DISSERTATION

LET'S TALK ABOUT FACTS:

ASSESSING THE USE OF EVIDENCE IN PUBLIC POLICY

Submitted by

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ABSTRACT

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Scholars and practitioners of public policy often assert that evidence **-** the full body of information with which policy actors engage to form and communicate their policy preferences – should be used in the process of public policy making. Furthermore, proponents of evidence-based policy state that evidence should be derived from methodologically rigorous sources. Despite this common decree, debate persists concerning which types of evidence should and are actually used by policy actors as well as the factors that influence its use. Normative differences among scholars have resulted in a disjointed approach to understanding the use of evidence in public policy as well as a lack of uniform discourse across disciplines. In response, I develop an integrative framework for assessing the use of evidence in public policy and test the framework by evaluating the use of evidence in the Diablo Canyon Nuclear Power Plant debate unfolding in San Louis Obispo County, California. The development of an integrative framework serves to unify the disparate scholars assessing the use of evidence by providing a common set of concepts that can be used to evaluate evidence use, interactions, and impacts. Subsequent analysis helps to not only test the efficacy of the framework but provides insight into who uses evidence where and when as well as what helps to predict evidence selection. The dissertation thus contributes to the existing literature on the use of evidence in public policy in two ways: by providing an integrative framework and advancing understanding of how evidence is used in public policy.

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Overview of the Dissertation

Facts are simple and facts are straight
Facts are lazy and facts are late
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Facts don't do what I want them to...
- "Crosseyed and Painless" by The Talking Heads

It is often asserted that the best public policy is evidence-based policy (EBP) and that the best EBP utilizes a very specific type of evidence. Specifically, EBP advocates for the use of methodologically rigorous, empirical evidence to make policy decisions (Bell 2004; Cairney 2016; Deeming 2013; Hess and Adams 2002). Despite preferencing facts derived from specific methodologies, debates concerning what constitutes evidence, which types are "best," and which types are actually used by policymakers endure across the myriad disciplines that consider the use of evidence in policy, politics, communication, and human cognition. While this debate cannot be settled within the pages of a single dissertation, the work herein critically examines the use of evidence in public policy in order to develop an integrative framework for assessing its use in public policy and then apply its concepts to a case study. As such, it contributes to a more recent but growing body of literature that seeks to better understand the dynamic and complex ways that actors come to utilize diverse sources of information in the policy process and its impacts (Jennings and Hall 2011). It advances the literature by drawing upon perspectives of evidence across disciplines, developing an integrative framework, then testing its efficacy and applying it to policy process research.

I do not attempt to take a normative stance on what constitutes evidence or what types should be used in public policy but instead aim to synthesize and build upon a disparate literature

with the goal of developing a more holistic and encompassing framework for assessing the use of evidence in policymaking. While EBP asserts which types of evidence should be used, it does not tell us what types are actually used, by whom, why, or how. The initial analysis is therefore not situated within a specific level of government (i.e. local, state, or federal), focused on a single actor or subgroup of actors (i.e. public versus bureaucrats), or a particular stage in the policy process (i.e. agenda setting or policy analysis). Instead, the framework seeks to capture the ways in which diverse actors may interact with evidence at any stage of the policy process, across levels of government, and within any policy environment. This is done so the integrative framework can be applied and assessed in a diverse range of cases and a broad aray of scholars.

The primary aim of analysis is to determine what types of evidence policy actors engage with in the policymaking process and what factors influence the types of evidence used by policy actors. I present an integrative framework for assessing the use of evidence in policymaking that integrates a broad array of literature seeking to answer these same questions. Without such a framework for analysis, the study of evidence in policymaking may remain disjointed. The development of an integrative framework strengthens the focus of research assessing evidence in public policy. A successful framework will provide a platform from which further research on evidence in policy can be organized and inspired.

Frameworks are considered, "a structure, overview, outline, system or plan consisting of various descriptive categories, e.g. concepts, constructs or variables, and the relations between them that are presumed to account for a phenomenon" (Nilsen 2015). In this sense, the framework seeks to identify and define those "concepts, constructs or variables" that influence the type of evidence used in policymaking in order to produce an "overview" of the "phenomenon" of how one might understand or assess the use of evidence in public policy. This

avoids the potential downfalls of framework building such as creating catch all models by including only determinate variables and identifying their relationship to one another (Ostrom 2007). The framework provides a foundation for future evaluation and the continuation of theory building around the connection between various elements of the framework and the use of evidence.

I begin by introducing the theoretical rationale for the development of an integrative framework for assessing evidence in public policy. In order to arrive at such a broad understanding of evidence in policy, we must first examine the current state of the literature including how EBP became a norm for government, what those methodological norms are, the types of evidence frameworks that have been developed to date, and how they could be improved. This review serves as the theoretical rationale for developing an integrative framework for evidence in policymaking and subsequent applications. The review includes a description of the institutionalization of EBP as well as critiques of EBP. Then, current frameworks and models of the use of evidence in policy are detailed and reviewed within the context of emerging critiques of EBP to demonstrate the need for additional improvements. Most notably, the review demonstrates that many frameworks fail to include the true diversity of information considered by policy makers, the psychology of actors and how it can affect the use of evidence, time, and policy outcomes. Overall, the review provides a justification for the development of an integrative framework for evidence in public policy.

The theoretical rational is followed by three unique research projects. In Project 1, I present the integrative framework for evidence in policymaking as well as identify and define its concepts. I then develop a codebook to demonstrate how the framework can be applied to research and for use in subsequent chapters. In Project 2, I test the framework by utilizing the

codebook developed in Project 1 to evaluate the use of evidence in public policy over time. In Project 3, I again utilize the framework developed in Project 1 to interrogate enduring questions within the Advocacy Coalition Framework (ACF) and Narrative Policy Framework (NPF) related to the strategic use of evidence. Namely, the project examines whether coalitions or actors drive evidence selection. Overall, results demonstrate that core concepts from the integrative framework for evidence in policy developed in Project 1 can further the study of evidence within theories of the policy process and beyond.

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Chapter 2

Theoretical Rationale

I. Introduction

In this section, I provide a theoretical rationale for studying evidence-based policy (EBP) In particular, I describe the institutionalization of EBP within the United States government including common approaches to EBP such as randomized controlled trials (RCTs) and cost-benefit analysis (CBA). It then provides a critique of evidence-based policy in order to justify the need for enduring critical examination of the use of diverse sources of information in the policy process. Next, some frameworks of evidence within the literature are detailed and reviewed within the context of critiques of EBP to demonstrate the need for additional improvements. Most notably, the review demonstrates that many frameworks fail to include the true diversity of information considered by policy makers, the psychology of actors and how it can affect the use of evidence, time in the policy process, as well as policy outcomes. While many frameworks capture one or two of these dimensions, none to date captures the true complexity of EPB by including evidence, psychology, process, and policy. This review thus demonstrates the need for an integrative framework of evidence in the policy process that captures and synthesizes these diverse elements into a single framework. Such a holistic framework can then provide a foundational body from which future researchers can dissect discrete areas for examination.

II. History of Evidence-Based Policy in the United States

Evidence-based policy is broadly considered a movement within government to use more empirical, methodologically rigorous sources of information such as those obtained through randomized control trials rather than rooted in anecdote or intuition to identify, design, fund,

implement and manage more effective policies and policy outcomes (Baron 2018; Cairney 2016; Heinrich 2017; Jennings and Hall 2011). The institutionalization of EBP can be traced along two paths beginning in the 1930s (Stone 2002)[1]. This first path emerges in the same decade following the development of cost-benefit analysis (CBA) as a standard method for evaluating and comparing policy alternatives (Ibid.). The second begins just after World War II in the 1940's and concerns the establishment of randomized controlled trials (RCTs) as a preferred means for verifying the viability of a policy intervention (Baron 2018). A review of these parallel developments in codified EBP within federal and state governments helps to illustrate the establishment of such norms as an enduring standard in U.S. policymaking over the last century.

The application of cost-benefit analysis to public policy began in the United States with the issuance of the U.S. Flood Control Act of 1936 which required that water resource projects be evaluated both in terms of their costs and benefits (Boardman 2001). This primarily applied to projects proposed by the U.S. Army Corps related to flood mitigation and harbor expansion (Stone 2002). It was not until the 1980's during the Reagan administration that CBA was codified through an executive order and required for all federal regulatory initiatives in the form of a regulatory impact assessment (RIA). An RIA differs from a CBA only in that it also requires consideration of distributional effects. In the following decade the United States reaffirmed its commitment to CBA through the issuance of another executive order under the Clinton administration. Other acts established at the time such as the Clean Air Act Amendments (1990) and the Government Performance and Results Act (1993) have CBA requirements for different phases of policy making including mandates for its use following policy change to evaluate

[1] Throughout this dissertation, I define institutionalize and institutionalization as "the action of establishing something as a convention or norm in an organization or culture" (New Oxford American Dictionary)

outcomes and during policy formation and selection. Overall, CBA is used in a diverse range of policy settings in order to weigh potential policy solutions against one another.

In addition to executive orders and congressional acts, CBA has also been upheld extensively in the courts further institutionalizing its use as a preferred method of EBP. This trend is most evident within environmental policy. Most notably, the courts have allowed the use of CBAs for policies where there is not a direct mandate for its use while also conducting close reviews and criticizing CBAs they find to be insufficiently rigorous or methodically flawed (Cecot 2020; Sunstein 2005). The results of court opinion on CBA have differed substantially in its effects leading in some cases to more rigorous policy evaluation while in others halting policy making altogether such as in the case of the EPA's attempt to ban asbestos in the 1990's (Cecot 2020). Here, a critical review of CBA methodology by the courts deterred the EPA from pursuing bans of chemicals under the Toxic Substances Control Act (Ibid.). Despite varying effects, the combined support of CBA across branches of the federal government have resulted in what some have referred to as a CBA consensus or revolution that has grown in strength since the 1980's (Ackerman and Heinzerling 2002; Boardman et al. 2014; Cecot 2020; Sunstein 2005).

Today, CBA is widely used by the Office of Management and Budget (OMB) in order to assess the financial impacts of proposed policy changes while overseeing the decisions of other regulatory agencies within the federal government (Weimer and Vining 2017). At the same time, the OMB provides standardized values for use in CBA across agencies such as discount rates for calculating future effects (Boardman 2001; Sunstein 2005). The codification of CBA in federal policy has diverted enormous sums of funds to the practice in order to comply with regulations. In the 1980's, for example, it was estimated that conducting CBA cost the EPA more than $100 million annually (Boardman 2001). While this consensus demonstrates that CBA has been

increasingly instituted overtime as a standard method for evidence-based policymaking, its application evolved alongside another prominent approach to EBP, that of randomized controlled trials.

The institutionalization of RCTs as evidence-based policy in the United States parallels the history of CBA and can be traced back to the post-World War II era of the 1940's and 1950's. RCTs at this time became particularly prominent in the realm of health policy (Baron 2018; Cairney 2016; Oliver, Lorenc, and Innvaer 2014; Stone 2002). This was due in part to medical advancements moving from generalizable and anecdotally observable interventions such as sanitation measures to those whose successes needed to be quantified through more discerning experimentation. As such, early conceptions of evidence-based policy came to be defined as interventions validated through rigorous methods, especially randomized controlled trials (RCTs) (Baron 2018; Cairney 2016). Most notably, one of the first RCTs conducted in 1954 demonstrated the effectiveness of the Polio vaccine which would later eradicate the disease from the United States populace (Baron 2018). The success of RCTs in identifying viable interventions for the advancement of public health eventually led to their adoption by the U.S. Food and Drug Administration (FDA) in 1962 as the standard of approval for new medicines and medical devices (Junod, nd.). Codifying the use of RCTs within the FDA thus identified the method as the preferred source of evidence for policy decisions and directed significant funding to the development of sophisticated trials.

A similar adoption of RCTs for social policy took longer with codification of the method not occurring until the late 1980's within the U.S. Departments of Health and Human Services (HHS) to justify welfare interventions (Baron 2018). This decision was based on decades of successful RCT evaluations of social policies ranging from post-incarceration programs to the

effects of providing low-cost preschool to children from communities with low socioeconomic standing. This again signaled the efficacy of RCTs by directly funding or facilitating more than 85 studies concerning work-to-welfare policy during the 1980's and 1990's. The findings gleaned from these studies and eventually implemented into welfare policy reform had effects that reached far beyond the United States and were adopted by Canada, Australia, and countries across Europe. From here, the use of RCTs in policy continued to expand to diverse areas of social policy. Most notably, throughout the 2000's randomized control trials were applied to education programs and eventually used to evaluate development programs for international aid.

Finally, the establishment of the Coalition for Evidence-Based Policy established in 2001 and their enduring partnership with the United States Office of Management and Budget (OMB) further institutionalizes the government's preferencing of RCTs and an enduring trend toward EBP (Jennings and Hall 2011). The Coalition for Evidence-Based Policy is a "non-profit, nonpartisan organization" that, "...seeks to increase government effectiveness through the use of rigorous evidence about what works" citing RCTs as a preferred method (Coalition for Evidence-Based Policy nd; Jennings and Hall 2011). With guidance from the coalition in 2004, the OMB developed its first guidelines for evidence-based policy at the federal level and, "identified well-conducted RCTs as the strongest method for evaluating program effectiveness" (Baron 2018). While the coalition transitioned to the Laura and John Arnold Foundation in 2015, its impact on federal agencies and congressional funding of RCT programs persists today (Coalition for Evidence-Based Policy nd). For example, three congressionally funded RCT programs were ongoing as of 2017 including the Department of Education's Education Innovation and Research program, the Maternal, Infant, and Early Childhood Home Visiting Program (HHS), and the Teen Pregnancy Prevention Program (HHS). Outside of OMB

partnerships, the Environmental Protection Agency (EPA) adopted new rules in 2021 requiring that decisionmakers reference studies that utilize data that can be independently verified and replicated (EPA 2023). These programs and others created in conjunction with the Coalition for Evidence-Based Policy are unique in that they are the first to award grants solely to programs able to prove their effectiveness through required and repeatable RCT testing (Baron 2018).

The brief history of evidence-based policy reviewed here indicates that RCTs were institutionalized across various sectors of the federal government ranging from public health policy to welfare, education, international aid, and more. However, it should be noted here that RCTs and CBA are not the only forms of rigorous, empirical evidence encouraged by the federal government. The OMB states that in cases when evaluation via RCTs is not possible, that agencies should pursue quasi-experimental techniques or other methodologically sound approaches (Jennings and Hall 2011). Despite the acknowledgement of other information sources, these recommendations demonstrate a preference towards a particular type of information gathering. Namely, these preferences are rooted in rationalist tradition which seeks to obtain an objective truth, one that separates facts from beliefs or the messier political aspects of policy problems (Keller 2009; Stone 2002). The history of the institutionalization of RCT in federal agency policy making, especially when considered in tandem with applications of CBA, most aptly demonstrates this phenomenon.

While the institutionalization of RCT and CBA are detailed here to provide a clear example of how EBP became normalized in policymaking, it must be noted that these methodologies are not the only prioritized in EBP. EBP preferences the use of any methodologically rigorous source of information gathering. Such methods may include quasi-experimental studies, non-experimental evaluations, systematic reviews, cohort studies, case-

control studies, surveys, and other quantitative and qualitative methods (Petticrew and Roberts 2002). EBP can thus be equated to policy based on empirical information to rationalize the decision-making process (Cairney 2016; Stone 2002; Keller 2009). From here forward, empirical and methodologically rigorous will be used to describe evidence preferenced under EBP.

What we fail to consider in the codification of EBP as a rational approach to decision-making that preferences empirical methodologies however, is the implications of this decision for society more broadly. In particular, it is important to ask what the impacts of privileging specific types of information are, why empirical methodologies are continually preferenced beyond their ability to verify the effectiveness of an intervention, and what other sources of evidence are used by policy actors. Observations such as these have inspired growing literature that not only critiques normative desires of EBP as traditionally defined, but also if, when, how, and which types of evidence are actually employed in the policy making process and why. Here we will begin to see the ideal EBP institutionalized as RCTs and CBA as the gold-standard for policy making turn into a complex and variable process where diverse factors influence the adoption of policy beyond the presence of rigorous evidence. A review of the literature evaluating and critiquing the use of evidence-based policy demonstrates that diverse sources of evidence are and often should be considered in policy making.

III. Critiques of Evidence-Based Policy

Traditional Approaches to Evidence-Based Policy

It may be an obvious assertion to state that sources of evidence as a body of information exist in a diversity of forms beyond those gleaned through empirical methodologies. Such alternatives include personal observation, public opinion, qualitative studies, or advice from experts, among others (Cairney 2016). This thus begs the question why methodologically

rigorous sources continue to be preferenced and placed at the top of the hierarchy of information gathering techniques (Kano and Hayashi 2021)? As Baron (2018) asserts, the institutionalization of RCT in the policies of the FDA, "...transformed the RCT in medicine from a rare and controversial method that had first appeared in the medical literature only 15 years earlier...into the widely used gold standard for assessing the effectiveness of all new drugs...". It is the coupling of the codification of such methodologies into policy and its transformation from a rare to a dominant source of evidence that provides a hint to its continued preference and the consequences of that privileging. It is through the institutionalization of particular sources of evidence we give power to its credibility and delegitimize other types. In other words, the trend of equating EBP to empirical methodologies is a self-reinforcing process that promotes the expansion of the practice through policy prescriptions and funding despite its original standing as an uncommon rather than rigorous methodology. As RCTs and other empirical methodologies were chosen by federal agencies again and again, it was able to acquire and maintain a dominant position in policy making despite the presence and importance of other evidence. Still, the question persists why evidence-based policy in this manner?

The preferencing of empirical methods is rooted in a rationalist tradition within the United States government and American culture more broadly. Here, the rationalist tradition is defined as the idea that there are objective means of evaluation that can assess alternatives in a way that is devoid of the personal interests or values of actors (Keller 2009; Stone 2002). In other words, when a problem arises, there is a correct solution, and this solution can be identified via apolitical means. Rationalist desires within the United States government can be traced back to seminal writings by Woodrow Wilson in the late 1800's calling for the establishment of a discipline concerning the science of public administration (1887). Wilson states that,

"...administration lies outside the proper sphere of politics. Administrative questions are not political questions. Although politics sets the tasks for administration, it should not be suffered to manipulate its offices" (Ibid.). Wilson further asserts that it is the duty of administrators to "straighten the paths of government," and "purify its organization," in order to do things with, "the utmost possible efficiency" and thus find, "the best way" (Ibid.). As a result, policy actors are to be technicians rooted in a science of administration where science serves as a vehicle of liberation from political will. This desire for a "neutral competence" is evident in the organization of federal branches of government itself with Congress managing political dimensions of policy and executive offices carrying out orders (Weber 1978; Wilson 1887; Keller 2009). Here we can observe rationalist ideals taking root early within the formation of modern bureaucracy in the United States.

Rationalist ideals themselves are rooted in conceptions of how individuals and thus policy actors process information. Wilson's ideal policy actor is conceptualized as rational, capable of consulting the full range of information available, weighing the facts objectively and then making a decision based on these findings devoid of personal biases and values. In reality however, we know that individuals are "boundedly rational" or restricted by constraints such as time and resources and therefore consult only a limited amount of information before making a decision, relying on mental shortcuts that are rooted in values known as "satisficing" (Lindblom 1959; Simon 1957). Within this process, such cognitive phenomenon as motivated reasoning and hot cognition dominate which causes one to primarily consider only information that aligns with their existing preferences or preferred solutions leading to biased decision-making (Kraft, Lodge, and Taber 2015; Lodge and Taber 2013; Zaller 1993). Rationalist processes such as RCTs and CBA are meant to provide a codified procedure in order to prevent cognitive processes that may

lead to biased decision-making from taking over. However, as will be demonstrated later in this chapter, there are opportunities for valuation even in rationalist approaches to EBP. Furthermore, information derived from methodologically rigorous sources are seldom the only sources of evidence used in decision-making concerning policy (Cairney 2016).

Within this context, the institutionalization of empirical methodologies as evidence-based policy is simply an extension of normative ideals concerning how government should operate that have dominated since at least the 1800s (Jennings and Hall 2011; Stone 2002). Efficiency in government extends from objective and neutral actors relying on rational methods of decision-making devoid of political will. Insight derived from methodically rigorous sources provide the means for administrators to arrive at "the best way," with "the utmost possible efficiency" (Wilson 1887). By codifying evaluative processes like CBA, these methods presumably eradicate the political while elevating neutral information to be assessed by technical administrators who act based on mandated procedure rather than personal values. While on the one hand this standard of operation gets us close to an ideal government in the image of Woodrow Wilson, it has been critiqued by many as an inaccurate conception of policy making (Ackerman and Heinzerling 2002; Boardman 2001; Cairney 2016; Heinrich 2007; Hess and Adams 2002; Jennings and Hall 2011; Mosley and Gibson 2017; Sunstein 2005). However, before diving into such criticisms, as they are myriad, it is important to first note all that rationalism codified as EBP has accomplished given its enduring place as a primary means for decision making.

The "rationality project," as Deborah Stone (2002) terms this trend in government, is not without its successes. As is evident in the history detailed above, rational approaches to policy making in the form of RCTs and CBA resulted in not only effective policy within the United

States but produced programs that were implemented in diverse countries (Baron 2018). There is likely not a major policy in place today whose passing was not aided by some sort of evidence-based practice. Broad support for a rational approach to policy making is further evident in the establishment of various institutions that promote its use ranging from the Coalition for Evidence-Based Policy to master's programs in public policy and administration at universities which teach policy analysis rooted in CBA to its students. Similar trends have emerged internationally in other highly developed countries. For example, the Cochrane Collaboration based in the United Kingdom provides meta-analysis of heath research in order to offer evidence-based policy solutions (Cochrane 2022; Heinrich 2007). In addition, much like the U.S., the Australian Office of Best Practice Regulation (OBPR) provides a codified system for conducting RIAs in order to, "...ensure high-quality and rigorous analysis equips us with the best possible information to support decision making" (The Office of Impact Analysis 2019). Combined, these trends demonstrate the success of a rational and evidence-based approach to policy making both domestically and abroad. Given the ubiquity and success of rationalist approaches to policy making, it is not the goal of this assessment to advocate for an alternative but instead illuminate critiques, other sources of information, and the overall complexity of the use of evidence. Evidence-based policy will and should continue.

Proponents continue to attest that empirical methodologies have a place in evidence-based policymaking. Namely, some state that CBA is a useful tool for identifying how much money to spend on a particular policy. In other words, CBA can help assess when additional spending may not lead to more benefits thus freeing up funds for other more advantageous policy (Livermore and Revesz 2011). This in turn can provide accountability for government action (Ibid.). Finally, CBA is inherently utilitarian in its goal to maximize benefits for the majority

while permitting costs to only a few. Generally, utilitarianism, though not without its criticisms, is considered an acceptable aim of democracy (Boardman 2001). As we will see in the next section, for each success and accolade of rationalist approaches to EBP there are criticisms as well. While no issue is black and white, it is important to review the critiques of rational methods in order to gain a more well-rounded understanding of the use of evidence in policymaking.

The Problem with Traditional Approaches to Evidence-Based Policy

The primary problem with EBP as empirical methodologies is that it is not the only way of knowing in the world. It more often aligns with an attempt to reach a perceived ideal way of knowing rather than a practical one. In other words, rationalism seeks to eliminate biases and values while failing to acknowledge that these characteristics are inherent to individuals and intrinsically tethered to the facts or evidence they encounter in daily life (Campbell 2002; Mosley and Gibson 2017; Stone 2002). As a result, rationalist approaches fail to consider the ways that biases and values impact even the most rigorous of methodologies. In this way, the "rationality project" fails in its goals by turning a blind eye to the reality of the true nature of individuals. While rational processes can steer the minds of decision makers towards certain policies identified via the rigorous methods prioritized under EBP, the process itself cannot eliminate the role of personal preferences entirely. Indeed, a decision must often be made between multiple viable but differing policies and how and why that decision is made exists outside the process of RCTs and CBA. Put simply, evidence-based methodologies offer a buffet of choices however, it is up to individuals which dishes they add to their plate or whether they choose to eat at the EBP buffet at all. Critiques of EBP seek to highlight the role of the individual in decision-making and illuminate other options of evidence-based fare beyond empirical methodologies in order to provide a more pragmatic perspective of evidence in policy making.

Rational choice theory asserts that individuals consciously use rational calculations including an internal cost-benefit analysis in order to make rational choices that align with their personal goals (Lovett 2006; Satz and Ferejohn 1994; Smith 1776). In this way, individuals are inherently self-interested making decisions that align with their personal preferences. While rational choice remains a pervasive theoretical perspective within the social and behavioral sciences, it is also one that has sparked an enduring debate between its proponents and dissidents. Seminal critiques assert that rational choice theory has a low rate of empirical success, and that analysis is biased towards cases that confirm its assumptions rather than identifying false claims (Hindmoor 2010; Green and Shapiro 1994). Others state that contextual factors beyond self-interest often motivate decision-making such as social norms, emotions, environmental context and framing (Ostrom 1990; Nyborg 2018). At the most basic level, rational choice theory is considered an oversimplification of human decision making and assumes that individuals have the capacity to act rationally. If individuals indeed use their own internal calculation methods akin to the methodologies preferenced by EBP, then a closer examination of such methods can provide greater insight into the complexities of rationally defined processes of decision-making.

The value-laden quality of empirical methods preferenced within EBP is perhaps most evident in the case of cost-benefit analysis especially when one considers the procedural aspect of the practice. CBA often begins with defining the problem then moves to developing policy alternatives, valuing impacts, comparing alternatives and finally, making a recommendation. Problem definition is the first instance in which values may find their way into cost-benefit analysis. This step entails identifying the problem and then framing it in a way that identifies a cause to be rectified, often conceptualized in terms of a market or government failure (Weimer

and Vining 2017). The chosen frame, however, is often selected either at the discretion of the policy analyst or by the client for whom the analysis is to be conducted (e.g. a government agency, non-profit, or advocacy group). In this way, the problem definition can vary greatly for the same issue depending on the interests of the individual or organization conducting the analysis. In turn, different problem definitions can lead to different outcomes for the remaining steps of the CBA. For example, defining a problem as a market failure versus a government failure will lead to vastly different policy alternatives in the proceeding step. This discretionary element of cost-benefit analysis is at the core of common critiques of the practice as a value-laden process rather than a rational ideal of decision-making.

In addition to problem definition, discretionary decisions are also particularly prominent in the process of valuing the cost and benefits of policy alternatives. Oftentimes, in order to comply with the process of CBA, monetary dollars must be assigned to costs and benefits that are not clearly financial in nature. Non-monetary costs and benefits include the value of a life lost or saved, time spent or saved, air quality, or the conservation of coastline. When costs or benefits of a policy alternative do not have clear monetary values, it is up to the analyst to determine such dollar amounts based on their own best judgement. While in some circumstances agencies such as the OMB provide standard values for ambiguous costs such as that of a life, for others a universal value remains contested and unclear. In this way, analysts have the potential to again inject their own biases or those of their organization when deciding the costs and benefits of a policy. This could, for example, lead industry to conclude that greenhouse gas mitigation is too costly to justify limited benefits but the EPA to argue such action is not only sound but financially feasible according to their own analysis. This exact scenario occurred with the formation of the Clean Power Plan under the Obama administration. The discretionary aspects of

assigning costs and benefits further demonstrate that even CBA can be used to promote policy in alignment with certain values rather than simply provide neutral options.

A final important aspect to discuss concerning the attachment of values to CBA is the process of policy evaluation. Within CBA, certain criteria are chosen from which to compare the potential impacts of proposed policies. Common criteria include efficiency, effectiveness, equity, and political feasibility. While these criteria are common, they are not required, indicating that an analyst or organization can change these measures based on their own interests in order to preference policies that might better align with their own goals versus those of others. This echoes the impact of discretionary decision-making in other aspects of CBA and its direct effect on outcomes. As Weimer and Vining state, "policy analysis, like life itself, forces us to confront conflicts among competing values" (2017). They suggest, in the face of such conflict, that the analysist must choose to voice their concerns to their client in an attempt to potentially change values, exit the organization, or act loyally/disloyally. Such explicit discussions of the role of values for both the analyst and client in a prominent CBA textbook exemplifies the fact that the pervasive subjectivity of the empirical approach to EBP is well known and only serves to strengthen the arguments of its critics. The very use of CBA to determine policy makes explicit the rational values of government in the United States and other developed countries as well as a preference for economic or monetary value above all others.

Thus far, we have identified the subjective aspects of one method of EBP despite assertions that these methods can achieve objectivity. As critics continue to point out, if we know that even empirical evidence is value-laden and not the only way of knowing, then why do we often fail to value more diverse sources of information in EPB? Hess and Adams (2002) in their review of the literature relating to the changing conceptions of knowledge in public

administration points to a cultural shift in perceptions moving away from a rationalist perspective and towards a more holistic one. Through historical analysis, they identify a shift in the public narrative concerning policy ideas from those focusing on economic questions to those related to social concerns. They assert that questions related to human capital are more qualitative in nature and thus defy traditional, rational methods that seek to quantify policies and outputs. Much like the criticism related to valuation in cost benefit analysis, social dimensions include aspects such as trust, community, and deliberation. In direct response to this shift, public administrators have been forced to change what they consider valid evidence in order to more aptly integrate these new ideas and thus the support of the public. As a result, the definition of knowledge is actively changing from a rationalist perspective to a more interpretive or constructivist perspective following the dominance of rationalist approaches since the 1980's (Hess and Adams 2002).

This analysis thus aptly answers the question why rationalism has dominated within public policy for so long. The answer is that such approaches are embedded in a historical and cultural trend in policy preferences rooted in rationalism. Furthermore, because trends are subject to change, knowledge preference can change in response. It is not surprising in an era dominated by wicked problems with human survival at its core such as a global pandemic and the climate crisis, that both the interests of the public and administrators are shifting in response. Much like the institutionalization of empirical methodologies as EBP, this shift in preferences is evident in the governments' both verbal and codified commitment to social concerns. For example, a focus on justice, communities, and tribes was made explicit in the Biden administration's Infrastructure Investment and Jobs Act (2022) which echoes a trend towards preferences beyond those related to economics. Centering communities in future decision making will thus necessitate a

consideration of their own knowledge which is unlikely to be quantified in more empirical terms but imbued with personal values, biases and experiences. Here, a shift towards knowledge constructed via diverse sources is evident.

Those scholars who have critically examined the use of evidence in the policy process have seldom found a strict adherence to rigorous methodologies despite its codification by leading institutions (Cairney 20116). They assert that while these sources of information are used, they are often considered in tandem with others, if at all. Alternative sources of information considered in the policy process include, but are not limited to, grey literature, or reports produced by non-publishing organizations (i.e. government reports, white papers, conference proceedings etc.), public opinion, legal precedence, anecdotal evidence of success, expert advice and community knowledge (Berry and Berry 2017; Burstein 2009; Carcasson 2018; Floridia 2018; Keller 2009; Lomis and Brown 2009; Luzi 2000; MacDonald et al. 2012; McClymont Peace and Myers 2012; Smith-Walter et al. 2016). This demonstrates that while methods like RCT and CBA assist policymakers in rational decision-making, they are not the only or primary means through which policy is chosen.

It should be noted here again that the critiques of EBP reviewed herein are not an argument to do away with such methods. It instead is intended to demonstrate that a focus on these particular methods provides only a partial and inaccurate understanding of how evidence operates in relation to policy. It is meant to show that values are involved in policymaking, that even rationalist approaches cannot be devoid of such valuations, and that other types of evidence are considered. As stated in the introduction, the analysis presented herein is not normative; it does not take a supportive nor disapproving stance towards EBP or its associated methodologies. This review simply demonstrates the types of information preferenced within EBP as well as

how those preferences might be changing in order to paint a more accurate picture of evidence-based policy. A comprehensive understanding of evidence in policy will indeed include sources of information such as CBA and RCTs.

The review of rationalism and its alternatives herein points to the problem with this approach. Namely, the rigorous methodologies EBP preferences no longer accurately captures policy goals nor represents the full spectrum of evidence utilized by policy actors. In other words, in rational policy making's attempt at being a neutral process, it fails to acknowledge the value-laden context in which such evaluations are conducted. While it is a normative assertion, it would seem more advantageous to model an accurate or pragmatic depiction of how evidence is used and understood in policy making rather than stick to ideals concerning an unattainable goal. Given that conceptions of evidence in public policy are actively evolving, the opportunity to reassess the literature and develop a new framework for assessing evidence in the policy process is ripe. A new framework would thus situate itself within the context of a constructivist perspective of knowledge and seek to inject and relate this into existing examinations of evidence in the policy process. First, a review of existing models of evidence in policy making is necessary in order to determine if such a revision is appropriate and if so, how such improvements might be made. In response, the proceeding section provides a review of current frameworks of evidence in policymaking.

IV. Frameworks of Evidence in Public Policy

Given the institutionalization of rational approaches to evidence-based policy since the 1980's, scholars have begun to examine the role of evidence in the policy process. Some have attempted to develop a descriptive framework of the use of evidence in order to assist both producers and consumers of such information understand best practices. While these frameworks

are emerging, they are limited in scope often rooted in public health policy focusing on RCTs and other experimental designs or seek to understand what types of evidence are used in which phases of the legislative process. Few consider the psychological dimensions of policy actors in order to understand why individuals may or may not consider certain sources of evidence as discussed above. Furthermore, frameworks to date do not consider the type of policy that results from the consideration of different sources of evidence nor the mechanisms by which information might induce policy change. As a result, frameworks of evidence to date fail to model a comprehensive picture of its use across policy arenas including both rigorous methodologies and alternative sources of information, the policy process, policy type, actor psychology, and effects. In the proceeding section, current frameworks of evidence are reviewed in order to identify where improvements are needed. The critique provides a justification for the development of a new framework.

A review of the literature reveals only six sources to date that identify some framework, model, or hierarchy of evidence (Cairney 2016; Hasson, Leviton, and Thiele Shwarz 2020; Jennings and Hall 2011; Kano and Hayashi 2021; Mosley and Gibson 2017; Petticrew and Roberts 2002). Included in this review is Cairney's (2016) sweeping review of the literature on evidence in the policy process which seeks to describe mechanism that affect its use. While not a framework, Cairney's work is the first major step towards a more comprehensive model of evidence as proposed herein and is important for informing such work. Two of the six articles focus exclusively on the health sector (Hasson, Leviton, and Thiele Shwarz 2020; Petticrew and Roberts 2002), one on the environment (Kano and Hayashi 2021), one on foster care (Mosley and Gibson 2017), one on the use of evidence at the state level (Jennings and Hall 2011), and one a mix of public health and the environment (Cairney 2016). Three articles focus exclusively on

empirical methods, particularly randomized controlled trials and other experimental designs (Hasson, Leviton, and Thiele Shwarz 2020; Kano and Hayashi 2021; Petticrew and Roberts 2002). The others ask what types of evidence are used by states (Jennings and Hall 2011), at each stage of the legislative process (Mosley and Gibson 2017), and how politics impacts the use of evidence in policy (Cairney 2016).

The literature assessing traditional approaches to EBP provides one framework (Kano and Hayashi 2021), one hierarchy (Petticrew and Roberts 2002), and one typology (Hasson, Leviton, and Thiele Shwarz 2020). Kano and Hayashi's (2021) framework for implementing evidence in environmental policymaking provides a guide for assessing the quality of scientific evidence specifically. They provide five measures of assessment including methodological rigorousness, consistency, proximity, social appropriateness, and legitimacy. Within their rigorousness to measure they provide a hierarchy of appropriate methodologies with randomized controlled trials at the top followed by quasi-experiments and observational studies. Next, Petticrew and Roberts' (2002) hierarchy of evidence in public health provides a matrix demonstrating how different methods can be matched to various questions concerning the same problem. They include eight rigorous methodologies including RCTs, quasi-experimental studies, non-experimental evaluations, systematic reviews, cohort studies, case-control studies, surveys, and qualitative research (i.e. information derived from its standardized methodologies). Last, Hasson, Leviton, and Thiele Shwarz's (2022) typology provides a description of what types of design qualities can provide more useful information in health care. Rather than describe the type of evidence often used in that space, they assert that study design should focus on the description, context, and design of the intervention, implementation strategies, context, and

outcome to make results more explicit. While this does not require a specific methodology, the paper primarily discusses exemplary cases involving randomized controlled trials.

Combined, these studies demonstrate a focus on empirical methods within the fields of public health and the environment. This is done despite indications that such sources are not the only types of information considered by policymakers, even within the fields of public health where RCTs were originally applied. Furthermore, Hasson, Leviton, and Thiele Shwarz's (2022) fail to consider factors that might influence the consideration of studies beyond the quality of their design. While Kano and Hayashi's (2021) do mention social appropriateness, they too focus on methodological design stating that studies should consider, "ethical, legal, and social factors" rather than aligning with perceptions of appropriate evidence, for example. While these frameworks of evidence in policymaking do provide a useful resource for those trying to identify and produce quality sources of evidence, they fail to explain how, when, why, and what types of evidence are used. Overall, they primarily identify appropriate methodology combined with quality design as drivers of use.

The following two studies evaluate evidence more descriptively asking what types of evidence are used by states (Jennings and Hall 2011) and at various states of the legislative process (Mosley and Gibson 2017). Jennings and Hall (2011) in their survey of state agency directors, demonstrate that actors rely on diverse sources of information ranging from staff, other agencies, and consultants, to professional literature, scientific studies, and formal evaluations. Overall, they found use of 19 unique sources of evidence. When weights of evidence were considered, agencies most heavily relied on information from internal agency staff followed by research and formal valuations. Based on their work they suggest their own framework for evidence in agency policy utilizing a two-by-two matrix. On one axis of the matrix lies conflict

while on the other scientific capacity. They assert that a low conflict agency with high scientific capacity such as the CDC or FDA is more likely to be evidence based than a high conflict, low-capacity agency such as an arts council. As a result, the use of evidence in policy can be potentially predicted based on agency characteristics. Mosley and Gibson (2017) find in their review of California foster care policy that different types of evidence are preferenced at various stages of the legislative process. Namely, when members are soliciting co-sponsors and committee approval they rely on empirical research, however under review of the appropriations committee they use CBA, and then in the voting stages rely on personal narratives for persuasion.

While the assessments of Jennings and Hall (2011) along with Mosley and Gibson (2017) identify what type of evidence are used by states and at various stages of the legislative process, they fail to identify what may cause this variation beyond conflict and scientific capacity. The former studies mentioned above also lack explanatory analysis. It is here that the final examination of evidence in policy listed in the review and conducted by Cairney (2016) becomes an informative assessment of EBP. Cairney (2016) takes a broader perspective of what constitutes evidence similar to Jennings and Hall (2011) and Mosley and Gibson (2017) but expands explanatory causes to include psychological factors as well as politics more broadly. In this way, Cairney offers a more practical perspective of evidence in the policy process in order to help those interested in influencing policy better understand why their information is considered or not and how to more effectively navigate the process of policy making.

Cairney (2016) asserts, much like the critics of rationalism discussed above, that EBP is an ideal that seldom occurs perfectly as proponents would desire in the real world. Just as rationality is bounded, EBP is bounded due to the same constraints as time, resources, and

knowledge given that policy is made by actors with these psychological limitations. These limitations thus explain that despite preferences within EBP towards rational methods such as RCTs and CBA, more diverse sources of information are used in the policy process. As a result, Cairney (2016) asserts it is more advantageous for proponents to understand and adjust to the policy process rather than expect a particular type of information to win out because it is simply assumed to be a superior type of evidence. Instead, those seeking to alter policy outcomes need to frame their evidence in accordance with policymaker's "beliefs and incentives." This further necessitates an understanding of the policy process overall, at what stages which type of information is used, and the knowledge preferences of an advocacy coalition or subgroup. Cairney (2016) thus asserts that if advocates are able to adjust themselves to the policy process, then more evidence would be used and we would move closer to the ideal principle of evidence-based policy rather than the bounded version experienced now.

Combined, the frameworks, typologies, hierarchies and critical analysis presented here demonstrate synthetic approaches to understanding how evidence is used in the policy process. While individually they provide pieces to the overall puzzle of EBP, there is still a lack of a holistic framework that demonstrates findings to date and combines all dynamics affecting the use of evidence. If, as Cairney (2016) asserts, understanding the complexity of evidence in policymaking is necessary to achieving the goals of EBP, then such a framework is needed in order to better inform both practitioners and scholars alike. Furthermore, at a time when the literature concerning evidence in policy is growing, establishing a standard framework of evidence based off findings and theoretical developments to date will aid in focusing the research moving forward. In particular, the new framework must include both evidence, those factors influencing its use, as well as effect. In addition, the framework must not operate from a

normative assumption of empirical methodologies but acknowledge the diverse types of information used by policymakers. This proposed framework will be fully explained and developed in Project 1. Given the limitations of current models as detailed above, a new framework is warranted to address existing shortcomings such as a lack of causal explanations, actor psychology, policy change overtime, and how evidence may (or may not) induce policy change.

V. Conclusion

Evidence-based policymaking is increasingly touted as a best-practice approach to policy change in the United States and beyond. In response, approaches to EBP have been institutionalized within government since the 1930's and most increasingly since the 1980's under the Reagan administration. While evidence-based approaches can be found in most policy spheres, they have been most successfully implemented in the fields of public health and social welfare where the empirical methodologies have taken precedent. These methodologies have been institutionalized by law, reinforced in the courts, and supported by powerful non-profits. In response to this trend, scholars have sought to better understand the use of evidence in the policymaking process identifying hierarchies of information (Hasson, Leviton, and Thiele Shwarz 2020; Kano and Hayashi 2021; Petticrew and Roberts 2002) and variation in the use of certain types of evidence across agencies and legislative stages (Jennings and Hall 2011; Mosley and Gibson 2017). What these studies reveal is that while there are many instances of evidence-based policy where preferred and codified methods are used, other times more diverse sources of information are referenced by policymakers. As a result, many critique EBP as it has been institutionalized by government and advocate for a more broad and pragmatic perspective of evidence in policymaking.

Critiques of EBP primarily assert that institutionalized methodologies are rooted in a rationalist approach to policymaking and fail to acknowledge how evidence is understood and used in the real world. Primarily, a focus on empirical methodologies negates other forms of knowing and sources of information individuals rely on such as community or indigenous knowledge, anecdotal stories of success and agency expertise. Furthermore, certain psychological factors including cognitive shortcuts cause individuals to reject evidence that does not align with their beliefs. Last, individuals are limited by time and resources meaning they are unable to fully explore the full scope of information concerning a policy issue before making a decision. These combined factors demonstrate that humans are boundedly rational, meaning that personal biases and constraints cause them to only consider a limited amount of information in the world. Therefore, rather than an ideal, EBP is bounded by the same constraints as the psyches of the individuals that make policy decisions. As a result, it is important to understand not only what types of information are considered evidence by policymakers but when in the policy process information is used and to what effect. To date, the literature seeking to synthesize such knowledge is limited and offers opportunity for further development.

Rather than integrate the breadth of knowledge concerning the use of evidence in public policy ranging from psychological factors to stages of the policy process, current frameworks focus on singular aspects and are thus limited. For example, many existing frameworks are rooted in rationalist perspectives and focus on the prioritization of empirical scientific methods such as RCTs (Hasson, Leviton, and Thiele Shwarz 2020; Petticrew and Roberts 2002). Others simply identify what types of information are used at various stages of the legislative process and levels of government (Jennings and Hall 2011; Kano and Hayashi 2021; Mosley and Gibson 2017). While these approaches are informative, they fail to capture a holistic understanding of

the factors affecting the use of evidence in public policy. As a result, the development of such a framework is necessary for both academic analysis and practitioners seeking policy change. While this chapter presents the theoretical justification for the development of a new framework of evidence in public policy, the following chapter develops and details the components of such a framework.

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Chapter 3

Project 1: Developing an Integrative Framework for assessing the Use of Evidence in Public Policy

I. Introduction

That evidence should be used in the policymaking process is a normative assertion made by practitioners, the public, and even legal precedence (Cairney 2016; Jennings and Hall 2011; Heinrich 2007; Hess and Adams 2002; Prewitt et al. 2012). The movement toward evidence-based policy (EBP) is imbued with the assumption that evidence is factual, objective and thus the best means of making decisions. Despite this near universal decree, evidence as defined by EBP is not always translated into policy solutions and furthermore, there is no consensus on what constitutes quality evidence (Cairney 2016). As a result, the literature addressing the use of evidence in public policy is disparate with some developing the very information needed to inform policy solutions, others determining hierarchies of evidence for use, and still more attempting to understand why, how, and when evidence is used in public policy. The disjointed nature of the literature is problematic for not only those who desire evidence-based policymaking but also those who study the use of evidence in policy (Bell 2004; Cairney 2016; Deeming 2013; Heinrich 2007; Kano and Hayashi 2021; Prewitt et al. 2012). Without a clear roadmap of how evidence is used in policymaking, interested individuals are left lost with no clear route to their ultimate goal whether it be effectively sharing the evidence they have or if that evidence will be considered by policymakers. In response to this problem, this project develops an integrative framework for assessing and evaluating the use of evidence in public policy.

To date, EBP preferences the use of rigorous methodologies of empirical analysis ranging from quantitative and qualitative analysis to randomized control trials, cost-benefit analysis and

quasi-experiments among others (Deeming 2013; Jennings and Hall 2011; Kano and Hayashi 2021). As a result, current frameworks that seek to explain the use of evidence in policymaking often focus exclusively on these types of evidence (see Hasson, Leviton, and Thiele Schwarz 2020; Kano and Hayashi 2021). This occurs despite enduring contentions concerning what type of information should and does constitute evidence that is considered by policymakers and stakeholders (Bell 2004; Deeming 2013). Namely, critics assert that evidence preferenced by EBP is grounded in rationalist traditions that fail to encapsulate a more complex understanding of evidence (Cairney 2016, Hess and Adams 2002). It is therefore imperative to develop a framework of evidence that encapsulates the full range of evidence employed by policy actors while also capturing the psychological and other factors that impact its use (Cairney 2016). The framework presented herein is thus integrative in the sense that it integrates both definitions of evidence and concepts that impact its use across a wide array of perspectives and disciplines.

This project begins by providing a more holistic definition of evidence that includes not only the empirical, methodologically rigorous approaches preferenced by EBP but conceptions that span a wide array of disciplines. It then presents the integrative framework and reviews and defines its various components. To demonstrate its usefulness for scholars, the project concludes with the development of a codebook based on the framework that can be utilized in research projects concerning the use evidence in public policy.

II. Defining Evidence in Policymaking

For the purposes of developing an integrative framework, evidence is defined broadly as *the full body of information with which policy actors engage to form and communicate their policy preferences.* This definition is formulated in response to the large body of literature contesting the nature of evidence. Reviewing the full extent of literature that contributes to this

definition of evidence is far beyond the scope of this paper and could indeed span several novels itself, however the enduring debate concerning facts primarily seeks to differentiate between rational and pragmatic notions of evidence. The definition presented here is thus necessary to produce a framework of evidence that is truly integrative and does not take a normative stance towards which types of evidence *should* be utilized by policy actors. Rather, the framework and this definition of evidence attempts to characterize and understand what types of evidence *are* employed by policy actors. In order to demonstrate the breadth of the definition of evidence presented herein, both the traditional and critical views of evidence-based policy are reviewed in turn.

The traditional perspective of evidence-based policy is rooted in a rationalist approach and assumes that evidence is objective representing an ultimate truth or fact (Stone 2002). As a result, evidence provides a solution in and of itself and we need only know what the facts are in order to make sound judgements. From this perspective, evidence is often equated with science, resulting from rigorous methods such as randomized controlled trials and other quasi-experiments (Cairney 2016; Hansen 2014; Keller 2009). However, despite extensive evidence in accordance with such standards, public policy problems persist and solutions lack effectiveness. This observation has led many to search for a more pragmatic assessment of evidence as it functions in our world. Namely, others assert that information cannot be separated from rhetoric (Mosley and Gibson 2017). In other words, while information itself has the potential to represent a neutral fact, as evidence it is often used to persuade others on a particular matter. The court room provides an apt metaphor for evidence in this sense. Often, an entire jury is necessary to decide how compelling, or persuasive, the same evidence is towards a guilty ruling.

A critical examination of the definition of evidence provides insight into the assertion that information cannot be separated from its interpreted element. Evidence is most broadly defined as, "the available body of facts or information indicating whether a belief or proposition is true or valid" (New Oxford American Dictionary). In other words, evidence is, "an argument or assertion backed by information" (Cairney 2016). It is this innate linkage between evidence, beliefs and argument that gives credence to the assertion that evidence itself is often constructed, contested, and subjective. Information cannot speak for itself but is instead given meaning by the actors who create, use, and share such evidence. In this sense, evidence is inherently political. That is, facts are malleable and capable of both constructing and contesting arguments, often simultaneously. Evidence, therefore, is value laden and cannot be separated from the political processes that seek to reconcile these values within our society. From this perspective we can then assert that evidence represents something far from an objective truth which we may normatively desire. Instead, the nature of evidence is ever changing and used strategically by those actors who seek to make their case (Stone 2002).

These combined definitions of evidence help determine its role in policymaking. As an objective, rational ideal, evidence is passive but as a subjective construction, evidence takes on a more active and complex role. In this sense, evidence is both objective and subjective in policymaking. The character of evidence explains what it is and can be defined as a type including information ranging from scientific studies to community-based knowledge (Cairney 2016). The role of evidence explains how it is used and can include such intents as legitimization, persuasion, and learning (McBeth, Shanahan, and Jones 2005; McBeth et al. 2010; Shanahan, Jones, and McBeth 2011; Shanahan et al. 2008; McBeth and Shanahan 2010). It is through types that evidence takes form as its objective ideal but it is through its role that

evidence becomes a subjective and pragmatic mechanism for change. Evidence as subjective, has the potential to impact the actors who encounter it. The primary goal of this impact is to affect the decisions of policy actors by supplying information that supports or contests their policy positions. In this way, the subjective nature of evidence is the source of both its power and importance in the policymaking process. Its connection to argumentation and beliefs innate in its basic definition gives evidence to its affective capabilities. Evidence thus demonstrates affect by providing an opportunity for policymakers to become more rational in their decision making through their consideration of diverse types of information (Harding 1992). Here, evidence becomes an active mechanism for potential policy change (James and Jorgensen 2009; Jenkins-Smith et al. 2017). To more fully understand the potential affective nature of evidence, we must also review the psychology of policymaking.

Theories of the policy process contest with the complex nature of evidence as both objective and subjective. The Advocacy Coalition Framework (ACF), and the Narrative Policy Framework (NPF) most directly address evidence. ACF in its explanation of policy beliefs asserts that evidence can be used to construct the way that actors view a policy problem. Policy belief systems within the ACF are generally considered a means to simplify and understand the world leading to a general stance on issues and instrumental means to achieve policy goals. The ACF thus states:

> "Belief systems are not, however, simply abstract representation of values and priorities but also encapsulate policy actors' perceived causal patterns and relationships that shape the empirical world. A major source of this causal representation in a given context is scientific and technical information that can point to specific causal relations, problem attributes, and, sometimes, policy alternatives. To better understand policy processes is thus to understand how scientific and technical explanations are integrated into (or deflected from) belief systems, used in political debates and negotiations, and integrated with other forms of knowledge, especially local knowledge (Jenkins-Smith et al. 2017)."

The NPF builds off of the ACF by asserting that actors primarily demonstrate their policy beliefs or preferences through the construction of policy narratives. Within this framework, narratives are assumed to be humans' primary means of understanding the world including complex information. Evidence, actors, causal mechanisms, and preferences can come together to tell a story about a particular policy problem. As a result, and as the quote above suggests, the NPF assesses when and how different types of evidence are utilized in policy debates. Combined, the ACF and NPF demonstrate that while evidence functions as objective information, it is also used by policy actors to construct meaning and beliefs concerning an issue.

Following this brief review of the contentions surrounding the nature of evidence, the term is again defined here as *the full body of information with which policy actors engage to form and communicate their policy preferences*. The term "f*ull body of information*" is used to indicate the framework seeks to identify all evidence referenced by policy actors not just that required by law or preferenced by proponents of EBP. "*Policy actors*" are defined as any individual or group of individuals who actively engages in the policy process. Finally, the phrase "*with which policy actors engage to form and communicate their policy preferences*" is used to denote that evidence is both a body of information from which policy actors draw and is also a tool that they use to construct arguments about their policy preferences and beliefs. Like the framework itself, this definition of evidence is thus integrative in that it encapsulates diverse perspectives of evidence.

The goal is to develop an integrative framework of evidence in public policy which takes a neutral stance towards which types of evidence should be preferenced as well as the ways that evidence is utilized by policy actors. In response, the framework adopts the holistic definition of evidence presented above to fully demonstrate how evidence is used in policymaking rather than

provide a prescriptive or normative approach. Based on the definition of evidence provided above, evidence has both an objective and subjective role in public policy. Within the framework, the objective role of evidence is operationalized as types of evidence and its valence or whether it has been institutionalized as a norm in the context of traditional approaches to evidence-based policy. The subjective role of evidence is operationalized as the factors that influence its use including the policy environment, psychology, time, and setting. In the next section, the integrative framework for assessing evidence in public policy is presented. Then, the various components of the framework are identified and defined in turn.

III. The Integrative Framework for Evidence in Public Policymaking

Frameworks are considered, "a structure, overview, outline, system or plan consisting of various descriptive categories, e.g. concepts, constructs or variables, and the relations between them that are presumed to account for a phenomenon" (Nilsen 2015). In this sense, the integrative framework for evidence in public policymaking seeks to identify and define those "concepts, constructs or variables" that influence the type of evidence used in policymaking in order to produce an "overview" of the "phenomenon" of how one might understand or assess the use of evidence in public policy. Namely, the framework identifies the various components that construct the role of evidence in public policymaking by integrating concepts across a wide array of literature spanning the social sciences. While frameworks are often criticized for their potential to be too broad or narrow in scope, the framework presented herein avoids such pitfalls by including only determinate variables and identifying their relationship to one another (Ostrom 2007). The framework therefore provides a foundation for future evaluation and the continuation of theory building around the connection between various elements of the framework and the use of evidence.

A purposeful review of the literature was conducted in order to identify key concepts for the integrative framework and develop the structure of the framework itself. This review began narrow in scope, first identifying the definition of evidence in public policy within the tradition of the evidence-based policy (EBP) literature. It then moved to critiques of EBP to integrate broader perspectives of evidence in public policy. From this foundational conception of EBP, the review then moved to examine the use of evidence in the broader policy studies and social science literatures including theories of the policy process, political science, political psychology, and communication studies among others. This review allows for the identification of concepts and the development of definitions that are more encompassing than those based on a single discipline. Broad conceptions help create an integrative framework that can be leveraged to assess questions related to the use of evidence across many disciplines.

In addition to conducting a purposeful review of concepts, existing frameworks or models of evidence in public policy were also identified in order to evaluate which concepts were common or missing and what further improvements could be made to develop a truly integrative framework. Only six sources to date identify some framework, model, or hierarchy of evidence (Cairney 2016; Hasson, Leviton, and Thiele Shwarz 2020; Jennings and Hall 2011; Kano and Hayashi 2021; Mosley and Gibson 2017; Petticrew and Roberts 2002). Half of these frameworks align with EBP in identifying how to assess or design quality sources of information defined as methodologically rigorous approaches (Hasson, Leviton, and Thiele Shwarz 2020; Kano and Hayashi 2021; Petticrew and Roberts 2002). The remaining approaches assess evidence descriptively identifying which types are employed by policy actors and at various stages of the legislative process asserting that EBP seldom aligns with ideals (Cairney 2016; Jennings and Hall 2011; Mosley and Gibson 2017). Of these frameworks, only one (Cairney

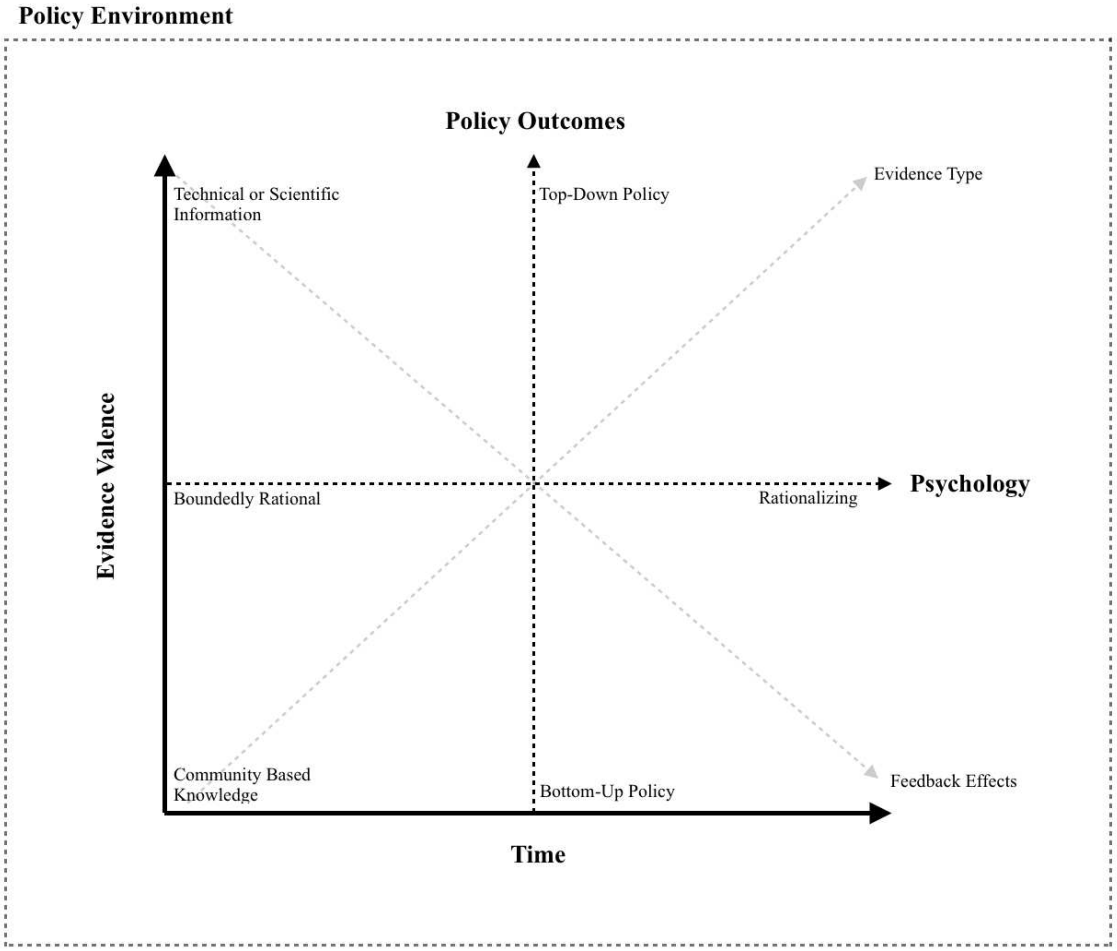
2016) begins to integrate both traditional approaches to EBP and as well as critical perspectives of evidence in addition to factors that may affect their use.

The limited scope of the models of evidence in policy to date demonstrates the need for a more integrative framework. First, the absence of an integrative framework perpetuates a disjointed literature that lacks a single model for how to assess evidence in public policy. The creation of an integrative framework therefore serves to strengthen and unify the study of evidence in public policy. In addition, the development of a framework that does not preference a certain definition or view of evidence but instead integrates concepts across disciplines provides an opportunity to develop a more empirically accurate and holistic understanding of the phenomenon. In other words, the framework provides a more generalizable foundation for the study of evidence in public policy rather than looking at a specific level of governance, group of actors, policy arena, single or limited evidence type, or neglects the factors that influence the preference and uses of evidence.

The integrative framework is presented in Figure 1 as a box encapsulating an iterative process where factors of influence interact with the types of evidence available to result in the use of varying types of evidence. This internal process is presented as iterative rather than linear given it represents the interaction of the objective and subjective functions of evidence. This process can change over time and in response to the concepts at play in relation to the use of evidence. The framework is presented as a matrix encapsulated by an external boundary. The external box that outlines the matrix represents the *policy environment* and its influence on the process and concepts at play in any given analysis including the policy arena, level of government, type of agency, socioeconomical, economic, or political factors. Within the policy environment, the y-axis of the matrix represents the *evidence valence* or the extent to which the

evidence type preferenced by a policy actor or group of actors has been institutionalized. The x-axis of the matrix represents *time* indicating that policy actors interact with evidence over time and may or may not demonstrate changes in preferences throughout the policy process. The types of evidence with which policy actors engage can then be mapped onto this matrix to better understand key questions concerning the use of evidence in public policy. Results may indicate, for example, that in a low conflict and non-technical policy environment, actors primarily engage with non-institutionalized sources of evidence consistently over time to produce bottom-up policy outcomes or minimal change. In the following section, each component is detailed in turn (see Table 1 for summary of terms).

Figure 1. The Integrative Framework for Assessing Evidence in Public Policy



Policy Environment

Policymaking occurs within a specific environment which impacts the overall contours of the policyscape. While the literature examining policy offers a lexicon of concepts to describe the environment within which policymaking occurs, the framework does not adopt one of these terms explicitly in order to achieve its goal of being a holistic, integrative framework that is useful for a broad range of scholars. Instead, individuals should identify a contextual frame that is most applicable to their research or focus on a particular set of environmental variables. Common concepts used to describe the policy environment within the policy literature include subsystems (Jenkins-Smith et al. 2017), policy paradigms (Hall 1993), policy communities (Baumgartner and Jones 1993), issue networks (Heclo 1978), and policy regimes (Jochim and May 2010). In addition to these frames, scholars also identify environmental factors that may affect the consideration of evidence including the nature of the policy problem, scientific capacity, agency capacity and culture, and rules and routines. In other words, environmental factors include those political, socioeconomic, and other contextual factors that can influence an agency, organization, and stakeholders' consideration of evidence in decision-making. Finally, the policy environment can simply be defined by a policy issue or case study.

Evidence and its associated concepts are therefore nested within the policy environment and understood within the boundaries of its particular characteristics. The policy environment is dynamic in that its granularity can be matched to the scholar or stakeholder's needs as determined by the research question or inquiry into the use of evidence in policymaking. For example, the policy environment can focus on a particular scale of analysis (i.e. international, national, state, or local policy), policy arena (i.e. health, education, or environmental policy), agency (i.e. the Colorado Department of Justice or the U.S. Department of the Interior), or any

combination of these and other factors (e.g. environmental executive orders passed by presidents in their second term in office). Alternatively, research can focus on a particular frame such as the policy subsystem. The inclusion of the policy environment in a framework of evidence thus demonstrates that the use of evidence does not occur in a vacuum but is influenced by the many factors in which it is considered or applied. Several studies have assessed the impact of specific environmental factors on the use of evidence.

Jennings and Hall (2011) in their examination of the use of evidence by state-level agencies theorize how agency culture and scientific capacity can impact the use of evidence. They assert that scientific capacity relates to the availability, accuracy, and applicability of information concerning a policy problem and the general capacity of the organization to use this information in a meaningful way. Without scientific capacity, evidence-based policy is unlikely. Furthermore, scientific capacity is also mediated by agency culture where high-conflict environments will be less able to effectively consider and apply available information. Combined, their theory asserts that low conflict, high scientific capacity agencies have the potential to best consider and use evidence in policymaking.

While the level of inter-agency conflict provides one aspect of agency culture, other aspects of this component as well as rules and routines should also be considered. For example, a tradition of EBP successes or reliance on certain information sources may relate to agency routines that preference certain modes of information gathering. This can also relate to both written and unwritten rules concerning the processes of information gathering. For example, some agencies may have engrained practices of regular public outreach and listening sessions that go beyond mandated processes of public comment while others do only what is formally required as part of the rulemaking process. These variations in agency routines can thus alter the

amount or type of information considered in policymaking. Therefore, it is important to observe and assess the culture, rules, or routines of a policymaking body in order to determine their effect on EBP and the consideration of evidence.

In addition to scientific capacity and agency culture, the nature of the policy problem can also affect the use of evidence. Early institutionalization of EBP as RCTs and CBA was primarily in the field of public health and highly technical engineering problems. As a result, policy problems conducive to such strict methodical assessment will more likely engage with high level EBP while social problems such as education will require a mediation between more diverse sources of evidence. In other words, the extent to which a policy problem matches traditional approaches to EBP should be considered when assessing the use of evidence and will be discussed more in depth in the following section. The nature of the problem has the potential to influence the type of evidence used. However, the extent to which the problem impacts the use of evidence can also be mediated by other contextual factors discussed in this section.

Evidence

Evidence Valence

As stated, the integrative framework for assessing the use of evidence in public policy does not take a normative stance concerning which types of evidence should be used by policy actors. However, while it is important for an integrative framework to take a non-normative stance towards the use of evidence, this body of information must still be considered within the context of the evidence-based policy discipline. Namely, the framework must also capture the extent to which the types of evidence employed by policy actors aligns with traditional approaches to EBP. Alignment with EBP policy is operationalized here as the extent to which the evidence type employed by an actor has been institutionalized or in other words, established as a

norm of EBP via written rules and regulations of governance. Within the framework, whether an evidence type has been institutionalized is termed the evidence *valence*.

Valence is defined here in accordance with the psychological definition where valence corresponds to the positive or negative value attached to a stimuli (Shuman, Sander, and Scherer 2013). The evidence valence thus takes on a binary quality where the positive evidence valence (1) is assigned to institutionalized evidence types and the negative valence (0) is assigned to the non-institutionalized evidence types. The binary thus represents a yes/no response where a particular evidence type is institutionalized. Therefore, a valence of zero does not indicate no valance but instead an evidence type that is not institutionalized. Identifying a valence for each evidence type maintains a holistic approach to understanding the use of evidence while simultaneously characterizing the use of evidence beyond discrete categories and acknowledging its normative properties. Assessing valence also allows for a more nuanced assessment of if and how policy actors align with institutional norms, where norms vary, and why. Here, a brief review of the institutionalization of EBP is included followed by a determination of which of the 12 types of evidence identified and defined in the next section are considered institutionalized.

The institutionalization of EBP began in the 1930's and 40's with the development of cost-benefit analysis (CBA) and the adoption of randomized control trials (RCTs) to evaluate the effectiveness of medical interventions including drugs and vaccines (Baron 2018; Cairney 2016; Oliver, Lorenc, and Innvaer 2014; Stone 2002). While RCTs became a norm within health policy following World War II, the methodology wasn't officially adopted by the U.S. Food and Drug Administration (FDA) as the standard of approval for new medicines and medical devices until 1962 (Junod, nd.). Since this early era of EBP institutionalization, methodologically rigorous approaches to information have been normalized through the issuance of executive orders, the

establishment of organizations and think tanks dedicated to producing such information, and other government agency rules For example, Executive Order 12291 issued by Ronald Reagan in 1981 states that all federal agencies whose rulemaking results in significant economic impact must justify its determination using Regulatory Impact Analysis which uses, "a well-established and widely-used framework for collecting, organizing, and evaluating data on the anticipated consequences of alternative policies" (HHS 2017). In 2018, the U.S. Environmental Protection Agency (EPA) issued a rule stating the agency will give greater consideration to science with sufficient data to verify results independently, "when promulgating significant regulatory actions or developing influential scientific information" (EPA 2024). These examples demonstrate that methodologically rigorous approaches to evidence have been preferenced as a norm of EBP since the development of such methods.

While this review of the institutionalization of evidence-based policy focuses on the adoption of CBA, RCTs, and other standardized methods of regulatory analysis, the broader literature identifies a full range of methodologies and research design characteristics that align with traditional approaches to CBA. For example, Petticrew and Roberts (2002) identify eight rigorous methodologies including RCTs, quasi-experimental studies, non-experimental evaluations, systematic reviews, cohort studies, case-control studies, surveys, and qualitative research. In addition to methods, Kano and Hayashi's (2021) framework for implementing evidence in environmental policymaking provides a guide for assessing the quality of scientific evidence specifically. They provide five measures of assessment including methodological rigorousness, consistency, proximity, social appropriateness, and legitimacy. Overall, EBP preferences any methodologically rigorous, empirical approach to information gathering. Utilizing conceptions of EBP along with the broader literature, the following types of evidence

from the list of 12 identified in the previous section are considered institutionalized, or a positive evidence valence for the purposes of this integrative framework: science and grey literature.

Science as defined as an evidence type encompasses the type of methodology rigorous studies preferenced by EBP. As a mode of information gathering characterized by standardized approaches they equate to the rational, institutionalized methods of EBP. *Grey literature* is also considered to align with EBP approaches given the type includes studies produced by government agencies, think tanks, and other organizations which continue to aid in the institutionalization of traditional approaches to EBP. In review, all evidence types are assigned a valence. Valence 1 evidence types are institutionalized under EBP and include science and grey literature. Valence 0 evidence types or non-institutionalized sources of information and include all other defined in the next section ranging from anecdotal to indigenous knowledge to risk. As a short hand, Valence 1 evidence can be referred to as "hard" evidence while Valence 0 evidence can be referred to as "soft" evidence. Hard and soft as well as institutionalized and non-institutionalized sources of evidence will be used interchangeably.

Evidence Types

The integrative framework provides a matrix onto which various evidence types can be mapped in response to interactions among other concepts. Identifying the types of evidence employed by policy actors provides researchers the means to better identify and describe the discrete preferences of the individuals or group of individuals being observed within a particular policy environment. A review of the literature examining the use of evidence in public policy reveals 12 distinct types which are reviewed here in turn.

Expert advice/opinion. While scientists may produce the scientific evidence preferenced in EBP, they are often called upon to disclose their expertise in relation to a given problem. Such

testimony often calls upon experts to go beyond their role as a producer of objective information to offer their own personal opinions or policy preferences (Keller 2009). Scholars of the narrative policy framework term this type of testimony *ipso dictum* meaning an appeal to authority. They expand expert advice, however, to also include statements made by diverse influential figures including prominent "celebrities or cultural figures" or any individual whose input is pursued, "owing to their fame, position, or title" (Smith-Walter et al. 2016). Here evidence can thus include the latent knowledge of individuals deemed knowledgeable on a given policy topic.

Opinion polls. Policy actors are often interested in the public's positionality on a proposed policy given that they may be subject to reelection and because policy often requires the support of the public for successful selection and implementation (Burstein 2009; Jones and Jenkins-Smith 2009). As a result, public opinion polls may be consulted in order to determine the standing of proposed policies (Lomas and Brown 2009; Smith-Walter et al. 2016). While the actual impact and sophistication of public opinion has long been contested (Converse 1964; Zaller 1992), its use as a source of evidence confirms its legitimacy and aligns with investigations that verify the impact of the public on policy (Burstein 2009).

Public comment. As stated above, public support is often necessary to enhance the legitimacy of policy. While opinion polls can offer insight into the public's general positionality, public comments are included here as a separate source of information given that they encapsulate a broader swath of the public. Public comments are defined as those gathered and submitted throughout the policy making process as legally required by the Administrative Procedures Act with the goal of enhancing the democratic nature of policymaking (Woods 2013). This process, however, permits commenting from diverse groups beyond interested lay

members of the public including businesses and advocacy groups. Given that the consideration of these comments is required by law they provide yet another source of evidential information in the policy process. Policy actors may reference results from public comments or former public comments when making policy arguments.

Anecdotal. Policymakers will sometimes look to other governments in order to identify policies that have been successfully implemented elsewhere to address a problem in their region (Cairney 2016; Lomas and Brown 2009). This can occur on a national or local scale, both within and between countries. Policy process theorists identify this as a form of policy learning and diffusion where anecdotal government success is identified as evidence to support a particular policy preference (Berry and Berry 2017). Here, success is equated with evidence even when factors that contribute to the adoption of similar policies, i.e. competition, coercion, or pressure, vary significantly from the careful consideration of a policy's realized outcomes or suitability to place (Dolowitz and Marsh 2000; Ettelt et al. 2012). Conversely, anecdotal evidence of failure can bolster arguments against certain policy positions as well.

Indigenous knowledge. Indigenous, sometimes referred to as traditional, knowledge is referred to as, "... a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, Colding and Folke 2000). Scholars assert that indigenous knowledge offers a legitimate source of information given that cultural practices are often rooted in accumulation of observations which mimics preferred conceptions of science (Ibid.). Indigenous knowledge is most commonly consulted in environmental policy such as land and animal management (Ibid.; Sillietoe 2017) however, it is beginning to emerge in other policy arenas such as medicine (Finn, Herne and

Castille 2017; Sidhu 2017). While such knowledge is not always effectively considered by policy makers (Deutsch 2017), at other times it has resulted in enhanced environmental outcomes (Finn, Herne and Castille 2017).

Community knowledge. Community knowledge differs from indigenous knowledge in that it can emanate from non-native individuals and span various cultures in a region. This type of information collection relies on community engagement rather than the simple collection of stakeholder comments and seeks to better understand the wide range of perspectives in a locality on a given issue as well as identify more tailored solutions. In this way, it goes beyond the requirements laid out in the Administrative Procedures Act to involve communities in a more intentional manner. Community engagement can come in such forms as public deliberation forums, community lead research, or role-playing games and participatory modelling among others (Carcasson 2018; d'Aquino and Bah 2014; Floridia 2018; Peace and Myers 2012). Given that community perspectives are increasingly considered in the formation of new policy, they provide yet another source of evidence for actors in the policy process.

Law. The range of available policy options is often restricted by law or legal precedent leading policy makers to alter their decisions accordingly. Investigations into policy narratives reveal that actors will often use applicable court rulings to defend their positionality on a problem (Smith-Walter et al. 2016). As a result, law represents yet another information input that actors use to support, contest, or shape policy preferences.

Statistics. Statistics is differentiated from scientific studies given that numerical data on a particular issue can exist outside of reports and itself be used strategically by policy actors (Stone 2002). As such it is defined as numbers that are identified or employed in arguments separate from a scientific report, poll, or even grey literature (Smith-Walter et al. 2016). For an evidence

type to be identified as a statistic it must plain data must be stated such as numbers or percentages.

Science. Evidence in relation to EBP is primarily defined as methodologically rigorous in nature. This is often considered information gathered in a codified and rigorous manner such as that published in peer-reviewed academic journals (Cairney 2016). Literature examining hierarchies of scientific evidence in policy tends to list randomized control trials, non-randomized control trials, quasi-experiments, and observational studies as preferred methods of inquiry (Deeming 2013; Heinrich 2007; Kano and Hayashi 2021; Jennings and Hall 2011; Prewitt et al. 2012). This aligns with rational interpretations of evidence that consider science the pursuit of an observable and objective truth (Hess and Adams 2002).

Grey Literature. While published, scientific studies are considered the golden standard of evidence in EBP, publicly available yet non-commercially published studies are also considered by policy actors (Lomas and Brown 2009; Luzi 2000; MacDonald et al. 2012). Grey literature in public policy is thus defined as,

> "working papers, discussion papers, briefings and guides, data-sets, conference papers and various others, produced by organisations such as government departments and agencies, universities, think tanks, non-government organisations, corporations and professional bodies, and made available to the public directly either in print or digitally" (Lawrence et al. 2015).

This category therefore excludes traditional publications such as books and academic articles and journals which often require a purchase for access. Here, grey literature is closely associated with science but is still considered a subcategory of evidence given that the diversity of sources included in its definition may not adhere to more stringent classifications of evidence as studies employing certain rigorous methodologies.

News Articles. Information published by news media represent another area of quasi-published information that is cited by policy actors as a source of evidence. News stories differ from grey literature in that they are not "non-commercially" published.

Risk. Risk is defined as the "likelihood that an agent or hazard will produce adverse effect" or "the potential for harm, loss, or hazard" (Flynn 2021; Swaney 1996). These risks have not yet been identified as a type of evidence employed by policy actors however, it is added here as a potential type given its prevalence in the literature and potential to be utilized in policy contexts with actor identified risks. Studies of risk communication and perception as well as political science have identified certain risks such as existential risk (i.e. climate change; nuclear war) as drivers of human behavior and decision making (Norris, de Calvo, and Mather 2020).

Psychology

In defining evidence, we have asserted that information does not simply represent a neutral or objective collection of facts but is also inexorably tethered to the construction of beliefs. As a result, evidence takes on an active role in the policymaking process in addition to its objective role. This active role becomes more nuanced when we consider the psychology of actors who participate in policymaking. Much like the definition of evidence itself, the rationality of actors is also conceptualized both idealistically and practically. The ideal rational policy actor is characterized as one who consults the entirety of available information, weighs carefully the facts, and then makes the best policy decision based on this body of evidence (Stone 2002). This rational actor can be most succinctly defined as objective, leaving behind biases and value laden judgments considering only the most technical of information. In reality however, the rationality of actors is limited by a multitude of factors including time and resources (Lindblom 1959). Furthermore, individuals are assumed to possess inherent values that

affect their positionality on a particular problem and the type of information they pursue. As a result, individuals are often instead considered boundedly rational in their decision making (Simon 1957). In other words, due to constraints, actors consider limited amounts of information to discern the best solution known as "satisficing" (Ibid.). Furthermore, they rely on mental shortcuts such as motivated reasoning and hot cognition which causes individuals to primarily consider information that aligns with their existing beliefs or known and preferred solutions (Kraft, Lodge, and Taber 2015; Lodge and Taber 2013; Zaller 1993). When evidence is considered by the boundedly rational individual it is moved from its place as an objective body of information to a mechanism in shaping preferences.

The following concepts covered in this review of the psychology of evidence-based policy can be considered by researchers when utilizing the framework:

Policy Beliefs and Coalitions

The policy preferences of actors are broadly termed policy beliefs within theories of the policy process. Policy beliefs consist of both core and secondary beliefs. Here, policy core beliefs are defined as "normative and empirical" identifying positionality on a topic as well as including overall problem definition and preferred solutions (Jenkins-Smith et al. 2017). Secondary beliefs refer to the, "specific instrumental means" for achieving policy goals as identified within core beliefs (Ibid.). If policymakers are boundedly rational and use information to support their preferences, then evidence serves a role in the construction of policy beliefs. This demonstrates the affective role of evidence in policymaking as it becomes a mechanism for explaining the nature of a problem. Here we see the pragmatic view of evidence taking shape as a means of constructing policy beliefs for boundedly rational actors. Rather than existing as a

neutral body of information, evidence plays a key role in reinforcing the biased cognition of policy actors.

Policy Learning

While actors select information that aligns with their existing beliefs, exposure to new information may lead to policy learning and alter those beliefs. In other words, policy beliefs and evidence consist of a feedback loop in which bounded rationality serves to amplify beliefs (Zaller 1993). Instances in which different types of information are pursued or collected throughout the policy process offer opportunities for interrupting this cycle and enable policy learning or a change in beliefs (Druckman and McGrath 2019). It is not however, guaranteed that such learning will occur in response to information gathering. On one hand, it is possible that actors will use their biases to continue to reject new evidence that conflicts with their existing preferences. On the other hand, it is possible that some actors may consider the new information presented to them and alter their policy beliefs in response. In either case, evidence provides a prerequisite for policy learning which itself becomes a precursor to policy change thus demonstrating its affective role.

Scientific Sophistication

In addition to bounded rationality affecting the interpretation and use of evidence, the cognitive capacities or the sophistication of actors can also influence their perceptions of evidence. Individuals' perceptions of scientific evidence, just as other types of information they encounter, is based on a diversity of characteristics ranging from socioeconomic factors including education to cognitive styles such as open-mindedness as well as general reasoning skills (Drummond and Fischhoff 2017; Kahan et al. 2012;

Stanovich and West 1997). This means that the ability to understand evidence lies on a scale with more sophisticated individuals having a greater ability to identify, interpret, and integrate more complex scientific information (Drummond and Fischhoff 2017). When considered in the context of the evidence framework developed above it becomes clear how actor sophistication can interact with evidence preferences. For example, those with high reasoning capabilities would be comfortable with more technical or scientific explanations of issues while those at the lower end of the scale might desire anecdotal evidence. If highly technical scientific evidence cannot be universally understood or interpreted, this further calls into question the bias towards the use of scientific information in evidence-based policymaking. Actors, groups of actors, or the agencies or organizations they represent may preference different types of evidence based on their own scientific literacy.

Literature exploring perceptions of evidence echo this sentiment. For example, Oliver and Wood (2018) conceive of a public split in two where half are rationalists and half are intuitionists. Rationalists have a greater tendency to use logic and scientific information to understand the world while intuitionists rely on gut instincts and information that aligns with how they feel about reality (Oliver and Wood 2018). In many ways this aligns with spectrums of sophistication, attitude formation, and interpretation of scientific evidence described above. A rationalist would have a higher ability to evaluate scientific evidence than that of an intuitive. However, it should be noted that we do not yet know that someone of an intuitionist nature would necessarily reject scientific explanations nor would someone with high scientific literacy always prefer technical information. These are conjectures based on the growing body of literature examining perceptions of information considered in light of the diverse sources of

evidence used in the policy making process. What we do know for sure though is that this interaction occurs. Various types of evidence are filtered through the rationality, cognitive capacities, and perceptions of the actors who use and interpret such information.

The Big Five

Finally, the discipline of political science has started to integrate personality traits into the study of political phenomena. The 5-factor model of personality or the "Big Five" is increasingly used to understand the impact of individuals' traits on a diversity of social and political factors ranging from political ideology to loneliness (Cooper, Golden and Socha 2013; Webster 2018). The Big Five personality traits include Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism (OCEAN). Political applications to date have demonstrated that openness to new experiences is associated with liberalism while conscientiousness is aligned with conservativism (Webster 2018). Furthermore, extraversion is associated with higher rates of political participation and extraversion coupled with agreeableness leads to higher levels of party identification (Gerber et al. 2012; Hibbing, Richie, and Anderson 2011). While identified as a highly replicable model for understanding the influence of personality traits on various social and political phenomenon, the concept has not been applied within the discipline of public policy or to assess preferences of evidence types. Given the model's ability to identify how personality traits may influence action, the Big 5 offers a promising avenue to explore the impact of personality traits on evidence choice. Openness, for example, characterizes individuals who are more willing to consider new ideas and opinions, a trait that may indicate a similar willingness to consider non-institutionalized types of evidence.

The psychological components of policymakers reviewed here combine to reveal the second building block in a new framework for assessing evidence in policymaking. Much like

the foundational level, this second layer is a continuum that encapsulates the range of conceptions affecting the interpretation of evidence by policy actors with bounded rationality on one end and rationality on the other. Here, bounded rationality encompasses a rational policy actor who only relies on innate information preferences and those privileged in traditional interpretations of EBP (i.e. science). Intuitive actors on the other hand rather than being characterized as objective in the sense that they only consider the "best" information are considered those who break out of cycles of bounded rationality to consider the most diverse sources of information or those most divergent from traditional EBP. In other words, rationality is defined in terms of strong objectivity or the idea that the inclusion of more diverse viewpoints actually leads to a better understanding of the truth than limiting perspectives or preferenced evidences (Harding 1992). This is complemented by the notion that in our boundedly rational nature we often fail to rationalize information or in other words carefully consider new evidence. Instead, we simply reject information that does not align with existing views. Conceptualizing the rational actor as one who considers and integrates new information and allows it to alter preferences further liberates conceptions of evidence from the confines of traditional interpretations of EBP to offer a more pragmatic view of evidence in policy (Taber and Lodge 2013). Here we are not searching for the impossible of comprehensive rationality but instead a more realistic and encompassing one (Cairney 2016).

Policy Outcomes

The use of evidence has the potential to impact policy outcomes. Indeed, the normative goal of evidence-based policy is to produce evidence-based policy outcomes however, little is known about how the introduction of new evidence in a policy debate directly affects outcomes. In Cheap and Clean, the authors detail how public education campaigns in the state of Texas lead

to increased support and adoption of renewable energy in the state, especially wind power (Ansolabehere and Konisky 2016). Jones (2014) finds that presenting readers with a list of facts was sufficient in persuading individuals to support a specific climate policy. However, detailed analysis of how new information directly impacts policy in real time is lacking. Additional work is needed in this area to help better understand the impact of information on policy outcomes (James and Jorgensen 2009)

In addition, there is significant debate over who should dominate decision-making within the policy cycle. Traditional approaches to policymaking placed government officials at the center of decision-making given their expertise and technical training (Cairney 2016; Greenhalgh 2014). Increasingly, however some advocated for a more decentralized and instead collaborative approach to policymaking that prioritizes the public or community members as arbiters of policy decisions (Ansell and Gash 2007; Bodin 2017; Emerson, Nabachi, and Balogh 2011; Greenhalgh 2014). Policies that arise primarily from governmental decision-making are referred to as a top-down approach, while those derived from the community or collaborative settings are considered bottom-up. These two approaches represent yet another source for the variation in the use of specific types of evidence. For example, members of the public may not prioritize rigorous methodologies when deciding on a policy but instead rely on their own personal knowledge concerning the issue at hand. In this way, the breadth of evidence used to make a policy decision can affect the type of policy that is selected for implementation. In other words, as policy actors move beyond the use of traditionally preferenced sources of evidence to include a broader swath of information, they have the potential to form more bottom-up solutions (Cairney 2016).

The type of policy derived through the consideration of diverse sources of information demonstrates the effective role of evidence in the policy process. Not only can policy makers

consider different types of information, but consideration of those different sources can alter the type of policy that is implemented. As a result, it is important to include policy type as the final component of a new framework of evidence in policymaking. Policy type also consists of a continuum ranging from top-down to bottom-up. A continuum is used to represent this element to demonstrate that policies are often not wholly top-down or bottom-up and that a policy's positionality along this line can shift throughout the policy process or over time. This aligns with preceding aspects of the framework described above including time, the psychology of evidence, and types of evidence.

Time

Public policy making is a process that unfolds overtime. Given this inherent characteristic, the influence of time on the use of evidence in policymaking is included in the integrative framework. The direct impact of time on policy change is less understood and is instead operationalized as varying concepts. Common concepts of time as it relates to policymaking include stages of the policy process (Lasswell 1956), policy windows (Herweg, Zahariadis, Zohlnhöfer 2018), punctuated equilibrium (Baumgartner and Jones 1993), and Issue Attention Cycles (Downs 1972). However, the framework developed herein does not preference one particular concept but encourages the researcher to select a concept of time that best aligns with their research goals. Therefore, time may be assessed within the context of common conceptions within the policy literature such as stages as of the policy process or simply in terms of passing days. Below, stages of the policy process as it relates to time are defined and discussed.

The policy process was traditionally defined as a linear process commonly conceptualized as a cyclical model moving from agenda setting to policy or program evaluation.

In between these bookends are periods of policy formulation, analysis, selection and implementation in between (Laswell 1956). Each stage of the policy process offers an opportunity for a review of available evidence concerning a policy problem beginning with the very first step however, the type of information can, and often must, vary from stage to stage. While at some points in the policy process the information used to make a decision is at the policy maker's discretion, at other times the collection of certain data such as public comment is required by law. As a result, different types of evidence are preferenced at varying stages of the policy process. Given such requirements, rational approaches to evidence gathering such as RCTs and CBA are not always considered or prioritized. Therefore, it is necessary to review how information is used at various stages of the policy process in order to develop a more holistic perspective of evidence in public policy.

Today the stages of the policy process remain relatively the same however, the cycle is now considered cyclical with feedback loops occurring between stages (Brewer and deLeon 1983; Cairney 2016; Easton 1957). As a result, the policy process will often be depicted as a circular cycle while moving forward in time. Furthermore, within the cycle itself, certain stages may need to be revisited if effective or popular solutions are not initially identified. In this way, the policy process both contains within it and is itself a feedback loop. This feedback is related to the psychological or active component of evidence detailed above. As actors in the policy process are exposed to and uncover new evidence throughout the cycle, it may cause them to revise policy definitions and alternatives. As a result, evidence becomes effective as it can cause policy learning by actors as it is used throughout the policy process. Therefore, while time is often depicted as linear in models, a feedback element must be evident in a framework of evidence in order to demonstrate its affective role within the policy process.

Many scholars argue that the stages approach to public policy is no longer a viable means of conceptualizing the process in the face of the many complexities of policy making including the cyclical nature of the cycle itself. As a result, the stages approach is considered over simplistic and many theories of the policy process have been developed in an attempt to better describe the dynamics of policy process ranging from the Advocacy Coalition Framework (ACF) to the Multiple Streams Framework and Punctuated Equilibrium Theory (PET) (Weible and Sabatier 2017). Despite the success of alternative conceptions of the policy process, the stages approach endures as a heuristic due to its ability to provide a simple and workable model (Capano and Pritoni 2020; Howlett, McConnell and Pearl 2016; Smith and Larimer 2017). When combined with theories of the policy process, the stages models serve to enhance understanding. For example, theories of the policy process such as the ACF can be mapped onto the policy stages providing insights into how coalitions interact at specific points in time. Therefore, the various frameworks and models for conceptualizing the policy process should be considered concurrently rather than mutually exclusive (Howlett, McConnell and Pearl 2016). While the potential interaction of the evidence and the policy stages is detailed below, time may be conceptualized in any way preferred by the scholar applying the framework developed herein.

Information plays a role in the policy process beginning with agenda setting. Agenda setting, or the process by which particular issues come to the attention of pertinent policy actors, inherently requires defining the problem at hand. This aspect of agenda setting is important because the way a problem is defined can determine the types of policies that are offered as a solution. Problem definition, however, is the result of collective negotiation both on the part of the public when they give attention to the issue and policy actors as they craft a definition for analysis (Kamieniecki, Sheldon and Kraft 2013). In this way, problem definition is similar to

issue framing in that it determines how the public perceives a problem. Evidence can be used to either support or contest the existence of a policy problem and its associated characteristics such as problem severity and attributes. Here, we see evidence takes on an active role where information is used by competing interests in order to vie for their respective policy positions. Evidence broadly becomes part of a story or narrative policy advocates tell about a particular problem in order to gain the attention of the public and policy makers. The problem definition that makes it onto the agenda in this first stage is important because it affects the formulation of policy in all others.

Another stage in the policy process during which evidence is an important factor is policy formation and adoption. The formulation of alternative policy solutions during this phase can rely on diverse sources of evidence. For example, solutions can be chosen from a list of programs legitimized through RCTs or instead anecdotal evidence of successful implementation by other governments may be considered. Here, we again see evidence for policy solutions take on many forms in the process of justifying decision making indicating that the way evidence is used can vary over time.

In addition to some of the informal steps of the policy process mentioned here, mandated review periods can also affect the type of evidence considered during policy making. In particular, once a policy is selected there is often a requirement for public comment. Here, a policy solution is presented to the public for consideration and individuals, along with other stakeholders such as companies and non-profits, can make comments listing their concerns, suggestions, and additional information for consideration. Once reviewed, these comments sometimes result in changes to policies that were originally determined through a rigorous or rational method such as CBA. As a result, the very mandated process of policymaking

necessitates the consideration of information outside of traditionally preferred methods. In the review and comment period, this means that more informal types of knowing such as community knowledge has the potential to take precedence over methods such as RCT and CBA. This again demonstrates that the type of information considered in policymaking varies over time.

Given the complex interaction of time, the policy process, and feedback, time is included as the next component in the integrative framework of evidence. The interaction can be imagined as a linear line with a corkscrew loop wrapping around it (see Figure 2). The linear timeline is maintained to represent the continual movement of time while individuals move through the policy making process. The loop is added to demonstrate that previous stages can be revisited at any time in the process and the psychological process that can occur as a result, namely policy learning. As discussed in the psychology section above, exposure to new information can interrupt belief systems and cause individuals to alter their perspectives (Druckman and McGrath 2019). As a result, new evidence can change policy outcomes. Additionally, including a feedback element simply offers a more accurate depiction of the policy process that is not captured through simply a linear model of time.

Figure 2. Concept of Time as Nonlinear

Time as continuous in conjunction with common conceptualization within the policy literature such as stages of the policy process is incorporated here as the final component of an integrative framework for assessing evidence in the policy process in addition to the valence and types of

evidence as well as psychological components. This captures yet another aspect of policymaking that both affects and is affected by the use of evidence contributing to a more holistic framework.

Table 1. Summary of Terms

Concept	Sub-concepts	Definition	Example research question
Policy Environment	Frames: subsystems, policy paradigms, policy communities, issue networks, policy regimes etc. Factors: policy problem, scientific capacity, agency capacity/culture/rules/routines, political, socioeconomic, etc.	The set and setting or context in which policymaking occurs. The environment can be assessed using a theoretical framework or considered within the context of applicable factors.	How do factors of the policy environment impact the use of evidence?
Valence	Non-institutionalized evidence Institutionalized evidence	The extent to which the evidence type employed by an actor has been institutionalized	Do winning or losing coalitions demonstrate a specific valence?
Evidence Type	Science, grey literature, public comment, anecdotal, indigenous knowledge, community knowledge, law, statistics, expert advice, public polls, news article, risk, other, etc.	The types of evidence employed by actors when participating in policy making.	Do specific actors preference certain evidence types.
Psychology	Rationality, policy beliefs, learning, scientific sophistication, the big 5, etc.	Psychological factors that impact the use of evidence by policy actors.	Do certain types of evidence lead to policy learning?
Policy Outcomes	Policy outputs or changes in policy	Substance of policy or policy change	Did the introduction of a specific piece of evidence such as an influential scientific study influence the substance of the policy outcome?
Time	Date, policy stages, policy streams, policy windows, focusing events, etc.	The passage of time during policymaking. This can be conceptualized as continuous or within a specific theoretical framework.	Are certain types of evidence engaged during specific stages of the policy process (agenda setting, legislation, etc.)?

IV. Utilizing the Framework in Research

The integrative framework for assessing the use of evidence in policymaking offers a unifying springboard from which theory building can occur and a variety of research questions and hypotheses can be assessed. Here, a codebook is developed that includes several components of the framework including evidence type, stage of the policy process, and policy belief (as a component of psychology). This provides just one example of how the framework might be leveraged by stakeholders in future work.

Variable	Description/Coding Instruction
Text Type	Type of document being coded 1 = legislation 2 = hearing transcript 3 = hearing document 4 = public comment
Time	Date text was published/written
Stages of the Policy Process	Stage of policy process text for analysis falls within 1 = agenda setting 2 = policy formation 3 = policy implementation 4= evaluation
Actor/Narrator Categorization	Individual or group who is making the statement 1 = member of the public 2 = policymaker 3 = government 4 = advocacy organization 5 = non-profit 6 = industry/private sector 7 = scientist 8 = other
Coalition	Policy preference of individual or group making statement 1 = pro-coalition 2 = anti-coalition 3 = neutral
Evidence Type	Type of evidence invoked by policy actor 1 = science 2 = grey literature 3 = public comment 4 = anecdotal 5 = indigenous knowledge 6 = community knowledge 7 = law 8 = statistics 9 = expert advice 10 = opinion polls 11 = news article 12 = risk 13 = other
Evidence Valence	Institutionalization of evidence type 1 = institutionalized (evidence types 1 and 2) 0 = non-institutionalized (evidence types 3-13)

V. Conclusion

EBP is a concept that asserts evidence can and should be used when making policy decisions. Traditional approaches to EBP institutionalized in U.S. policy often preferences the

use of rigorous methods including RCTs and CBA. However, assessments of EBP to date find that agencies and policymakers often consider more diverse sources of information ranging from traditional knowledge to expert advice. As a result, the limited models of EBP that have been developed to date fail to capture the dynamic nature of evidence by instead focusing too narrowly on methodologically rigorous sources and failing to consider other factors that influence the use of evidence beyond agency capacity. Some more critical assessments of EBP such as Cairney (2016) assert that factors such as the psychology of actors must also being considered when attempting to understand the use of evidence in policymaking. As a result, a new more comprehensive framework of evidence in policy is necessary in order to fully capture the breadth of knowledge concerning its application. A new framework must be able to account for the full range of evidence or information considered by policy actors as well as other influencing elements in order to account for why (or why not) evidence is considered in a variety of policy settings and across levels of government.

The concepts explored in the chapter identify four elements of a new model of evidence in policy making that include (1) the policy environment, (2) evidence including valence and type, (3) psychology, (4) policy outcomes and (5) time. The type of evidence corresponds to the use of evidence as objective fact, or a body of information. This component includes the full range of evidence considered by policy actors ranging from methodologically rigorous sources to traditional knowledge, expert testimony, and anecdotal evidence of success, among others. The psychology of evidence conceptualizes the use of evidence subjectively to argue, convince, or construct meaning in the world. It also acknowledges the limited capacity of individuals to consider all information concerning a problem as well as preference information that aligns with their existing beliefs. The element of time is used to capture the policy process and how the use

of evidence can vary throughout this process and across time. For example, the stages of the policy process may be used to assess which types of evidence are used at various points in time during policymaking. Policy types include the full range of evidence or body of information that is considered or used by policy actors in communicating their policy preferences while valence identifies if the type has been institutionalized. Policy outcomes consider how the substance of policy may be influenced by evidence. Last, the policy environment captures environmental factors that can influence the use of evidence including the policy problem, capacity, and agency culture, norms, or rules. Combined, these concepts offer a more complex and holistic representation of the interaction of evidence and policy.

The purpose of developing a more holistic framework of the use of evidence in public policy is twofold in that it seeks to assist academics and practitioners alike. The framework is able to assist academics by providing a synthesis of research related to EBP and the use of evidence in public policy to date and highlight areas of interest for future research. For example, a scholar may choose to focus on potential feedback loops between information exposure and policy position or type of policy. In this way the framework helps to identify less understood aspects of EBP and continue to grow our body of knowledge to fill these gaps. The framework can assist practitioners by providing a succinct assessment of EBP and help actors better understand how their information may be used or applied, why or why not, and how to effectively engage with the policy process. Given the real-world implications of public policy and the use (or not) of evidence throughout the process, it is imperative that any such framework of evidence in policy be useful to diverse audiences.

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Chapter 4

Project 2: "Where were you when Diablo Blew?": Evaluating stakeholder's use of evidence overtime in the Diablo Canyon Nuclear Power Plant debate in San Luis Obispo County, California

I. Introduction

Policy process theories assert that policy knowledge is utilized by actors when forming their policy beliefs and selecting alternatives. However, there is limited understanding of the substantive content of this knowledge or the impact of and factors affecting its use. One question concerning policy information that has yet to be answered is: *does the use of evidence change throughout the policy process?* The dynamic nature of the policy process as well as the rules and norms associated with each phase suggest that different types of evidence are considered by policy actors throughout the process (Cairney 2016; Mosley and Gibson 2017). For example, during the agenda setting phase, the public may invoke diverse sources of information in order to vie for a dominant definition of a common policy problem. However, in later stages such as policy formation, actors may rely on more narrow sources of information when deciding which policies to design and pursue. Despite this theorized change in evidence use over time, few have studied how information sources change throughout the policy process.

To date, the literature evaluating the use of evidence demonstrates mixed results when assessing the variation in the use of evidence throughout the policy process (Klatt and Blum 2024; Mosley and Gibson 2017). However, these studies fail to include a more detailed assessment of the type of evidence used (James and Jorgensen 2009). In other words, an evaluation using a more formalized framework of evidence that includes a broad range of evidence types and valence may produce different results. Furthermore, analysis of evidence is

often limited to a single phase of the policy process (i.e. policy formation), failing to capture the changes in the use of evidence overtime. An evaluation of a policy problem over a longer time period is necessary for expanding our understanding of the use of evidence in the policy process in order to provide practical knowledge to stakeholders and better determine how policy is made. In response to the question *how does the use of evidence change throughout the policy process,* this paper posits that variation will be observed in the use of evidence between phases of the time period observed.

To answer the research question, I apply concepts from an integrative framework of evidence to answer the research question. Namely, the framework expands concepts of policy information by including a more diverse array of evidence types as well as evidence valence which assesses the institutionalization of evidence. Institutionalized sources of evidence include information derived from methodologically rigorous sources or "hard" evidence whereas non-institutionalized evidence comes from less formal or "soft" sources. This provides insight into not only which types of evidence are used but also the impact of institutional norms. framework for assessing. This study thus contributes to the literature by conducting a time-based study but also examining a broad array of evidence types used in multiple stages of the policy process by a variety of stakeholders. The primary research question is assessed in the context of the ongoing decision to recommission the Diablo Canyon Nuclear Power Plant (DCNNP) in San Luis Obispo County in California following Pacific Gas and Electric's (PG&E) decision to file for a license extension in 2009. Results indicate that more evidence is invoked during policy formation likely in an attempt to expand the scope of the conflict. Overall, soft, non-institutionalized sources are preferences.

II. Policy Environment

The research question is evaluated in the context of the ongoing decision to decommission and recommission the Diablo Canyon Power Plant located in San Luis Obispo County in California. Contentions surrounding the building and operation of the nuclear power plant date back to its original construction in the 1970s. The plan faced significant opposition from a diverse set of actors including citizens, local activist groups, scientists, and government agencies and officials. Focused interest in the power plant resurfaced in 2009 when the plant's license renewal application was submitted for review by the Nuclear Regulatory Commission (NRC). Diablo Canyon's decision to renew its license drew criticism from long-standing anti-nuclear activists in the region and resulted in a public hearing contesting the safety of continuing the plant's operations. Eventually, Diablo Canyon withdrew its application stating that operations were not necessary to meet California's energy demand. However, following sweeping blackouts in 2020 and near misses in subsequent years, the California legislature passed a bill in September of 2022 urging the Public Utilities Commision to revoke its acceptance of the Diablo Canyon decommissioning project and approved $1.4 billion in funding to Pacific Gas & Electric to continue operations until 2030. An updated application for license renewal was submitted on November 11th 2023 ahead of the legislature's mandated due date. Review of the renewal application is still ongoing at the time of this writing. A brief timeline of events is as follows:

Table 1: Timeline of key events in the commissioning of Diablo Canyon Nuclear Power Plant

Date		Event
1963	February	PG&E announces plans to construct a nuclear facility.
1968	April	Atomic Energy Commission approves construction permit for Unit 1 of Diablo Canyon Nuclear Power Plant.
	July	Construction begins on Unit 1.
1970	December	Atomic Energy Commission approves construction permit for Unit 2 of Diablo Canyon Nuclear Power Plant.
1971	January	Construction begins on Unit 2.
1984	August	Nuclear Regulatory Commission (NRC) grants full power license for Unit 1.
	November	Nuclear Regulatory Commission grants full power license for Unit 2.
1985	May	Unit 1 begins commercial operations.
1987	March	Unit 2 begins commercial operations.
2009	November	PG&E files for license renewal of Diablo Canyon Nuclear Power Plant.
2010	October	The NRC begins the environmental impact statement (EIS) process for DCNPP's license renewal.
2016	June	PG&E announces plans to decommission DCNPP in 2024 and 2025.
2018	January	California Public Utility Commission approves closure of DCNPP.
	February	PG&E removes DCNPP license renewal application.
2020	August	California experiences rolling blackouts due to extreme heat and energy shortages, leading to growing concerns about the state's energy grid reliability.
2020	October	The California State Legislature and CPUC revisits energy policy in response to blackouts, with discussions on the potential importance of keeping Diablo Canyon operational.
2022	August	California Senate holds a special hearing to discuss the continuation of DCNPP .
	September	Govenor Gavin Newsom signs SB 846 into law authorizing the continued operation of Diablo Canyon for up to five additional years beyond its previously planned closure in 2025. The bill also allocated funds to support the extension of operations and to address energy reliability concerns amid California's grid challenges.
2023	November	PG&E refiles a license renewal application for DCNPP in accordance with requirements of SB 846.

III. Evidence in the Policy Process

That actors rely on policy knowledge when forming their policy preferences is a common assertion of scholars. What is less understood is the content of that knowledge and why, how and when it is used (James and Jorgensen 2009; Klatt and Blum 2024; Mosley & Gibson 2017; Weimer 1998). Proponents of evidence-based policy (EBP) assert that evidence should be used in the policy making process and that such evidence should be gleaned from methodologically rigorous sources of evaluation (Cairney 2016). Scholars of the policy process further affirm that evidence is indeed utilized in policymaking however, this broader literature along with critics of EBP contest that the types of evidence employed by policy actors varies widely and is not limited to those sources preferenced by EBP (Bell 2002; Jennings and Hall 2011; Smith-Walter et al. 2016;). Beyond methodologically accepted sources of information institutionalized by proponents of EBP, policy actors have been found to cite a variety of sources of evidence ranging from stories of anecdotal success to expert opinion and indigenous knowledge, not preferenced by EBP proponents (Cairney 2016; Heinrich 2007). Despite these findings, little is known about what type of evidence is employed by actors throughout the policy process and how and if the type of evidence used changes overtime (Mosley and Gibson 2017). Foundational theories of both politics and the policy process provide insight into why and how we might expect policy actors' use of evidence to change throughout the policy process.

First, the conceptualization of policy actors as boundedly rational is reviewed. This is necessary to demonstrate how individual psychology can impact actors' engagement with different types of evidence throughout the policy process. Furthermore, bounded rationality is an assumption of theories of the policy process and so its impact on actors' consideration of evidence helps bolster concepts within those theories. Next, three major theories of the policy

process are reviewed to demonstrate how they conceptualize evidence in policy and what their underlying assumptions posit about the use of evidence over time. First, Punctuated Equilibrium Theory (PET) is highlighted for its focus on shocks to the policy system which bring new information to actors and happen at a particular moment in time. Second, the Advocacy Coalition Framework (ACF) is discussed given its emphasis on policy beliefs which are made up of empirical knowledge of the world and can change in response to exposure to new information or policy learning. Similar to PET, new information may emerge due to shocks to the policy subsystem or interactions and negotiations with other actors that occur over time and throughout the policy process. Last, the Narrative Policy Framework (NPF) is reviewed not only because the associated literature includes the most explicit discussion of and expansive definition of evidence but also due to the theory's assertion that policy narratives unfold over time. Combined, the conceptualization of the policy actor as boundedly rational and several theories of the policy process provide theoretical justification for why the use of evidence is expected to change over time.

The conceptualization of policy actors as boundedly rational can impact the types of evidence individuals use throughout the policy process (Cairney 2017; Jenkins-Smith, Nohrstedt, Weible and Ingold 2017; Mosley and Gibson 2017; Shanahan et al. 2017). The boundedly rational policy actor is restricted by constraints such as time and resources and therefore consults only a limited amount of information before making a decision, relying on mental shortcuts that lead to decisions that are "satisficing" (Lindblom 1959; Simon 1957). Within this process, cognitive phenomenon such as motivated reasoning and hot cognition dominate which causes the actor to primarily consider information that aligns with their existing preferences or preferred solutions leading to biased decision-making (Kraft, Lodge, and Taber 2015; Taber and Lodge

2006; Zaller 1993). Evidence is therefore selected moment to moment to support current preferences. The type of evidence employed therefore has the potential to change throughout the policy process in response to shifts in arguments, beliefs, and the policy preferences of others (Baumgartner, Jones and Mortensen 2017; Birkland 1998; Jenkins-Smith et al. 2017; Shanahan et al. 2017. Furthermore, constraints on time and a reliance on mental shortcuts can cause individuals to rely on information that is close at hand or from trusted sources rather than rigorous sources preferred by proponents of EBP (Cairney 2016). If the perceptions of boundedly rational policy can change in response to exposure to new information, then the content of that evidence must be understood within the temporal nature of the policy process to better understand the type of information driving policy preferences.

In addition, the psychology of actors as they move through the policy process also helps to demonstrate the dual function of evidence as both an objective and subjective phenomenon. In other words, evidence as a neutral body of information (objective) is leveraged throughout the policy process by policy actors to make arguments and persuade others to align with their preferred outcomes (subjective) (Cairney 2016; Jenkins-Smith et al 2017; Jones 2014; Mosley and Gibson 2017; Schlaufer 2018; Shanahan et al. 2017). This dual function of evidence can explain why actors may change their preferences throughout the policy process. As Keller (2009) observes in her assessment of scientists' rhetoric during the legislative process, these actors transition from arbiters of neutral fact to using science to advocate for their policy beliefs. Combined, the bounded rationality of actors and their use of evidence as both an objective fact and a subjective means for persuasion force provides theoretical reasoning for why the use of evidence may vary throughout the policy process.

In addition to the psychology of actors influencing the use of evidence overtime, the policy process also inherently unfolds over time. This policy process is cyclical with feedback loops occurring both within and across stages. For example, a failure to adopt a specific policy may prompt a return to the formation stage and a reevaluation of the problem definition. Furthermore, the process from beginning to end is cyclical emulating an ouroboros rather than a linear line. The complex temporal nature of the policy process inherently lends itself to an evaluation of evidence over time however, more pointed theories of the policy process further conceptualize temporal phenomena which may impact the use of evidence. Namely, Punctuated Equilibrium Theory (PET), the Advocacy Coalition Framework (ACF), and the Narrative Policy Framework (NPF) provide insights into how evidence may change over time, though theories of the policy process with theoretical underpinnings related to time are not limited to those mentioned herein (Baumgartner, Jones and Mortensen 2017; Birkland 1998; Jenkins-Smith, Nohrstedt, Weible and Ingold 2017; Shanahan et al. 2017).

Punctuated Equilibrium Theory asserts that public policy is characterized by long periods of stability and stagnation that are occasionally punctuated by periods of rapid change. These periods of change often occur in response to shocks in the policy system or focusing events that bring attention to an issue (Baumgartner, Jones and Mortensen 2017; Birkland 1998). Here, evidence may shift to new sources in response to changes in policy beliefs that ultimately lead to substantive policy change itself (Cairney 2017). For example, in their examination of nuclear energy policy in the United States, Baumgartner and Jones (1993) identify major disasters related to nuclear energy such as Chernobyl and Three Mile Island as focusing events that shift the attention of policy actors to anecdotal concerns surrounding risk and away from scientific support of the effectiveness and safety of nuclear energy overall. This shift in focus between

different sources of evidence eventually lead to increased regulation of and decreased deployment of nuclear energy in the United States. Punctuated Equilibrium Theory thus points to shocks in the policy system over time as a driver of changes in the evidence used to support changing policy beliefs among actors.

The Advocacy Coalition Framework (ACF) not only points to temporal aspects of the policy process that may lead to changes in the use of evidence but also speaks directly to the use of evidence in public policy. The ACF focuses on the policy subsystem as the driver of policy change. A policy subsystem consists of both actors and circumstances among other factors that interact in a nontrivial way to affect the policy system (Jenkins-Smith et al. 2017). The ACF then identifies four pathways to policy change. Like Punctuated Equilibrium Theory, some of these pathways involve shocks or focusing events that bring attention to a specific issue. These shocks can occur either externally, such as natural disasters, or inside of the policy subsystem itself such as failed implementation. In addition to focusing events, policy change can also occur as a result of policy learning or negotiated agreement. Here, the ACF asserts evidence can be leveraged as a strategic tool to influence the policy beliefs of actors within the subsystem and effect policy change. Like PET, new evidence can be cited following internal or external shocks, or evidence can be strategically leveraged to induce learning or sway preferences among members. In this way, evidence again serves as both an objective body of information and a subjective force throughout the policy process. For example, seminal ACF studies concerning the use of evidence evaluated science within the context of policy analysis and found that more technical applications occurred in policy contexts with higher conflict which contributes to the alteration of policy actors' beliefs (Jenkins-Smith 1990; Weible 2008). To better understand how shifts in

information might impact policy beliefs and thus the substance of policy, the type of evidence used throughout the policy process must be assessed (James and Jorgensen 2009).

Finally, the Narrative Policy Framework (NPF) not only examines evidence as a component of narrative employed by policy actors but also demonstrates that narrative is temporal and displays variation in the use of characters and components over time. The NPF defines a narrative as consisting of both elements and strategies (Shanahan et al. 2017). Elements identified by the NPF that constitute a narrative include the presence of characters, a plot, setting, and policy solution or moral. Conversely, strategies are narrative devices that use the elements of the story and include the devil-angel shift, scope of the conflict, and causal mechanisms (Ibid.). Evidence is considered an aspect of the setting element within narratives. In response, NPF studies have assessed the impact of evidence on the persuasiveness of narratives, policy learning, and policy outcomes among others (McBeth, Shanahan, and Jones 2005; McBeth et al. 2010; Shanahan, Jones, and McBeth 2011; Shanahan et al. 2008; Shanahan and McBeth 2010). These studies demonstrate the subjective function of evidence in policy as objective elements of information used to persuade and influence the policy preferences of other actors. For example, Jones (2014) finds that use of scientific evidence increases the persuasiveness of narratives concerning climate change.

In addition to the effects of evidence, the NPF also finds that the use of evidence varies over time and between policy coalitions. NPF studies assessing narratives related to gun policy found that between the National Riffle Association and the Brady Campaign, the anti-gun coalition used evidence more frequently in narratives constructed on Twitter and in internal newsletters (Merry 2016; Smith-Walter et al. 2016). Other findings suggest that narrative elements and components shift temporarily in response to focusing events that bring attention to

an issue as well as galvanizing events that represent a call to action for stakeholders (Merry 2016; Rupinsky et al. 2022). While assessments of the temporal nature of policy narratives and evidence as an element is limited, these seminal results indicate that evidence, when strategically employed by policy actors, presents the potential to vary throughout the policy process. Additional analysis is needed to determine how the use of evidence varies across the policy process.

Finally, PET, the ACF, and NPF align in the assertion that expanding and containing the scope of the conflict is a common tactic employed by actors in policy debates (Baumgartner, Jones and Mortensen 2017; Jenkins-Smith et al. 2017; Shanahan et al. 2017). Concepts of conflict containment and expansion is rooted in Schattschneider's (1960) seminal work which highlights conflict as the root of politics and success in the policy arena as the direct result of attracting a larger number of actors to one side of the debate. Alternatively, those who do not desire policy change will seek to minimize conflict or contain the scope of the conflict. Subsystems, coalitions, and actors therefore employ strategic measures to expand or contain the scope of the conflict to meet their goals. Additionally, expansion and containment can shift at various times throughout the policy debate (Pralle 2006). An expanse of literature within theories of the policy process support this assertion with winners expanding the scope by increasing narrative use, strategic engagement practices, the allocation of costs and benefits, shifting venues, and more (Gottlieb et al. 2018; Gupta et al. 2016; Holyoke, Brown, and Henig 2012; Olofsson 2022; Rupinsky et al. 2022). Engaging evidence may be an additional strategy used to manage the scope of the conflict at various points in time throughout the policy debate.

IV. Theory Building

This paper seeks to expand understanding of the use of evidence in the policy process. A review of the policy actor as boundedly rational and the Punctuated Equilibrium Theory, Advocacy Coalition Theory and Narrative Policy Theory posit two assertions concerning the use of evidence in the policy process. First, policy actors are likely to use evidence strategically due to bounded rationality to persuade and attempt to assert and advance policy beliefs (Cairney 2017; Jenkins-Smith et al. 2017; Mosley and Gibson 2017; Shanahan et al. 2017). Second, the use of evidence is likely to change in both content and frequency in response to focusing events and at other indeterminant times when policy actors identify its use as necessary to advance their goals (Baumgartner, Jones and Mortensen 2017; Jenkins-Smith, Nohrstedt, Weible and Ingold 2017; Mosley and Gibson 2017; Shanahan et al. 2017). Evidence, therefore, serves as both an objective body of information as well as a subjective force leveraged by policy actors across the policy process. In this way, evidence acts as another tool in the toolbelt of policy actors as they vie to advance in the policyscape by expanding the scope of the conflict (Baumgartner, Jones and Mortensen 2017; Jenkins-Smith, Nohrstedt, Weible and Ingold 2017; Schattschneider 1960). If the policy process unfolds overtime, then it follows that the use of evidence will change throughout the process in response to events occurring both internal to and external to the policy subsystem (Jenkins-Smith, Nohrstedt, Weible and Ingold 2017).

While many theories of the policy process posit evidence plays a role in policymaking, the scope of the literature assessing its use is limited to date. Further analysis of the potential variation of evidence use over time is needed to advance our understanding of the use of evidence in the policy process. A better understanding of how the use of evidence varies throughout the policy process will also give greater insight to how and why actors use specific

types of evidence and its impact on the substance of policy – perhaps one of the most important yet least understood questions of policy scholarship (James and Jorgensen 2009; Weimer 1998). As the literature asserts, "policy process models stress the relations between actors...and institutions...but often neglect the policy knowledge exchanged in this process; hence, there is little systematic investigation into why, when, and how decision makers utilize policy knowledge especially regarding which policy knowledge actors use" (James and Jorgensen 2009). Furthermore, it is important to understand whether the evidence types used by policy actors aligns with the preferences of evidence-based policy to only include methodologically rigorous sources of information or those considered less formal by proponents of EBP.

To expand our understanding of what types of evidence are used by policy actors, this paper presents a more systematic investigation by not only taking stock of *all* sources of information referenced by policy actors but also expanding upon evidence to assess its character. Identifying a comprehensive list of the types of evidence used by policy actors in addition to a way to assess its character allows scholars to begin to formalize analysis of evidence thus increasing legitimacy and unification of the field. First, types of evidence commonly used by policy actors are identified by a broad review of the literature that has examined its use. The review reveals 12 distinct types of evidence:

Evidence Types

Expert opinion. While scientists may produce the scientific evidence preferenced in EBP, they are often called upon to disclose their expertise in relation to a given problem. Such testimony often calls upon experts to go beyond their role as a producer of objective information to offer their own personal opinions or policy preferences (Keller 2009). Scholars of the narrative policy framework term this type of testimony *ipso dictum* meaning an appeal to

authority. They expand expert advice, however, to also include statements made by diverse influential figures including prominent "celebrities or cultural figures" or any individual whose input is pursued, "owing to their fame, position, or title" (Smith-Walter et al. 2016). Here evidence can thus include the latent knowledge of individuals deemed knowledgeable on a given policy topic.

Opinion polls. Policy actors are often interested in the public's positionality on a proposed policy given that they may be subject to reelection and because policy often requires the support of the public for successful selection and implementation (Burstein 2009; Jones and Jenkins-Smith 2009). As a result, public opinion polls may be consulted in order to determine the standing of proposed policies (Lomas and Brown 2009; Smith-Walter et al. 2016). While the actual impact and sophistication of public opinion has long been contested (Converse 1964; Zaller 1992), its use as a source of evidence confirms its legitimacy and aligns with investigations that verify the impact of the public on policy (Burstein 2009).

Public comment. As stated above, public support is often necessary to enhance the legitimacy of policy. While opinion polls can offer insight into the public's general positionality, public comments are included here as a separate source of information given that they encapsulate a broader swath of the public. Public comments are defined as those gathered and submitted throughout the policy making process as legally required by the Administrative Procedures Act with the goal of enhancing the democratic nature of policymaking (Woods 2013). This process, however, permits commenting from diverse groups beyond interested lay members of the public including businesses and advocacy groups. Given that the consideration of these comments is required by law they provide yet another source of evidential information

in the policy process. Policy actors may reference results from public comments when making policy arguments.

Anecdotal. Policymakers will sometimes look to other governments in order to identify policies that have been successfully implemented elsewhere to address a problem in their region (Cairney 2016; Lomas and Brown 2009). This can occur on a national or local scale, both within and between countries. Policy process theorists identify this as a form of policy learning and diffusion where anecdotal government success is identified as evidence to support a particular policy preference (Berry and Berry 2017). Here, success is equated with evidence even when factors that contribute to the adoption of similar policies, i.e. competition, coercion, or pressure, vary significantly from the careful consideration of a policy's realized outcomes or suitability to place (Dolowitz and Marsh 2000; Ettelt et al. 2012). Conversely, anecdotal evidence of failure can bolster arguments against certain policy positions as well.

Indigenous knowledge. Indigenous, sometimes referred to as traditional, knowledge is referred to as, "... a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, Colding and Folke 2000). Scholars assert that indigenous knowledge offers a legitimate source of information given that cultural practices are often rooted in accumulation of observations which mimics preferred conceptions of science (Ibid.). Indigenous knowledge is most commonly consulted in environmental policy such as land and animal management (Ibid.; Sillietoe 2017) however, it is beginning to emerge in other policy arenas such as medicine (Finn, Herne and Castille 2017; Sidhu 2017). While such knowledge is not always effectively considered by policy

makers (Deutsch 2017), at other times it has resulted in enhanced *policy* outcomes (Finn, Herne and Castille 2017).

Community knowledge. Community knowledge differs from indigenous knowledge in that it can emanate from non-native individuals and span various cultures in a region. This type of information collection relies on community engagement rather than the simple collection of stakeholder comments and seeks to better understand the wide range of perspectives in a locality on a given issue as well as identify more tailored solutions. In this way, it goes beyond the requirements laid out in the Administrative Procedures Act to involve communities in a more intentional manner. Community engagement can come in such forms as public deliberation forums, community lead research, or role-playing games and participatory modelling among others (Carcasson 2018; d'Aquino and Bah 2014; Floridia 2018; Peace and Myers 2012). Given that community perspectives are increasingly considered in the formation of new policy, they provide yet another source of evidence for actors in the policy process.

Law. The range of available policy options is often restricted by law or legal precedent leading policy makers to alter their decisions accordingly. Investigations into policy narratives reveal that actors will often use applicable court rulings to defend their positionality on a problem (Smith-Walter et al. 2016). As a result, law represents yet another information input that actors use to support, contest, or shape policy preferences.

Statistics. Statistics is differentiated from scientific studies given that numerical data on a particular issue can exist outside of reports and itself be used strategically by policy actors (Stone 2002). As such it is defined as numbers that are identified or employed in arguments separate from a scientific report, poll, or even grey literature (Smith-Walter et al. 2016).

Science. Evidence in relation to EBP is primarily defined as methodologically rigorous in nature. This is often considered information gathered in a codified and rigorous manner such as that published in peer-reviewed academic journals (Cairney 2014). Literature examining hierarchies of scientific evidence in policy tends to list randomized control trials, non-randomized control trials, quasi-experiments, and observational studies as preferred methods of inquiry (Deeming 2013; Heinrich 2007; Kano and Hayashi 2021; Jennings and Hall 2011; Prewitt et al. 2012). This aligns with rational interpretations of evidence that consider science the pursuit of an observable and objective truth (Hess and Adams 2002).

Grey Literature. While published, scientific studies are considered the golden standard of evidence in EBP, publicly available yet non-commercially published studies are also considered by policy actors (Lomas and Brown 2009; Luzi 2000; MacDonald et al. 2012). Grey literature in public policy is thus defined as,

> "working papers, discussion papers, briefings and guides, data-sets, conference papers and various others, produced by organisations such as government departments and agencies, universities, think tanks, non-government organisations, corporations and professional bodies, and made available to the public directly either in print or digitally" (Lawrence et al. 2015).

This category therefore excludes traditional publications such as books and academic articles and journals which often require a purchase for access. Here, grey literature is closely associated with science but is still considered a subcategory of evidence given that the diversity of sources included in its definition may not adhere to more stringent classifications of evidence as studies employing certain rigorous methodologies.

News Stories. Information published by news media represent another area of quasi-published information that is cited by policy actors as a source of evidence. News stories differ from grey literature in that they are not "non-commercially" published.

Risk. Risk is defined as the "likelihood that an agent or hazard will produce adverse effect" or "the potential for harm, loss, or hazard" (Flynn 2021; Swaney 1996). These risks have not yet been identified as a type of evidence employed by policy actors however, it is added here as a potential type given its prevalence in the literature and potential to be utilized in policy contexts with actor identified risks. Studies of risk communication and perception as well as political science have identified certain risks such as existential risk (i.e. climate change; nuclear war) as drivers of human behavior and decision making (Norris, de Calvo, and Mather 2020).

Evidence Valence

Second, the character of evidence is assessed by identifying its valence. The valence of an evidence type considers whether the type has been institutionalized in accordance with the standards of EBP. Valence is defined here in accordance with the psychological definition where valence corresponds to the positive or negative value attached to a stimuli (Shuman, Sander, and Scherer 2013). The evidence valence thus takes on a binary quality where the positive evidence valence (1) is assigned to institutionalized evidence types and the negative valence of (0) is assigned to the non-institutionalized evidence types. The binary represents a yes/no response where a particular evidence type is institutionalized or not. Therefore, a valence of zero does not indicate no valance but instead an evidence type that is not institutionalized. Identifying a valence for each evidence type represents a novel approach to the study of evidence in public policy with the intent to lead to a more holistic understanding of the use of evidence. Valence allows the scholar to simultaneously characterize the use of evidence beyond discrete categories while acknowledging its normative properties. Adding the valence variable in conjunction with evidence bridges the divide between theories of the policy process's focus on actor interactions with institutions to their use of policy knowledge. Findings will therefore allow for a more

nuanced assessment of if and how policy actors align with institutional norms, where norms vary, and why aiding future investigations of the use of evidence and how it drives policy change.

Utilizing conceptions of EBP along with the broader literature, the following types of evidence from the list of 12 identified in the previous section are considered institutionalized, or a positive evidence valence for the purposes of this integrative framework: science and grey literature. *Science* as defined as an evidence type encompasses the type of methodology rigorous studies preferenced by EBP. As a mode of information gathering characterized by standardized approaches they equate to the rational, institutionalized methods of EBP. *Grey literature* is also considered to align with EBP approaches given the type includes studies produced by government agencies, think tanks, and other organizations which continue to aid in the institutionalization of traditional approaches to EBP. In review, all evidence types are assigned a valence. Valence 1 evidence types are institutionalized under EBP and include science and grey literature. Valence 0 evidence types or non-institutionalized sources of information and include all other defined in the next section ranging from anecdotal to indigenous knowledge to risk. As a shorthand, Valence 1 evidence can be referred to as "hard" evidence while Valence 0 evidence can be referred to as "soft" evidence. Hard and soft as well as institutionalized and non-institutionalized sources of evidence will be used interchangeably.

In response to the question *how does the use of evidence change throughout the policy process:*

I first hypothesize that the type of evidence will demonstrate differences between identified policy stages.

Second, I hypothesize that the valence of evidence will also demonstrate differences between identified policy stages.

V. Methods

The primary research question is assessed by coding both written and verbal comments submitted online and at public hearings concerning the decommissioning and relicensing of the Diablo Canyon Power Plant. These comments are chosen in order to capture various stages of the policy process unfolding overtime. The data series begins in 2015 when the public was presented with its first opportunity to comment on PG&E's relicensing application process since its original filing date in November of 2009. The data set concludes in September of 2024 when data collection began and nearly one year after PG&E filed their second license renewal application as mandated by the California state legislature. This near 10-year span allows for the analysis of evidence over multiple iterations of the policy cycle including. In addition, this time period includes a policy reversal from the decision to decommission to recommission the DCNPP presenting a unique opportunity to observe how information is leveraged in a particularly tumultuous policy setting (see Table 1). In addition, the assessment of public comments allows for a greater understanding of how a broader array of actors uses evidence rather than limiting observations to settings where only politicians or rule makers can make statements, for example.

All public comments posted on Regulations.gov in reference to the non-rulemaking docket titled "Notice of Receipt and Availability of Application for Renewal of Diablo Canyon Nuclear Power Point License" were collected for coding. In addition, all comments recorded in the web archive of the Diablo Canyon Decommissioning Panel were also collected[2]. Non-relevant comments were excluded from the data set including those that were illegible or

[2] The Diablo Canyon Decommissioning Panel was organized by Pacific Gas & Electric to manage the decommissioning process. The panel was run by a group of volunteers and comments can be submitted online at anytime as well as verbally or in writing at public hearings hosted by the panel.

appeared to be advertisements or spam. Comments not containing evidence were kept in the dataset. Data was coded based on the codebook listed in the Appendix. The codebook assigns a number (1-12) to evidence types listed in the previous section. A 13th type is added to capture evidence types not identified in the initial list for analysis. The codebook also assigns a numeric value to the seven types of expected policy actors that may participate in public commenting as well as four types of settings including a written public comment or hearing transcript which are both observed in the data set. Valence is coded as a 1 for institutionalized types of evidence or 0 for non-institutionalized types. Institutionalized types of evidence are identified in accordance with traditional approaches to EBP to include evidence types that employ methodologically rigorous approaches. From the list of 12 evidence types presented above, institutionalized types include science and grey literature. Therefore, science and grey literature is coded as a valence of one while all other types are coded as a valence of zero.

For the purposes of this study, policy stages were identified in accordance with standard stages of the policy process. Many scholars argue that the stages approach to public policy is no longer a viable means of conceptualizing the process in the face of the many complexities of policy making including the cyclical nature of the cycle itself. As a result, the stages approach is considered over simplistic and many theories of the policy process have been developed in an attempt to better describe the dynamics of policy process ranging from the Advocacy Coalition Framework (ACF) to the Multiple Streams Framework and Punctuated Equilibrium Theory (PET) (Weible and Sabatier 2017). Despite the success of alternative conceptions of the policy process, the stages approach endures as a heuristic due to its ability to provide a simple and workable model (Capano and Pritoni 2020; Howlett, McConnell and Pearl 2016; Smith and Larimer 2017). When combined with theories of the policy process, the stages models serve to

enhance understanding. For example, theories of the policy process such as the ACF can be mapped onto the policy stages providing insights into how coalitions interact at specific points in time. Therefore, the various frameworks and models for conceptualizing the policy process should be considered concurrently rather than mutually exclusive (Howlett, McConnell and Pearl 2016). This is one such study in which time is best operationalized using the stages heuristic and is used in combination with additional theories of the policy process.

Stages were coded sequentially as 1-5 with each stage defined as follows:

- Stage 1– Policy Formation (4/21/2010-9/13/2017): This stage represents the period of time during which PG&E has filed for license renewal, but no decision has been made on the application.
- Stage 2 – Policy Implementation (9/14/2017-10/22/2020): This stage represents the period of time during which PG&E announced their decision to close DCNPP and begin decommissioning planning.
- Stage 3 – Policy Evaluation (10/23/2020 - 8/23/2022): This stage represents the time during which blackouts occurred in California and the state began to reconsider its energy plans including the closure of DCNPP.
- Stage 4 – Policy Formation (8/24/2022 - 8/31/2022) This stage represents the time during which the California state legislature held special hearings, passed, and signed into law SB 846 requiring the continued operation of DCNPP
- Stage 5 – Policy Implementation (9/1/2022 - 12/11/2024): This stage represents the period beginning the decision to recommission DCNPP to the present.

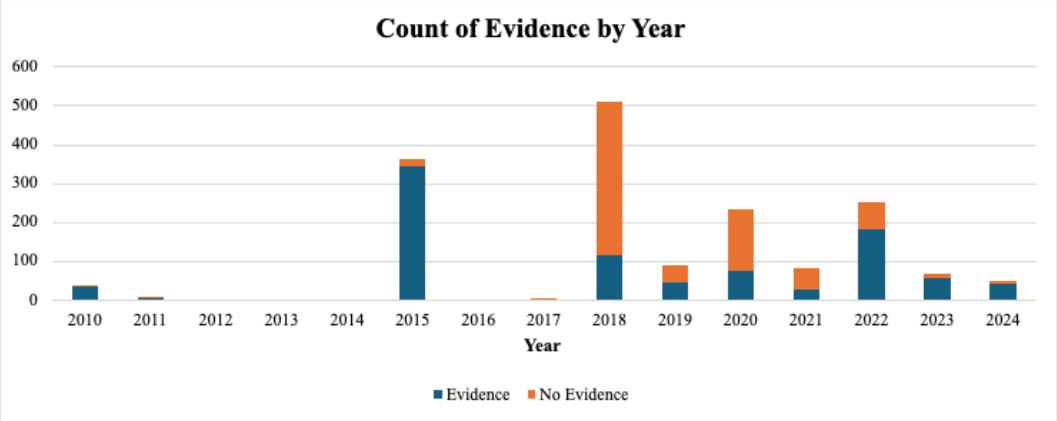
This coding method was chosen to capture both the linear and cyclical or overlapping nature of the policy process. By coding the identified stages chronologically, they can be evaluated as five

sequential stages as well as condensed into three unique stages given Stage 1 and 4 as well as 2 and 5 represent the same policy stage. The dual evaluation of stages allows for an examination of the effects of the stages independently and overtime.

Comments were coded at the comment level with evidence statements coded according to the codebook meaning an observation occurs when an actor made a statement that contained evidence. If a single sentence contained more than one reference to evidence, then a single observation would be recorded for each reference within that statement. Comments that did not contain a reference to evidence were coded as a zero for the evidence type variable. Coding was completed deductively with the option of coding an observation as "other" for the evidence type so that unexpected types could be discovered and used to expand definitions of evidence in future work. All data was coded by the researcher. Final analysis yielded n=1721 observations. Initial results of coding are presented below in Figure 1 below.

To assess the relationship between the categorical variables of hypotheses 1 and 2 (stage, evidence type, and evidence valence), a chi squared test of independence is conducted. Chi squared tests are considered the best method for analyzing frequencies between categorical variables by comparing observed versus expected frequences. As a result, it remains one of the most common methods employed in the literature for assessing categorical data (Naioti and Mudrak 2022; Sharpe 2015). Standardized residuals are calculated following a chi-squared test to identify which specific cells in a contingency table contribute most to the overall chi-squared statistic. By scaling the residuals, they allow for easier comparison across cells, highlighting significant deviations from the null hypothesis of independence (Ibid).

Figure 1. Evidence Count by Year



VI. Results

Initial analysis of the data began with a review of summary statistics. Two stacked bar charts were created to visually represent the distribution of evidence types and evidence valence across the five identified policy phases. Figures 2 and 3 illustrate the count of evidence type per policy stage while Figures 4 and 5 display the count of valence across the policy stages. Combined, these tables demonstrate the variety of evidence and evidence valence preferenced by policy actors at different points in the policy process. These visualizations support the findings of subsequent chi-square tests, demonstrating variation in both evidence types and valence across policy stages.

Figure 2. Count of Evidence by Stage

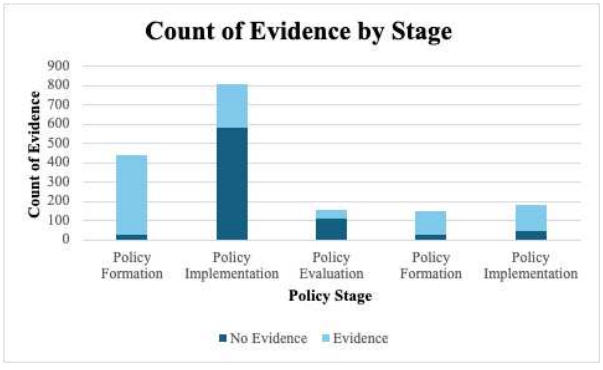


Figure 3. Count of Evidence by Stage

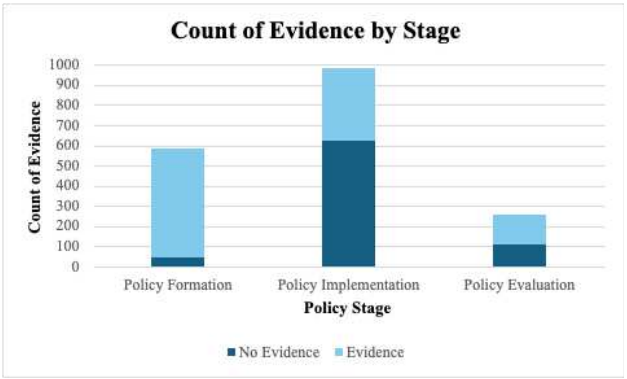


Figure 4. Count of Valence by Stage

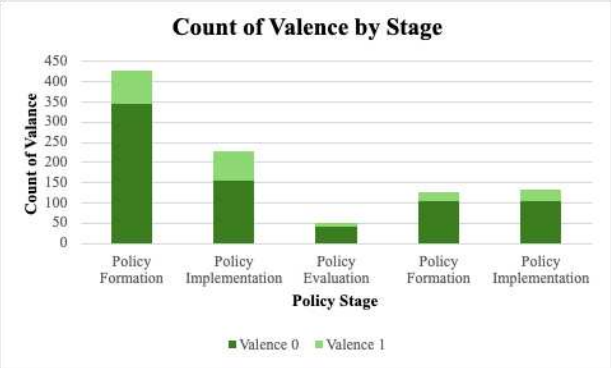
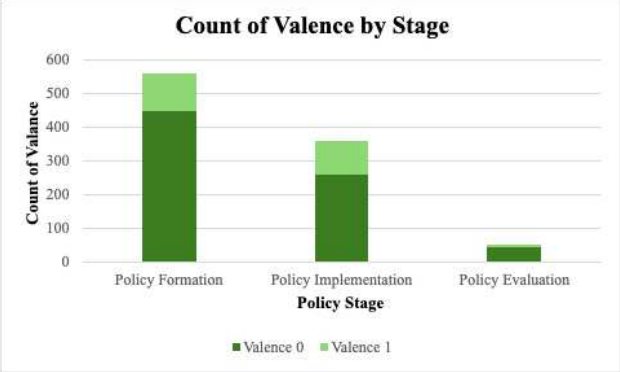


Figure 5. County of Valence by Stage



Upon first glance, significant changes in the use of evidence can be observed between Stage 1 and 2. Namely, the use of evidence goes from high employment in Stage 1 to low employment through Stages 2 and 3. Here, actors are observed making policy statements and assertions that are not supported by a specific evidence type. Stage 2 and 3 in the expanded stages model or Stage 2 in the condensed stages model represent a time when the implementation of the Diablo Canyon Nuclear Power Plant decommission project began. In these stages participants largely move from trying to provide evidence that their pro or anti-nuclear stance is correct to simply stating what they think should be done with the decommissioned site. An example of a policy statement in this stage includes, “I’d ask you to consider allowing public access including coastal trails with overarching land conservation goals” (2018, comment submitted to the “Diablo Canyon Decommissioning Engagement Panel”). Comparatively, statements made in Stage 1 state, “For 30 years, Diablo Canyon has continued to safely produce clean and reliable energy without greenhouse gases (GHG), avoiding 6 to 7 million tons per year of GHGs that would be emitted by conventional generation sources” (Boyer, 2015, comment made on Docket (NRC 2009-0552-0026) on Regulations.gov). This shift in evidence use indicates that Actors view evidence as more imperative for making policy arguments prior to

policy selection and implementation. Chi-square tests help to further demonstrate which evidence types actors find most important in these stages.

Following a review of the summary data, two chi-squared tests of independence were conducted to examine the relationship between the stage of the policy process and the evidence type and valence respectively. The results of the first chi-square test indicate a significant association between the Stage of the policy process and Evidence Type with $X^2 = 858.49, p < .001$. This result suggests that the distribution of the evidence type varies significantly across stages demonstrating support for the first hypothesis.

In addition to the chi-squared test, standardized residuals were calculated to provide further insight into the relationship between the policy stage and evidence type. The standardized differentials are useful for identifying which specific cells in the contingency table (Tables 2 and 3) contribute most to the overall chi-square results. The standardized residuals indicate the magnitude and direction of deviation from the expected counts under the assumption of independence. Standardized residuals with a value greater than +/- 2 are considered significant for smaller tables whereas values of +/- 3 are considered significant for larger tables (Naioti and Mudrak 2022; Sharpe 2015). Given the size of the table for this analysis the threshold of +/- 3 is used where the highest residual values are reviewed given they represent the strongest and most noteworthy relationships.

Table 2. Pearson Standardized Residuals for Evidence Type by Policy Stage

	Policy Formation	Policy Implementation	Policy Evaluation	Policy Formation	Policy Implementation
NA	*-19.44**	*21.07**	*6.25**	*-7.63**	*-5.60**
Science	*6.21**	*-4.00**	*-0.50*	*-0.45*	*-1.43*
Grey literature	*2.85*	*-2.64*	*-2.78*	*0.90*	*2.02*
Public comment	*-0.29*	*-3.57**	*0.02*	*0.09*	*6.19**
Anecdotal	*6.22**	*-6.64**	*-2.10*	*4.32**	*-0.007*
Indigenous knowledge	*-1.43*	*2.61*	*-0.76*	*-0.74*	*-0.82*
Community knowledge	-	-	-	-	-
Law	*-1.21*	*-1.11*	*-1.91*	*-1.04*	*6.35**
Statistics	*6.70**	*-7.19**	*-2.73*	*6.46**	*-1.17*
Expert advice	*7.51*	*-6.37**	*-1.21*	*-0.21*	*1.03*
Opinion polls	*-1.65*	*1.60*	*0.35*	*0.40*	*-0.95*
News articles	*4.74**	*-3.55**	*-0.07*	*-0.60*	*-0.32*
Risk	*8.15**	*-9.04**	*-0.37*	*2.06*	*1.62*
Other	*3.27*	*-3.77**	*-0.18*	*1.68*	*0.11*

Note: Significant residuals are demarcated with an *

Table 3. Pearson Standardized Residuals for Evidence Type by Policy Stage (condensed)

	Policy Formation	Policy Implementation	Policy Evaluation
NA	*-22.38**	*17.81**	*6.25**
Science	*5.44**	*-4.91**	*-0.50*
Grey literature	*3.16**	*-1.42*	*-2.78*
Public comment	*-0.21*	*0.19*	*0.02*
Anecdotal	*8.27**	*-6.70**	*-2.10*
Indigenous knowledge	*-1.76*	*2.12*	*-0.76*
Community knowledge	-	-	-
Law	*-1.73*	*2.76*	*-1.91*
Statistics	*9.97**	*-7.97**	*-2.73*
Expert advice	*6.78**	*-5.79**	*-1.21*
Opinion polls	*-1.28*	*1.02*	*0.35*
News articles	*4.00**	*-3.78**	*-0.07*
Risk	*8.71**	*-8.12**	*-0.37*
Other	*4.00**	*-3.73**	*-0.18*

Note: Significant residuals are demarcated with an *

A review of the standardized residuals table indicates a few key trends in the data. First, in Stage 1, risk, expert advice, and statistics all have high, positive residuals indicating that there

were more observations of these types of evidence than would be expected under the null hypothesis. In Stage 2, this shifts to the evidence types of risk, anecdotal and expert advice however with negative residuals indicating a movement away from the use of these evidence types in the second stage. The only significant evidence type with a positive residual at Stage 2 is no evidence indicating a movement away from evidence use during Stage 2. Stage 3 indicates a continuous movement away from evidence use with no evidence again indicating the most significant result. In Stage 4, statistics and anecdotal evidence again demonstrate high, positive residuals with law and public comments demonstrating the highest significance level in Stage 5. Overall, institutionalized sources of hard evidence – science and grey literature – demonstrate limited significance with science showing significant levels in Stage 1 and 2 and grey literature having no significant influence.

Results indicate that when actors do use evidence in policy statements, they tend to rely on more soft, noninstitutionalized sources with a Valence of 0. Early on in the policy debate, individuals speak to their concerns about a potential nuclear meltdown due to failure, and earthquake, terrorist attack, or other natural disaster as well as radiation exposure and DCNPP's impact on the environment, especially surrounding marine life. Here, such risks to life are a primary source of evidence for actors. These risks are further bolstered by experts who assert similar opinions or statistics – data and numbers – that exemplify why the DCNPP should be shuttered. What is interesting is that pro and anti-nuclear stakeholders may both use similar types of evidence however, the content of evidence statements change. For example, an anti-nuclear actor concerned with risk will speak to the dangers of a nuclear meltdown while a pro-nuclear actor will assert that increased greenhouse gas emissions that would result from decommission the power plant increase the effects and risk of climate change for all.

The significance of anecdotal evidence – stories of policy successes and failures – indicate that stakeholders often look towards real world case studies to support their positions. Here, the anti-coalition points to nuclear failures in Chernobyl, Russia, Fukushima, Japan, and Three Mile Island in the U.S. while the pro-coalition cites Germany's challenges in phasing out nuclear as well as the proven safety record of DCNPP itself. Stage 5 represents a reversal in policy from a decision to decommission Diablo Canyon to recommission. Law is a significant source of evidence here as both pro and anti-nuclear actors begin to cite California Senate Bill 846 which requires recommissioning with some added conditions such as additional seismic testing. Here, actors move away from citing risk, statistics, anecdotal evidence, and experts and simply put to the aspect of a new existing law which supports their assertions.

While the identified policy stages represent the chronological progression of the recommissioning of the Diablo Canyon Nuclear Power Plant, specific phases repeat themselves as policy decisions are revised. As a result, repeating policy stages should also be compared to determine if similar evidence types are employed in repeated stages. First, Stage 1 and 4 both represent policy formation. In the stages representing policy formation both statistics and anecdotal evidence or soft evidence have high significance. Next, Stage 2 and 5 both represent policy implementation. Here, a greater difference between significant evidence types is observed. While risk and statistics are significant in Stage 2, law and public comments are most significant. This demonstrates some indication that the cyclical nature of the policy process can have implications for the type of evidence used at later stages however, soft, noninstitutionalized sources are preferenced throughout.

A special note should be made here for the use of no evidence. While the standardized differential values for no evidence remains significant in every policy stage, the strength of the

significance reduces overtime. Standardized residuals that are significantly larger than others in the data set can represent outliers. Upon closer examination Stage 1 represents the stage with the fewest observations of no evidence while Stage 2 represents the stage with the highest observation of no evidence. This may explain why the standardized differentials for these two stages are the highest as they represent two extremes in the overall data. This, however, calls for a more detailed analysis of such a significant use of evidence in stage one which will follow in the discussion section.

The results of the second chi-square test indicate a significant association between the stage of the policy process and evidence valence with $X^2 = 679.01$, $df=8$, $p < .001$. This result suggests that the distribution of the evidence valence varies significantly across the stages demonstrating support for the second hypothesis. Standardized residuals with a value greater than +/- 3 are considered significant for larger tables (Tables 4 and 5).

Table 4. Pearson Standardized Residuals for Valence by Policy Stage

	Policy Formation	Policy Implementation	Policy Evalution	Policy Formation	Policy Implementation
NA	*-20.18**	*21.55**	*6.24**	*-7.49**	*-5.44**
Valence 0	*17.13**	*-19.10**	*-4.37**	*7.02**	*4.46**
Valence 1	*4.67**	*-3.77**	*-2.83*	*0.73*	*1.50*

Note: Significant residuals are demarcated with an *

Table 5. Pearson Standardized Residuals for Valence by Policy Stage (condensed)

	Policy Formation	Policy Implementation	Policy Evaluation
NA	*-22.98**	*19.90**	*4.72**
Valence 0	*18.39**	*-16.52**	*-2.88*
Valence 1	*6.24**	*-4.37**	*-2.83*

Note: Significant residuals are demarcated with an *

When changes in valence are observed for each policy stage, results are significant throughout the process. Like evidence types, there is an overrepresentation of valence in Stage 1, particularly Valence 0 evidence and an underrepresentation of observations in Stage 2. Again, no valence has the highest significance in Stages 1 and 2 due to the low and high prevalence of evidence used in those respective stages. Overall, a valence of 0 has a higher significance level than a valence of 1 indicating this relationship may be more impactful. Recalling that valence 0 represents soft, noninstitutionalized sources of evidence, this aligns with results for the first chi-squared test and residuals which showed that noninstitutionalized sources of evidence had a greater impact in the overall model.

These findings demonstrate the actors in the DCNPP policy debate preference non-institutionalized sources of evidence overall. As stated above, both anti and pro-nuclear coalitions often cite soft sources of evidence including risk, anecdotal evidence, expert advice, and use statistics – data and numbers – to support their preferences. Rather than align with norms of evidence-based policy, most actors in this policy debate rely on what they feel, see and hear from experts and case studies in the real world to make their policy judgements. As one comment posits, "Where were you when Diablo blew?" Assessing both the use of individual evidence types and valence across the policy stages provides greater insight into whether its use varies over time. An analysis of distinct evidence types such as statistics and anecdotal evidence demonstrates significant use throughout the policy process. Conversely, evidence valence provides insight into the greater contours of the evidence landscape in this case demonstrating that soft, noninstitutionalized evidence has a greater impact overall. In the next section I discuss the implications of these findings for understanding the use of evidence in the policy process.

VII. Discussion

The results of this analysis of the use of evidence overtime in the Diablo Canyon Nuclear Power Plant debate provide insight into not only the types of evidence employed by policy actors at different stages of the policy process by also the character of those evidence types in terms of their alignment with institutionalized sources under traditional approaches to evidence-based policy (EBP). It was determined that both evidence type and evidence valence demonstrate distinct differences over the course of the policy process. First, evidence type varies both in overall frequency of use as well as the specific types of evidence with the strongest influence in each stage. The frequency of evidence use peaks in the first identified stage of policy formation. The use of evidence then decreases in Stage 2 and 3 until it begins to rise again in Stage 4 which is also a period of policy formation. A majority of comments posted in Stage 1 occur after the DCNPP filed its application with the Nuclear Regulatory Commission (NRC) for license renewal and in response to the first opportunity to respond publicly to an aspect of the review process – the development of the Environmental Impact Statement. Comments posted in Stage 4 are in response to meetings held by the California state legislature to discuss the potential reversal of the decommissioning of the DCNPP. In both cases, the formation of policy related to the operations of the DCNPP prompted actors to increase their references to evidence when asserting their policy positions publicly. This provides support for the strategic use of evidence by policy actors in specific policy stages. Second, while Valence does vary between stages due to its reliance on evidence use, Valence 0 or soft evidence has the most significant impact throughout the policy process. This aligns with critics of evidence-based policy that asserts actors often consider a broad array of information when forming their policy preferences (Cairney 2016; Smith-Walter et al. 2016).

Fundamental to many theories of the policy process is Schattschneider's (1960) assertion that conflict lies at the heart of politics. During political conflict, actors seek to expand the scope of the conflict in order to bring more individuals to their side and win the policy debate. In their assessment of narrative strategies, Rupinsky et al. (2022) finds that expanding the scope of the conflict occurs most significantly at the beginning of a policy debate then will contract and expand in response to moments of winning and losing throughout the policy process (Pralle 2006; Schattschneider 1960). This not only explains the frequency of evidence use peaking during Stage 1 but resurfacing during Stage 4 when policy formation begins again reversing a previous victory or loss for perspective actors. As a result, evidence may be employed most during stages of the policy process where there is the most to gain or lose for participating actors (Rupinsky et al. 2022). As the ACF asserts, events such as the opening and closing of policy venues will invoke a, "…mobilization by minority coalitions to exploit the event, for instance, by pursuing public narratives to attract attention to favored courses of action by appealing to new actors" (Jenkins-Smith et al., 2017). If moments of policy formation serve as the opening of a policy venue or window (Jenkins-Smith et al. 2017) as well as a focusing event which mobilizes actors and the use of evidence increases during this time (Baumgartner, Jones, Mortensen 2017), then findings indicate that evidence is a tool used by actors to expand the scope of the conflict.

Findings thus align with a breadth of literature in both the NPF and ACF literature that finds actors and coalitions use a variety of methods to expand and contain the scope of the conflict. Previous studies of the NPF found that evidence often serves a buttressing effect in narratives (Smith-Walter et al. 2016; Schlaufer 2018). Here too, evidence may be used to support policy positions and the scope of the conflict due to its ability to work in tandem with many mechanisms of conflict expansion including narrative use, strategic engagement practices, and

the allocation of costs and benefits (Gottlieb et al. 2018; Olofsson 2021; Rupinsky et al. 2022). This is further supported by the wide array of evidence used in the first stage of the policy process. More evidence types in Stage 1 demonstrated significant, positive use than at any other stage including science, anecdotal evidence, statistics, expert advice, news articles, and even "other." This demonstrates that during the policy formation stages, actors seek to expand the scope of the conflict by also expanding their engagement of a large array of information to support their policy preferences.

Engagement of diverse evidence types may also be related to procedural norms associated with policy formation. In particular, the policy formation stage involves processes such as public comment periods, legislative hearings, or research that engages a broader spectrum of inputs. This is in contrast to stages two and five which both represent policy implementation as well as stage three which is policy evaluation. During policy implementation and evaluation, a policy decision has been made providing less opportunities for actors to strategically engage in the process. The relative openness of a policy stage may therefore promote or inhibit the diversity of evidence engaged. In addition, information from later stages of the policy process may be integrated in earlier stages when revisited. These findings have implications for policy learning in addition to demonstrating how evidence can be used as a strategic tool. Future research may focus on tracing specific evidence types throughout the policy cycle to identify when information surfaces, when it is integrated in subsequent stages, and if that leads to a policy reversal or change in preferences. A longitudinal study would be most beneficial for demonstrating how specific information types might integrate into the evidence landscape of particular actors, coalitions, or policy arenas.

Finally, the use of a particular type of evidence in stage five – law – demonstrates the impact a single type can have in the policy process. In stage five, actors begin to cite existing law SB 846 which requires DCNPP to file for relicensing to support their argument either for or against the decision. This demonstrates that once a policy decision is defined legally, it can become a primary source of evidence used to characterize policy preferences. This can help to better explain the phenomena of path dependency. It appears that once a policy decision is made, the policy becomes more narrowly defined within the context of the decision. This combined with the relatively closed nature of later stages of the policy process serve to narrow the focus on evidence in those stages.

In concluding a discussion of the relationship between stages of the policy process and evidence type and valence, it is important to note limitations of research presented herein. First, the decision to assess evidence in public comments may have impacted results. Public comments and forums allow for the participation of a large array of actors. Much like more restrictive stages of the policy process, characteristics of venues may impact the types of evidence employed. Beyond stages of the policy process, some scholars have found that specific evidence types are preferenced by specific agencies (Jennings and Hall 2011) or in the legislative setting (Mosley and Gibson 2017). More investigation is necessary to determine if policy stage or setting is a more significant driver of evidence selection or if similar trends arise in various settings at particular stages. Second, while this study introduces the concept of evidence valence, future research should test additional applications of this concept to determine its viability for characterizing evidence use and preferences. For example, while the study herein determined that evidence valence zero (noninstitutionalized) has the strongest impact, future studies may focus

on determinants of valence at the venue, individual, coalition, or policy arena level (i.e. do policy actors demonstrate differences in valence; do actors of the same coalition?).

Finally, the case selection of this study may have also impacted results and limited generalizability. Nuclear energy policy is known to demonstrate significant variance between expert and lay person opinions with the former claiming that the technology is low risk and the latter often expressing opposition or concern. Furthermore, energy policy has remained a contentious subject since its development and early nuclear disasters of the 1970s and 80s including the melt down of Chernobyl in Russia as well as the U.S. based Three Mile Island facility. The tumultuous and historically significant nature of the nuclear policy arena itself may explain why such a significant array of evidence was observed in various stages of the policy process. Furthermore, this study represented an examination of the most recent policy punctuation in the enduring saga of the Diablo Canyon Nuclear Power Plant and failed to capture all standard phases of the policy process. For a more nuanced understanding of how evidence is engaged over time, analysis could begin as far back as 1963 when PG&G first announced their decision to build DCNPP and include additional policy stages such as agenda setting.

VIII. Conclusion

This study contributes to the broader understanding of the use of evidence in public policy by assessing both the type and valence of evidence employed by policy actors during various stages of the policy process. Results demonstrate that while specific types of evidence are preferenced during different stages of the policy process, overall evidence with a valence of 0, or soft, noninstitutionalized sources of evidence are broadly favored. In particular, phases of the policy process that are more open in terms of procedure or who may participate in that stage as well as present an opportunity for actors to win or lose see increases in not only the amount of

evidence employed but also the diversity. Despite subsequent, more closed phases of the policy process seeing a decreased use of evidence, the primary types employed remain soft, noninstitutionalized types. These finding stand in stark contrast to proponents of EBP who assert that information gleaned from methodologically rigorous sources of information should be used when selecting policy preferences. Findings thus align with the growing body of literature which asserts policy actors instead engage a broad array of both institutionalized and noninstitutionalized sources. The findings reviewed herein thus demonstrate a need for continued assessment of many evidence types in order to develop a more holistic understanding of the use of information in policymaking. This pursuit is fundamental to furthering the utility of policy process research.

In addition to enhancing broad understanding of the use of evidence in policymaking, findings also have implications for several theories of the policy process reviewed during the theoretical rational of this paper – the PET, ACF and NPF. First, findings support the assertions of the PET and ACF that more information enters the policy subsystem during key events or shocks. Here, key events include an opening of the policy process during the policy formation stage. This opening provides an opportunity for stakeholders to employ a broader array of evidence to assert their policy positions. This further provides support for a hypothesis of the ACF which theorizes actors may use evidence as a tool to bring more stakeholders to their side of the debate. Actors appear to strategically employ more information when they have the most to lose or gain leading up to a policy decision. During a high conflict phase, this serves to expand the scope of the scope of the conflict, primarily at the outset of a policy debate, supporting enduring findings of the NPF. Taken together, this demonstrates that in periods of increased attention and argumentation, actors call upon diverse arrays of information coinciding with

particular stages of the policy process. However, more research is needed to better understand if coalitions or actors differ in the types of evidence they employ. This would provide greater insight into whether volume or type of information matters most for key stakeholders answering greater philosophical questions concerning the nature of evidence and if the substance of information matters.

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Appendix

Codebook:

Variable	Description/Coding Instruction
Text Type	Type of document being coded 1 = legislation 2 = hearing transcript 3 = hearing document 4 = public comment
Time	Date text was published/written
Stages of the Policy Process	Stage of policy process text for analysis falls within 1 = policy formation 2 = policy implementation 3 = policy evaluation 4 = policy formation 5 = policy implementation
Actor/Narrator Categorization	Individual or group who is making the statement 1 = member of the public 2 = policymaker 3 = government 4 = advocacy organization 5 = non-profit 6 = industry/private sector 7 = scientist 8 = other
Coalition	Policy preference of individual or group making statement 1 = pro-coalition 2 = anti-coalition 3 = neutral
Evidence Type	Type of evidence invoked by policy actor 1 = science 2 = grey literature 3 = public comment 4 = anecdotal 5 = indigenous knowledge 6 = community knowledge 7 = law 8 = statistics 9 = expert advice 10 = opinion polls 11 = news article 12 = risk 13 = other
Evidence Valence	Institutionalization of evidence type 1 = institutionalized (evidence types 1 and 2) 0 = non-institutionalized (evidence types 3-13)

Regression Models:

In addition to the chi-squared tests performed in this study, multinomial regressions were also conducted to confirm that the chi-squared test was the most suitable for the data. Results indicate that the regression model was not suitable for handling the high number of categorical variables in the data. Overfitting occurred likely due to collinearity as well as sparse data. As a result, the chi-squared test remains most suitable for handling categorical data. Results from the regression tests are as follows:

Table 1. Regression Results for Evidence Type and Policy Stage

	1	2	3	4	5	7	8	9	10	11	12	13
Stage 2	25.90 ***	3.156 ***	4.187 ***	4.563 ***	2.252 ***	2.550 ***	3.975 ***	5.399 ***	9.712	4.523 ***	4.460 ***	4.369 ***
Stage 3	-4.346 ***	-3.816 ***	-2.489 **	-4.406 ***	-9.278	-3.364 ***	-4.093 ***	-4.212 ***	9.617	-3.518 ***	-3.386 ***	-3.364 ***
Stage 4	-2.773 **	-1.194 **	-0.917	-0.936*	-9.045	-1.281*	-0.777*	-2.128 ***	11.190	-2.351 **	-1.386 ***	-1.099*
Stage 5	-19.69 ***	-1.551 ***	0.095	-2.323 ***	-8.436 ***	-0.288	-2.451 ***	-2.234 ***	-11.859 ***	-2.639 ***	-1.996 ***	-2.197 ***
Constant	-0.318	1.099 ***	-1.481 **	0.841 ***	-16.821 ***	-0.201	1.375 ***	0.647*	-14.281	-0.046	1.431 ***	-0.200

Following logistic regression was performed to further examine the relationship between valence and policy stage with results displayed below in Table 2.

Table 2. Regression Results for Valence and Policy Stage

	Estimate	Standard Error	Z value	Pr(>|z|)
Intercept	-1.431	0.122	-11.641	< 0.001***
Stage 2	0.704	0.187	3.758	< 0.001***
Stage 3	-0.203	0.405	-0.501	0.616
Stage 4	-0.168	0.269	-0.628	0.530
Stage 5	0.118	0.245	0.483	0.628

Chapter 5

Project 3: The Devil's in the Details: Examining predictors of evidence selection in the Diablo Canyon Nuclear Power Plant debate in San Luis Obispo County, California

I. Introduction

Conflict is the crux of politics (Schattschneider 1960). Resolution of such conflict is achieved through rigorous debate both between and within competing coalitions and actors. In communicating their respective opinions on a matter, coalitions and stakeholders must carefully construct their arguments in order to vie for their position in the policy arena. An important element in the stories that policy actors tell about their policy preferences is evidence or the available body of facts or information indicating whether a belief or proposition is true or valid. While the Advocacy Coalition Framework (ACF) and the Narrative Policy Framework (NPF) both assert that evidence plays a role in the formation of coalitions, their policy beliefs and the construction of narratives, research assessing the use of evidence to date is limited and a lack of conclusive findings persist concerning its role. In response, this paper tests several hypotheses focused on the primary question: *are coalitions or actors predictors of evidence selection?*

Given that both the ACF and NPF theorize how coalitions and actors may strategically use evidence, these frameworks provide an opportunity to further explore the role of evidence in public policymaking. Assessing the role of evidence utilizing key concepts explored in both the ACF and NPF also enhances understanding of the evidence-based policy (EBP) movement by interrogating the centrality of evidence for policymakers. Determining whether coalitions or actors prefer specific types of evidence would further solidify the importance of evidence for policymaking whereas converse results would require a reconceptualization of its role. The hypotheses tested herein therefore, represent a significant contribution to not only theories of the

policy process but also normative assertions that specific evidence types should and are used by policy actors.

The primary research question is assessed in the context of the ongoing decision to recommission the Diablo Canyon Nuclear Power Plant in San Luis Obispo County in California. The decision to decommission and subsequently recommission the power plant was met with significant opposition from a diverse set of groups including citizens of the county and broader California, local activist groups, scientists, and government officials. While the plant initially determined that its operation was no longer necessary to support the energy demand of California, the state legislature determined the opposite following a series of blackouts and near misses in the state. As a policy conflict unfolding in real-time with energized actors, the ongoing recommissioning of Diablo Canyon provides a fruitful opportunity to evaluate if coalitions or actors preference certain types of information. Results show that actors and coalition membership are the best predictors of evidence selection and valence. Overall, actors and coalitions preference similar soft or non-institutionalized evidence sources providing further evidence that narrative matters.

II. Evidence in Evidence-Based Policy, the Advocacy Coalition Framework, and the Narrative Policy Framework

Evidence-Based Policy

Evidence-based policy is broadly considered a movement within government to use more methodologically rigorous sources of information such as those obtained through randomized control trials rather than rooted in anecdote or intuition to identify, design, fund, implement and manage more effective policies and policy outcomes (Baron 2018; Cairney 2016; Heinrich 2017; Jennings and Hall 2011). The institutionalization of EBP can be traced along two paths

beginning in the 1930s (Stone 2002). This first path emerges in the same decade following the development of cost-benefit analysis (CBA) as a standard method for evaluating and comparing policy alternatives (Ibid.). The second begins just after World War II in the 1940's and concerns the establishment of randomized controlled trials (RCTs) as a preferred means for verifying the viability of a policy intervention (Baron 2018). Such approaches to EBP were eventually institutionalized across sectors of the federal government ranging from public health policy to welfare, education, international aid, and more. The institutionalization of EBP demonstrates a preference towards a particular type of information gathering. Namely, these preferences are rooted in a rationalist tradition which seeks to obtain an objective truth, one that separates facts from beliefs or the messier political aspects of policy problems (Keller 2016; Stone 2002).

Despite the broad institutionalization of methodologically rigorous approaches to EBP, others assert that policy actors should and do use a broader range of evidence in making policy. Alternative sources of information can include grey literature, or reports produced by non-publishing organizations (i.e. government reports, white papers, conference proceedings etc.), public opinion, legal precedence, anecdotal evidence of success, expert advice and community knowledge (Berry and Berry 2017; Burstein 2009; Carcasson 2018; Floridia 2018; Keller 2009; Lomas and Brown 2009; Luzi 2000; MacDonald et al. 2012; Smith-Walter 2016). This assertion stems from the conceptualization of policy actors as boundedly rather than purely rational. In other words, actors have limited time and resources when making decisions and so often default to mental shortcuts or rely on personally preferred sources of evidence which may or may not include methodologically rigorous studies. Furthermore, in addition to serving as an objective body of information, evidence also plays an active role in the policy process as a tool used to

persuade stakeholders. In this way, actors may choose the type of evidence they perceive to be most impactful rather than rigorous or even accurate thus preferencing various types of evidence.

Beyond EBP, theories of the policy process provide insight into how policy actors might use evidence. First, the Advocacy Coalition Framework (ACF) is discussed given its emphasis on policy beliefs which are made up of empirical knowledge of the world and can change in response to exposure to new information or policy learning. New information may emerge due to shocks to the policy subsystem or interactions and negotiations with other actors that occur over time and throughout the policy process. Evidence can therefore be impactful not only for the individual policy actor's beliefs but also the overall preferences of the coalition with which they align. Second, the Narrative Policy Framework (NPF) is reviewed because the associated literature includes the most explicit discussion of and expansive definition of evidence beyond its initial conceptualization as science. This conceptualization has allowed for the interrogation of the role of evidence yielding mixed results where coalitions were not found to differ in their use of evidence until more sources of information were considered beyond science – or those methodologically rigorous sources preferenced under EBP.

The Advocacy Coalition Framework

The ACF focuses on the policy subsystem as the driver of policy change. Policy subsystems consist of both actors and circumstances that interact in a nontrivial way to affect the policy system (Jenkins-Smith et al. 2017). The ACF then identifies four pathways to policy change including internal and external shocks, policy learning, or negotiated agreement. In all four of these cases, new or changing evidence can play a role in changing policy by influencing the policy beliefs of subsystem actors. Given that policy beliefs are made up of individuals' "perceived causal patterns and relationships that shape the empirical world," new information

has the power to alter these concepts and induce changes in policy beliefs and thus preferences (Jenkins-Smith, et al. 2017; Sabatier 1987). The ACF therefore asserts that evidence is a tool in the belt of policy actors that is strategically leveraged in order to alter policy beliefs to induce policy change (Ibid.).

Given coalitions within subsystems are made up of actors, new information or evidence has the potential to impact beliefs and preferences at both the individual and collective level. However, despite the potential impact of evidence within the ACF, there is a lack of investigation into whether coalitions or policy actors vary in their evidence preferences as well as the composition of that evidence (Nam and Weible 2023). Developing a better understanding of what evidence is preferenced by actors and coalitions is the first step towards better understanding the role of evidence in policy subsystems and policymaking. While theories of the ACF make it a good framework for assessing how coalitions and its members use evidence, the literature to date is limited and often fails to incorporate a broad range of evidence types beyond those traditionally preferenced by EBP (James and Jorgenson 2009; Mosley and Gibson 2017).

The Narrative Policy Framework

The Narrative Policy Framework (NPF) not only examines evidence as a component of narrative employed by policy actors but also demonstrates that narrative is temporal and displays variation in the use of characters and components over time. The NPF defines a narrative as consisting of both elements and strategies (Shanahan et al. 2017). Elements identified by the NPF that constitute a narrative include the presence of characters, a plot, setting, and policy solution or moral. Conversely, strategies are narrative devices that use the elements of the story and include the devil-angel shift, scope of the conflict, and causal mechanisms (Ibid.). Evidence is considered an aspect of the setting element within narratives. In response, NPF studies have

assessed the impact of evidence on the persuasiveness of narratives, policy learning, and policy outcomes among others (McBeth, Shanahan, and Jones 2005; McBeth et al. 2010; Shanahan, Jones, and McBeth 2011; Shanahan et al. 2008). Additionally, as NPF scholars have begun to expand their definition of evidence beyond traditional conceptions of scientific information, the literature has yielded more nuanced results that better demonstrate variation in evidence use and choice between coalitions (Smith-Walter et al. 2016). Combined with the ACF and EBP literature, the NPF offers an additional lens through which to assess the utilization of evidence in the policy process. Assessments to date offer a foundation to begin assessing the question of whether coalitions preference specific sources of evidence.

III. Theory Building

A primary question that persists both within the ACF and NPF is whether coalitions or actors use evidence in a systematically different way or engage the same types when stating policy preferences and instead focus on narrative. The ACF asserts that coalitions form around core policy beliefs or preferences. As a result, the framework suggests that evidence is a tool that actors can use to bolster support and signal preferences to others. Therefore, opposing coalitions may use different sources of evidence to advocate for their particular positions. Conversely, while the NPF identifies evidence as a narrative element, or a structural component of narrative, it does not inherently assert that this element is used in strategically different ways by competing coalitions. Instead, by preferencing narrative the NPF suggests that rather than the substance of evidence, it is narrative in which it is imbedded that is most important. In other words, the NPF posits that opposing groups may invoke the same sources of evidence but instead use the same evidence to construct different policy stories or narratives. In line with these opposing

arguments, research assessing the use of evidence reveals mixed results concerning whether opposing coalitions use evidence in a systematically different manner.

Developing greater understanding of this question becomes even more important when considered in light of the evidence-based policy literature. As Cairney (2016) asserts, successful engagement with the policy process necessitates an understanding of policy subsystems and their associated coalitions. Within EBP, this includes how coalitions use information so that it can be framed by actors in a way appropriate to the desired coalition for engagement whether they be for or against a desired policy outcome. Furthermore, when attempting to understand how coalitions engage with evidence, policy scholars assert it is important to pay attention to both analytic and local knowledge, or both scientific and less formal ways subsystems understand problems (Weible et al. 2012). This perspective acknowledges that coalition hierarchies of information can differ from methods of knowing preferred within EBP norms and can also vary from one subsystem to the next (Cairney 2016; Weible et al. 2012). As a result, evidence is considered an important aspect of coalition formation and detailing its use is imperative for both policy scholars and actors trying to effectively engage with the policy process. The importance of the use of evidence within both the EBP and policy process literature justifies further exploration of questions related to evidence hierarchies. Such analysis is necessary for determining the nature of evidence hierarchies and whether these information preferences center around coalitions.

Despite the potential importance of evidence in coalition building, arguments endure concerning whether coalitions differ in their use of evidence. To date, findings offer mixed results. Shanahan et al. (2008; 2013) find that pro and anti-coalitions do not differ statistically in their use of evidence in the case of both windfarm development as well as policy concerning the

Greater Yellowstone Area. In the case of windfarm development, groups failed to invoke science to bolster their arguments in distinct ways (Shanahan et al. 2013), while opposing coalitions concerning Yellowstone policy used evidence related to conservation solutions (Shanahan et al. 2008). Furthermore, Crow and Breggren (2014) find no difference between coalitions' use of science as evidence across four cases related to environmental and natural resource policy. Based on their findings, the authors call into question the importance of evidence in coalition building.

In opposition to these findings, both McBeth, Shanahan, and Jones (2005) and Smith-Walter et al. (2016) find that coalitions do differ in their use of evidence. While McBeth, Shanahan, and Jones (2005) evaluate the same data that produced null results concerning coalition use of evidence in Shanahan et al. (2008), they instead develop a science score to determine a scale of evidence use between opposing coalitions. This scale determines the homogeneity of evidence use ranging from highly technical to conservation-based science and demonstrated that the pro-conservation group engaged more diverse types of evidence. While Smith-Walter et al. (2016) did not use a science score, they expanded on prior studies by including five categories of evidence as opposed to one or two in earlier studies and was able to demonstrate a significant difference of use between pro and anti-gun reform coalitions. Not only did the two coalitions differ in their use of evidence overall, but within each category of evidence identified in the study. In particular, the anti-coalition invoked evidence more often than the pro-gun coalition.

Despite coalitions being made up of individual groups or actors, no studies from the review of the literature herein have sought to compare the effects of coalition membership on information selection compared to actors. However, some NPF analysis indicates that evidence is often linked to characters, especially heroes in policy narratives (Smith-Walter et al. 2016).

While actors or groups may take on the role of hero, victim, villain or even neutral character in policy narratives, this research indicates there may be some connection between actors and evidence use (Ibid.). Furthermore, the ACF states that even within larger coalitions, individuals can express secondary policy beliefs that differ in implementation strategies for the larger policy preference or concern (Jenkins-Smith et al. 2017). This too indicates that actors may have differing secondary preferences and thus information preferences that are independent from the larger coalition. However, the policy preferences of the overall coalitions could still outweigh individual preferences. As Weible (2008) asserts, coalitions may seek to add members who can provide certain sources of information or evidence. Further assessment is needed to determine if actors and the coalitions align or differ in their evidence preferences.

Beyond theories of the policy process, the interest group literature provides additional insight into how coalitions and actors may engage evidence. Broadly, organizations tend to mimic and engage in standard political processes and norms in order to gain legitimacy and ground in the policy arena (Duffy 2013). This trend indicates that non-profits participating in the DCNPP debate may preference more hard, institutionalized types of evidence in order to align with the standard practices and procedures of policymaking. Keller (2009) shows that when participating in legislative hearings, scientists tend to highlight existing research rather than their opinions. Keller's (2009) findings indicate that scientists may also be more likely to prefer hard, institutionalized sources of evidence. Finally, governmental bodies or agencies themselves that are subject to upholding procedural norms of policymaking may preference hard, institutionalized sources of evidence when participating in the policy process (Jennings and Hall 2011). These theorized information preferences of some actors add complexity to the policy landscape as their broader coalition and fellow actors may have differing evidence needs.

Assessing preferences at both the actor and coalition levels is necessary to better understand how evidence is leveraged.

To expand our understanding of what types of evidence are used by policy actors and coalitions and if their membership drives selection, this paper presents a more systematic investigation by not only taking stock of *all* sources of information referenced by policy actors but also expanding upon evidence to assess its character. Identifying a comprehensive list of the types of evidence used by policy actors in addition to a way to assess its character allows scholars to begin to formalize analysis of evidence thus increasing legitimacy and unification of the field. First, types of evidence commonly used by policy actors are identified by a broad review of the literature that has examined its use. The review reveals 12 distinct types evidence:

Evidence Type

Expert opinion. While scientists may produce the scientific evidence preferenced in EBP, they are often called upon to disclose their expertise in relation to a given problem. Such testimony often calls upon experts to go beyond their role as a producer of objective information to offer their own personal opinions or policy preferences (Keller 2009). Scholars of the narrative policy framework term this type of testimony *ipso dictum* meaning an appeal to authority. They expand expert advice, however, to also include statements made by diverse influential figures including prominent "celebrities or cultural figures" or any individual whose input is pursued, "owing to their fame, position, or title" (Smith-Walter et al. 2016). Here evidence can thus include the latent knowledge of individuals deemed knowledgeable on a given policy topic.

Opinion polls. Policy actors are often interested in the public's positionality on a proposed policy given that they may be subject to reelection and because policy often requires

the support of the public for successful selection and implementation (Burstein 2009; Jones and Jenkins-Smith 2009). As a result, public opinion polls may be consulted in order to determine the standing of proposed policies (Lomas and Brown 2009; Smith-Walter et al. 2016). While the actual impact and sophistication of public opinion has long been contested (Converse 1964; Zaller 1992), its use as a source of evidence confirms its legitimacy and aligns with investigations that verify the impact of the public on policy (Burstein 2009).

Public comment. As stated above, public support is often necessary to enhance the legitimacy of policy. While opinion polls can offer insight into the public's general positionality, public comments are included here as a separate source of information given that they encapsulate a broader swath of the public. Public comments are defined as those gathered and submitted throughout the policy making process as legally required by the Administrative Procedures Act with the goal of enhancing the democratic nature of policymaking (Woods 2013). This process, however, permits commenting from diverse groups beyond interested lay members of the public including businesses and advocacy groups. Given that the consideration of these comments is required by law they provide yet another source of evidential information in the policy process. Policy actors may reference results from public comments when makng policy arguments.

Anecdotal. Policymakers will sometimes look to other governments in order to identify policies that have been successfully implemented elsewhere to address a problem in their region (Cairney 2016; Lomas and Brown 2009). This can occur on a national or local scale, both within and between countries. Policy process theorists identify this as a form of policy learning and diffusion where anecdotal government success is identified as evidence to support a particular policy preference (Berry and Berry 2017). Here, success is equated with evidence even when

factors that contribute to the adoption of similar policies, i.e. competition, coercion, or pressure, vary significantly from the careful consideration of a policy's realized outcomes or suitability to place (Dolowitz and Marsh 2000; Ettelt et al. 2012). Conversely, anecdotal evidence of failure can bolster arguments against certain policy positions as well.

Indigenous knowledge. Indigenous, sometimes referred to as traditional, knowledge is referred to as, "... a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, Colding and Folke 2000). Scholars assert that indigenous knowledge offers a legitimate source of information given that cultural practices are often rooted in accumulation of observations which mimics preferred conceptions of science (Ibid.). Indigenous knowledge is most commonly consulted in environmental policy such as land and animal management (Ibid.; Sillietoe 2017) however, it is beginning to emerge in other policy arenas such as medicine (Finn, Herne and Castille 2017; Sidhu 2017). While such knowledge is not always effectively considered by policy makers (Deutsch 2017), at other times it has resulted in enhanced environmental outcomes (Finn, Herne and Castille 2017).

Community knowledge. Community knowledge differs from indigenous knowledge in that it can emanate from non-native individuals and span various cultures in a region. This type of information collection relies on community engagement rather than the simple collection of stakeholder comments and seeks to better understand the wide range of perspectives in a locality on a given issue as well as identify more tailored solutions. In this way, it goes beyond the requirements laid out in the Administrative Procedures Act to involve communities in a more intentional manner. Community engagement can come in such forms as public deliberation

forums, community lead research, or role-playing games and participatory modelling among others (Carcasson 2018; d'Aquino and Bah 2014; Floridia 2018). Given that community perspectives are increasingly considered in the formation of new policy, they provide yet another source of evidence for actors in the policy process.

Law. The range of available policy options is often restricted by law or legal precedent leading policy makers to alter their decisions accordingly. Investigations into policy narratives reveal that actors will often use applicable court rulings to defend their positionality on a problem (Smith-Walter et al. 2016). As a result, law represents yet another information input that actors use to support, contest, or shape policy preferences.

Statistics. Statistics is differentiated from scientific studies given that numerical data on a particular issue can exist outside of reports and itself be used strategically by policy actors (Stone 2002). It is defined as numbers that are identified or employed in arguments separate from a scientific report, poll, or even grey literature (Smith-Walter et al. 2016).

Science. Evidence in relation to EBP is primarily defined as methodologically rigorous in nature. This is often considered information gathered in a codified and rigorous manner such as that published in peer-reviewed academic journals (Cairney 2014). Literature examining hierarchies of scientific evidence in policy tends to list randomized control trials, non-randomized control trials, quasi-experiments, and observational studies as preferred methods of inquiry (Deeming 2013; Heinrich 2007; Kano and Hayashi 2021; Jennings and Hall 2011; Prewitt et al. 2012). This aligns with rational interpretations of evidence that consider science the pursuit of an observable and objective truth (Hess and Adams 2002).

Grey Literature. While published, scientific studies are considered the golden standard of evidence in EBP, publicly available yet non-commercially published studies are also considered

by policy actors (Lomas and Brown 2009; Luzi 2000; MacDonald et al. 2012). Grey literature in public policy is thus defined as,

> "working papers, discussion papers, briefings and guides, data-sets, conference papers and various others, produced by organisations such as government departments and agencies, universities, think tanks, non-government organisations, corporations and professional bodies, and made available to the public directly either in print or digitally" (Lawrence et al. 2015).

This category therefore excludes traditional publications such as books and academic articles and journals which often require a purchase for access. Here, grey literature is closely associated with science but is still considered a subcategory of evidence given that the diversity of sources included in its definition may not adhere to more stringent classifications of evidence as studies employing certain rigorous methodologies.

News Stories. Information published by news media represents another area of quasi-published information that is cited by policy actors as a source of evidence. News stories differ from grey literature in that they are not "non-commercially" published.

Risk. Risk is defined as the "likelihood that an agent or hazard will produce adverse effect" or "the potential for harm, loss, or hazard" (Flynn 2021; Swaney 1996). These risks have not yet been identified as a type of evidence employed by policy actors however, it is added here as a potential type given its prevalence in the literature and potential to be utilized in policy contexts with actor identified risks. Studies of risk communication and perception as well as political science have identified certain risks such as existential risk (i.e. climate change; nuclear war) as drivers of human behavior and decision making (Norris, de Calvo, and Mather 2020).

Evidence Valence

Second, the character of evidence is assessed by identifying its valence. The valence of an evidence type considers whether the type has been institutionalized in accordance with the standards of EBP. Valence is defined here in accordance with the psychological definition where

valence corresponds to the positive or negative value attached to a stimuli (Shuman, Sander, and Scherer 2013). The evidence valence thus takes on a binary quality where the positive evidence valence (1) is assigned to institutionalized evidence types and the negative valence of (0) is assigned to the non-institutionalized evidence types. The binary represents a yes/no response where a particular evidence type is institutionalized or not. Therefore, a valence of zero does not indicate no valance but instead an evidence type that is not institutionalized. Identifying a valence for each evidence type represents a novel approach to the study of evidence in public policy with the intent to lead to a more holistic understanding of the use of evidence. Valence allows the scholar to simultaneously characterize the use of evidence beyond discrete categories while acknowledging its normative properties. Adding the valence variable in conjunction with evidence bridges the divide between theories of the policy process's focus on actor interactions with institutions to their use of policy knowledge. Findings will therefore allow for a more nuanced assessment of if and how policy actors align with institutional norms and where norms vary aiding future investigations of the use of evidence and how it drives policy change.

Utilizing conceptions of EBP along with the broader literature, the following types of evidence from the list of 12 identified in the previous section are considered institutionalized, or a positive evidence valence for the purposes of this integrative framework: science and grey literature. *Science* as defined as an evidence type encompasses the type of methodology rigorous studies preferenced by EBP. As a mode of information gathering characterized by standardized approaches they equate to the rational, institutionalized methods of EBP. *Grey literature* is also considered to align with EBP approaches given the type includes studies produced by government agencies, think tanks, and other organizations which continue to aid in the institutionalization of traditional approaches to EBP. In review, all evidence types are assigned a

valence. Valence 1 evidence types are institutionalized under EBP and include science and grey literature. Valence 0 evidence types or non-institutionalized sources of information and include all other defined in the next section ranging from anecdotal to indigenous knowledge to risk. As a shorthand, Valence 1 evidence can be referred to as "hard" evidence while Valence 0 evidence can be referred to as "soft" evidence. Hard and soft as well as institutionalized and non-institutionalized sources of evidence will be used interchangeably.

The following hypotheses are assessed in this study:

H1: Actor will predict evidence type and valence.

In addition to employing specific evidence types or valence however, actors and coalitions are also making selections in the context of broader interacting concepts within the policy environment (see project 1). Namely, evidence statements are made at a certain point in point time, stage in the policy process, and various settings including public hearings and written comments. Therefore, date, policy stage, and text type are included as additional independent variables for consideration. To determine if actors or coalitions are the most significant driver of evidence and valence preferences, the following is assessed:

Evidence = Actor + Coalition + Stage + Text Type + Date

Valence = Actor + Coalition + Stage + Text Type + Date

In addition to evidence type and valence being predicted by actor type, the following is hypothesized on the review of literature and characteristics of coalitions and actors presented above:

H2: The pro-nuclear coalition will engage evidence less than the anti-nuclear coalition.

H3: The pro-nuclear coalition will use institutionalized evidence (valence 1).

H4: Government, non-profits, and scientists will prefer science and grey literature.

H5: Government, non-profits, and scientists will use institutionalized evidence (valence 1).

IV. Methods

The primary research question is assessed by coding both written and verbal comments submitted online and at public hearings concerning the decommissioning and relicensing of the Diablo Canyon Power Plant. Public comments are chosen in order to capture input from a variety of policy actors as well as coalition members. The data series begins in 2015 when the public was presented with its first opportunity to comment on PG&E's relicensing application process since its original filing date in November of 2009. The data set concludes in December of 2024 when data collection concluded and nearly one year after PG&E filed their second license renewal application as mandated by the California state legislature. This near 10-year span allows for the analysis of evidence over multiple iterations of the policy cycle. In addition, this time period includes a policy reversal moving from a decision to decommission to recommission the DCNPP presenting a unique opportunity to observe how information is leveraged in a particularly tumultuous policy setting. In addition, the assessment of public comments allows for a greater understanding of how a broader array of actors uses evidence rather than limiting observations to settings where only politicians or rule makers can make statements, for example.

All public comments posted on Regulations.gov in reference to the non-rulemaking docket titled "Notice of Receipt and Availability of Application for Renewal of Diablo Canyon Nuclear Power Point License" were collected for coding. In addition, all comments recorded in the web archive of the Diablo Canyon Decommissioning Panel were also collected. Non-relevant comments were excluded from the data set including those that were illegible or appeared to be advertisements or spam. Comments not containing evidence were kept in the dataset. Data was

coded based on the codebook listed in the Appendix. The codebook assigns a number (1-12) to evidence types listed in the previous section. A 13th type is added to capture evidence types not identified in the initial list for analysis. Valence is coded as a 1 for hard, institutionalized types of evidence or 0 for soft, non-institutionalized types. The codebook also assigns a numeric value to the seven types of expected policy actors that may participate in public commenting as well as four types of settings including a written public comment or hearing transcript which are both observed in the data set.

Comments were coded at the comment level with evidence statements coded according to the codebook meaning an observation occurs when an actor made a statement that contained evidence. If a single sentence contained more than one reference to evidence, then a single observation would be recorded for each reference within that statement. Comments that did not contain a reference to evidence were coded as a zero for the evidence type variable. Coding was completed deductively with the option of coding an observation as "other" for the evidence type so that unexpected types could be discovered and used to expand definitions of evidence in future work. All data was coded by the researcher. Final analysis yielded n=1721 observations.

A Random forest classification model is used to assess the first hypothesis and identify which variables most influence evidence type and valence selection. Random forest is a machine-learning algorithm that predicts outcomes by averaging results from decision trees trained on a subset of the original dataset. Random forest models are ideal for assessing datasets with a high number of categorical variables and achieve higher accuracy on classification tasks than regression models (Schonlau and Zou 2020). Two models were trained using actor, coalition, policy stage, text type, and date as predictor variables, while evidence type and valence were assessed as outcome variables. The dataset was split into training (70%) and testing (30%)

subsets to evaluate model performance. Variable importance was assessed using mean decrease in accuracy which indicates the influence of each explanatory variable in predicting evidence type or valence. Mean Gini decrease was also assessed to determine which variables were important for creating splits in trees and grouping data. This analysis allows for the identification of key factors influencing the selection of evidence type and valence, providing insight into the patterns underlying the datasets.

To asses hypotheses 2-4 summary statistics and chi squared tests are conducted. Primarily frequency tables were constructed to understand the amount and types of evidence employed by each actor and coalition as well as the valence of each actor and coalition. Then, chi squared tests are conducted to determine if differences in evidence and valence exist between actor types and coalitions. Chi squared tests are considered the best method for analyzing frequencies between categorical variables by comparing observed versus expected frequencies. As a result, it remains one of the most common methods employed to assess categorical data (Naioti and Mudrak 2022; Sharpe 2015).

V. Results

Hypothesis 1

The first hypothesis posits that actor will predict both evidence type and valence and includes the additional independent variables of coalition, policy stage, text type, and date. Random forest modeling is used to test the first hypothesis. Results of the Random forest models are assessed in two ways. First, variable importance is reviewed to determine which of the independent variables is the best predictor of the dependent variables (evidence type and valence). Second, the Gini index is reviewed to determine which independent variable was most important in constructing decision pathways or building the logic of the model. In sum, variable

importance results show which variable has the most predictive power in the model similar to how key predictors in an OLS model explain more variance in the dependent variable. While high Gini index variables are also important, they are more important in shaping the overall model or decision trees rather than forecasting.

The Random forest models are presented below for both evidence type (Figure 5) and valence (Figure 6)[3]. For legibility, the evidence tree was pruned to include only the most observed evidence types including no evidence, grey literature, statistics, and risk. Similarly, the valence tree was also pruned to include no evidence and valence zero, or soft, non-institutionalized evidence. The full decision trees can be reviewed in the Appendix. The plot of the decision tree model illustrates how the independent variables (actor, coalition, stage, date, and text type) group the outcome variable (evidence type and valence). Each node represents a decision split based on a predictive variable with branches leading to different classifications of evidence type or valence. Terminal nodes indicate the predicted category.

The modeling demonstrates mixed results for the first hypothesis. Actor was the primary predictor of evidence type selection supporting the first hypothesis. However, coalition was the primary predictor for valence selection. Following actor and coalition, stage of the policy process also demonstrates importance. The identification of stage as a strong predictor variable supports findings from Project 2 but demonstrates that actor and coalition are stronger predictors of evidence type and valence. The variable importance of all predictors for evidence type and valence are displayed below in Figure 1 and Figure 2 respectively.

[3] Initial results of the Random forest model highlight the collinearity of evidence type and valence resulting in strong variable importance between the two. When valence was included as a predictor for evidence type, valence was the primary predictor variable. Conversely, evidence type was the primary predictor when included in the valence model. Not only were evidence type and valence the strongest predictors in these models but were also most important for splitting. In order to reduce redundancy, a second round of modeling was conducted removing evidence type and valence as predictors. The resulting decision tree from the second round of modeling are displayed in Figure X below for evidence type and Y below for valence.

Figure 1. Evidence Type Variable Importance

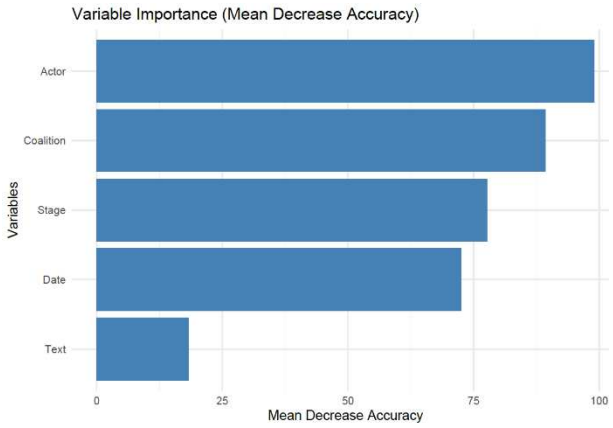
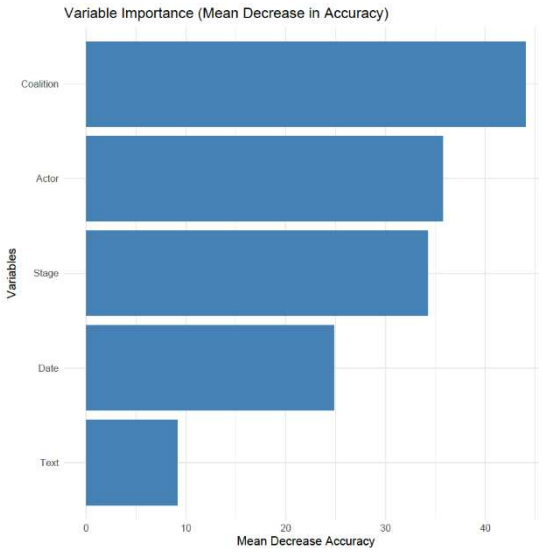


Figure 2. Valence Variable Importance



Alternatively, the Gini index indicates that date and policy stage are most important for categorizing data in the evidence type and valence model respectively (see Figures 3 and 4) below). In other words, date and policy stage were relied upon most to categorize data when building the logic of the Random forest models. This also reinforces findings from Project 2 and suggests that temporal patterns strongly influence the classification process, indicating shifts in how evidence type or valence are used over time.

Figure 3. Evidence Type Variable Importance and Gini Plot

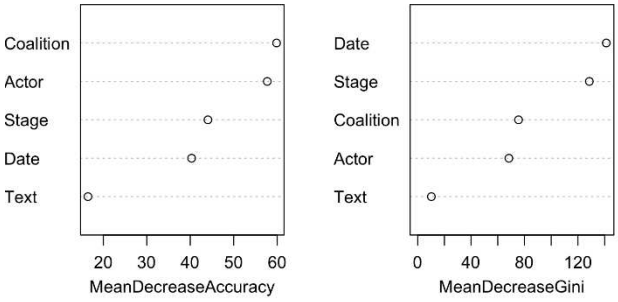
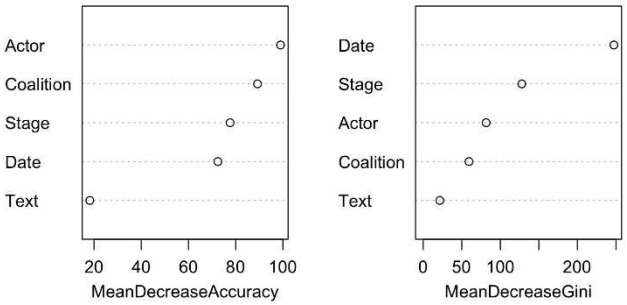


Figure 4: Valence Variable Importance and Gini Plot



Finally, the Random forest models were tested using new, unseen data to determine a type and valence output and verify the accuracy of the model. The test case selected was a pro-nuclear non-profit submitting a written comment in policy stage four (policy formation) on March 31st, 2025. The Random forest model accurately predicted an outcome of evidence type 8 (statistics) and a valence of zero (soft, non-institutionalized evidence). Predicted outcomes based on new data demonstrate the models' ability to generalize results beyond the initial training data set based on real world observations. Successful outcomes show the model accurately reflects predictive relationships between variables and outputs.

In sum, the Random forest model results show that actor and coalition had the highest variable importance, indicating that these variables were the most essential for correctly classifying new or unseen cases of evidence type and valence. This provides partial support for the first hypothesis. Conversely, date and policy stage had the highest Gini index, suggesting they are especially influential in determining how the data was split and organized across the decision trees. This means that date and policy stage played a central role in shaping the internal structure of the model and how observations were grouped into categories at each branch. Findings highlight the dynamic nature of the dataset, where contextual factors such as time and stage play a critical role in shaping evidence outcomes.

Figure 5. Pruned Evidence Type Decision Tree

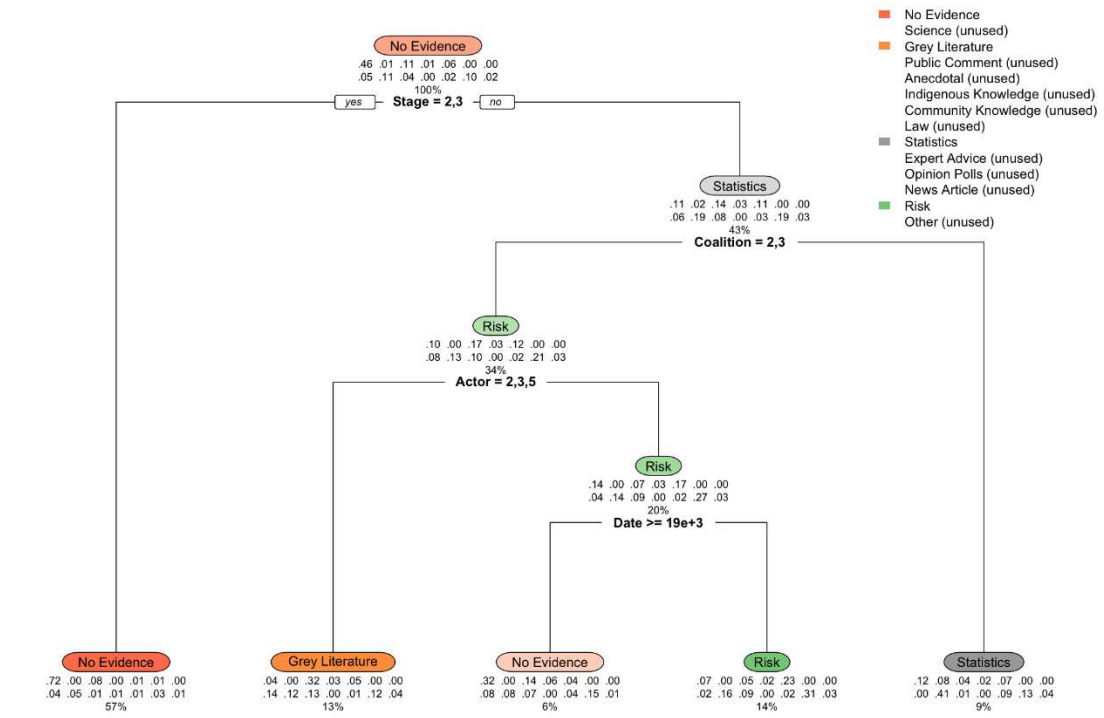
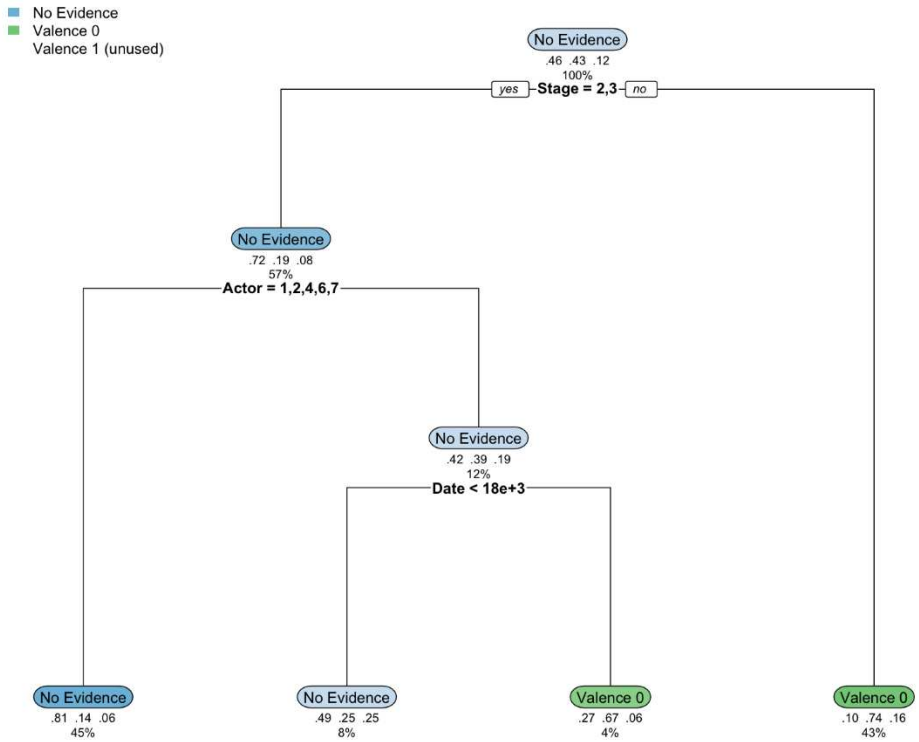


Figure 6. Pruned Valence Decision Tree



To assess hypothesis 2-4, two frequency tables were created to represent the distribution of evidence types across coalitions (see Appendix). Combined, these tables demonstrate the variety of evidence types preferenced by policy actors and coalitions.

Hypothesis 2

The second hypothesis posits that the pro-nuclear coalition will engage less evidence than the anti-nuclear coalition. The pro-nuclear coalition used evidence less often than the anti-nuclear coalition demonstrating support for the second hypothesis. The pro-nuclear coalition employed evidence in 60% of observations while the anti-nuclear coalition used evidence in 86% of observations. While the pro and anti-coalitions differed in how frequently they cited evidence, overall they both employed all evidence types and preferenced similar types of evidence. In particular, both the pro and anti-nuclear coalitions preferenced the use of statistics, risk, and anecdotal evidence.

Hypothesis 3

The third hypothesis posits that the pro-nuclear coalition will preference institutionalized evidence or preference hard evidence. Results demonstrate that the pro, anti and neutral coalitions all preference soft evidence or have a valence of zero, indicating no support for hypothesis three. The findings demonstrate that coalitions in the DCNPP policy debate preference soft, non-institutionalized sources of evidence overall. Rather than align with norms of evidence-based policy, the coalitions in this policy debate rely on what they feel, see, and hear in the real world to make their policy judgements rather than scientific findings.

Hypothesis 4

The fourth hypothesis posits government, non-profits, and scientists will prefer science and grey literature. Findings offer support for hypothesis four. Of the evidence types employed

by non-profits and government, grey literature was used most often however, science was primarily employed by scientists. Non-profits employed grey literature more than any other actor, making up nearly half of all grey literature observations at 47%. Government referenced grey literature in 58% of its evidence statements. Science was primarily employed by scientists with this actor making up 88% of science observations. While science was only preferenced by scientists, overall both grey literature and science were the preferred evidence types of government, non-profits, and scientists confirming the fourth hypothesis.

Hypothesis 5

The fifth hypothesis posits that government, non-profits, and scientists will preference institutionalized evidence. Results offer only partial support for hypothesis five. Government is the only actor to demonstrate a valence of 1 or preference hard, institutionalized sources of evidence. This preference was demonstrated in the results of the fourth hypothesis with grey literature making up more than half of the government's evidence statements. Non-profits and scientists engage enough non-institutionalized, soft evidence types to maintain a valence of zero.

Chi-squared Test

In addition to the assessment of summary statistics to assess hypotheses 2-5, four chi squared tests were conducted to confirm if actors and coalitions demonstrate differences in their use of evidence types and valence. Results indicate a significant association between all variables with significance levels of < 0.001. While these results indicate that actors and coalitions demonstrate discrete preferences for evidence types, the Random forest model presented above better helps to determine predictor variables.

VI. Discussion

The results of this analysis first provide insight into what predicts the types of evidence and valence employed by policy actors and coalitions. It was determined that actor was the strongest predictor of evidence type while coalition was the strongest predictor of valence showing that actors and coalitions demonstrate some level of discrete preferences in their choices. Given that coalitions are made up of actors and valence is made up of evidence types, the individual preferences of actors aggregate at the coalition and valence level resulting in the predictive power of valence for coalition. Beyond the influence of actors and coalitions in the selection of evidence type and valence, the Random forest models also demonstrate the efficacy of the integrative framework developed in Project 1 for assessing the use of evidence in policy making. Namely the Random forest model integrates several concepts of the framework beyond evidence type, valence, actors and coalitions to include time as both date and stages of the policy process as well as the text type or the setting of the evidence statement. While actor and coalition were the most significant predictors in the model, all variables included had some impact indicating that all concepts work together to influence evidence use. This highlights the dynamic and complex nature of the use of evidence by policy actors.

In addition to identifying the predictors of evidence type and valence, analysis also revealed which types of and the amount of evidence used by actors and coalitions. The use of science in particular demonstrates unique insights about this evidence type. Scientists made up the majority of science observations. Other than scientists, members of the public referenced science just twice and was the second to least used evidence type followed only by opinion polls. Conversely, grey literature was employed much more broadly across actors with all actors employing this type. Comments from these actors demonstrate a much more objective and

factual approach to participation than is observed in others. For example, scientists will detail a study in length including many additional citations of academic articles that support their assertions. Similarly, government agencies primarily reference existing reports when submitting comments. Findings indicate actors with a greater understanding of the evidence norms of EBP and scientific capacity tend to cite such institutionalized sources of evidence. The limited use of science also highlights the limitations of prior studies assessing the use of evidence in public policy that rely on a narrow definition of evidence as empirical. If only scientists utilize methodologically rigorous sources of information, then the use of other evidence types by other actors is entirely missed by limiting the definition of evidence.

In addition, all coalitions and actors with the exception of the government had a valence of zero or did not preference hard, institutionalized sources of evidence. This means all actors and coalitions demonstrated a preference for soft evidence types. This stands in stark contrast to proponents of EBP who assert that only methodologically rigorous sources of information should be used in policy making. Results demonstrate that the only actor to follow this standard is the party responsible for institutionalizing such norms in policymaking and directed to follow them – government. This demonstrates that procedural requirements and norms can restrict the evidence choices of some groups. However, individual actors including policymakers themselves more often engage a broader array of evidence when expressing policy preferences. The results align with critics of EBP's assertion that evidence is much more subjective and constructed in response to beliefs (Cairney 2016; Stone 2002).

The anti-nuclear coalition in particular engaged evidence most often. Fundamental to many theories of the policy process is Schattschneider's (1960) assertion that conflict lies at the heart of politics. During political conflict, actors seek to expand the scope of the conflict in order

to bring more individuals to their side and win the policy debate. The ACF, and NPF align in the assertion that expanding and containing the scope of the conflict is a common tactic employed by actors in policy debates (Baumgartner, Jones and Mortensen 2017; Jenkins-Smith et al. 2017; Shanahan et al. 2017). An expanse of literature within theories of the policy process supports this assertion with winners expanding the scope by increasing narrative use, strategic engagement practices, the allocation of costs and benefits, shifting venues, and more (Gottlieb et al. 2018; Gupta et al. 2016; Holyoke, Brown, and Henig 2012; Olofsson 2022; Rupinsky et al. 2022). Here we see the overall losers of the policy debate – the anti-coalition who wishes to see DCNPP decommissioned use evidence the most. This aligns with other assessments of evidence in public policy that found the losing coalition to engage more evidence types (Smith-Walter et al. 2016) yet in opposition to others who have found no difference in use between groups (Shanahan et al. 2008; McBeth et al. 2010). However, early studies only assessed evidence cited that was rooted in either conservation or technological innovations in environmental management. Given that Smith-Walter et al. 2016 expanded the definition to include more diverse types, it is expected that future assessment of coalitions use of evidence may begin to observe finding in accordance with this paper across policy arenas.

While the pro-nuclear coalition was not found to have an overall preference towards hard, institutionalized sources of evidence – science and grey literature – they did employ science more than the anti-nuclear coalition. There are two possible explanations for this. First, given the pro-nuclear coalition was in a winning position, it may be characteristic of winning coalitions seeking to enforce the status quo will utilize hard, institutionalized evidence sources to foster legitimacy to align with procedural norms. In contrast to the anti-nuclear coalition's attempt to expand the scope of the problem, this is an attempt to contain the scope in order to minimize the

perceived problem and deflect participations (Baumgartner 1989; Pralle 2006; Schattschneider 1960). Conflict containment is another strategy by which coalitions may use specific evidence types or not evidence strategically to achieve their policy goals. Indeed, Olofsson (2022) finds that both the pro and anti-coalitions identified providing information as the best way to achieve their goals. Citing evidence may be a means of providing information in a policy debate. Additionally, the pro-coalition acted to contain the scope of the conflict while the anti-coalition expanded the scope of the conflict. Taken together, the engagement of evidence appears to be a means for bolstering efforts to control the scope of the conflict (Smith-Walter et al. 2016). Winning coalitions will engage fewer evidence types, less often whereas losing coalitions will engage more evidence types, more often. Findings thus align with a breadth of literature in both the NPF and ACF literature that finds actors and coalitions use a variety of methods to expand and contain the scope of the conflict.

Second, the pro-coalition's use of hard evidence could be a function of the policy arena in that proponents of nuclear energy tend to rely more on technical information compared to opponents. As a result, more research is needed to determine if the winning coalition’s use of hard, institutionalized evidence types is indeed a strategy of legitimization or maturation or is simply a function of setting. Similarly, government, non-profits, and scientists behaved as expected and selected either grey literature or science more often compared to other actors. This further suggests that evidence may be used as a means of aligning with institutional norms (Duffy 2013). A more nuanced assessment of which non-profits preferenced certain evidence types however, would be needed to determine if more mainstream actors are aligning with institutional norms compared to more grassroots organizations. Not only would additional findings in support of those here help to identify additional ways interest groups, actors and

organizations seek to legitimize themselves within policy systems but also continue to demonstrate how evidence can be leveraged as a tool within theories of the policy process.

Overall, the pro and anti-nuclear coalitions preferenced similar evidence types. In particular, both cited statistics, risk, and anecdotal evidence. Here, it is important to note that while the type of evidence used was similar between groups, the content of evidence statements changes. For example, an anti-nuclear actor concerned with risk will speak to the dangers of a nuclear meltdown while a pro-nuclear actor will assert that increased greenhouse gas emissions that would result from decommissioning the power plant increases the effects and risk of climate change for all. Conversely, the same source of risk would sometimes be cited by opposing coalitions to support their positions such as climate change. Members of the public were the only actor group to engage all evidence types, closely followed by non-profits. Overall, members of the public and non-profits cited the most amount of evidence and the greatest diversity of evidence.

Coalitions' preference of similar evidence types also demonstrates that additional research is needed to answer an enduring question among NPF scholar's concerning the primacy of narrative over evidence (Jones 2014; Jones, McBeth, Shanahan 2014; Schlaufer 2018). Foundational NPF literature asserts that the story in which evidence is embedded is most influential in shaping public policy opinions than evidence itself. In other words, evidence cannot exist or be considered independently of narrative. Despite this assumption, Jones (2014) finds that presenting "just the facts" to survey respondents in the format of a list was sufficiently persuasive in shaping policy preferences. While the findings of this paper cannot speak to the influence of the evidence employed on policy outcomes, it does demonstrate that similar evidence types can be employed on opposing sides of a policy debate and sometimes the same

information is used within a different contextual argument or narrative. These findings suggest that additional research is required to determine if facts alone are useful for actors and coalitions, or if it is narrative that shapes their applicability to a particular side of a debate.

The influence of evidence both independently and as part of narrative is likely tied to psychological components of information processing – an understudied yet important part of the framework developed in Project 1. Individuals process information with an emotional bias rather than considering facts objectively (Lodge and Taer 2013). In other words, we often reject information that does not align with our existing beliefs about a policy problem. Narratives however, offer a way to alter the charge of a fact. If evidence is embedded within a contextual statement that signals alignment with a preferred policy statement, then individuals may be more likely to accept that fact even if the same one could be used to support an opposing position. The results of this study do not support this notion however, automatic, often biased information processing does help to explain why opposing coalitions might choose similar evidence types. Emerging work within the ACF literature seeks to understand how emotions impact policy beliefs and coalition formation (Fullerton and Weible 2024; Fullerton, Gabehart, and Weible 2024; Fullerton et al. 2023). They find that coalitions link emotions with policy beliefs in distinct ways that differ from one another. These studies represent a first attempt to operationalize an observable component of affect which is stated emotionality (Fullerton, Gabehart, and Weible 2024). However, a more nuanced examination of the congruency of evidence narratives is needed to determine if opposing coalitions frequently use similar information to construct policy narratives.

Some limitations of the research must also be addressed. First, much of the literature today exploring the use of evidence in public policy including this one are case studies

suggesting that findings to date may be case driven rather than representative of generalizable trends in the use of evidence. For example, a more technical and less public policy arena may reveal the use of hard, institutionalized evidence types by more actors. However, early studies primarily focused on science as a source of evidence. Once the definition of evidence is expanded, more robust findings emerge. Future research should focus on using a broad definition of evidence both in case studies and large-scale studies to determine if patterns of use emerge at various scales. More research is needed to reveal if indeed actors predict evidence type or if other contextual factors such as stage of the policy process or coalition, actor, and venue characteristics or something else is driving evidence use.

Furthermore, within the NPF literature, this study fails to provide any clarity to the question of whether evidence or narrative matters more in policy statements. While coalitions and actors employed different types of evidence, this study assessed the type of evidence used rather than the substance of those statements in conjunction with other narrative elements and structure. In addition, only actor type was assessed rather than identity or organization name and coalitions were labeled as pro, anti or neutral. Future research should focus on more robust mapping of actors, coalitions, beliefs along with the substance of evidence statements to identify the congruency between actor and coalitions beliefs and their evidence statements. This would provide more nuanced understanding of whether evidence, narrative or policy beliefs take precedent when constructing narratives. Enhanced knowledge of the substance of evidence statement is imperative for further understanding of its role in influencing policy beliefs and policy change (James and Jorgensen 2009)

Finally, results offer feedback for the usefulness of the introduction of the new evidence valence variable. Findings demonstrate that valence may be best for understanding high level

evidence preferences and group or actor alignment with institutional norms of EBP or a certain policy arena while evidence type reveals more discrete preferences. Both may continue to have utility for the scholars depending on the research question. For example, the valence measure was useful for demonstrating that government aligns with its own institutional norms when participating in public commenting whereas non-profits appear to not and instead employs a wide range of evidence likely to attract more actors to the debate. Assessing evidence types remains important for developing a more nuanced understanding of how evidence is used to form policy beliefs and narratives. Combined, evidence types and valence provide a more holistic picture of coalitions and actors' institutional alignment. Future work may improve the use of valence by creating a valence scale rather than treating classification as binary.

VII. Conclusion

This study contributes to the broader understanding of the use of evidence in public policy by assessing which factors most significantly predict the type of evidence or valence used by actors. Results indicate that while all variables play a role in the Random forest prediction model, that actor is the most significant predictor of evidence type and coalition membership is the most significant predictor for valence. In addition, policy stage and date appear to play a role in splitting or categorizing evidence types and valence. Overall, findings indicates that actors and coalitions may demonstrate discrete preferences in their use of evidence. This provides support for theories of the policy process such as the ACF and NPF that hypothesize that evidence may be used as a strategic tool by actors to advance their preferences and attract new members to their side of a policy debate and expand the scope of the conflict (Jenkins-Smith, Nohrstedt, Weible and Ingold 2017; Shanahan et al. 2017). This is further supported by the finding that the losing, anti-nuclear coalition engaged more evidence than the winning, pro-nuclear coalition.

In addition, clear distinctions in the use of institutionalized and non-institutionalized sources of evidence emerged. Overall, government was the only actor to demonstrate a preference for hard, institutionalized sources of evidence suggesting they are the primary actor willing to adhere to the norms of evidence-based policy. Similarly, a preference for science is limited to those actors who are close to the discipline – scientists – indicating an alignment with scientific sophistication. For the sample population as a whole, risk, statistics and grey literature followed by anecdotal evidence was most cited indicating an interest in primarily soft, non-institutionalized evidence types and less formal institutionalized types. This demonstrates a divergence between proponents of EBP and the various actors that participate in policy making. While proponents of EBP state methodologically rigorous sources of evidence should be used in making policy decisions, participant actors rely on less formal sources and even emotionally driven risk assessments to inform their choices.

Understanding what information actually matters and is used by policymakers and actors serves to enhance the potential utility of public policy and policy process literature (James and Jorgensen 2009). Therefore, by providing insight into not only what drives evidence selection but also what types of evidence are employed by actors, the findings of this study enhance the ability of public policy and process literature to provide more utility to policy scholars and practitioners alike. That actors and coalitions preference specific types of evidence and act as predictors of evidence use and valence is only one part of the larger picture of policymaking, however. Future research should continue to examine the types of evidence employed by actors and coalitions while attempting to bridge the gap in knowledge between evidence use, policy beliefs, learning and outcomes. Continuing to identify linkages between concepts that affect

evidence use not only within case studies but at scale will help to develop a more holistic understanding of how actors utilize information in policymaking.

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Appendix

Codebook

Variable	Description/Coding Instruction
Text Type	Type of document being coded 1 = legislation 2 = hearing transcript 3 = hearing document 4 = public comment
Time	Date text was published/written
Stages of the Policy Process	Stage of policy process text for analysis falls within 1 = policy formation 2 = policy implementation 3 = policy evaluation 4 = policy formation 5 = policy implementation
Actor/Narrator Categorization	Individual or group who is making the statement 1 = member of the public 2 = policymaker 3 = government 4 = advocacy organization 5 = non-profit 6 = industry/private sector 7 = scientist 8 = other
Coalition	Policy preference of individual or group making statement 1 = pro-coalition 2 = anti-coalition 3 = neutral
Evidence Type	Type of evidence invoked by policy actor 1 = science 2 = grey literature 3 = public comment 4 = anecdotal 5 = indigenous knowledge 6 = community knowledge 7 = law 8 = statistics 9 = expert advice 10 = opinion polls 11 = news article 12 = risk 13 = other
Evidence Valence	Institutionalization of evidence type 1 = institutionalized (evidence types 1 and 2) 0 = non-institutionalized (evidence types 3-13)

Figure 1. Full Evidence Decision Tree

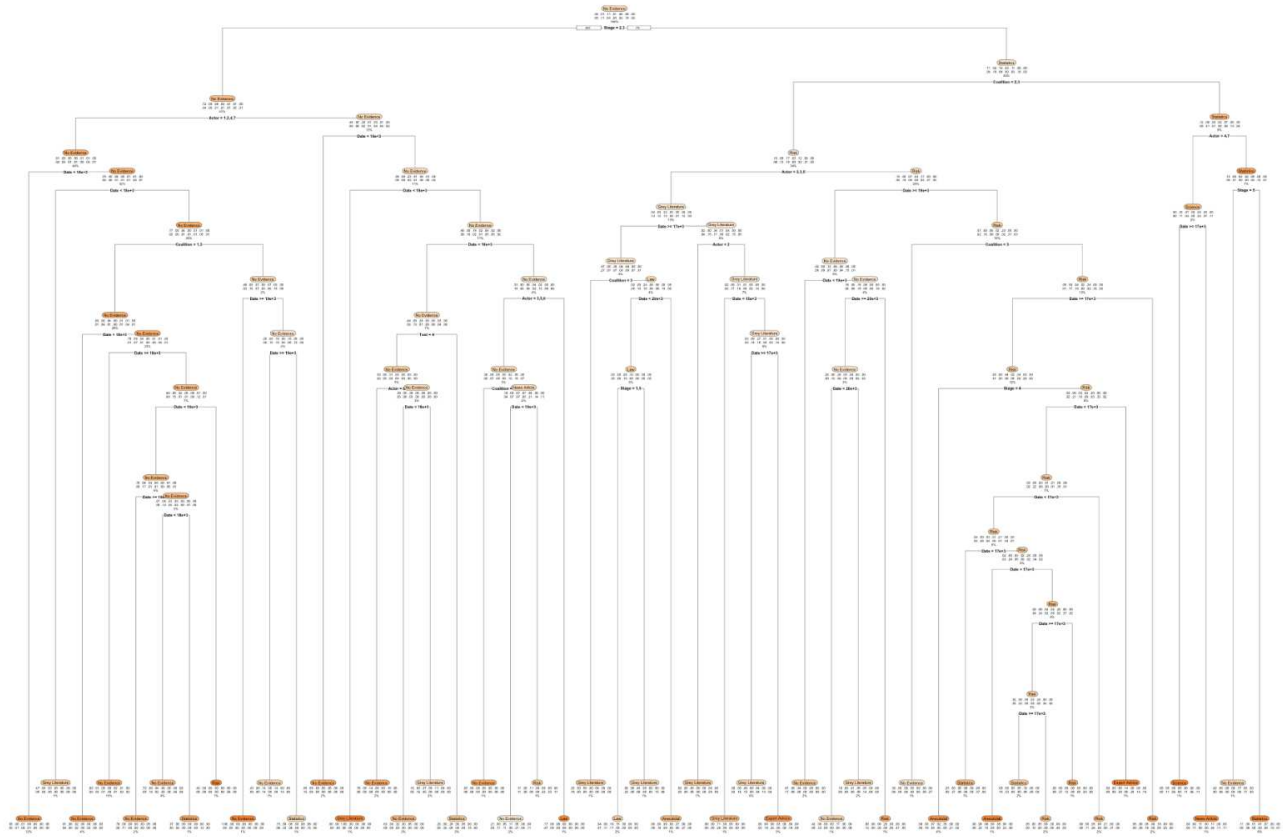
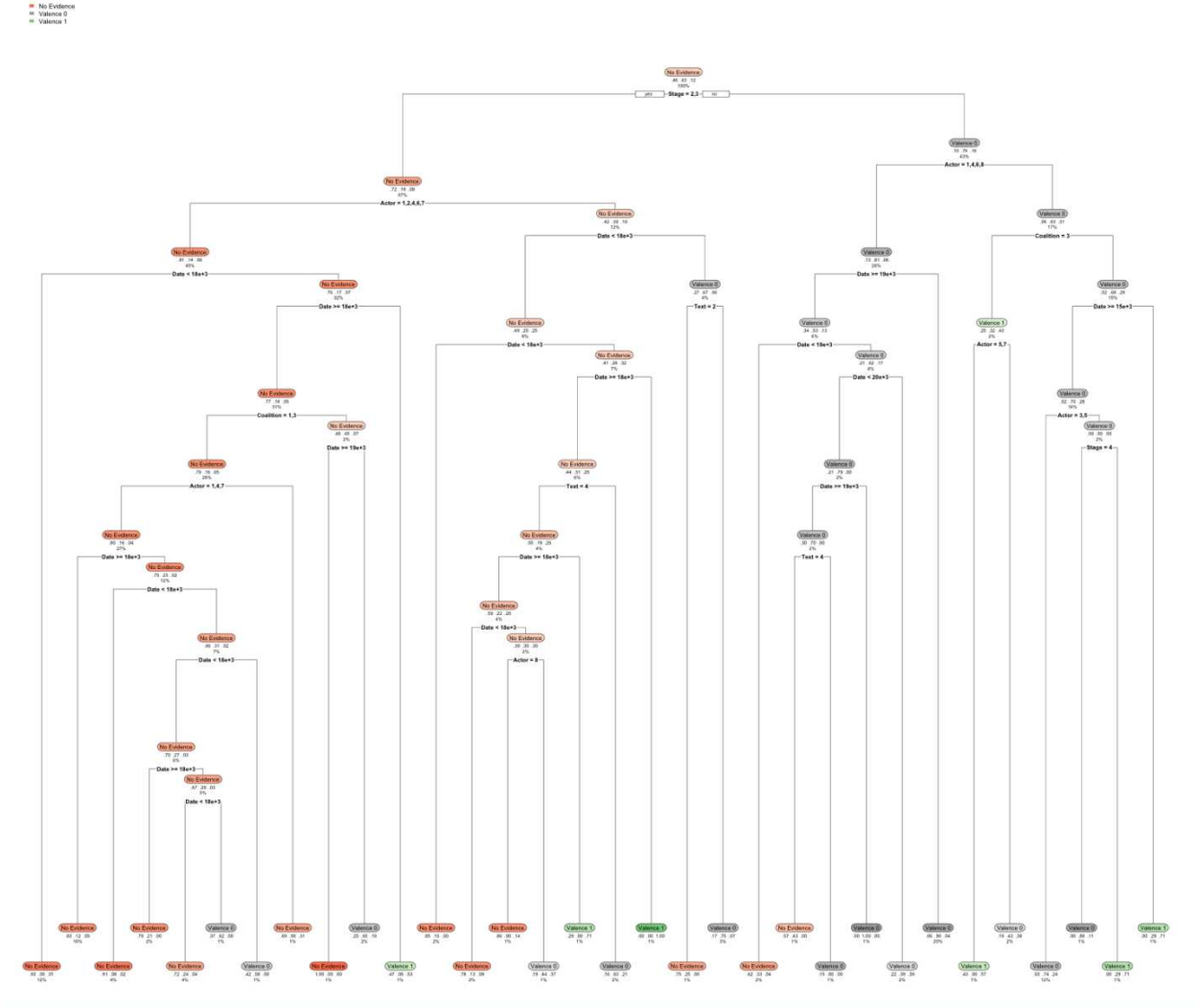


Figure 2. Full Valence Decision Tree



Regression Models:

Multinomial regressions were conducted prior to selecting the Random forest model to determine which model was the best fit for the data set and first hypothesis. Results indicate the that the regression model was not suitable for handling the high number of categorical variables in the data. Overfitting occurred likely due to the non-linear nature of the data as well as collinearity and small cells. Over fitting is particularly noticeable evidence type 5 – indigenous knowledge – which only has four observations in the data set. In addition, adding date to the models was particularly problematic given it is the only continuous variable in the data set. As a result, the Random forest model is the best for assessing predictive outcomes of categorical data due to its nonparametric nature. Results from the regression tests are presented in Tables W-Z below.

Table 1. Regression Results for Evidence = Actor + Coalition + Stage + Text Type (no Date)

	Dependent variable:											
	1	2	3	4	5	7	8	9	10	11	12	13
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Actor2	-9.005***	2.292***	-17.025***	0.485	-7.937***	3.031***	-0.379	-39.360***	-7.377	-25.144***	0.632	-45.473***
	(0.001)	(0.662)	(0.00000)	(1.188)	(0.001)	(0.717)	(1.157)	(0.000)	(288.991)	(0.000)	(0.820)	(0.000)
Actor3	-8.666***	2.025***	-18.340***	1.453*	-24.693***	1.837**	-0.541	-41.413	-6.188	-36.896***	-57.700***	-51.341***
	(0.002)	(0.447)	(0.000)	(0.715)	(0.000)	(0.647)	(0.838)		(161.199)	(0.000)	(0.000)	(0.000)
Actor4	-7.480	0.566	-20.826***	-40.705	-36.203***	1.687***	-0.232	1.018	3.755**	2.431***	-50.572***	-32.306***
	(191.171)	(0.466)	(0.000)		(0.000)	(0.485)	(0.594)	(1.130)	(1.149)	(0.697)	(0.000)	(0.000)
Actor5	-13.021***	2.524***	1.843***	0.435	-16.493***	2.487***	1.042***	1.406***	0.867	1.573***	0.222	1.371**
	(0.00003)	(0.252)	(0.481)	(0.327)	(0.00000)	(0.330)	(0.259)	(0.331)	(1.332)	(0.442)	(0.269)	(0.437)
Actor6	-19.740	1.982***	-23.340***	0.259	-16.461***	-39.660***	0.584	-35.172***	-7.335	-43.121***	-55.799***	-42.441***
		(0.558)	(0.000)	(1.162)	(0.00000)	(0.000)	(0.696)	(0.000)	(298.753)	(0.000)	(0.000)	(0.000)
Actor7	5.919***	2.106*	-16.459***	1.836*	-1.571	-13.829***	0.885	1.665	-9.506***	1.489	0.839	2.463*
	(1.571)	(0.818)	(0.00000)	(0.789)	(19.695)	(0.00000)	(0.698)	(1.284)	(0.0002)	(1.031)	(0.797)	(0.992)
Actor8	1.931	1.840***	-23.133	-38.720	2.174*	2.970***	0.602	-30.945	2.587	-29.801***	-55.842***	2.885***
	(29.947)	(0.415)			(0.927)	(0.441)	(0.518)		(1.350)	(0.000)	(0.000)	(0.701)
Coalition2	0.043	2.368***	1.249	1.594***	2.594	2.753***	0.111	2.494***	1.517	0.063	1.479***	1.433*
	(1.508)	(0.430)	(0.671)	(0.376)	(1.508)	(0.761)	(0.265)	(0.623)	(1.346)	(0.459)	(0.304)	(0.635)
Coalition3	-17.972***	1.728***	-1.328	-0.729	0.042	2.281**	-0.855**	-0.718	-0.956	-2.292**	-0.514	1.084
	(0.00000)	(0.441)	(1.244)	(0.508)	(1.168)	(0.770)	(0.298)	(0.990)	(1.318)	(0.804)	(0.366)	(0.737)
Stage2	-18.619***	-2.414***	-2.500**	-3.174***	21.717***	-2.174***	-3.335***	-3.500***	31.266***	-2.972***	-3.106***	-4.444***
	(0.001)	(0.352)	(0.944)	(0.458)	(0.383)	(0.469)	(0.349)	(0.618)	(0.772)	(0.629)	(0.373)	(0.739)
Stage3	-0.282	-3.184***	-1.728	-4.283***	-12.126	-2.601***	-3.869***	-3.281***	32.191***	-2.205**	-2.881***	-2.795***
	(1.519)	(0.505)	(0.907)	(0.700)		(0.705)	(0.491)	(0.691)	(0.874)	(0.698)	(0.410)	(0.735)
Stage4	-3.557**	-0.087	-0.138	-1.163*	-1.164***	-0.206	-0.889*	-1.347*	33.379***	-1.536	-1.230**	-0.712
	(1.156)	(0.451)	(0.929)	(0.480)	(0.000)	(0.643)	(0.401)	(0.605)	(0.882)	(0.849)	(0.425)	(0.624)
Stage5	-38.119	-1.237**	0.211	-2.681***	-23.245	0.106	-2.700***	-2.095***	-4.689	-1.900**	-2.121***	-2.068**
		(0.382)	(0.631)	(0.478)		(0.448)	(0.413)	(0.479)		(0.696)	(0.369)	(0.638)
Text4	34.487***	0.978**	0.496	-0.946**	52.485***	1.266**	-0.555*	0.766	55.263***	33.605***	-0.109	2.175*
	(0.712)	(0.329)	(0.618)	(0.361)	(0.383)	(0.446)	(0.271)	(0.589)	(0.510)	(0.232)	(0.292)	(1.060)
Constant	-37.134***	-3.057***	-3.380***	0.536	-79.079***	-5.070***	1.664***	-2.457**	-92.101***	-34.250***	0.548	-3.796**
	(0.712)	(0.574)	(0.986)	(0.552)	(0.383)	(0.926)	(0.413)	(0.872)	(0.510)	(0.232)	(0.460)	(1.245)
Akaike Inf. Crit.	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433	5,040.433
Note:												*p<0.05; **p<0.01; ***p<0.001

Table 2. Regression Results for Evidence = Actor + Coalition + Stage + Text Type + Date

	Dependent variable:											
	1	2	3	4	5	7	8	9	10	11	12	13
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Actor2	-0.000***	0.00000***	-0.000***	-0.000***	-0.000***	0.00000***	-0.000***	-0.000***	-0.000***	-0.000***	0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Actor3	-0.000***	0.00000***	-0.000***	0.000***	-0.000***	0.000***	-0.00000***	-0.000***	-0.000***	-0.000***	-0.00000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Actor4	-0.000***	-0.00000***	-0.000***	-0.00000***	-0.000***	0.000***	-0.00000***	-0.000***	0.00000***	0.00000***	-0.00000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Actor5	-0.00000***	0.00000***	0.00000***	-0.000***	-0.000***	0.00000***	0.00000***	0.00000***	-0.000***	0.00000***	-0.00000***	0.00000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Actor6	-0.000***	0.00000***	-0.000***	-0.000***	-0.000***	-0.000***	0.00000***	-0.000***	-0.000***	-0.000***	-0.00000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Actor7	0.00000***	-0.000***	-0.000***	0.000***	-0.000***	-0.00000***	0.00000***	-0.000***	-0.000***	0.000***	-0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Actor8	-0.000***	0.00000***	-0.000***	-0.00000***	0.000***	0.00000***	-0.000***	-0.000***	0.000***	-0.000***	-0.00000***	0.00000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Coalition2	-0.00000***	0.00000***	0.00000***	0.00000***	-0.000***	0.00000***	0.00000***	0.00000***	-0.000***	0.00000***	0.00000***	0.00000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Coalition3	-0.00000***	-0.00000***	-0.00000***	-0.00000***	0.000	0.000***	-0.00000***	-0.00000***	-0.000***	-0.00000***	-0.00000***	-0.00000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Stage2	-0.00000***	-0.00000***	-0.00000***	-0.00000***	0.000***	-0.00000***	-0.00000***	-0.00000***	0.000***	-0.00000***	-0.00000***	-0.00000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Stage3	-0.000***	-0.00000***	0.000***	-0.00000***	-0.000***	-0.00000***	-0.00000***	-0.000***	0.000***	0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Stage4	-0.000***	0.00000***	0.000***	0.00000***	-0.000***	-0.000***	0.00000***	0.000***	0.000***	-0.000***	0.00000***	0.00000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Stage5	-0.000***	0.00000***	0.00000***	0.000***	-0.000***	0.00000***	-0.00000***	0.00000***	-0.000***	-0.000***	0.00000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Date	-0.0002***	-0.0001***	-0.0002***	-0.0001***	-0.0003***	-0.0001***	-0.0001***	-0.0001***	-0.0003***	-0.0002***	-0.0001***	-0.0002***
	(0.00001)	(0.00000)	(0.00001)	(0.00001)	(0.00002)	(0.00001)	(0.00000)	(0.00001)	(0.00002)	(0.00001)	(0.00000)	(0.00001)
Text4	0.000***	0.00000***	-0.00000***	-0.00000***	-0.000***	0.000***	-0.00000***	0.00000***	-0.000***	0.00000***	-0.00000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.000***	0.000***	-0.00000***	-0.000***	-0.00000***	-0.00000***	0.000***	0.000***	-0.00000***	-0.000***	0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Akaike Inf. Crit.	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768	6,686.768

Note: *p<0.05; **p<0.01; ***p<0.001

Table 3. Regression Results for Valence = Actor + Coalition + Stage + Text Type (no Date)

	Dependent variable:	
	1	2
	(1)	(2)
Actor2	0.887	2.263***
	(0.628)	(0.660)
Actor3	0.310	2.072***
	(0.494)	(0.457)
Actor4	0.470	0.572
	(0.307)	(0.466)
Actor5	1.151***	2.504***
	(0.205)	(0.249)
Actor6	0.034	1.950***
	(0.606)	(0.566)
Actor7	0.386	3.298***
	(0.604)	(0.639)
Actor8	1.142***	1.794***
	(0.308)	(0.409)
Coalition2	0.924***	1.976***
	(0.224)	(0.390)
Coalition3	-0.510*	1.299**
	(0.212)	(0.398)
Stage2	-3.763***	-3.187***
	(0.330)	(0.389)
Stage3	-3.722***	-3.763***
	(0.364)	(0.514)
Stage4	-1.342***	-1.000*
	(0.392)	(0.467)
Stage5	-2.497***	-2.151***
	(0.352)	(0.415)
Text4	0.096	0.952**
	(0.198)	(0.327)
Constant	2.333***	-1.875***
	(0.383)	(0.562)
Akaike Inf. Crit.	2,366.128	2,366.128
Note:	*p<0.05; **p<0.01; ***p<0.001	

Table 4. Regression Results for Valence = Actor + Coalition + Stage + Date + Text Type

	Dependent variable:	
	1	2
	(1)	(2)
Actor2	0.866***	2.291***
	(0.000)	(0.000)
Actor3	0.278***	2.027***
	(0.000)	(0.000)
Actor4	0.611***	0.736***
	(0.000)	(0.000)
Actor5	1.207***	2.572***
	(0.000)	(0.000)
Actor6	0.166***	2.032***
	(0.000)	(0.000)
Actor7	0.346***	3.242***
	(0.000)	(0.000)
Actor8	1.095***	1.729***
	(0.000)	(0.000)
Coalition2	0.940***	1.992***
	(0.000)	(0.000)
Coalition3	-0.378***	1.444***
	(0.000)	(0.000)
Stage2	-5.059***	-4.649***
	(0.000)	(0.000)
Stage3	-5.663***	-5.963***
	(0.000)	(0.000)
Stage4	-3.476***	-3.399***
	(0.000)	(0.000)
Stage5	-4.918***	-4.889***
	(0.000)	(0.000)
Text4	0.093***	0.940***
	(0.000)	(0.000)
Date	0.001***	0.001***
	(0.00000)	(0.00001)
Constant	-9.804***	-15.465***
	(0.000)	(0.000)
Akaike Inf. Crit.	2,359.935	2,359.935
Note:	*p<0.05; **p<0.01; ***p<0.001	

Frequency Tables:

Table 5: Evidence Type Frequency by Actor

	Public		Policymaker		Government		Advocacy Organization		Non-profit		Private Sector		Scientist		Other		Total Count	Total Percent
Evidence Type	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent		
No Evidence	586	75.81%	6	0.78%	17	2.20%	57	7.37%	58	7.50%	14	1.81%	4	0.52%	31	4.01%	773	100.00%
Science	2	11.11%		0.00%		0.00%		0.00%		0.00%		0.00%	16	88.89%		0.00%	18	100.00%
Grey Literature	55	28.21%	8	4.10%	14	7.18%	6	3.08%	93	47.69%	6	3.08%	3	1.54%	10	5.13%	195	100.00%
Public Comment	10	45.45%		0.00%		0.00%		0.00%	12	54.55%		0.00%		0.00%		0.00%	22	100.00%
Anecdotal	66	67.35%	1	1.02%	4	4.08%		0.00%	21	21.43%	1	1.02%	5	5.10%		0.00%	98	100.00%
Indigenous Knowledge	4	66.67%		0.00%		0.00%		0.00%		0.00%		0.00%		0.00%	2	33.33%	6	100.00%
Law	24	26.67%	6	6.67%	4	4.44%	7	7.78%	37	41.11%		0.00%		0.00%	12	13.33%	90	100.00%
Satistics	114	59.38%	1	0.52%	2	1.04%	4	2.08%	51	26.56%	6	3.13%	9	4.69%	5	2.60%	192	100.00%
Expert Advice	32	50.00%		0.00%		0.00%	1	1.56%	30	46.88%		0.00%	1	1.56%		0.00%	64	100.00%
Opinion Polls	2	25.00%		0.00%		0.00%	4	50.00%	1	12.50%		0.00%		0.00%	1	12.50%	8	100.00%
News Article	14	40.00%		0.00%		0.00%	6	17.14%	13	37.14%		0.00%	2	5.71%		0.00%	35	100.00%
Existential Risk	140	76.50%	3	1.64%		0.00%		0.00%	36	19.67%		0.00%	4	2.19%		0.00%	183	100.00%
Other	18	48.65%		0.00%		0.00%		0.00%	12	32.43%		0.00%	3	8.11%	4	10.81%	37	100.00%
Grand Total	**1067**	**62.00%**	**25**	**1.45%**	**41**	**2.38%**	**85**	**4.94%**	**364**	**21.15%**	**27**	**1.57%**	**47**	**2.73%**	**65**	**3.78%**	**1721**	**100.00%**

Table 6: Evidence Type Frequency by Actor

	Pro-Nuclear		Anti-Nuclear		Neutral		Total Count	Total Percent
Evidence Type	Count	Percent	Count	Percent	Count	Percent		
No Evidence	114	14.75%	89	11.51%	570	73.74%	773	100.00%
Science	17	94.44%	1	5.56%		0.00%	18	100.00%
Grey Literature	9	4.62%	104	53.33%	82	42.05%	195	100.00%
Public Comment	3	13.64%	18	81.82%	1	4.55%	22	100.00%
Anecdotal	17	17.35%	70	71.43%	11	11.22%	98	100.00%
Indigenous Knowledge	1	16.67%	1	16.67%	4	66.67%	6	100.00%
Law	2	2.22%	44	48.89%	44	48.89%	90	100.00%
Statistics	72	37.50%	85	44.27%	35	18.23%	192	100.00%
Expert Advice	4	6.25%	58	90.63%	2	3.13%	64	100.00%
Opinion Polls	1	12.50%	3	37.50%	4	50.00%	8	100.00%
News Article	15	42.86%	17	48.57%	3	8.57%	35	100.00%
Existential Risk	25	13.66%	134	73.22%	24	13.11%	183	100.00%
Other	6	16.22%	22	59.46%	9	24.32%	37	100.00%
Grand Total	**286**	**16.62%**	**646**	**37.54%**	**789**	**45.85%**	**1721**	**100.00%**

Chapter 6

Conclusion: Summary of the Dissertation

Scholars and practitioners of public policy often assert that evidence **-** the full body of information with which policy actors engage to form and communicate their policy preferences – is used in the process of public policy making. Furthermore, proponents of evidence-based policy state that evidence should be derived from methodologically rigorous sources. Despite this common decree, debate persists concerning which types of evidence should and are actually used by policy actors as well as the factors that influence its use. Normative differences among scholars have resulted in a disjointed approach to understanding the use of evidence in public policy as well as a lack of uniform discourse across disciplines. In response, I develop an integrative framework for assessing the use of evidence in public policy and test the framework by evaluating the use of evidence in the Diablo Canyon Nuclear Power Plant debate unfolding in San Luis Obispo County, California. The development of an integrative framework serves to unify the disparate scholars assessing the use of evidence by providing a common set of concepts that can be used to evaluate evidence use, interactions, and impacts. Subsequent analysis helps to not only test the efficacy of the framework but provides insight into who uses evidence, where and when as well as what helps to predict evidence selection. The dissertation thus contributes to the existing literature on the use of evidence in public policy in two ways: by providing an integrative framework and advancing understanding of how evidence is used in public policy.

Summary of Findings

In Project 1, I developed the integrative framework by conducting a purposeful review of the literature. This review began narrow in scope, first identifying the definition of evidence in

public policy within the tradition of evidence-based policy (EBP). It then moved to critiques of EBP to integrate broader perspectives on evidence in public policy. From this foundational conception of EBP, the review then expanded to examine the use of evidence in the broader policy studies and social science literatures including theories of the policy process, political science, political psychology, and communication studies among others. This review allowed for the identification of concepts and the development of definitions that are more encompassing than those based on a single discipline. Primary concepts identified in the integrative framework include: the policy environment, evidence type and valence, psychology, time, and outcomes. Within each concept are several sub-concepts suggested for analysis. For example, the policy environment may be defined by a specific framework (i.e. subsystem) or factors (i.e. capacity; agency; socioeconomic). The chapter concludes with a discussion of how to use the framework in research including the development of a codebook that is utilized in subsequent projects.

In Project 2, I explore the question *how does the use of evidence change over time* and evaluate the use of evidence in various stages of the policy process within the ongoing decision to decommission then recommission the Diablo Canyon Nuclear Power Plant. The research question is assessed by utilizing a codebook developed in Project 1 to code public comments submitted on Regulations.gov as well as the Diablo Canyon Decommissioning Engagement Panel. Results indicate spikes in evidence use occur in more open stages of the policy process such as policy formation where a policy decision has not yet been made and there is opportunity for public participation. In subsequent stages, evidence use declines and becomes narrower with evidence use focused on prior policy decisions encoded into law. Furthermore, evidence use demonstrated an overall valence of zero indicating that soft, non-institutionalized evidence types were preferenced throughout the policy stages. Findings indicate that evidence may be used

strategically as a tool in order to expand the scope of the conflict and attract more actors to a particular policy position. In addition, evidence use in stages of the policy process do not align with traditional approaches to evidence-based policy that assert scientific or methodologically rigorous information should be used in policymaking.

In Project 3, I assed whether actors are a driver of evidence selection and valence using a Random forest model to predict categorical outcomes. The use of evidence is again evaluated utilizing public comments coded for Project 2 and made in the ongoing decision to decommission then recommission the Diablo Canyon Nuclear Power Plant in California. Results indicate that actor is the primary predictor of evidence type while coalition is the primary predictor of evidence valence. Furthermore, the losing or anti-nuclear coalition employs the most evidence overall and preferences soft, non-institutionalized evidence types such as risk, anecdotal evidence, and statistics. Results show that actors and coalitions may demonstrate discrete preferences towards evidence type and valence and that greater analysis should be conducted to determine how evidence use relates to policy beliefs, learning, and outcomes. In addition, the integration of diverse concepts from the integrative framework for evidence in public policy into the Random forest model helps to demonstrate its predictive capacity and shows that evidence use is the result of complex interactions among many factors ranging from actor to policy stage to setting.

Discussion

Overall, findings revealed several trends in the use of evidence including insights for the evidence-based policy tradition, the new evidence valance measure, and evidence in the context of winning and losing coalitions and the scope of the conflict. First, the results of Project 2 and 3 demonstrate that the use of evidence by policy stakeholders in the Diablo Canyon Nuclear Power

Plant debate stands in stark contrast to evidence-based policy proponents. Namely, a majority of actors and all coalitions of the policy date preference soft, non-institutionalized sources of evidence overall. When hard, institutionalized sources of evidence are utilized by actors it is most often grey literature. The use of science remains primarily limited to scientists who took part in public commenting. The limited use of institutionalized sources of evidence demonstrates that traditional approaches to evidence-based policy was not the preferred means of asserting policy preferences in this case. More often than not, actors and coalitions members rely on what they feel, see, and hear in the real world to make their policy judgements rather than scientific findings. As a result, future analysis of the use of evidence in public policy should continue to explore a broad array of evidence types to fully assess trends in use.

Second, a meaningful contribution of this work was not only expanding the definition of evidence to include all evidence types considered by policy actors, but also introducing the concept of evidence valance as a new way of measuring evidence use. Valence is an alternative way of coding evidence that represents whether the observed type is institutionalized under traditional approaches to evidence-based policy. In other words, it identified whether the evidence type is institutionalized or not or "hard" evidence or not. Assessments conducted in Project 2 and 3 demonstrate successful application of the novel variable, however additional research is needed to determine the extent of its utility.

At this time, valence appears to offer a shorthand method of determining the general contour of the evidence landscape. Valence essentially functions as an aggregator of the evidence type variable to demonstrate if the sum of evidence use trends towards institutionalized sources. If a scholar wants to understand general evidence trends for a policy environment as part of a larger study, then valence may be a sufficient measure. However, if more nuanced evaluation of

evidence use is required, evidence should be evaluated instead of, or in conjunction with valence. The utility of the valance variable therefore depends on the level of analysis and research question at hand.

Examining coalitions as a collection of independent actors and organizations helps to demonstrate how evidence valence serves as an aggregator. For example, specific actors or organizations within a coalition may preference certain evidence types or hard, institutionalized evidence while others may preference soft, noninstitutionalized sources. While the valance score for each actor would vary, at the coalition level the valence measure would aggregate based on the variation in evidence used across actors. Therefore, even if actors within a coalition preference hard sources of evidence, significant variation among members can lead to the coalition as a whole preferencing soft sources of information.

Results from Project 3 demonstrate how evidence valance acts as an aggregator and shows contours of evidence use compared to evidence types. While actors such as government, non-profits, and scientists and the pro-nuclear coalition cited hard sources of evidence more often, overall, all actors and coalitions still preferenced soft evidence as a whole. Valence serving as an aggregator is partially a result of how the variable was coded. Namely, hard coding was used to assign each evidence type a valance score indicating a yes/no for institutionalized with set evidence types (science and grey literature) coded as a value of 1 and all other evidence types assigned 0. As a result, evidence type and valence are colinear variables making their independence difficult to assess. Future applications and other scholars may experiment with alternative coding methods to further test the utility of the valence measure. Potential alternative methods of coding valence include coding institutionalization based on the case study or policy

arena as opposed to traditional and critical approaches to EBP or using fuzzy coding for the binary.

The evidence valence variable as developed in Project 1 was originally intended to measure the character of evidence in reference to the institutionalization of methodologically rigorous evidence types under traditional approaches to EBP. As such it identified science and grey literature as institutionalized (1) and all other evidence types as noninstitutionalized (0). The valence measure was defined according to traditions of EBP in order to standardize the measure across all potential research cases. However, an alternative approach a scholar may employ is to measure valence according to the rules or norms of a particular case. For example, Projects 2 and 3 assessed the use of evidence in the case of nuclear energy policy in California. Instead of defining valence in accordance with EBP, the valence measure could have identified sources of evidence required specifically by the relicensing procedures in California. Altering the basis of the valence measure could result in differing evidence included under institutionalized sources (1) if required within a particular case. For example, a rulemaking process which requires interviews or testimony of experts would move expert advice and opinion from a noninstitutionalized source (0) under the original valence coding to an institutionalized source (1). Findings may therefore differ once the valence coding shifts.

In addition to changing the reference for hard coding to the institutional environment of the case being studied, scholars could also use fuzzy coding for the valence measure. Rather than assign a strict 1/0 code for institutionalized or noninstitutionalized evidence, fuzzy coding of a binary allows values between 0 and 1 to indicate partial membership to a category. Using fuzzy coding provides the advantage of capturing additional nuance and better reflecting the diversity of information that actors or coalitions use rather than forcing them into strict categories of

institutionalized or not (Ragin 2000). As a result, fuzzy coding may enhance the accuracy of data analysis and allow for better cross case comparisons (Ibid.). Fuzzy coding can be particularly useful for network and text analysis so future work focusing on evidence networks within coalitions or among actors as well as the substantive congruency of evidence statements should consider the use of fuzzy coding if they include a valence measure (Ingold 2011). Overall, adjusting valence coding from hard to fuzzy will move the valence variable closer to a nuanced measure of institutionalization rather than an aggregator of evidence selection.

Next, overall trends in evidence use largely align with enduring findings within both the Advocacy Coalition Framework (ACF) and the Narrative Policy Framework (NPF) concerning winning and losing coalitions and the scope of the conflict. Namely, evidence appears to be a tool strategically used by actors to expand or contain the scope of the conflict depending on their winning or losing positionality. For example, the losing coalition (anti-nuclear) who would be expected to expand the scope of the conflict did reference evidence more often in their public comments than the winning coalition (pro-nuclear). In addition, more evidence was used during policy formation when an opportunity for winning or losing emerged. These findings call for further analysis of the supportive role that evidence plays in policy narratives, especially as a means for demonstrating the policy problem and supporting solutions (Smith-Walter et al. 2016; Schlaufer 2018).

Last, the dissertation successfully develops and tests the efficacy of an integrative framework for assessing evidence in public policy. The successful application of concepts of the framework in Project 2 and 3 demonstrates the utility of the framework for scholars. Now that the framework has been tested and evidence has been found to act in alignment with core concepts of the ACF and NPF and other theories of the policy process, future research should

focus on evaluation of more tenuous hypotheses. First, the research identified that coalitions preferenced similar sources of evidence including statistics, anecdotal evidence, risk, and even grey literature. While this provides some support to existing research that states narrative may be more important than evidence in policy statements, more research is needed to fully settle this ongoing dispute in the literature (McBeth et al. 2010: Shanahan et al. 2008). In particular, future assessments of the use of evidence among coalitions or actors should better assess evidence congruency. In other words, the similarity of particular evidence cited should be compared to determine if competing coalitions cite different information evidence or simply alter arguments. Such insights are imperative for determining if just the facts matter or if it is indeed simply the story we tell about a particular issue.

Future studies focused on evidence could also help to further less understood components of the ACF such as how new or changing information impacts policy learning and policy beliefs. Within the ACF, policy beliefs "encapsulate policy actors' perceived causal patterns and relationships that shape the empirical world" (Jenkins-Smith et al. 2017). If an actor's empirical understanding is made up of information, then it stands to reason that new information has the potential to impact policy beliefs. Analysis of the impact of evidence on policy beliefs could help to determine not only how information shapes such beliefs but also the level of beliefs it is most likely to influence such as policy core beliefs or secondary beliefs. In addition, the ACF also asserts policy learning is a potential mechanism for policy change however, such learning likely occurs over long periods of time and can be difficult to measure (Jenkins-Smith et al. 2017). A longer-term study would be required to trace the types of evidence that come in and out of a policy debate over time and influence the beliefs of coalitions and actors. Therefore, a study that

assesses evidence, policy beliefs, and learning simultaneously would provide significant insights for central theories of the ACF.

Last, one particular concept of the integrative framework – psychology – remains understudied not only within theories of the policy process but also in relation to evidence. In particular, sub-concepts detailed in the integrative framework from political psychology should be applied to the analysis of evidence within public policy. For example, hot cognition or affect should be used to determine the extent to which emotionality plays a role in the use of evidence. Seminal work within the ACF has begun to explore how emotion relates to policy beliefs (Fullerton, Gabehart, and Weible 2024). Adding evidence to such analysis offers a natural progression for the work to determine how information is also coupled with emotionality in public policy. In addition, the assessment of personality traits in relation to evidence use is also suggested. The big five personality traits including openness, conscientiousness, extroversion, agreeableness, and neuroticism have been used to determine their impact on a diversity of social and political factors ranging from political ideology to loneliness (Cooper, Golden and Socha 2013; Webster 2018). These factors could be used to identify if personality traits impact evidence selection or the amount of policy learning that occurs in response to exposure to different evidence types. Insights would not only advance the field of political psychology and advance public policy, but also the connection between evidence, psychology and policy outcomes.

In conclusion, the integrative framework for assessing the use of evidence in public policy has presented a useful set of concepts to aid future scholars in their evaluation of the phenomena. The framework presented in this dissertation provides greater utility than past frameworks by not only integrating concepts related to the study of evidence across the literature

but also expanding the definition of evidence to include the full range of information considered by actors as well as providing a novel valence variable to assess how actors align with institutional norms of evidence-based policy. The framework will serve to unify scholars who seek to better understand applications of evidence in policy making as well as help scholars identify important areas for research and future development. The applied work herein further demonstrates that evidence should continue to be evaluated using an expanded definition of evidence and that overall, actors prefer soft, noninstitutionalized sources of evidence rather than aligning with norms of evidence based policy. Continued exploration will allow scholars to uncover the character of evidence used in policy making and its role in the policy process.

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