Policy Beliefs, Belief Uncertainty, and Policy Learning

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Abstract: Within the Advocacy Coalition Framework (ACF), policy-oriented learning is understood as a change in policy beliefs. Additional work has noted that belief reinforcement, not just belief change, is also a potential policy learning outcome. Yet, little work has attempted to reconcile how learning could involve both belief change and belief reinforcement. In this paper, I propose a policy-oriented learning model where policy beliefs – deep core, policy core, or secondary aspects – are understood as having a distribution with a central tendency (i.e., the belief) as well as variance (i.e., certainty associated with the belief). With policy beliefs considered as distributions, learning can be understood as changes in beliefs (i.e., a change in the central tendency) as well as changes in certainty (i.e., variance) such as a decrease in belief uncertainty (i.e., reinforcement). Using data from a deliberative forum that brought together various stakeholders including experts, natural resource managers, and the public to discuss environmental issues impacting coastal communities, I explore changes in concern regarding several key coastal issues before and after the forum. Additionally, I examine the association between concern following the forum and self-reported learning. I find support for the proposed policy-oriented learning model as shown by significant changes in average concern as well as average variance among participants across several of the issues discussed.

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Introduction

Policy learning is a key aspect of the policymaking process; however, learning in the policy context is difficult to conceptualize and measure (see Zaki, Wayenberg, and George 2022). Several of the leading theories of the policy process discuss policy learning, with the Advocacy Coalition Framework (ACF) being the most notable. The ACF argues that policy-oriented learning is one of the prominent pathways of policy change (e.g., Jenkins-Smith et al. 2018), yet given the conceptual and measurement challenges associated with policy learning, it is

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one of the least studied aspects of the ACF (Pierce et al. 2017). In brief, policy learning, specifically policy-oriented learning within the ACF, is associated with "enduring" changes in views and/or behaviors connected to the policy-related beliefs of individuals and/or collectives (Sabatier and Jenkins-Smith 1993).[1]

The study of policy-oriented learning involves the examination of both the process of learning as well as the outcomes of learning (Henry et al. 2022). The process of learning involves how learning occurs and outcomes involve changes in beliefs and/or behaviors that result from learning. However, belief reinforcement, as opposed to belief change, is also considered a learning outcome (Crossan, Lane, and White 1999; Heikkila and Gerlak 2013; Pattison 2018). Indeed, given the nature of belief systems and biases, belief reinforcement is likely the most prevalent learning outcome (Weible, Olofsson, and Heikkila 2022).

For a better understanding of policy-oriented learning, it is necessary to reconcile policy learning understood as both belief change and belief reinforcement within a single conceptual and empirical approach. To develop such an approach, I posit a model where beliefs are conceptualized as having distributions with central tendencies (i.e., the belief) as well as variances (i.e., belief certainty). With this conceptualization, learning can be understood and measured as a change in the central tendency and/or as a change in the variance. A change in central tendency would represent belief change and a reduction in variance, without a change in the central tendency, would represent belief reinforcement.

Beyond the conceptualization of policy-oriented learning, it is also necessary to understand the context in which policy learning might be possible. According to ACF scholarship, there are several factors that are associated with learning including the attribute of policy forums in which learning could occur (see Jenkins-Smith and Sabatier 1993). Forum attributes such as its' openness and its' norms can influence the potential for learning. Additionally, the structure, social dynamics, and the technology and functional domain of a learning forum can make learning within and across actors more (or less) likely (Gerlak and Heikkila 2011). Recent work on deliberation, specifically deliberative mini-publics, show that they may be contexts that are conducive for learning (Fishkin 2020; Willis, Curato, and Smith 2022). Yet, little work has examined connections between deliberative forums and policy-oriented learning.

In this paper, I develop and provide a proof-of-concept test for a policy-oriented learning model that theorizes policy beliefs as distributions and changes in those distributions as indicative of learning. Specifically, I posit that a change in the central tendency of a distribution is evidence of belief change and a change in the variance is evidence of belief reinforcement. To test this approach I draw on data collected from public participants prior-to and following a deliberative forum that brought together members of the public, experts, and decision-makers to discuss the impacts of climate change on coastal communities in South Carolina. Using data from a deliberative forum allows me to also examine the role that such forums can play in facilitating policy learning by examining beliefs before and after the deliberative forum.

The policy-oriented learning model I develop has four possible learning outcomes including no learning, belief reinforcement, belief change, and belief change and reinforcement. I test three hypotheses based on these possible outcomes and overall, I find that support for the model as learning is demonstrated as belief change

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[1]There are other ways of defining or characterizing policy learning beyond policy-oriented learning, which is the focus of this paper. For a discussion of other understandings of learning see Dunlop and Radaelli (2013); Gerlak et al. (2018); Albright and Crow (2021); Zaki, Wayenberg, and George (2022).

(i.e. change in the mean), belief reinforcement (i.e., change in the variance), and both change and reinforcement. A secondary finding is that deliberative forums can provide a structure and context that may facilitate learning.

Policy Beliefs and Learning

The connection between policy beliefs and learning is central to the ACF's notion of policy-oriented learning. Within the ACF, beliefs are understood to be hierarchical with deep core beliefs informing policy core beliefs and policy core beliefs informing secondary aspects. Deep core beliefs involve beliefs such as political ideology or cultural worldviews that span multiple policy issues (Jenkins-Smith et al. 2014; Ripberger et al. 2014). Learning is not likely to occur with deep core beliefs because they are highly resistant to change. Policy core beliefs are associated with particular issues and subsystems and include the causes of the problem and potential solutions; methods of program finance; and the involvement of policy actors in decision-making (public, experts, elected officials) (Sabatier and Jenkins-Smith 1999, 132–34). Advocacy coalitions tend to form around shared policy core beliefs. Changes in policy core beliefs are more likely than with deep core beliefs, but learning regarding policy core beliefs is not especially common. Secondary aspects are preferences for particular policy tools or instruments and are constrained by policy core beliefs (Kammermann and Angst 2021). Learning is most likely to occur with the beliefs associated with secondary aspects.

Policy-oriented learning is associated with changes in beliefs and is defined specifically as "enduring alterations of thought or behavioral intentions that result from experience and which concerned with the attainment or revision of the precepts of the belief systems of individuals or of collectives" (Sabatier and Jenkins-Smith 1993, 42). Yet, belief reinforcement, not only belief change, is also considered to be a learning outcome. Further it's not necessarily clear what constitutes a change in beliefs. Specifically, is there a directional aspect of belief change? To constitute a change, do beliefs need to move in the opposite direction? For example, if an individual does not believe that human activity has had an impact on climate, would only a change to believe that humans do indeed impact the climate be sufficient for belief change? Clearly if a belief moves significantly in the opposite direction that would be a belief change, but is that the only direction in which beliefs can move to be considered learning?

Recent work on policy learning and information processing can shed light on the directional aspect of learning (Nowlin 2021). Learning through information processing occurs as prior beliefs are updated *in the direction of the information* as a result of the processing and weighing of the information. With this approach, learning occurs only when beliefs change in a way that is consistent with the information being processed. Additionally, learning is a function of the strength of the prior belief and the strength of the information signal and how it's weighed. Therefore, to change strongly held beliefs the information signal and its weighing must be sufficiently strong. In other words, the information signal must exceed a threshold to elicit learning, and the extent of that threshold is relative to the strength of the prior belief. With the learning and information processing approach, information anchors the direction in which beliefs should change to be considered learning.

To better understand belief change as policy-oriented learning, clarity is needed about how beliefs are conceptualized and how that conceptualization connects to learning. Along these lines, I posit that beliefs including deep core, policy core, and secondary aspects, include two key components: the *beliefs* as well as the *certainty*

associated with the beliefs. In other words, beliefs include what is believed to be true as well as the certainty that it is true. Further, beliefs can be seen as a probability distribution that has a "central tendency" that represents the belief and "variance" that represents the (un)certainty associated with the belief. Therefore, policy beliefs are a function of the belief, β, and uncertainty, ϵ, where beliefs = $\beta + \epsilon$. To illustrate this approach, Figure 1 shows three hypothetical belief distributions.

Figure 1: Hypothetical Distributions of Policy Beliefs
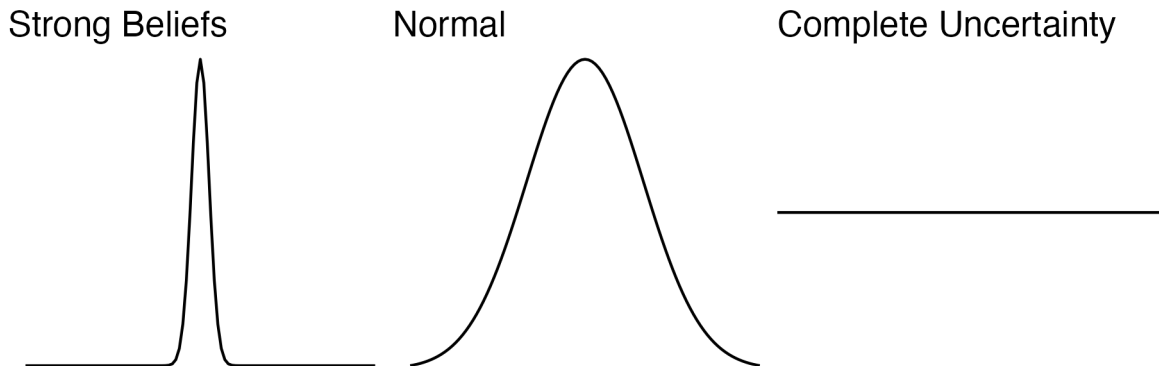
As shown, the belief distribution in the left panel of Figure 1 represents beliefs that are *strongly held* and have little variance, or uncertainty. On the other end of the spectrum, and shown in the right panel, are beliefs that have *complete uncertainty*, represented as a flat line that illustrates an overall lack of belief and/or belief certainty. Finally, beliefs can have a theoretical *normal distribution*, shown in the middle panel, where beliefs are strong but reasonable levels of uncertainty exists. The distribution of beliefs and uncertainty can impact the likelihood that learning might occur with strongly held beliefs (i.e., beliefs with little to no uncertainty) less likely to change then beliefs that are less strongly held (i.e., moderate to high levels of uncertainty). Belief certainty can vary across individuals and over time. For example, using panel data Jenkins-Smith et al. (2020) found that Republicans and conservatives held less stable views over time on climate change than Democrats or liberals.

The conceptualization of policy beliefs as distributions connects clearly to policy-oriented learning. As noted, belief change and belief reinforcement are considered outcomes of policy learning, and understanding beliefs as distributions can provide a way to conceptually and empirically account for learning that encompasses both belief change and reinforcement. Specifically, if beliefs are understood as probability distributions then learning as belief change can be understood to occur when the central tendency of the belief shifts, which can be measured empirically as a statistically significant change in the central tendency (e.g., the mean) of the belief distribution. Learning as belief reinforcement occurs when the uncertainty associated with the belief is reduced. This can be measured as a statistically significant change in the variance of the distribution, and a significant reduction in variance would indicate belief reinforcement. Therefore, with this approach no learning (e.g., no shifts in beliefs or certainty), belief reinforcement, belief change, and both reinforcement and change are possible learning outcomes.

Understanding policy-oriented learning, which includes both belief change and belief reinforcement, from a foundation of belief distributions provides some conceptual and empirical clarity but does not provide clarity

on the direction of change or reinforcement. As noted, apart from a 180 degree change in beliefs the direction of learning should be based on the information that is being processed such that to be considered learning, beliefs should shift to be in line with the information. Therefore, a significant shift in beliefs and/or a significant shift in belief certainty should be in the direction of the information to be considered as policy-oriented learning. Using again the example of anthropogenic climate change; if an individual that believes human activity has no impact on climate and consumes some information that supports that belief and, as a result of that information, they become more certain in their belief, then that is learning as belief reinforcement. However, if the information caused a significant shift in the belief itself and in the direction of the information, then it is learning as belief change even if the individual still believes that human activity has no impact on the climate.

Several factors can shape the possibilities for policy learning including the nature of the forum in which policy is discussed and debated. In the next section, I examine connections between policy learning and deliberative forums.

Learning and Deliberation

There are several possible mechanisms through which learning might occur, and scholars using the ACF have noted four important factors related to policy-oriented learning including the attribute of forums, level of conflict between coalitions, attributes of the stimuli, and attributes of actors (Jenkins-Smith et al. 2018; Jenkins-Smith and Sabatier 1993). Key attributes of forums include its openness, the degree to which actors share a common epistemology, and the norms associated with the forum. Level of conflict within a subsystem can matter, with learning less likely to occur across coalitions within a subsystem that has a high level of conflict. Attributes of the stimuli involve the type(s) of information available and the tractability of the problem. Finally, actor attributes include their "belief systems, resources, strategies, and network contacts" (Jenkins-Smith et al. 2018, 152). As a result of these and other factors, institutional designs can work to help or hinder learning (Heikkila and Gerlak 2019).

Policy-oriented learning typically occurs in a collective context involving a collective process of information acquisition, translation, and dissemination, as well as collective outcomes associated with new beliefs and/or behaviors (Gerlak and Heikkila 2011; Heikkila and Gerlak 2013). Yet, it is individuals that learn in a collective context and the aggregation of individual learning is the foundation of collective learning.[2]

As noted, the type of forum can shape policy learning, and forums organized around deliberation may be conducive to policy learning (Fishkin 2020). Deliberation involves the reasoned and informed consideration of policy issues through discussion among individuals (Bessette 1997; Nabatchi 2012). One of the central aspects of deliberation, particularly in the context of deliberative democracy, is persuasion rather than the aggregation of preferences. With persuasion there is the potential for a shift in preferences, or learning.

There are several types of deliberative forums including government decision-making bodies such as courts and legislatures but also smaller-scale forums such as deliberative mini-publics. A deliberative mini-public

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[2]In this paper, I adopt a methodological individualism approach where individual and collective learning are both a result of similar dynamics.

involves a representative sample of the public that is brought together to have a facilitated discussion regarding issues of public concern. Mini-publics can have various goals or outcome including to help participants gain a better understanding of the problem(s), improved understanding of the decision-making process of the community, the consideration of trade-offs associated with various policy approaches, and to make a recommendation, among others (Escobar and Elstub 2017).

Regardless of the overall goal, deliberative mini-publics tend to have similar stages and processes (Escobar and Elstub 2017; Willis, Curato, and Smith 2022). The first stage involves the recruitment of participants. Ideally, participants should be a representative sample of the broader population. Next is the learning phrase where participants learn about the issue(s) they will be discussing. Often participants are sent materials ahead of time and/or experts are on-hand during the deliberation to give presentations and answer questions. The third stage is the deliberation where participants engage in meaningful and facilitated dialogue about the issue(s). The final stage is the conclusion, the specifics of which depend on the overall goal of the deliberative forum. For example, the conclusion could involve the crafting of a consensus document that reflects the recommendation of the deliberative panel (e.g., the Citizens' Initiative Review in Oregon (Gastil and Knobloch 2019)), among other possible outputs.

In the next section, I describe the Our Coastal Future Forum, a deliberative forum consisting of the public, experts, and decision-makers that met to discuss environmental issues occurring in South Carolina's coastal communities.

The *Our Coastal Future Forum*

The Our Coastal Future Forum (OCFF) was a deliberative mini-public that occurred in October 2017 in Charleston, South Carolina. The OCFF brought together about 100 total participants from each of South Carolina's eight coastal counties to discuss climate change and the various impacts of climate change on coastal communities. The goal of the OCFF was to give participants an improved understanding of the environmental issues facing the coast as well as an improved understanding of the decision-making processes in the community. Specific topics included climate change, biodiversity, off-shore energy resources, environmental health, and sea-level rise.

The OCFF took place on a Friday evening and a Saturday. The Friday evening session included an introduction and overview of the forum as well as a presentation on climate change. The Saturday session involved plenary presentations from the experts on the various issues as well as several break-out groups where participants deliberated.

Participants were recruited from South Carolina's eight coastal communities and included the public, experts, natural resource managers, and city and county government officials. Public participants were recruited through an email survey and flyers placed in and around the communities.[3] The email survey, which was fielded from August 9, 2017 to September 11, 2017, included several questions regarding the respondents' views about climate change and other environmental issues as well as a question about participating in a public forum to discuss issues important to the local community. Expert and government participants were recruited

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[3]An email list of residents in coastal counties was purchased from the marketing firm Dunhill International List Co., Inc.

with the help of the South Carolina Sea Grant Consortium. Overall about 100 participated in the OCFF including the public, experts, and decision-makers.

The learning phase of the OCFF included briefing materials that were sent to participants before the forum as well as presentations by the experts at the forum itself. Additionally, the experts were available to answer participant questions.

For the deliberation phase, participants were put into eight separate groups of 8 to 12 participants to deliberate. Each group was facilitated by a trained facilitator. Experts moved between groups to answer questions and provide clarification.

Finally, the conclusion of the OCFF involved each of the small groups reporting to the others what they discussed in their groups. Participants also answered a survey after the forum. The post-forum survey included some of the same measures as the previous survey, but also added questions about the forum itself as well as questions regarding whether the participants learned about the issues as a result of the forum.

Deliberative forums provide good conditions for learning to occur within a collective context, and the next section outlines several hypotheses regarding policy-oriented learning as a result of the OCFF.

Learning Hypotheses

Policy-oriented learning involves changes in beliefs and/or behaviors associated with policy issues. Yet, the outcomes of learning include both belief change and/or belief reinforcement. To reconcile belief change and reinforcement as learning outcomes, I argue that beliefs should be conceptualized as having distributions with central tendencies as well as variance, where a significant shift in the central tendency indicates belief change and a shift in the variance indicates belief reinforcement. Additionally, I note that to be considered learning beliefs should be changed and/or reinforced in the direction of information. Finally, I argue that deliberative forums are likely to provide an institutional design conducive to learning.

To provide a proof-of-concept for the model of policy-oriented learning discussed above, I posit and test three hypotheses: the first is related to belief change, the second is about belief reinforcement, and the third hypothesis is about belief change and self-reported learning. Participants in the OCFF were asked, as part of both the pre-and-post survey, their level of concern about 10 specific environmental issues (listed below). The concern questions are used as measures as policy beliefs related to the issues.

The first hypothesis regards policy learning as changes in beliefs following the processing of information in a deliberative forum. I expect that average concern in the aggregate and across the different issues will increase following the OCFF. The increase in concern is expected because the information provided to the participants highlighted the environmental challenges facing coastal communities.

Belief change hypothesis:

H1: *Concern about each issue will increase following the deliberative forum*

For H1, I expect that the mean level of concern in the aggregate as well as for each issue will be higher following the deliberative forum, $\mu_1 < \mu_2$.

The second hypothesis regards uncertainty and belief reinforcement. I expect that, on average, the uncertainty surrounding how concerned about the issues participants are will decrease following the OCFF. A decrease in uncertainty would be indicative of belief reinforcement. Finally, the decrease in uncertainty is expected because of the nature of the information provided, as discussed above.

Belief certainty hypothesis:

> H2: *Uncertainty about concern will decrease following the deliberative forum*

With H2 I expect that the variance will be lower following the forum in the aggregate and for each issue, $\sigma^2_1 > \sigma^2_2$.

Following the OCFF participants were asked questions about the forum including questions intended to gauge if they learned as a result of the OCFF. If an increase in the mean level of concern is indicative of belief change, then it follows that higher levels of concern following the forum will be associated with measures of self-reported learning. Therefore, I posit that:

> H3: *As concern about issues increases post-forum, participants will be more likely to report that they learned*

Finally, following the OCFF participants were asked if they changed as a result of the forum and, with an open-ended question, how they changed. I use some representative responses to the open-ended questions to further examine the hypotheses. The next section describes the data and analytical approaches I used.

Data and Analysis

The test the above stated hypotheses, I draw on the survey data of public participants from both before the OCFF as well as after. The prior data was through an online survey that was administered in Qualtrics and collected 4 to 8 weeks before the forum. The majority of the post-surveys were collected on paper immediately following the forum, but a few were collected online the following week. The overall number of participants with complete pre-and-post surveys is 61.

Respondents were asked both before and following the OCFF to rate their level of concern about several environmental issues that are impacting coastal communities on a 0 to 10 scale. The following analysis includes an aggregate measure of overall concern that combines all of the issues as well as an analysis for each issue individually. The question wording was as follows, and the order in which the issues appeared was randomized:

> *Listed below are several issues that may impact the natural environment and human health. On a scale from 0 to 10, with 0 being not at all concerned and 10 being extremely concerned, how concerned are you about each of the following?*
>
> * *Loss of biodiversity*

- *Changes in South Carolina's shoreline*
- *The contamination of coastal waters*
- *Sea-level rise*
- *Flooding in your local area*
- *Drought in your local area*
- *Changes in the chemical balance of the oceans*
- *An increase in infections resistant to antibiotics*
- *An increase in the intensity of hurricanes*
- *The quality of natural waterways such as streams, lakes, and rivers in your local area*

To examine learning as shifts in the mean of concern as well as shifts in variance, I examine changes following the OCFF using paired sample t-tests for the means and F-tests for the variance. For overall change, I used an aggregate measure where I combined each issue on a single 0 to 10 scale for both the pre and post-measures. The Cronbach's α for the pre-aggregate measure is 0.898 and for the post measure it is 0.85, which indicates that concern for one issue is closely related to concern for the other issues.

Results

First, to test H1 and H2 I examine the distribution of the overall concern measure followed by the distributions for each issue. Then, to test H3 I examine the association between aggregate concern following the OCFF and two measures of self-reported learning. Finally, I conclude with representative example statements from an open-ended question about whether participants felt they changed as a result of the OCFF.

Concern about Issues

Looking first to overall concern, Figure 2 shows the kernel density distribution of the aggregate concern measure as well as a histogram of the pre-and-post difference (post-forum concern — pre-forum concern) in aggregate concern. Additionally, the left panel of Figure 2 shows the differences in the mean, $\Delta \bar{X}$, and the difference in variance, Δs^2 for the measure of overall concern.

As shown in Figure 2, the post-forum mean of 8.62 was significantly higher, at $p<0.05$, than the pre-forum mean of 8.16. In addition, the post-forum variance (1.032) was significantly lower than the pre-forum variance (2.05). These findings support both H1 and H2 for the aggregate measure of concern.

The right panel of Figure 2 shows a histogram of the difference of aggregate concern pre-and-post the OCFF. As can be seen, 24 or 0.36%, of participants either had no change or a decrease in aggregate concern following the forum. However, the vast majority of participants, 48 or 0.72%, saw an increase in concern.

The findings regarding overall concern indicate support for the belief change and belief reinforcement hypotheses in the aggregate; however, there are likely some differences concerning the individual issues. Next, I examine changes in mean and variance for each of the 10 issues and those results are shown in Figure 3 and Table 1.

Figure 2: Aggregate Concern and Difference in Aggregate Concern Pre-and-Post Forum
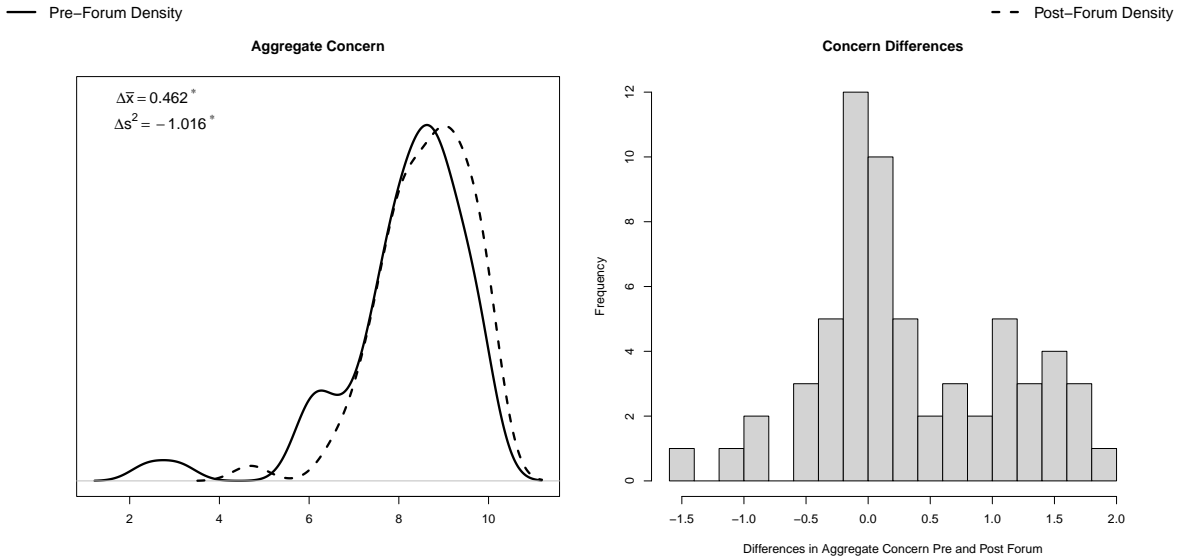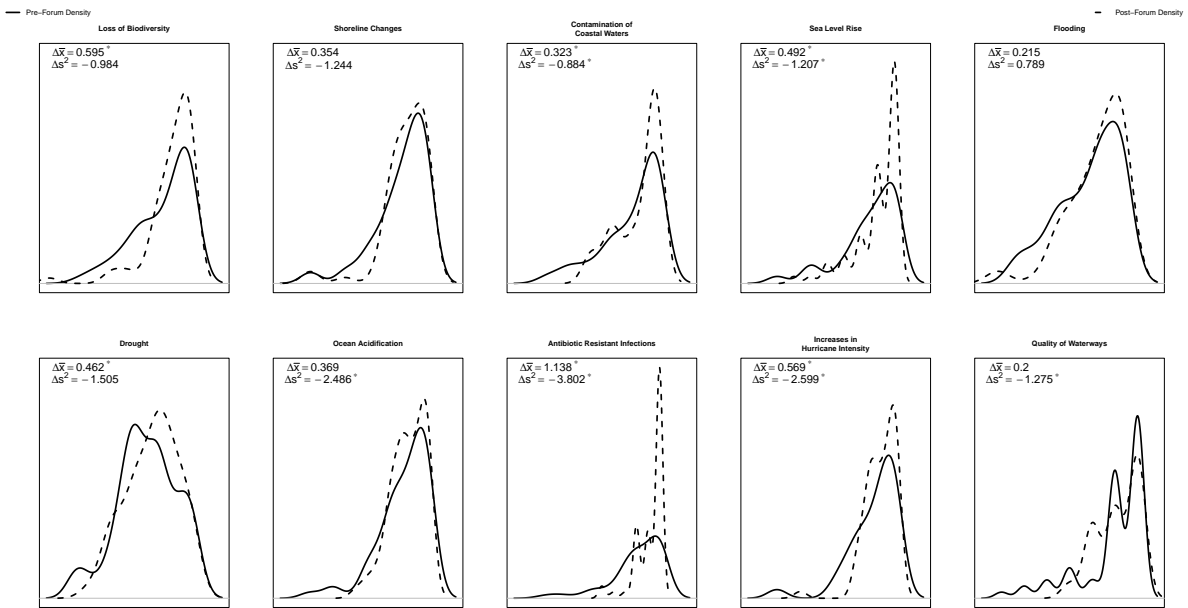
Pre−Forum Density   Post−Forum Density

Aggregate Concern

$\Delta\bar{x} = 0.462^*$

$\Delta s^2 = -1.016^*$

Concern Differences

Frequency

Differences in Aggregate Concern Pre and Post Forum

Figure 3: Concern about each Issue Pre-and-Post Forum

Pre−Forum Density   Post−Forum Density

Loss of Biodiversity

$\Delta\bar{x} = 0.595^*$
$\Delta s^2 = -0.984$

Shoreline Changes

$\Delta\bar{x} = 0.354$
$\Delta s^2 = -1.244$

Contamination of Coastal Waters

$\Delta\bar{x} = 0.323^*$
$\Delta s^2 = -0.884^*$

Sea Level Rise

$\Delta\bar{x} = 0.492^*$
$\Delta s^2 = -1.207^*$

Flooding

$\Delta\bar{x} = 0.215$
$\Delta s^2 = 0.789$

Drought

$\Delta\bar{x} = 0.462^*$
$\Delta s^2 = -1.505$

Ocean Acidification

$\Delta\bar{x} = 0.369$
$\Delta s^2 = -2.486^*$

Antibiotic Resistant Infections

$\Delta\bar{x} = 1.138^*$
$\Delta s^2 = -3.802^*$

Increases in Hurricane Intensity

$\Delta\bar{x} = 0.569^*$
$\Delta s^2 = -2.599^*$

Quality of Waterways

$\Delta\bar{x} = 0.2$
$\Delta s^2 = -1.275^*$

On a scale from 0 to 10, with 0 being not at all concerned and 10 being extremely concerned, how concerned are you about...

Looking first at Figure 3, as can be seen, some issues saw a belief change (i.e., a significant, at $p<0.05$ using a one-tailed test, increase in concern); a change in certainty (a significant decrease in variance); changes in neither belief nor certainty; or changes in both. Visually, the most dramatic changes seem to be associated with contamination of water, sea-level rise, antibiotic resistant infections, and increases in hurricane intensity with each of these issues showing an increase in the mean of concern (i.e., belief change) as well as a decrease in variance (i.e., belief reinforcement).

Table 1 shows the mean and variance values, the statistical significance, and the learning outcome including no learning, belief reinforcement, change, or change and belief reinforcement for each issue.

Table 1: Pre-and-Post Forum Mean and Variance for Concern about Issues

	Pre-Forum Mean (Variance)	Post-Forum Mean (Variance)	Learning Outcome
Aggregate Concern	8.159(2.048)	8.622***(1.032***)	Change & Reinforcement
Individual Issues			
Loss of biodiversity	8.328(3.452)	8.923*(2.478)	Change
Shoreline changes	7.923(5.385)	8.277(4.141)	No Learning
Contamination of water	8.923(1.978)	9.246*(1.094*)	Change & Reinforcement
Sea-level rise	8.492(3.129)	8.985*(1.922*)	Change & Reinforcement
Flooding	8.446(2.345)	8.662(3.135)	No Learning
Drought	6.108(6.691)	6.569*(5.186)	Change
Ocean acidification	8.046(4.701)	8.415(2.215***)	Reinforcement
Infections	8.062(5.246)	9.20***(1.444***)	Change & Reinforcement
Hurricane intensity	8.246(4.438)	8.815*(1.840***)	Change & Reinforcement
Quality of waterways	8.923(2.135)	9.123(0.897***)	Reinforcement
Observations	61	61	

Note: One-tailed test $^*p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

As can be seen in Table 1, two issues, shoreline changes and flooding, saw no learning (i.e., no changes in mean or variance); two issues, ocean acidification and waterway quality, saw belief reinforcement; two issues, loss of biodiversity and drought, saw a belief change; and four issues, contamination of water, sea-level rise, infections, and hurricane intensity saw both changes in belief and belief reinforcement.

Beliefs and Self-Reported Learning

Belief changes associated with learning should move in the direction of the information that individuals and/or collectives consider within a policy context. I argue, for the purposes of this study, that belief change is measured by a significant shift in beliefs in the direction of information. I posit in H3 that respondents that had high levels of concern about the issues following the OCFF would be more likely to indicate that they learned, which would provide evidence that beliefs are associated with self-reported learning.

As part of the post-forum survey, participants were also asked their views of the deliberative forum and a few of these questions were intended to assess learning. Specifically, in the post-forum survey participants

were prompted with, *A goal for this forum was to help participants learn enough about these issues to reach an informed decision*, then participants were asked if they *believe they learned enough to make an informed decision* on a scale from 1 (definitely not) to 5 (definitely yes). The mean for the question was 4.32 on the 1-5 scale, which indicates that, on average, participants felt they learned about the issues as a result of the forum.

Additionally, following the OCFF participants were also asked, *Did you change your opinion on these issues as a result of the discussion, or are your views mostly the same*? Overall, 10 or 16.39% of participants indicated that their views are *entirely* the same as before, 33 (54.1%) indicated their views are *mostly* the same as before, and 23 (37.7%) indicated that their views *changed somewhat* following the forum. However, no participants indicated their views change completely.

As noted, a significant increase in the level of concern is assumed to be indicative of belief change. Therefore, higher levels of concerns post-forum should be associated with self-reported learning as measured by the *learned enough to make an informed decision* and the *views change* questions (see H3). To examine this hypothesis, I used OLS regression to measure the association between post-forum aggregate concern (0 to 10 scale) and learning (1-5 scale) and views changed (0-4 scale) while controlling for pre-forum levels of aggregate concern. The results are shown in Table 2.

Table 2: OLS Analysis of Learning and if Views Changed Pre-and-Post Forum

	Dependent variable:	
	Learning	Views Changed
Aggregate Concern Pre-Forum	−0.058	−0.125
	(0.090)	(0.109)
Aggregate Concern Post-Forum	0.309**	0.280*
	(0.110)	(0.133)
Constant	2.111***	−0.161
	(0.593)	(0.716)
Observations	61	61
Adjusted R^2	0.170	0.049
Note:	$^*p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$	

Table 2 shows that, on average, as aggregate concern increased participants were more likely to indicate that they learned and that their views changed. Specifically, a one-point increase in aggregate concern is associated with a 0.309 increase in the 1-5 learning scale. For the views changed question, a one-point increase in concern is associated with a 0.28 increase in the 0-4 scale. These results indicate support for H3.

Open-Ended Comments

The goals of the OCFF were to assist participants in learning more about the environmental issues impacting coastal communities as well as learning more about how decisions are made regarding these issues in their communities. To further gauge the impact of the OCFF, we asked respondents if they felt they had changed as a result of participating in the forum.

Some people leave processes like this feeling the same as when they came. Others leave feeling differently about government, themselves, and other citizens. How about you? Do you think that this process has changed you?

- *YES, I changed*
- *NO, I didn't change*

Overall, 65%, or nearly two-thirds, of participants indicated that they had changed as a result of the OCFF. Next, participants were also asked, in an open-ended question, to indicate how they did (or didn't) change. Some representative example responses to the open-ended responses are below and include changes related to belief as well as behavior changes:

Beliefs

I have a broader area of concerns and considerations

Climate change more of a threat

I feel more educated of some of the issues, and I feel like I have a better sense of the interconnectivity of the issues

_I am more convinced / passionate about the urgency of caring for our environment. These are not concerns for the distant future, but for today.

More informed on the issues facing us

Regarding beliefs, many participants expressed that their beliefs had changed following the OCFF. Some examples of belief changes include broader concerns, a heightened view of the risks from climate change, and the risk posed by climate change in the present. Another common theme related to beliefs was that respondents felt more educated and knowledgeable following the forum.

Behaviors

I'm more interested in being proactive to affect climate change

I want to become more involved locally with town halls and planning

... I am more inclined to get involved in local efforts

I intend to set goals to get more involved

Policy-oriented learning involves not only belief change but also subsequent changes in behavior. A second common theme of the open-ended responses involved participants expressing an intention to become more involved in environmental issues, particularly at the local level.

Not all participants indicated that they changed, with 35% indicating they had not changed as a result of the OCFF. Some of the comments of those that indicated that they did not change include:

I knew the information presented by the experts and was already aware of the complexities of the issues

I have gone through similar processes in the past, so the forum was not new to me

The process reinforced for me the need for public involvment and engagement in coastal resource issues

It didn't change my views because everything we learned and discussed strengthened my existing viewpoint

Affirmed and strengthened my concerns but didn't change my views

Two common themes were present in the open-ended respondents of those that indicated they had changed. The first was that they already knew enough about the issues, and the second was that the information provided only reinforced their views. Interestingly, in the minds of the OCFF participants belief reinforcement does not seem to be associated with learning.

Discussion

Outcomes of policy-oriented learning include not just belief change, but also belief reinforcement. However, including change and reinforcement as learning outcomes adds to the challenges of conceptualizing and measuring policy learning. In this paper, I argued that understanding beliefs as probability distributions provides a way to account for both belief change (i.e., a significant shift in the mean) and belief reinforcement (i.e., a significant shift in variance) as outcomes of policy-oriented learning within a single model of learning. Then, based on the model I posited three hypotheses about belief change, belief reinforcement, and beliefs and self-reported learning. Finally, I used data from a deliberative forum to explore the potential of the model to measure learning as belief change and/or reinforcement by testing the three hypotheses.

I found that participants in the deliberative forum demonstrated each of the expected learning outcomes of the model including no learning, belief reinforcement, belief change, and belief reinforcement and change. Regarding the hypotheses, with the first hypothesis, I posited that participants would exhibit a belief change, specifically a significant increase in concern about the issues following the forum. I largely found support for H1 with participants becoming more concerned in the aggregate as well as across six of the ten issues.

For the second hypothesis, I posited that uncertainty around concern for the issues would decrease following the forum. H2 was supported as variance decreased following the OCFF for aggregate concern as well as for six of the ten issues.

Finally, with the third hypothesis, I posited that beliefs would be associated with self-reported learning. Specifically, H3 stated that as concern increased participants would be more likely to feel that they learned. The results provided support for the H3 with increasing levels of concern post-forum associated with an increased

likelihood for participants to say that they learned and that their views changed as a result of the OCFF. Additionally, the open-ended responses of those that indicated they changed included mentions of increased levels of concern, which provides further evidence of the connection between beliefs and self-reported learning.

Overall, the findings provided support for each of the hypotheses. In addition, the findings supported the argument that the direction of learning is anchored by the information. In both the aggregate and the individual issues, concern shifts consistently moved in the direction of the information provided before and during the OCFF. Further support is offered based on the connection between self-reported learning and increased aggregate concern, which shows that movement in the direction of the information was associated with learning in the minds of the participants.

An additional finding was that in the aggregate concern as well as in four of the ten issues, participants experienced both belief change and reinforcement. These findings indicate that participants both changed their beliefs as they became more concerned about the issues and became more certain about their beliefs (i.e., how concerned they should be about the issues) as a result of the deliberative forum. While this was one of the expected outcomes of the model, it is under-theorized in the broader literature. Further research is needed to examine some possible causes and consequences of learning as both change and reinforcement.

Another potential learning outcome is an increase (as opposed to a decrease) in uncertainty associated with the belief. In such a scenario, the beliefs do not change but policy actors become less certain of the belief. That was not a result that occurred in this study; however, it follows that an increase in uncertainty would be a necessary precursor to belief change. This potential outcome points to the need to examine the process implications of the policy-oriented learning model. Along these lines, it is likely that learning is iterative and moves from less certainty to belief change, typically over time. This is the central idea of the enlightenment function associated with policy-oriented learning (Jenkins-Smith et al. 2018; Weiss 1977). Understood in this way learning would occur as uncertainty increases until the point in which a belief change occurs.

Further research is also needed about the information processing aspects of the model. Apart from beliefs moving in the opposite direction, I argued that learning – either change or reinforcement – should also be understood to occur when beliefs shift in the direction of information. For this study the information implications were clear; participants should and did, move in the direction of more concern about the issues. However, the policymaking process is awash in multiple information signals that contain conflicting directions (e.g., climate change is a risk and climate change is not a risk) or are ambiguous with information that does not present a clear direction in which beliefs should move. As noted by Jones and Baumgartner (2005), the central factor is not the amount (or direction) of information but rather to which signals policy actors pay attention. In this way, the model presented here connects to the learning and information processing model (see Nowlin 2021) because belief change or reinforcement results from the particular information that is processed. Just like the model in Nowlin (2021), learning is posited to move in the direction of the information.

Additionally, future research needs to examine the time aspect, or how long-lasting are the belief changes. Panel data would be needed to examine the longevity of learning (e.g., Weible, Olofsson, and Heikkila 2022). Also, other measures of certainty could be employed, such as simply asking respondents how certain they are in their views (e.g., Jenkins-Smith et al. 2020). Finally, future research should examine the policy-oriented learning model with clearly identified policy beliefs such as deep core, policy core, and secondary aspects.

Conclusion

Policy learning is an important component of policymaking, and as a result, it is a feature of several of the most prominent theories of the policymaking process. The ACF in particular considers policy-oriented learning to be a key aspect of the framework and a facilitator of policy change. Policy-oriented learning is understood as enduring changes in beliefs, which lead to changes in behaviors. Despite its importance, policy learning – policy-oriented learning in particular – needs some theoretical clarity given how difficult it is to conceptualize and measure.

One conceptually challenging aspect of policy-oriented learning is that both belief change and belief reinforcement are considered to be learning outcomes. To account for this, I developed a model with beliefs, including deep core, policy core, and secondary aspects, being understood as having distributions with central tendencies and variance. With learning understood in this way, belief change can be measured as a change in the central tendency, and belief reinforcement can be seen as a change in the variance.

I tested the policy-oriented learning model with data from a deliberative forum to provide a proof-of-concept for this approach to understanding learning outcomes. Overall, I find support for the model as participants exhibited changes in both beliefs and belief certainty following the forum. Yet, more research is needed to further develop this approach across different contexts.

References

Albright, Elizabeth A., and Deserai A. Crow. 2021. "Capacity Building Toward Resilience: How Communities Recover, Learn, and Change in the Aftermath of Extreme Events." *Policy Studies Journal* 49(1): 89–122.

Bessette, Joseph M. 1997. *The Mild Voice of Reason: Deliberative Democracy and American National Government*. Chicago, IL: University of Chicago Press.

Crossan, Mary M., Henry W. Lane, and Roderick E. White. 1999. "An Organizational Learning Framework: From Intuition to Institution." *The Academy of Management Review* 24(3): 522–37.

Dunlop, Claire A., and Claudio M. Radaelli. 2013. "Systematising Policy Learning: From Monolith to Dimensions." *Political Studies* 61(3): 599–619.

Escobar, Oliver, and Stephen Elstub. 2017. *Forms of Mini-Publics: An Introduction to Deliberative Innovations in Democratic Practice*. Sydney, New South Wales: newDemocracy Foundation.

Fishkin, James S. 2020. *Democracy When the People Are Thinking: Revitalizing Our Politics Through Public Deliberation*. Oxford: Oxford University Press.

Gastil, John, and Katherine Knobloch. 2019. *Hope for Democracy: How Citizens Can Bring Reason Back into Politics*. Oxford: Oxford University Press.

Gerlak, Andrea K., and Tanya Heikkila. 2011. "Building a Theory of Learning in Collaboratives: Evidence from the Everglades Restoration Program." *Journal of Public Administration Research and Theory* 21(4): 619–44.

Gerlak, Andrea K., Tanya Heikkila, Sharon L. Smolinski, Dave Huitema, and Derek Armitage. 2018. "Learning Our Way Out of Environmental Policy Problems: A Review of the Scholarship." *Policy Sciences* 51(3): 335–71.

Heikkila, Tanya, and Andrea K. Gerlak. 2013. "Building a Conceptual Approach to Collective Learning: Lessons for Public Policy Scholars." *Policy Studies Journal* 41(3): 484–512.

———. 2019. "Working on Learning: How the Institutional Rules of Environmental Governance Matter." *Journal of Environmental Planning and Management* 62(1): 106–23.

Henry, Adam Douglas, Karin Ingold, Daniel Nohrstedt, and Christopher M. Weible. 2022. "Advocacy Coalition Framework: Advice on Applications and Methods." In *Methods of the Policy Process*, eds. Christopher M. Weible and Samuel Workman. New York, NY: Routledge, 105–36.

Jenkins-Smith, Hank C., Daniel Nohrstedt, Christopher M. Weible, and Karin Ingold. 2018. "The Advocacy Coalition Framework: An Overview of the Research Program." In *Theories of the Policy Process*, eds. Christopher M. Weible and Paul A. Sabatier. New York, NY: Westview Press, 135–72.

Jenkins-Smith, Hank C., Joseph T. Ripberger, Carol L. Silva, Deven E. Carlson, Kuhika Gupta, Nina Carlson, Ani Ter-Mkrtchyan, and Riley E. Dunlap. 2020. "Partisan Asymmetry in Temporal Stability of Climate Change Beliefs." *Nature Climate Change* 10: 322–28.

Jenkins-Smith, Hank C., and Paul A. Sabatier. 1993. "The Dynamics of Policy-Oriented Learning." In *Policy Change and Learning: An Advocacy Coalition Approach*, eds. Paul A. Sabatier and Hank C. Jenkins-Smith. Boulder, CO: Westview Press, 41–56.

Jenkins-Smith, Hank C., Carol L. Silva, Kuhika Gupta, and Joseph T. Ripberger. 2014. "Belief System Continuity and Change in Policy Advocacy Coalitions: Using Cultural Theory to Specify Belief Systems, Coalitions, and Sources of Change." *Policy Studies Journal* 42(4): 484–508.

Jones, Bryan D., and Frank R. Baumgartner. 2005. *The Politics of Attention: How Government Prioritizes*

Problems. Chicago, IL: University Of Chicago Press.

Kammermann, Lorenz, and Mario Angst. 2021. "The Effect of Beliefs on Policy Instrument Preferences: The Case of Swiss Renewable Energy Policy." *Policy Studies Journal* 49.

Nabatchi, Tina. 2012. "An Introduction to Deliberative Civic Engagement." In *Democracy in Motion: Evaluating the Practice and Impact of Deliberative Civic Engagement*, eds. Tina Nabatchi, John Gastil, G. Michael Weiksner, and Matt Leighninger. Oxford: Oxford University Press, 3–17.

Nowlin, Matthew C. 2021. "Policy Learning and Information Processing." *Policy Studies Journal* 49(4): 1019–39.

Pattison, Andrew. 2018. "Factors Shaping Policy Learning: A Study of Policy Actors in Subnational Climate and Energy Issues." *Review of Policy Research* 35(4): 535–63.

Pierce, Jonathan J., Holly L. Peterson, Michael D. Jones, Samantha P. Garrard, and Theresa Vu. 2017. "There and Back Again: A Tale of the Advocacy Coalition Framework." *Policy Studies Journal* 45(S1): S13–46.

Ripberger, Joseph T., Kuhika Gupta, Carol L. Silva, and Hank C. Jenkins-Smith. 2014. "Cultural Theory and the Measurement of Deep Core Beliefs Within the Advocacy Coalition Framework." *Policy Studies Journal* 42(4): 509–27.

Sabatier, Paul A., and Hank C. Jenkins-Smith. 1993. *Policy Change and Learning: An Advocacy Coalition Approach*. Boulder, CO: Westview Press.

———. 1999. "The Advocacy Coalition Framework: An Assessment." In *Theories of the Policy Process*, ed. Paul A. Sabatier. Boulder, CO: Westview, 117–66.

Weible, Christopher M., Kristin L. Olofsson, and Tanya Heikkila. 2022. "Advocacy Coalitions, Beliefs, and Learning: An Analysis of Stability, Change, and Reinforcement." *Policy Studies Journal* Forthcoming.

Weiss, Carol H. 1977. "Research for Policy's Sake: The Enlightenment Function of Social Research." *Policy Analysis* 3(4): 531–45.

Willis, Rebecca, Nicole Curato, and Graham Smith. 2022. "Deliberative Democracy and the Climate Crisis." *WIREs Climate Change* 13(2): e759.

Zaki, Bishoy Louis, Ellen Wayenberg, and Bert George. 2022. "A Systematic Review of Policy Learning: Tiptoeing Through a Conceptual Minefield." *Policy Studies Yearbook* 12(1).