking place and is something that rather powerfully focuses attention, rather than as a prime mover in agenda setting. Symbols catch on and have important agenda-setting effects because they captured a nutshell some sort of reality the people already sense in a vaguer, more diffuse way.” (Kingdon 1995, 98).

This is a rather different process than the processes involved with an event, that takes place in a particular space and time, which muscles its way onto the agenda, often to the dismay of those who would prefer to contain the scope of conflict (Schattschneider 1975), and who would therefore rather not see an event elevate the issue to broader prominence.

Furthermore, the policy literature in general focuses primarily on the notion of a focusing event as being an event that occurs in a time and place. To the extent that Baumgartner and Jones discuss focusing events in their book, these are events, not personal experiences or the uptake of symbols. And the literature on agenda setting speaks of focusing events, or other things, like “circumstantial reactors” (Cobb and Elder 1983) which they see as an anticipated event that drives the public to at least seem to demand action; Johnson-Cartee argues that the Columbine High School “massacre” was such an event that “sparked another national debate about gun control” (Johnson-Cartee 2005, 58).

Furthermore, to the extent that the term “focusing event” is used in the policy literature, its primary meaning is to describe an unexpected event outside the control of the major actors

in the policy domain in the sense that the major actors cannot gain a strategic advantage by pre-planning an event, such as a protest rally, in advance. As Heikkila and Cairney note,

Events can be routine and anticipated, such as elections that produce limited change or introduce new actors with different ideas. Or they can be unanticipated incidents, including social or natural crises or major scientific breakthroughs and technological changes.... Their unpredictability makes them difficult to theorize, and they can often be treated as “errors” or external factors providing an additional source of explanation. Or they can be incorporated within theories that focus on how actors interpret and respond to events (Heikkila and Cairney 2017, 304).

Much like Kingdon, Heikkila and Cairney lump together several different ideas into their definition of events, including routine and scheduled events, social and technological changes that may seem sharp and sudden, but which tend to build over time, and “social and natural crises.” The latter type of events is best conceived as focusing events because they are least predictable, and theories of focusing events do indeed “focus on how actors interpret and respond to events.” What makes focusing events particularly interesting is their very unpredictability, which therefore can lead to policy actors casting about to search for ways to frame or even make sense of the most recent event in order to make arguments for change.

This is not to say that focusing events don’t have an important role in symbol propagation. Warnement (2018) has documented how Hurricane Katrina became a condensation symbol. And focusing events often generate their own symbology, such as imagery of an elderly woman using an American flag as a blanket, or images of people being rescued from flooded buildings. Birkland and Lawrence (2001) have argued that the *Exxon Valdez* oil spill gained its attention in large part because the propagation of symbols around the spill, such as oiled wildlife and the Alaskan wilderness in which it was set made the event particularly troubling to many people. This propagation of symbols is important, but the event is what triggers the creation and propagation of these symbols.

Focusing on the “bowling over” effect of natural disasters allows us to develop hypotheses about their focal influence. For example I defined a *potential* focusing event as one that is rare, harmful, affects a specific community (geographical or a community of interest), and is known to elites and to mass publics simultaneously (Birkland 1997). I call such events potential events because, like Kingdon’s theory, my theory of the ways in which focusing events influence the agenda and policy discourse is entirely retrodictive—we cannot know “how focal” an event was until we observe its effects over time. In my work, I have argued that we can see the effects of an event in the two years after the event. Clearly, though, for some events, the agenda-setting effects may come very quickly, and then fade just as quickly, while for other events, the effects may play out over a much longer time.

However, I did not pay much attention to the content of the discussion around the event in the empirical models I outlined in that book. Rather, I was simply measuring change in the size of the agenda around the events themselves. The question I asked was simple: what features of events cause people to pay more attention to those events? I gathered data about the “size” of

the event, such as the number of people killed or the value of property damage, as well as data about the scope of the event—that is, how many people might reasonably be affected. But the content of the narratives around the events themselves was not studied. Megan Warnement’s recent dissertation research may provide a foundation for this sort of study.

## The Role of Time in Focusing Events and Agenda Setting

Relatively few treatments of the MSA consider time a part of its depiction. For example, Jones et al. (2016) provide a Diagram of the Multiple Streams Approach that shows how the streams interact with the policy window, and how that entrepreneur relates to the window. Time ordering is assumed because the arrows in this diagram are single-headed, but the depiction is more a diagram of the interaction of these elements than it is a full appreciation of the idea of time. To take the stream seriously, we need to consider that time moves forward, and that time can be associated with dynamism in the process, as “new” issues and “new” ideas are triggered by new events.

But, in considering the streams metaphor, we cannot assume that everything within a stream is carried along at the same pace. To continue the streams metaphor, consider how a stream, in nature, can often have snags, eddies, and other features in which the things that are carried by the stream are delayed from flowing through the streams. Some things in those streams may never get into the stream at all or may never see the “end” of the stream, having been permanently hung up or even cast out of the stream. And, as Jones (2016, 15) argues: “As Kingdon describes, “each of these streams has a life of its own, and runs along without a lot of regard to happenings in the other streams.””

Rüb argues that the MSF “puts time at the centre of the analysis of policy decisions and has moved away from traditional rationality conceptions of problem-solving” (2016, 51). Rüb argues that we should consider time in at least two ways. First, he argues that we should consider “in which historical time agenda-setting a policy-making takes place” (ibid.). By asking “where on the historical time axis are we situated today?” Rüb considers the historical context in a manner similar to the political stream in the MSF, although along a much longer continuum. Perhaps more important to the understanding of focusing events, Rüb notes that “agenda-setting and policy-making are fundamentally shaped by the temporal rhythms of politics.” He goes on to say that “policy-making requires time and this political time may not be in harmony with the speed of economic and social changes” (Rüb 2016, 52). It is this disharmony between what is revealed by an event and the usual speed of policymaking, which is slow and deliberate, often by design, which makes the time after focusing events so contentious and so prone to turmoil.

Of particular note in current day policymaking is the acceleration of time and the contraction of space created by modern technology and the modern imperatives of globalization. Rüb argues that “one possible way of viewing globalization, however, is as the compression of space and time “ (Rüb 2016, 57). In such a world in which both time and space are compressed, an event that happens anywhere in the world can have repercussions anywhere else in the world. For example, one of the reasons I argued that the *Exxon Valdez* oil spill had such a significant influence on US domestic environmental politics is because of advancements in telecommunication technology, which allowed news broadcasters to

broadcast imagery from area of the oil spill in real time to the rest of the nation. These images, as noted before, were laden with discordant images of a pristine wilderness covered in oil. As this event happened 20 years earlier, one wonders whether it would have had the same influence on the agenda, given that the symbols of the event would've been more difficult to propagate. A more recent example of the effect of globalization on the propagation of event-driven policy debate is the 2011 Fukushima tsunami and nuclear accident in Japan, which not only drove concern about nuclear power in Japan, but also rekindled debates about nuclear power in the United States and Europe, albeit with different conclusions being reached about the event in different countries (Hoffman and Durlak 2018, Wittneben 2012)

In my more restricted definition of a focusing event, nearly everyone in the policy communities affected by that event should be able to locate the event at a time (2005, the second term of the Bush Administration) and a place (New Orleans, the Gulf Coast, within the United States). The time dimension is important because the suddenness of the event is related to the sudden realization of problems. This is consistent with Downs's issue attention cycle (Downs 1972). Downs argues that many public problems become known very quickly, in a period of "alarmed discovery." The sudden appearance of an issue on the agenda through a focusing event serves as a trigger of "alarmed discovery," and thereby opens a window in the problem stream into which policy entrepreneurs can add potential solutions to the problems putatively revealed by the event. The location of an event as having happened in a *place* is important for understanding the near-term political and social dynamics that will shape post-event discussion. The place in which an event occurs is important, for example, in the Narrative Policy Framework's understanding of the "setting" of policy making (Shanahan et al. 2017). The setting matters for any number of reasons. The setting of the Exxon Valdez oil spill in *Alaska*—a place redolent with symbolism and meaning (Birkland and Lawrence 2001)—made it much more urgent and shocking to many observers than it might have been had the spill occurred, say, in an already highly industrialized area in which an oil spill would be simply just another of a long series of insults on the environment, instead of a uniquely damaging and shocking event.

Policy entrepreneurs know that policy windows are open for only a very short time. Thus, policymakers experience post-event time pressures because some policy entrepreneurs are making the *prima facie* case that the instant event is evidence of policy failure. Time management, then, for the contestants in post-event politics is a function of either (a) exploiting the opportunity opened up by the focusing event to link a heretofore unadopted policy idea to a problem or (b) slowing of the post-event processes so as to move the debate out of the realm of alarmed discovery and into the realm of the realization of the actual costs that might be involved in addressing the instant problem.

This conceptualization adds a new way of understanding efforts to expand or contain the scope of conflict. Schattschneider's ideas about issue expansion and containment imply temporality and ordering in the sense that groups act and react to each other over the course of a policy debate. Focusing event politics may add time pressure to decision-making, making group efforts more intensive and more urgent, as pro change groups realize that the window of opportunity opened by the focusing event is short. And as anti-change groups realize that the focusing event may create time pressures to do something that will require extraordinary efforts to fend off.

## Focusing events and accompaniments

Kingdon says that focusing events need accompaniments. What he means by this is that focusing events draw upon ideas that already exist in the policy and problem streams. He also argues the disasters or crises can serve as a warning of potentially greater future crises; I capture this in my definition of a potential focusing event, which I described as an event that is harmful or suggests potential harms. Kingdon argues that “these focusing events can affect problem definition in combination with other similar events” (Kingdon 1995, 98). He also argues that the aggregated effect of disasters can make them more prominent.

This form of aggregation works in two ways. In the first way, the event itself aggregates a great deal of harms in one place. In his well-known example, an airplane crash kills more people at one time than do several, diffuse in time and space accidents involving automobiles. This is why the aviation domain is more prone to focusing events the automobile domain, because, even though aviation is safer statistically than highway travel, the aggregation of damage in one place and one time is much more dramatic. Second, Kingdon suggested events that come close together in time also aggregate upon each other. He noted that in his interviews of transportation experts, all of the mentions of aviation accidents came in 1979, the result of a dramatic crash of the DC-10 airplane in Chicago in 1979, in a midair collision between a 727 and the general aviation aircraft in San Diego in late 1978.

## Ambiguity

My operationalization of the focusing event idea relies on this logic: an event occurs, and bad things happen. Political actors are compelled to address the bad things. The potential causes and consequences of the event are brought into focus, as policy actors are compelled to examine the event, learn from it, and take steps to prevent it from happening again. In so doing, policy actors learned that in some way policies failed, and we should learn from that failure to improve policy (Birkland 2006). The focusing event, therefore, brings causes and consequences into focus when before the event these were less clear, and subject to considerable debate and interpretation.

My original conception of focusing suggested that the event brings more information into the policy domain about causes and consequences, and therefore reduces ambiguity. I implied that what comes into focus are aspects of the policies in question, thereby narrowing the range of debate to relatively few alternative causal stories (Stone 1989, 2012) and making alternative selection more straightforward.

This mechanistic depiction of the focusing event process has several shortcomings. Perhaps the most important shortcoming is its conflation of greater attention and information seeking with a reduction in ambiguity. But it is well-known that more information does not necessarily reduce ambiguity (Herweg, Zahariadis, and Zohlnhofer 2017). Nor is it clear that a focusing event even adds more information to a policy domain. Such an event would add information to a policy debate only if it were *new* information about causes, or about potential policy interventions that could have limited the effects of the recent event. An event that occurs in

what I have called “domains prone to events” is likely not to add more *information* to the debate, except at the margin: some particular aspect of an event might be novel, but not so much so that the existing policy community cannot process the information. And, indeed, if a focusing event really did decrease ambiguity, it might have the effect of making policy change *more* difficult, for a degree of ambiguity is needed to create the space for compromise, and what may result from reduced ambiguity is pro-status quo interests digging in even harder to resist any sort of change. The spate of school shootings and other mass shootings in the United States may be examples of this phenomenon.

## Case Studies

To illustrate some of these ideas, I will draw on three cases from my prior research. Interestingly these examples speak directly to Jones’ argument that “Focusing events become attached to particular problems, providing powerful impetus for action or change. A few notable focusing events that increased attention and recognizably preceded policy change include the 9/11 terrorist attacks, the Three-Mile Island nuclear accident, and the Columbine shootings” (Jones et al. 2016, 15).

### The September 11 attacks and the “real cause” of the terrorist attacks

The September 11 terrorist attacks on the United States were immediately recognized as a turning point in United States and world history. The specter of international terrorism seemed much more palpable to most Americans after September 11 than it did before, because these attacks happened in the “homeland,” and struck at the heart of symbols of commercial and military power. Of course, the United States has experienced terrorist attacks, both against its interests and people overseas and on its own soil, but a September 11 attack was so large, and the means by which it was accomplished was so unorthodox, that it couldn’t help but get attention.

But what did the September 11 attack focus on? Did this attack make terrorism a more ambiguous problem? Or an unambiguous problem? In other words, did the event yield a *focus* on a small, well-defined set of issues? It did not, for at least two reasons. First, within weeks of the September 11 attack, a seemingly unrelated anthrax outbreak occurred in the United States. It was clear that this transmission of anthrax was intentional, but it was not at all clear that it was related other than temporally to the September 11 attacks. Most importantly, the two events occurring so close together in time made these attacks particularly unsettling. This illustrates Kingdon’s argument that, while one event might seem like a fluke, two events that occur close in time may signal a particularly worrisome trend to which serious attention must be paid.

Even as shocking as these attacks were, the September 11 attacks were not *sui generis*. The attacks themselves, and the response to those attacks, reflected ideas that had existed well before the event. For the moment, then, let’s stipulate that, at its heart, the September 11 attacks were, in the main, an attack on civil aviation and therefore revealed problems with civil

aviation. The aviation industry had long understood that it was a target for criminals or terrorists. The 1989 Lockerbie bombing was still fresh in the minds of most American security experts, and memories of that event were reinforced by the crash of TWA flight 800 in 1996, which looked like the Pan Am bombing, even though it was laid to a much more mundane cause: a fuel vapor explosion in a near-empty central fuel tank. Interestingly, this failure mode was not at all unknown to aviation, and the early designs of the 747 aircraft included some consideration of a gas inerting system to reduce the likelihood of these kinds of explosions.

As I have argued in other contexts, focusing events trigger an attempt to learn the causes of bad things so as to prevent them in the future (Birkland 2004, 2006). But, in the macro sense, there was not much effort in the near term to learn from these terrorist attacks. We can consider this along two different dimensions. First, we can look at the media policy reaction in the United States after the September 11 attacks. The most immediate result from policymaking perspective was not the formation of an investigating committee or similar panel, but instead was the drafting and enactment of the USA Patriot Act. The Patriot Act was a bundle of criminal justice reforms that made it easier to prosecute crimes related to terrorism, and, in this way, was a paradigmatic example of entrepreneurial policymaking: many, if not most, of its provisions were already on the wish list of the political right, members of which had been seeking to create more stringent criminal law and improved methods of intelligence gathering in the United States for years.

What efforts were made to learn of the causes of the September 11 attacks? The events, right from the outset, were framed as terrorist attacks that sought to attack the heart of America, in the spatial sense (its largest city, its capital city) and in the metaphoric sense, as an attack on American values. They were not, by and large, framed in the popular media, and by most of the highest-level political leadership in the United States, primarily framed as failures of the aviation security system. If these attacks were evidence of the “terrorism problem,” what efforts were undertaken to learn about terrorism? The “National Commission on Terrorist Attacks Upon the United States,” hereinafter the 9/11 commission, was set up over a year after the 9/11 attacks. It made little headway until 2003 and issued its final report in May 2004. Its report came well *after* the policy response to the September 11 attacks, such as the enactment of the USA Patriot Act, or the establishment of the Department of Homeland Security, which was officially established in late 2002 and opened for business in 2003. The final 9/11 commission report reserved most of its criticism for the FBI and the CIA. It devoted relatively less attention to the remarkably lax system of domestic aviation security that prevailed in the United States. Indeed, it was well known to most observers that the lax aviation security was a considerable contributor to the success of the plot, and that this problem was known to most aviation interests well before 9/11.

But while national attention did not necessarily settle on the ways in which lax aviation security measures could have made the September 11 attacks possible, the attacks did unsurprisingly generate considerable debate and discussion among the expert members of the policy community concerned with aviation safety and security. If, indeed, the most basic reason for the success of these hijackings was the hijackers’ ability to bring weapons aboard the aircraft without detection, and to breach the cockpit door, one might expect that the policy response to this event would focus primarily on screening and cockpit security. One might expect that if the

September 11 attacks reduced ambiguity around current threats to some extent, that these would be the foci of subsequent policymaking.

In an article I wrote in 2004, I showed how different ideas about aviation safety and security tracked with different aviation security and safety events (Table 1). **The September 11 attacks did not generally yield novel ideas about the broad area of aviation safety.** Nor were the ideas limited to cockpit security or more stringent passenger screening. Instead, a remarkably wide range of issues relating to aviation security were activated by the September 11 attack. Most of these measures had already existed as important issues in the aviation policy domain. Indeed, even the mode of attack — rushing the cockpit and attacking the flight crew — was not considered novel by people in the aviation security or counterterrorism domains. What the September 11 attacks did was provide an opportunity to gather up all the ideas that come before and package them into a more unified discussion of all the modes in which aviation safety and security were lacking and could be improved.

One might find this curious, given that the way in which the airplanes were hijacked was relatively simple. First, the attackers were able to bring weapons, like sprays and box cutters, on board an airplane without being challenged at the security checkpoints at airports where they boarded. Second, they were able to breach the cockpit because cockpit doors at that time did not lock and were easily accessible to a determined attacker. One might argue that the issues that were most important after 9/11 were airport screening and cockpit security. Indeed, both issues were addressed in subsequent legislation. But the September 11 attacks also provide an opportunity for other policy entrepreneurs to couple this event with other perceived needs in this domain, ranging from the use of better bomb detection devices to better security controls for employees working in and around airplanes.

In this sense, the September 11 attacks did not “focus” attention on one set of issues but opened the debate to a much wider range of issues. If ambiguity means that a policymaker can plausibly interpret an event, discern some sort of meaning from the event, and formulate policies to address the putative causes of the problems revealed by the event, then the September 11 attacks were ambiguous, not only for aviation security, but also for national security and counterterrorism issues more broadly. This is not to say that ambiguity impeded policymaking, nor is it to say that subsequent policymaking was ineffective. After all, a wide range of policies were changed and presumably improved after September 11. But did the September 11 attacks focus discussions on the things that mattered most? This is debatable.

Table 1: Key Issues Addressed in Aviation Security Legislation

<i>Topic</i>	<i>Aviation Security Improvement Act of 1990</i>	<i>Federal Aviation Authorization Act of 1996</i>	<i>Federal Aviation Administration Authorization Bill</i>	<i>Airport Security Improvement Act of 2000</i>	<i>Aviation and Transportation Security Act</i>	<i>Homeland Security Act of 2002</i>
Airport access control	•				•	
Baggage matching	•	•			•	
Background checks of employees	•	•		•	•	
Cargo and mail security	•	•			•	
Cockpit security					•	
Employee ID systems					•	
Explosives and explosives detection	•	•	•		•	•
Create or restore air marshals					•	
Modify existing organizations	•					•
Create new organizations						•
Passenger profiling		•			•	
Allow pilots to carry fatal weapons					•	•
Allow pilots to carry nonfatal weapons					•	
Certification of screening companies		•				
Require screening personnel be U.S. citizens						•
Require all airport personnel be screened (including flight crews)					•	
Screeners—general issues	•				•	
Make screeners federal employees		•			•	
Provide security training to the aircrew					•	
Provide security training to pilots					•	
<b>Total</b>	<b>7</b>	<b>8</b>	<b>1</b>	<b>1</b>	<b>17</b>	<b>5</b>

## School shootings, Columbine, and “real causes”

A second class of focusing events is the number of school shootings and other acts of violence that have taken place in United States schools and colleges since about the mid-1990s. Several events exemplify this issue, including the 1999 Columbine high school shooting, the 2007 Virginia Tech shootings, the Sandy Hook elementary school shootings in 2012 in Connecticut, and the 2018 shootings at the Marjory Stoneman Douglas high school in Parkland, Florida. In 2004, and later in 2009, Regina Lawrence and I sought to understand the ways in which the news media and Congress address issues of school shootings (Lawrence and Birkland 2004; Birkland and Lawrence 2009). This research can help us to understand whether a focusing event reduces ambiguity, or increases it, in the sense that the event can come to mean more than one thing.

One form of ambiguity is in the causes of the event: what is the reason why the school shooting happened? Who or what is at fault? In my original conception of a focusing event, such an event should clarify the causes of such problems. But in our analysis of the school shooting issue, we found a wide range of potential “causal stories” (Stone 1989) for school shootings. Reasons included the usual issues, such as the easy availability of guns in the United States, but other ways of framing the causes of school shootings emerged in the immediate aftermath of the Columbine shooting, such as the putatively malign influence of popular entertainment, such as music and video games, lax parenting, the failure of communities to engage their youth, shortfalls in federal, state, and local funding for school-based programs intended to dissuade violent behavior, and so on. Interestingly, we found that the sorts of causal stories told in the news media and in the *Congressional Record* did not vary greatly from each other, but the kinds of policies that were ultimately enacted into law do not reflect the full range of the stories that were told about the shootings. Ultimately, the legislative enactments focused on two things that Congress could actually legislate about: more stringent requirements for harsh criminal justice penalties on school shooters, and more funding for school security and other programs to reduce or mitigate school violence.

What we concluded was that Congress is constitutionally constrained to enact certain kinds of legislation, and not others. It is constrained on to at least two levels: first, Congress cannot easily pass highly restrictive laws governing the content of popular entertainment and second Congress, and the federal government broadly, are not engaged in the provision of public education. This is primarily a local function in the United States, with greater or lesser state oversight depending on the state in question, so the extent to which the federal government gets involved in public education, the federal government exists as a funder, and encourager of particular policy directions, but the federal government cannot apply strong tools to problems that exist in public schools. In this case then one can argue that the meaning and causes of school violence incidents are incredibly ambiguous, with policy entrepreneurs being available to tell all manner of different stories about the causes and consequences of school violence. But it’s also true that the actual range of politically feasible policies is ultimately very constrained at any one time. Put another way, there are many policy-entrepreneur opportunities generated by school shootings, but the institutions in which policy entrepreneurs work are constrained by constitutional, historical, and cultural norms that are very slow to change.

## TMI and the “system works” in the face of decline

A third example is provided by the Three Mile Island nuclear power plant accident in 1979. This is widely considered to be the most serious nuclear power plant accident in the United States. The details of what happened at this power plant are well described in Perrow’s seminal book *Normal Accidents* (1999). In summary, one of the reactors at the Three Mile Island plant suffered a loss of coolant accident, which led to a shut down and partial meltdown of some of the fuel in that reactor.

It is popularly believed by many that the Three Mile Island nuclear plant accident “caused” the collapse of the nuclear power plant industry in the United States. Indeed, by the early 1980s, the number of planned new nuclear power plants had declined considerably. And, in 1982, a major nuclear operator, the Washington Public Power Supply System, known locally as WPPSS (pronounced whoops) defaulted on \$2.25 billion worth of municipal bonds, the largest municipal bond default in American history. But Baumgartner and Jones (2009), in their extensive discussion of the changes in the governance of nuclear power in the 1970s, documented how the policy image around nuclear power—of cheap, abundant energy that could be safely produced—had, by the mid-1970s, been replaced by an image of nuclear power as being potentially risky and in need of careful regulation. The former policy subsystem in nuclear power was a closed system that was dominated by the Atomic Energy Commission and the Joint Committee on Atomic Energy in Congress. This was quite swiftly replaced by a regulatory regime that involved multiple congressional committees and the Nuclear Regulatory Commission, which was established less to promote civilian uses of atomic energy—the AEC’s mandate—and more to regulate this potentially dangerous technology. These processes were well underway five years *before* TMI: Baumgartner and Jones found that, “by 1974, not only had the subgovernment collapsed, but the civilian nuclear option was, for all practical purposes, dead” (2009, Kindle edition, location 1629-30))

In *After Disaster*, I found a curious difference between the debate surrounding the Three Mile Island accident and nuclear power plant safety in general, and the debate surrounding *Exxon Valdez* and oil spills. In the oil spill case, I found the familiar strategies of attempting to expand the scope of conflict, on the part of environmental groups, and attempting to contain that scope, on the part of oil industry representatives. Members of environmental groups were much more prone to appear before congressional committees after *Exxon Valdez* than before and were more likely to mention specific oil spills by name. In contrast, oil industry representatives were less likely to appear before Congress and they were before the spill, and when they did appear, they sought to describe the oil spill problem as a general problem, and not to link it to the *Exxon Valdez* spill. Why did they do this? Because the *Exxon Valdez* spill, as Regina Lawrence and I noted, was much more symbolically rich than was the typical oil spill. It happened in Alaska, in a “pristine wilderness”, and resulted in the oiling of birds, sea mammals, rocky beaches, and other areas that aroused anger both among local people and concerned citizens around the nation (Birkland and Lawrence 2001).

So, what of the Three Mile Island accident? This accident did no visible damage. It, by all accounts, killed no one. The nuclear power industry was much more likely to appear before Congress to talk about this accident and about the safety nuclear power than was the oil industry to discuss *Exxon Valdez* and the safety of oil transportation. I attribute this to two factors. First, the policy domain governing nuclear power had already become extremely polarized by the late 1970s, and, as Baumgartner and Jones note, the policy regime that governed nuclear power had radically changed in

the 1970s, to the point where the federal government had shifted its attitudes towards nuclear power away from active promotion to a more skeptical regulatory environment. Second, the proponents of nuclear power, armed with the knowledge that the very damage done by the Three Mile Island accident was itself ambiguous, was able to interpret the Three Mile Island accident not as a disaster, but as a success. They argued that “defense in depth” measures, characterized by redundant systems, had prevented

## Discussion

There is little doubt that focusing events matter to policy making, although we are often only able to assess their effect for some time after the event. But if we know something about the event and about the policy community in which they happen, we can likely venture to predict the agenda-setting and policymaking outcomes that will follow the event.

First, we can predict that a focusing event will, in the very early days after the event, lead to a profusion of ideas about the “reasons” why the event happened and what the event means to the culture broadly, and to public policy specifically. The event opens time for policy entrepreneurs to link the problems revealed by the event with their pet solutions. This time is limited, and all the parties to the debate know this, so that the agenda-setting efforts of the participants are likely to be very intense.

Second, because these events stir up so many ideas, it’s unlikely that but a fraction of these ideas will make it very far in the process of winnowing down ideas from the public agenda, through the institutional agenda, and into the decision agenda.

Howlett, McConnell, and Perl (2015) offer an improvement on the three-stream metaphor offered by Kingdon. They argue that policy making is best considered in a sequence “in which critical confluence and distribution points among policy streams are linked to specific ‘stages’ of the policy process in a cycle model’ (426). In this new approach, the three classic MSA streams converge in the agenda-setting stage, which serves as the “start of policy formation, where the streams converge into ‘whirlpool’—at times turbulent and hidden from public view—constituting a period of initial strategic appraisal by policy makers” (426). Here, a focusing event triggers this period of appraisal, setting the whirlpool in motion and triggering efforts to derive meaning from the event and form policy alternatives. At least one sub-confluence point then ensues, in which efforts are made to join policies with problems, in ways that are conditioned by the structural features of the policy process and by the integration of new ideas with existing public programs. If this process runs its course, a second appraisal whirlpool opens, at which point the policy formation phase which would culminate in actual policy decisions.

Given the contingent nature of the process, ambiguity is still a major feature of the policy process, even as a focusing event seems to focus attention on a public problem. For example, in the policy formation phase, with respect to school shootings, all manner of ideas were advanced to explain both the cause of the problem and the potential solutions to it, keeping in mind that oftentimes problem definition is part and parcel of the definition of solutions, because groups that favor particular policies will define the problem so as to lead to the adoption of a particular policy. But then, the second appraisal whirlpool must consider the usual features for understanding the successful policy proposal,

such as political feasibility, problem tractability and technical feasibility. This further winnows down the realistic policy responses to the event.

This process helps to explain why, even though in the school shooting domain, all manner of ideas about lax parenting, the lack of religion, the malign influence of pop culture, and the like were proposed as causes of school violence, with the concomitant solutions being implied, the actual policy output at the federal level after the Columbine school shooting was more funding for school violence prevention programs for school security. After all, these tools were among the few that were realistically available to the federal government. The federal government does not directly administer schools and is wary of imposing programmatic solutions on schools in most cases. And, of course, effective gun control in the United States is foreclosed by the power of the National Rifle Association, which remains remarkably influential among members of Congress. In a similar manner, while the 2001 terrorist attacks on the United States yielded some definitive policy outcomes, in the aviation safety and security realm, at least, the *meaning* of the hijackings was rather more ambiguous than was suggested by the rapid creation of the Transportation Security Administration and the securing of cockpits. A wide range of other policy responses rose to prominence on the agenda, because the attacks opened up greater space on the agenda to consider general matters of aviation security.

## Hypotheses and Future Directions

Based on the analysis in this, paper, I offer the following hypotheses that are suggested by current understandings of focusing events and current conceptualizations of the MSA. Future research will test and refine these hypotheses. Some of these hypotheses are a restatement of ideas that have appeared elsewhere, but are brought together here for a more comprehensive statement of potential future research on focusing events in the policy process.

### Focusing events increase attention to events

That focusing events attract attention to public problems is unsurprising. A wide body of literature has demonstrated that disasters and crises do have an influence on attention, and therefore on agenda setting. The interesting question is not whether an event has an influence on the agenda, but how much. We can measure this in the typical ways, such as by measuring bill introductions, the number of witnesses called before Congress to testify, the number of newspaper articles or television news stories that address a certain issue, and even today, the uptake and spread of event-generated ideas in social media. A more interesting outcome might be finding that a particular event had less of an effect on the agenda than we might otherwise believe. For example, what if a major hurricane or a large school shooting had a lower level of agenda activity than did a prior event that was no larger and of at least equivalent scope. At some point, if events become frequent, they may stop serving as focusing events. Of course, scholars tend to pick what I call “domains prone to disaster,” which means that we may in some ways be selecting our cases on the dependent variable.

### Focusing events increase the range of potential policy responses to an issue

More important than the volume of attention paid to an event is the range of potential policy responses raised to an event. This can be thought of in two ways. The first, as discussed above, is the

range of claims about the causes of a problem. Was the Exxon Valdez oil spill caused by lax regulation of oil tankers? By the unusual but tragic inattention of its crew on one particular day? Or is the “real cause” of the oil spill the nation’s insatiable appetite for petroleum? The range of meanings attributed to an event is likely infinite, although it is realistically bounded by cultural predispositions that would make some interpretations nonstarters from a policy perspective. For example, claiming the private ownership of oil is the problem which would imply the need to nationalize oil companies is not likely to make it very far in the United States. But focus events provide an opportunity for, if you will, philosophizing about the causes and consequences of the choices we as a society make. Indeed, as I argued in *Lessons of Disaster*, focusing events provide an opportunity for both single loop and double loop learning of the sort discussed by Argyris in his work on organizational learning (Argyris 1977). Single loop learning relates to instrumental policy learning, which is about learning about the operation of policy instruments, such as various types of regulations, and whether and to what extent they work to prevent undesired outcomes. Double loop learning, on the other hand, maps with political learning, which is focused on more fundamental questions about whether or not we should be doing something at all, such as drilling for oil in Alaska, placing it in the pipeline, loading it onto tankers, and shipping it to the lower 48 (on instrumental and policy learning, see May 1992). No claim is made here that focusing events automatically or often yield any instrument or social policy learning, although I believe they can under some circumstances. The important point here is that the events is that, to use Kingdon’s metaphor, stir the primordial soup of policy ideas.

### The range of potential solutions is reduced as time passes after the event

The third hypothesis is that the range of potential solutions being discussed becomes more constrained over time. This has important strategic implications for policy entrepreneurs. Pro-change groups need to flood the zone with as many ideas as possible in order to achieve a policy change, while groups that seek to protect the status quo need only play defense, wait until time pressures to “do something” are eased, and await what Downs would argue is the growing realization of the costs of taking bold action as a result of an event. Indeed, in the school shooting case, the National Rifle Association and its allies denigrate the idea of fast action itself, on two levels. One, they make a normative claim that it is wrong to “exploit a tragedy for political gain.” Second, they argue against making hasty decisions driven more by the emotional response in the event than by some sort of careful analysis over the efficacy of potential policy solutions. Of course, the National Rifle Association and its allies are unlikely to seek to assess the likely value of more stringent regulation of guns, and their position is enshrined in federal government decisions to not support research on effective gun violence protection. But, Schattschneider would argue, pro-status quo groups need only hold their ground and seek to contain the growth of the scope of conflict, confident in the notion that attention to the problems revealed by the event will, like memories of the event itself, fade over time.

Another reason why the range of ideas is reduced is that the sudden rush of idea generation after focusing events is attenuated by the realization that some of the ideas are politically unrealistic. Summary ideas are simply not constitutional; stringent regulation of the content of popular culture, for example, is unlikely under current First Amendment jurisprudence in the United States. But the policy ideas also must pass the test of political feasibility, and given the polarized state of American politics, it’s very unlikely for all but the least controversial ideas to gain much traction in advance to actual policymaking.

## Conclusion

The Multiple Streams Approach has moved well beyond its origins in Kingdon's 1984 book to become one of the most important theories—and research programs—in policy studies. And the focusing event idea has been adopted, in various forms, across most of the major theories of the process, such as the Advocacy Coalition Framework and Punctuated Equilibrium Theory. Indeed, there is a considerable degree of cross-fertilization between these theories. Focusing events are one such concept that spans the major theories of agenda setting in the policy process. But most theories—and most applications of those theories—assume that focusing events are, primarily, sharp, sudden, and largely unexpected events. They are not unexpected in the sense that they will never be expected to happen, but they are unexpected in terms of where and when they happen. And they are unexpected in the sense that they are not expected by generalist policymakers, such as elected officials, general assignment journalists, and the broader public.

Going forward, students of the multiple streams approach should restrict the use of the term “focusing event” to this notion of a sudden, harmful, unexpected event. Kingdon's definition of focusing events that encompasses the sudden uptake of symbols and the personal experience of policy makers is too broad, and these phenomena work quite a bit differently in the policy process.

With this more restricted definition of focusing events, we are better prepared to address the hypotheses I outline in this paper, to apply them to the case studies I outlined herein and to new case studies, all with the goal of better understanding how and when the shocks generated by focusing events lead to agenda change, and, in some cases, policy change.

## References

- Argyris, Chris. 1977. “Double Loop Learning in Organizations.” *Harvard Business Review*. September 1, 1977. <https://hbr.org/1977/09/double-loop-learning-in-organizations>.
- Baumgartner, Frank R., and Bryan D. Jones. 2009. *Agendas and Instability in American Politics*. 2nd ed. Chicago Studies in American Politics. Chicago: The University of Chicago Press.
- Beland, Daniel, and Robert Henry Cox. 2010. *Ideas and Politics in Social Science Research*. Oxford University Press.
- Béland, Daniel, and Michael Howlett. 2016. “The Role and Impact of the Multiple-Streams Approach in Comparative Policy Analysis.” *Journal of Comparative Policy Analysis: Research and Practice* 18 (3): 221–27. <https://doi.org/10.1080/13876988.2016.1174410>.
- Birkland, Thomas A. 1997. *After Disaster: Agenda Setting, Public Policy and Focusing Events*. Washington, D.C.: Georgetown University Press.
- . 2004. “Learning and Policy Improvement After Disaster: The Case of Aviation Security.” *American Behavioral Scientist* 48 (3): 341–64. <https://doi.org/10.1177/0002764204268990>.
- . 2006. *Lessons of Disaster*. Washington, D.C.: Georgetown University Press.

- Birkland, Thomas A., and Regina G. Lawrence. 2001. *The Exxon Valdez and Alaska in the American Imagination*. Edited by Steven Biel. New York University Press.
- . 2009. "Media Framing and Policy Change After Columbine." *American Behavioral Scientist* 52 (10): 1405–25. <https://doi.org/10.1177/0002764209332555>.
- Cobb, Roger W., and Charles D. Elder. 1983. *Participation in American Politics: The Dynamics of Agenda-Building*. Baltimore: Johns Hopkins University Press.
- Cohen, Michael D., James G. March, and Johan P. Olsen. 1972. "A Garbage Can Model of Organizational Choice." *Administrative Science Quarterly* 17 (1): 1. <https://doi.org/10.2307/2392088>.
- Downs, Anthony. 1972. "Up and Down with Ecology: The Issue Attention Cycle." *The Public Interest* 28 (Summer): 38–50.
- Heikkila, Tanya, and Paul Cairney. 2017. "Comparison of Theories of the Policy Process." In *Theories of the Policy Process*, edited by Christopher M. Weible and Paul A. Sabatier, Fourth edition, 301–27. Boulder, CO: Westview Press.
- Herweg, Nicole, Nikolaos Zahariadis, and Reimut Zohlnhofer. 2017. "The Multiple Streams Framework: Foundations, Refinements, and Empirical Applications." In *Theories of the Policy Process*, edited by Christopher M. Weible and Paul A. Sabatier, Fourth edition, 17–52. Boulder, CO: Westview Press.
- Hoffman, Steve G., and Paul Durlak. 2018. "The Shelf Life of a Disaster: Post-Fukushima Policy Change in The United States And Germany." *Sociological Forum* 33 (2): 378–402. <https://doi.org/10.1111/socf.12419>.
- Howlett, Michael, Allan McConnell, and Anthony Perl. 2015. "Streams and Stages: Reconciling Kingdon and Policy Process Theory: Streams and Stages: Reconciling Kingdon and Policy Process Theory." *European Journal of Political Research* 54 (3): 419–34. <https://doi.org/10.1111/1475-6765.12064>.
- Johnson-Cartee, Karen S. 2005. *News Narratives and News Framing: Constructing Political Reality*. Communication, Media, and Politics. Lanham: Rowman & Littlefield Publishers.
- Jones, Michael D., Holly L. Peterson, Jonathan J. Pierce, Nicole Herweg, Amiel Bernal, Holly Lamberta Raney, and Nikolaos Zahariadis. 2016. "A River Runs Through It: A Multiple Streams Meta-Review: A Multiple Streams Meta-Review." *Policy Studies Journal* 44 (1): 13–36. <https://doi.org/10.1111/psj.12115>.
- Kingdon, John W. 2011. *Agendas, Alternatives, and Public Policies*. Updated 2nd ed. Longman Classics in Political Science. Boston: Longman.
- Lawrence, Regina G., and Thomas A. Birkland. 2004. "Guns, Hollywood, and School Safety: Defining the School-Shooting Problem Across Public Arenas." *Social Science Quarterly* 85 (5): 1193.
- May, Peter J. 1992. "Policy Learning and Failure." *Journal of Public Policy* 12 (4): 331–54.
- Perrow, Charles. 1999. *Normal Accidents : Living with High-Risk Technologies, with a New Afterword and a Postscript on the Y2K Problem*. Princeton NJ: Princeton University Press.

- Rüb, Friedbert W. 2016. "Agenda-Setting and Policy-Making in Time: What the Multiple-Streams Approach Can Tell Us – and What It Cannot." In *Decision-Making under Ambiguity and Time Constraints: Assessing the Multiple-Streams Framework*, edited by Friedbert W. Rüb and Reimut Zohlnhöfer, 51–69. Colchester, UK: ECPR Press.
- Rüb, Friedbert W., and Reimut Zohlnhöfer, eds. 2016. *Decision-Making under Ambiguity and Time Constraints: Assessing the Multiple-Streams Framework*. Colchester, UK: ECPR Press.
- Schattschneider, E.E. 1975. *The Semisovereign People*. Hinsdale, Ill.: The Dryden Press.
- Shanahan, Elizabeth A., Michael D. Jones, Mark K. McBeth, and Claudio M. Radaelli. 2017. "The Narrative Policy Framework." In *Theories of the Policy Process*, eds. Christopher M. Weible and Paul A. Sabatier. Boulder, Colo.: Westview.
- Stone, Deborah A. 1989. "Causal Stories and the Formation of Policy Agendas." *Political Science Quarterly* 104 (2): 281–300.
- . 2012. *Policy Paradox: The Art of Political Decision Making*. 3rd ed. New York: W.W. Norton & Co.
- Warnement, Megan K. 2018. "Narratives in the Policy Process: Hurricane Katrina as a Condensation Symbol." Annual Meeting of the Midwest Political Science Association.
- Weible, Christopher M., and Edella Schlager. 2016. "The Multiple Streams Approach at the Theoretical and Empirical Crossroads: An Introduction to a Special Issue." *Policy Studies Journal* 44 (1): 5–12. <https://doi.org/10.1111/psj.12143>.
- Wittneben, Bettina B. F. 2012. "The Impact of the Fukushima Nuclear Accident on European Energy Policy." *Environmental Science & Policy* 15 (1): 1–3. <https://doi.org/10.1016/j.envsci.2011.09.002>.