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Determinants of Science Policy Change and the Need for Reform in Congressional Decision-Making and Political Science Research

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Abstract

Science impacts nearly all aspects of American society; however, the extent of this impact depends on favorable legislation. Given the key role Congress plays in policymaking, it is thus necessary to determine what factors cause legislators to change science policy, so that researchers can determine more successful ways of producing meaningful science policy outputs. I therefore measure the influence of eleven political variables on policy change in science and four other issue areas during thirty-one congressional terms. Results reveal that scholars need to identify a more effective method Congress can use to contemplate science policy change, which I propose needs to incorporate both expertise and citizen participation. I also demonstrate that conducting issue-specific studies augments the field of political science, by providing a more comprehensive understanding of congressional behavior that one cannot ascertain from aggregative studies alone.

Introduction

"The relationship between science and politics can be described as a recursive coupling of two interdependent developments—the scientification of politics and the politicization of science" (Weingart, 2002). Through case study analysis, science policy theorists argue that extensive use of scientific expertise in political processes weakens democracy by distancing citizens from technically driven policy decisions and simultaneously delegitimizes science by introducing political bias into the work of researchers (Jasanoff, 1987; Weingart, 2002; Jasanoff, 2004; Mooney, 2005; Brown, 2006). However, in order to determine the role experts should play in politics, it is necessary to first quantify their impact on policy decisions in reality. Because aforementioned scholars rely on anecdotal evidence and do not discuss other political determinants that might be involved, existing research fails to adequately measure the influence expertise has on science policy change over time, an insufficiency this paper seeks to resolve.

This quantification of science policy change is also important for providing a more comprehensive understanding of congressional behavior. I discuss and test an existing theory, which claims that analyses of overall congressional legislating incompletely portray policymaking, because they do not account for variations in congressional behavior across issue-areas (Lapinski, 2013). If results reveal that policy change determinants differ appreciably across the five issue areas this paper examines, then the study will require political scientists to supplement broad research with issue-specific studies.

Consequently, this paper asks the question: what political factors cause meaningful change in congressional science policy and how do these dynamics similarly influence change in other major issue areas, namely health, transportation, education and community development & housing (hereinafter CD&H)? When investigating general congressional behavior, scholars

suggest that partisan dynamics and external support from the president and public largely influence policy outcomes, due to pressure from party leaders and a need to secure future votes from constituents. Although minimally, academics also note that the size of the federal budget plays a role in shaping policy outcomes, by clarifying the feasibility of policy goals.

I expect that these determinants of general congressional policy change will influence some, if not all, of the issue areas in this study. Specifically, I hypothesize that expertise will have the largest effect on science policy change, with external support, partisan characteristics, and size of the federal budget having minimal impacts. Furthermore, I anticipate that explanatory variables for science will correspond highly with those for health and education, since subtopics in these areas often interrelate. Because transportation and CD&H are less prioritized, I predict these areas will depend mostly on the federal budget.

I test these hypotheses by examining *Congressional Quarterly Almanac* coverage of 1,224 laws passed between the 80th and 111th Congresses, or between 1947 and 2010. By comparing highly differing trends in policy change across the five issue areas, I conclude that congressmen's unique and exclusive reliance on expertise for science explains its relatively small policy output relative to other issue areas. I also determine that issue-specific investigations are necessary to supplement existing political science research.

Why Congressional Science Policy?

Both the executive and judicial branches can act as important sources of policy change; however, as the legislative branch of the United States, Congress undoubtedly plays the most direct and formative role in shaping American law. Scholars agree that Congress is in a "privileged position" to produce tangible "outputs" in health policy, foreign policy and other key issue areas (Adler and Lapinski, 2006), since the Constitution grants the Legislature direct

lawmaking powers. While they admit that other governmental actors, such as the president, participate in policymaking, political scientists conclude that the outcomes of actions put forth by other branches heavily depend upon congressional behavior.

For instance, presidential success in Congress is contingent upon congressional perception of public support for the president (Rivers and Rose, 1985) and party composition of Congress (Cohen, 2012). In fact, Adler and Lapinski (2006) note that, even George W. Bush, who had relatively substantial agenda-setting power after the September 11th terrorist attacks, rarely saw his policy proposals come to fruition in Congress during 2003 and 2004, unless they related to security and defense (Babington, 2004). Clearly, presidential policymaking capability largely rests on Congress's willingness to support his initiatives.

Likewise, although the judiciary has some lawmaking power, primarily through settling conflicting understandings of law, courts can only interpret and apply law that others have already legislated (Schauer, 1983). It cannot simply create law that did not previously exist in some form. Congress is thus the "institution where the collective choice of the nation is forged into outcomes" (Adler and Lapinski, 2006, p. 3), so understanding the factors that influence congressional decision-making is crucial to understanding legislation both broadly and for specific issue areas.

Issue Substance is Fundamental to Understanding Congressional Lawmaking

Determining the dynamics that shape science-specific and other topic-specific policy change is not only valuable for those interested in science issues, but also for the general field of political science. Aggregating all policy into a general unit deceptively exaggerates the predictability of congressional behavior, through ignoring the potential for variation across different issue areas. By focusing on congressional tendencies in specific issue areas, scholars

can acquire a "more accurate picture" of how Congress makes policy decisions (Lapinski, 2013, p. 160). Lapinski (2013) explains that early research assessed how congressional propensities differed based on changes in types and content of policy issues, thereby vastly advancing political scientists' understanding of legislation (Lowi, 1964,1970, 1972; Clausen, 1967, 1973; Mayhew, 1966; and Clausen & Cheney, 1970). However, as later work eliminated this focus on issue areas and fixated on trends in general policy, scholars began "mischaracterize[ing]…policymaking process[es]" and making "incorrect inferences about lawmaking" (Lapinski, 2013, p. 181).

Lapinski substantiates this claim by discussing his case study analysis of polarization in Congress. He notes that literature depicts a certain trend in polarization as fact: "polarization has been increasing since the 1970s, and…has followed a U-shaped form across the last 130 years of American history" (Lapinski, 2013; McCarty, Poole, and Rosenthal, 2006). Yet, when Lapinski reassesses this claim by disaggregating policy into different issue areas, he finds that this picture is actually more complicated. Specifically, while party polarization is consistently present in both chambers of Congress for domestic issues and therefore does not follow this U-shaped curve, developments in polarization for sovereignty issues and international affairs are much more volatile. In fact, large declines in polarization occur between the 1930s and '70s for sovereignty-related issues and for international affairs, while polarization remains at constantly high levels for domestic topics. In other words, members' decision-making process fluctuates across issue areas. Lapinski (2013) thus concludes that identifying the factors influencing change in specific policy areas, such as science, advances the field of political science by providing a more exhaustive explanation of lawmaking and by decreasing the likelihood that that researchers make the costly mistake of "getting it wrong" through generalizations (p.181).

Quantification of Policy Change

Given the key role of Congress in promoting scientific progress and the importance of issue substance studies in advancing political science research, it is essential to quantify and explain congressional science policy change over time, in relation to other topic areas. Adler & Wilkerson (2009) clarify that policy is a culmination of many laws, distinct from lawmaking, which focuses more on discrete legislative acts. It is clear that policy change is important for understanding congressional behavior and legislative patterns, as many scholars have conducted research in this area (Adler & Wilkerson, 2009; Kingdon, 1995; Baumgartner & Jones, 1993; Birkland, 1997).

Some scholars have attempted to quantify policy change with equations, such as "100 * [(Number of Issue Area Additions + Number of Issue Area Deletions)/(Number of Issue Areas Retained from Previous Congress)]" (Cohen, 2006). Although this type of measure decently describes changes in the size of policy agendas, it fails to capture meaningful changes in policy content. For instance, Congress could pass less science policies than did the previous Congress, but these new policies might have much more significant effects on scientific research.

Adler & Wilkerson (2009; 2012) use a more effective method, which quantifies the degree of meaningful policy change in a topic as the amount of *Congressional Quarterly Almanac* (hereinafter CQ) coverage for that issue area. The authors explain that CQ provides "policymakers, lobbyists, academics, and other congressional observers" with consequential legislation that "mattered most in a given year," thereby focusing on significant policy (Adler & Wilkerson, 2009, p. 6). Using the CQ dataset that Policy Agendas Project (PAP) provides, the scholars define policy change as "the sum of CQ article lines devoted to a given [topic] during a given congressional term" (p. 6).

The scholars justify use of this measure by citing other studies that equate CQ lines of coverage to policy significance (Anderson, Box-Steffensmeier & Sinclair-Chapman, 2003; Edwards, Barrett, & Peake, 1997; Carson, Finocchiaro & Rohde, 2010; Mayhew, 1991; Sinclair, 1995; and Stimson, MacKuen & Erickson, 1995). They further validate this measure by finding that the most important laws according to CQ coverage highly coincide with those found in the Mayhew (1991) "list of 'most innovative and consequential' laws," as well as those emerging from the policy significance scores Clinton and Lapinski (2006) use to identify meaningful legislation (Adler & Wilkerson, 2012, p. 173-174).

While the authors admit there is not a perfect standard to validate CQ coverage as a measure of significant policy change, they argue based on the aforementioned evidence that CQ coverage sufficiently describes policy substance and that a change in the amount of coverage represents meaningful policy change within issue areas. This paper thus makes the same assumption and uses fluctuations in CQ coverage between 1947 and 2010 as a measure of policy change in science and the other four analyzed topic areas.

Trends in Science Policy and its Comparison to other Topic Areas

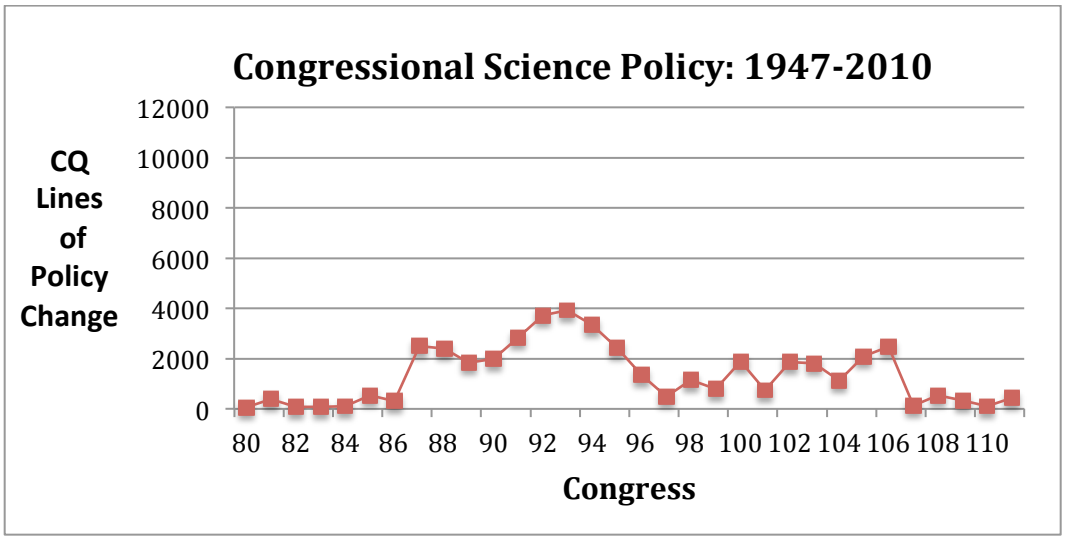

Figure 1: Total Number of CQ Column Lines per Congress Discussing Passed Science Laws. Data is taken from Policy Agendas Project Congressional Quarterly Almanac dataset.

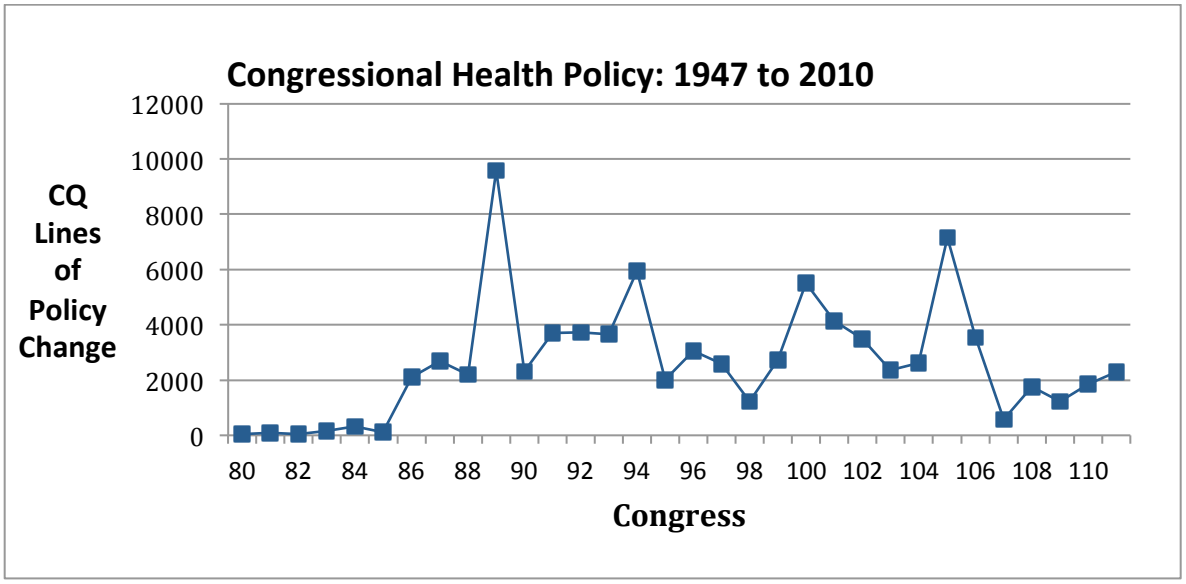

Figure 2: Total Number of CQ Column Lines per Congress Discussing Passed Health Laws. Data is taken from Policy Agendas Project Congressional Quarterly Almanac dataset.

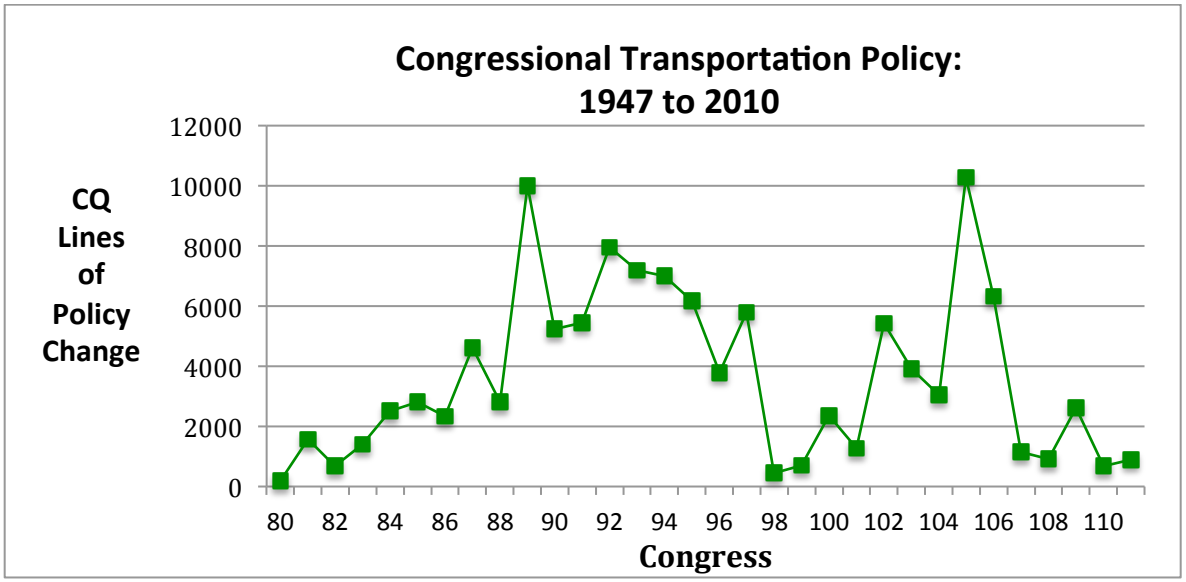

Figure 3: Total Number of CQ Column Lines per Congress Discussing Passed Transportation Laws. Data is taken from Policy Agendas Project Congressional Quarterly Almanac dataset.

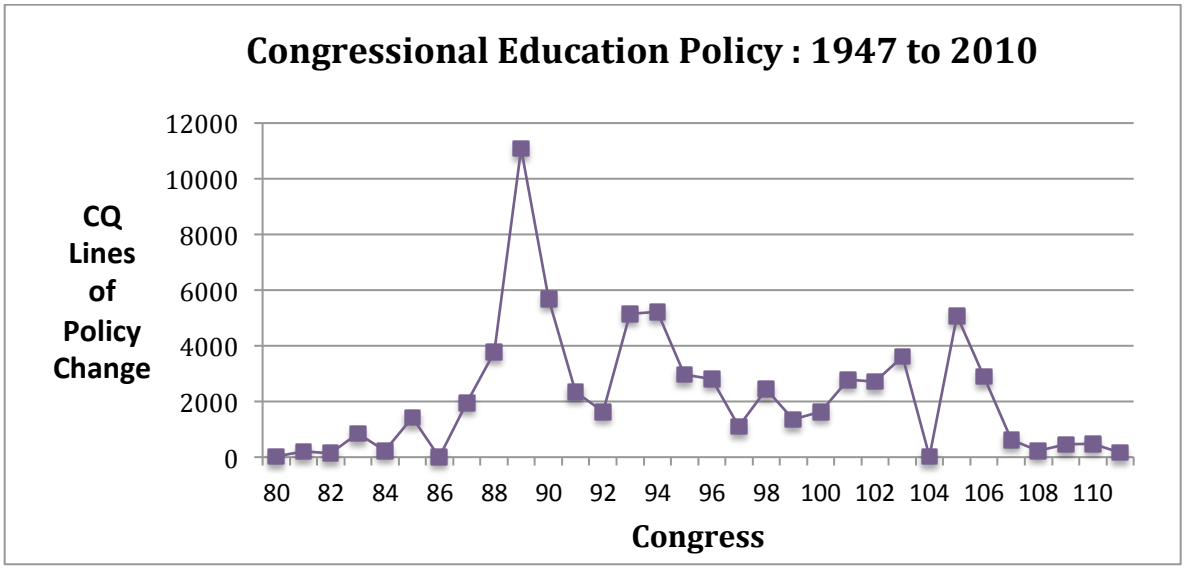

Figure 4: Total Number of CQ Column Lines per Congress Discussing Passed Education Laws. Data is taken from Policy Agendas Project Congressional Quarterly Almanac dataset.

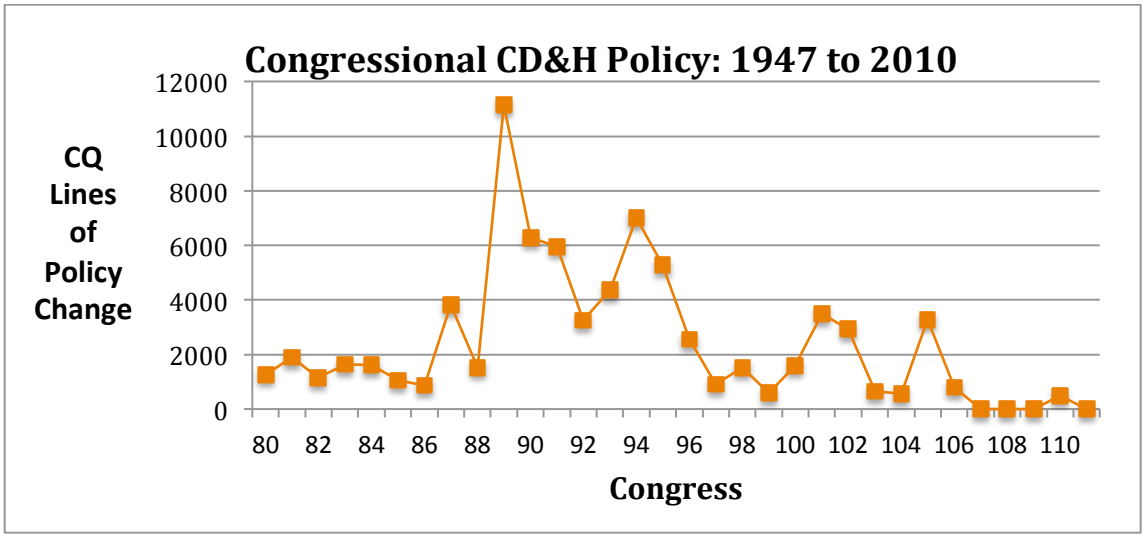

Figure 5: Total Number of CQ Column Lines per Congress Discussing Passed CD&H Laws. Data is taken from Policy Agendas Project Congressional Quarterly Almanac dataset.

As the role of science in society continues to grow (Weingart, 2002; Price, 1971), one would expect that science policy is correspondingly expanding over time. However, Congress has actually passed a decreasing amount of meaningful science legislation over the last sixty-two years (Figure 1). The largest and virtually singular development in science policy occurred between the 87th and 94th Congresses, or during the 1960s and early 1970s, and has steadily declined thereafter. Also noteworthy, the Congresses serving between 2001 and 2010 troublingly

returned to the almost nonexistent levels of science legislation during the 1950s Legislatures, a decade during which the apparent role of science in society had barely begun to emerge in America (Rossiter 1985).

Although these trends in science are seemingly disappointing, they are not entirely unique. The volume of significant transportation, education and CD&H legislation has similarly decreased but at even faster rates (Figures 3, 4, and 5). Notwithstanding a minor increase in transportation policy during the 109th Congress (2005-2007), these issue areas also experienced a similar return to 1950s legislative trends in the final decade examined. One might wonder if the decline in science policy therefore simply represents diminishing legislative behavior overall; however, figure 2 suggests otherwise. Passage of significant health policy has increased at a relatively rapid rate, even during the latest decade, thereby suggesting policy change does vary in magnitude and direction between issue areas.

Further demonstrating this variation, there are important characteristics unique to science policy change. Most notably, the amount of CQ science coverage ranges between 0 and 4,000 lines of law, while the other four areas experience ranges between 0 and at least 10,000. In fact, the other issue areas receive, on average, between 2,200 and 3,700 CQ lines of coverage per year, while science receives only 1,370 lines of coverage on average per year (PAP, 2014). Not only does science therefore experience generally smaller outputs of meaningful policy, but it also remains highly constant, while the other areas experience drastic spikes of growth and decline. For instance, the other four topics all radically increase in policy during the 89th Congress, while science actually declines. Similarly, science policy experiences its largest growth between the 91st and 93rd Congresses, when three of the other four issue areas either decrease in significant policy outcomes or remain constant.

Because science policy changes in these distinct ways, it is clear that the factors influencing policy in other issue areas likely have different or absent effects on science policy. One should thus wonder what influences science policy and why legislative action in this area is so minimal compared to that in the rest.

Congressional Science Policy: the Weakness of Existing Theories

In the rare occasions scholars study science policy, they primarily examine either policy solutions for scientific issues (Schneider, 1989; Jones, 2010) or how science policy benefits the economy (Smith, 1990; OECD, 2000), national security, and health (Richter, 1995). Scholars thus usually focus on the effects, rather than the causes of science policies. The few scholars who do evaluate the factors influencing science policy choices often concentrate on the Cold War as a causal factor (Leslie, 1993; Rossiter, 1985). This research fails to explain science policy trends beyond the Cold War, as well as instances when science policy did not adequately reflect the war's conditions. For example, large increases in significant science policy occur immediately after the Cuban Missile Crisis, which many consider to be the height of the Cold War, but also more appreciably when the US embraced détente, or relaxation of tensions, in the early '70s (Figure 1). Therefore, research needs to develop more timeless, encompassing theories to explain changes in science policy.

A small subset of research investigates the process of science policymaking. However, these investigations advocate political processes theorists believe would produce the best science policy outcomes, such as citizen panels that combine expertise with public deliberation, while barely describing the science policymaking process as it actually exists in reality (Jasanoff 1987; Weingart, 2002; Jasanoff 2004; Mooney 2005; Brown 2006). Nevertheless, these scholars analyze some cases, such as those related to carcinogen regulation and genetically modified

food, and agree that "it has become common practice for…politics [to] request special scientific expertise," because "scientific knowledge has been [historically] regarded as superior and of higher value than popular knowledge or 'common sense" (Weingart, 2002, p. 2). The researchers suggest that scientists not only give advice to politicians, but they can also set the science policy agenda. For example, environmental issues and technology controversies did not arise as political issues, until scientists found pesticides in the food chain and released findings on the potential harm technology can cause (Weingart 2002, 1991). While these studies highlight a probable trend in politics, they do not control for other possible causal factors. To assess the validity of this consensus that political "decision-making [has become] more technical and expert-driven," it is necessary to use a much larger number of policy cases and measure the effect of expertise on policy change over time (Dauvergne, 2005, p.369).

Quantifying Issue Specialization

One way to measure the influence of expertise on meaningful policy change is to investigate committee activity. According to Joseph Cooper, who scholars recognize as an expert in congressional committees, the committee system emerged "to make legislative specialization [or expertise] possible" (Cooper 1970; Gilligan & Krehbiel 1990, p. 536). Gilligan & Krehbiel (1990) likewise argue that committees provide "informational efficiency," since committee members become specialists, by "obtain[ing] superior information about the consequences of various legislative alternatives" (p. 536). By obtaining "superior" information, committees allow "Congress to accomplish more with its limited manpower," given that Congress is not capable of becoming experts in all policy initiatives, unless there is a division of labor (Adler &Wilkerson 2012, p. 60; Talbert, Jones & Baumgartner, 1995).

A staff member from the Senate Labor and Human Resources Committee explained that committees acquire a reputation for being experts on particular issues, because they get a referral for a particular bill, hold investigative hearings in which they invite expert witnesses to testify, and consequently obtain future jurisdiction over similar bills (Talbert, Jones & Baumgartner, 1995). Legislative hearings, which investigate the implications of bills that were referred to the committee of jurisdiction, especially tend to invite experts who are both supporters and dissenters, thereby theoretically allowing committee members to gain balanced information about the relevant issue (Talbert, Jones & Baumgartner, 1995). Given committees' clear role as issue experts in Congress, the level of committee activity is a valid proxy for issue specialization, since members obtain relevant bill information from field experts during hearings.

Although science policy literature suggests a unique role of expertise in science policy outcomes, the efficiency that committees provide makes it possible that committee activity is a key determinant of policy change for other topic areas, as well. Increased committee activity, by expanding the amount of information Congress can acquire, should result in more policy change. In fact, scholars find that committees "control the pace and direction of policy change within their jurisdiction" (Adler & Lapinski, 2009; Deering & Smith, 1997; Fenno, 1973; Weingast & Marshall, 1988). Committee activity is thus a likely indicator of policy change within specific topic areas.

Other Factors Causing Congressional Policy Change

Papers discussing the relationship between experts and science policy do not control for other possible causal factors, making it necessary to measure the effect of additional political variables. In turn, I examine theories of general congressional behavior and test how well they apply to science policy specifically. Such theories recognize many predictors of general policy

change, which I will categorize broadly as: partisan characteristics of government, external mood and support, and size of the federal budget.

Partisan Characteristics of Government

With antipathy between Republicans and Democrats currently reaching a peak (Pew Research Center, 2014), it does not seem unlikely that party preferences could significantly shape policy change in certain issue areas. Scholarly research supports this assumption, as McMonagle (2008) notes that some members "vote primarily based on their party affiliation or party leadership pressures" (p. 109). Likewise, Berry, Burden & Howell (2006) examine every federal discretionary program created between 1974 and 2004 and find that changes in congressional partisan compositions leads to changes in the durability of these programs, suggesting that the party composition of Congress affects policy change and stability. These findings likely apply to specific issue areas, as well, since other studies discover that party composition of Congress has a large influence on environmental policy (Shipan and Lowry, 2001) and economic policy, but minimal influence on defense (Snyder & Groseclose, 2000).

Issue Ownership literature further implicates political party as a factor influencing policy outcomes. These works argue that certain issues are "owned" by each party, so when America is facing problems, the party that owns those problems has an advantage in getting elected (Petrocik, Benoit, & Hansen, 2013). A party owns a topic when the public consensus assigns higher trust to one party for that topic (Egan, 2013). Egan (2013) finds that Democrats own issue areas, such as health, education, and the environment, and Republicans own crime, the military, and taxes. Although this literature associates issue ownership with campaign outcomes, it is likely that issue ownership also plays a role in policy outcomes, since parties are intuitively more likely to pass more policies in issue areas that will secure their future elections.

Party composition of Congress in relation to the executive branch is another explanatory factor that political scientists often cite as influencing policy change. In fact, Binder (2003) explains that divided government, in which the party of the president differs from at least one legislative chamber, "erects [a] barrier in the legislative process" and "traps bills that might have been enacted had control of government been unified in a single political party" (p.67). Numerous other studies support this claim, arguing that divided government reduces policy action (Mayhew, 1991; Howell, Adler, Cameron & Riemann, 2000; and Maltzman & Shipan, 2008). Cohen (2012) adds to this literature, by suggesting that party separation between the executive and legislative branches hinders policy change even more than party division within congressional chambers. He argues that congressional members who are not members of the president's party are less likely to feel pressured to support and act on his policy agenda preferences.

However, Nicholson-Crotty & Miller (2011) contrarily assert that governments controlled by both parties actually provide policymakers with more "discretion" and "room to innovate policy solutions," because diminished pressure to conform to party practices increases productivity. Adding to the disagreement, Mayhew (1991) and Krehbiel (1998) actually find that there is no difference in policy outcomes between unified and divided governments. One possible explanation for these incompatible findings is that divided government affects policy change differently within different issue areas. It is therefore worth investigating the role divided government plays in science and the other four examined topics.

External Mood and Support

The president does not simply influence Congress through partisan dynamics, but also through agenda-setting. Most scholars contend that "no other single actor in the political system

has quite the capability of the president to set agendas in given policy areas" (Kingdon, 1984, p. 23; Gelman, Wilkenfeld & Adler, 2015, p.2). Scholars provide three reasons for the president's critical role in the policymaking process. First, the president's policy agenda largely influences the congressional legislative agenda, as "over 70 percent of the president's issue priorities get congressional consideration" (Gelman et al., 2015, p. 2; Edwards and Barrett, 2000; Peterson, 1990). Furthermore, presidential policy proposals provide opportunities to shift the focus of the legislative agenda to new policy areas (Gelman et al., 2015). Lastly, legislators often base their support for policies merely on the fact that presidents are recommending them (Gelman et al., 2015; Lee, 2009). Given that the President so frequently influences congressional policy activity, it is likely that the president's party likewise contributes to policy change.

It is important to note that presidential sway fluctuates throughout his time in office. Presidential impact is especially high during the honeymoon phase, because elections indicate "what 'the people' expect from their representatives as they head to Washington" (Beckman & Godfrey, 2007, p.250). Therefore, when the public chooses a president, they expect that Congress will enact his agenda. Similarly, when presidents are running for reelection, they are more likely to recommend policies that have strong public backing, which Congress will thus be less likely to resist (Cohen, 2012). However, lame-duck presidents, or presidents in office after a new president has been elected, experience a 38% decline in legislative success, because Congress no longer sees a need to support their agenda (Cohen, 2012).

Apparent in these trends is the role of the public in shaping congressional support for the president. In fact, the public provides an extra source of external support that may even be more influential, since members of Congress hope to get reelected (Adler & Wilkerson, 2005; Binder, 2003). A 1998 study found that between 1960 and 1979, policy outcomes reflected public

opinion on 63% of cases, although declining to 55% between 1980 and 1993 (Monroe, 1998). Furthermore, science policy subtopics, such as the environment and energy, had among the highest consistency between policy outcomes and public opinion compared to most other issue areas (Monroe, 1998). Adler & Wilkerson (2012) explain that "lawmakers…should…mobilize around and respond to issues that have the public's attention" (p. 152). The scholars use the Stimson and Coggins Policy Moods dataset, which aggregates responses to survey questions and quantifies the public's broad support for legislative action, and find that public mood significantly contributes to policy change in half of their models (Adler & Wilkerson, 2012). It is therefore worthwhile to assess the role of public opinion on science policy, in comparison to the four other issue areas.

In addition to measuring public opinion directly, one might also indirectly gauge public enthusiasm for certain types of policy through religiosity measures. Koopman (2009) explores how religion molds American public policy and identifies at least five policy types that are characterized as "morality policies". For example, he discusses the study Colby & Baker conducted in 1988, which finds that religious communities associated homosexuality with AIDS and consequently were less willing to spend money on education, prevention, and treatment for AIDS. This example clearly demonstrates how religion can hinder education, health, and science policy. Similarly, religious populations have tended to oppose sex education in public schools, forcing the lawmakers who passed relevant legislation to minimize its implementation (Koopman, 2009). Religious contention with abortion has likewise interfered with science policy efforts to fund stem cell research, while the belief in creationism prevents religious groups from supporting public school education of evolution. Koopman concludes by highlighting the overall

failure Congress experiences when trying to enact these morality policies. This literature suggests that religion must influence at least some areas of policy change.

Federal Budget

Size of the federal budget also contributes to the political environment in Congress. Cohen (2012) explains that higher deficits constrain legislative action, because there are less spending opportunities. Furthermore, non-fiscal policies, such as those related to science, might be especially unsuccessful (Cohen, 2012). Light (2000) similarly argues that large budget deficits limit the government's ability to tackle issues, especially inhibiting spending for initiatives in new policy areas. In turn, lawmakers focus primarily on the less costly process of enhancing existing programs, rather than producing meaningful policy change.

The federal budget also plays an important role in agenda setting. Eshbaugh-Soha (2005) reports that budget deficits shrink the president's policy agenda in terms of both overall size and the number of issue areas included. As aforementioned scholars attest, the presidential agenda significantly shapes the congressional agenda. Consequently, if the federal budget determines the size of the presidential agenda, it should likewise influence the scope of the congressional agenda. DiNitto & Johnson (2012) summarize the budget's impact on lawmaking, by describing it as "the single most important policy statement," which "lies at the heart of all public policies" (p. 23). They further argue that the size of the budget clarifies who in society benefits and who pays the costs. Based on Cohen's (2012) argument, non-fiscal areas would pay the cost of diminished policy attention during higher deficits, while they would receive the benefits during surpluses. Clearly, the budget plays an important role in setting legislative priorities and defining Congress's freedom to take initiative in new policy areas.

Methodology

All of the aforementioned variables should play some role in policymaking; however, the degree to which they significantly affect policy change likely varies between issue areas. Hence, it is necessary to measure the explanatory power of these variables through multiple regression models.

Operationalizing the Dependent Variable

In order to quantify meaningful policy change in a given topic area, this study uses the aforementioned method of measuring CQ topic coverage (Adler & Wilkerson 2012). Specifically, the total number of CQ article column lines per Congress discussing laws passed in a given topic represents meaningful legislation in that issue area. This measure is derived from the Policy Agendas Project Congressional Quarterly Almanac dataset, which computes "ArticleSize" as the "length in column lines of the article" (PAP 2014). Although the dataset includes articles discussing both failed and successful legislation, I only define topic coverage as the number of lines discussing bills that became public law, a condition Adler and Wilkerson (2012) also use, since failed legislation is ultimately meaningless for determining policy change.

One should note that the Policy Agendas Project accounts for format changes of articles over time. Because the average number of words per column line in early Almanac years is half as much as that of later years, the Project halves the number of column lines counted per article in early years. This variable is therefore a consistent measure over time.

Defining Topic Areas

The Policy Agendas Project 2014 Topic Codebook defines 20 major topic areas and 220 subtopic areas by numerical code. All datasets used in this analysis have categorized legislation

according to these major and subtopic codes. Adler & Wilkerson (2012) also use Policy Agendas Project topic and subtopic codes to define the issue legislation they include in their study.

Science legislation includes laws with eight of the ten "Space, Science, Technology and Communication" codes. The two excluded codes are "Telephone and Telecommunication Regulation" and "Broadcast Industry Regulation," since these two refer to communication legislation, rather than science policy. Stine (2009) clarifies that science policy is involved in the following additional issue areas: health, environment, energy, transportation, defense, and education, through research and development efforts. In turn, I also define science as having the "research and development" codes under the first five of these six topic areas. Lastly, I include legislation with the "Education Excellence" code, only if the bill refers to science-related education.

Health, transportation, education, and CD&H legislation include public laws with all the codes listed under these major topic areas, except the research and development codes that are being defined as science. Using these codes for both science and one of the other issue areas would not be an accurate measure of policy change in a given topic area, as there would be issue overlap.

Independent Variables

1. Issue Specialization

As previously discussed, committees allow legislators to gain specialized knowledge in specific issue areas. Therefore, committee activity acts as a proxy variable for expert knowledge and issue specialization. I use the PAP Congressional Hearings dataset, which records each US congressional hearing from 1946 to 2013 and codes them by PAP topic areas. I thus measure committee activity as the total number of days per Congress committees hold referral hearings in

each topic area. I exclude non-referral committees, as these focus on "issues for which [the committee has] not received a bill referral" and therefore do not directly "shape the fate of bills" (Baumgartner & Jones, 2002, p. 99).

2. Partisan Characteristics

Partisan characteristics include: the party composition of the legislature, the extent of divided government, and the party of the president. To measure the effect of congressional party composition on policy change, this study uses the percentage of seats per Congress occupied by Democrats (History, Art & Archives, U.S. House of Representatives 2015; Senate Historical Office 2015). The Republican percentage of Congress is not included as a variable, because it would provide the same measure but in the reverse direction.

Divided government occurs when the party controlling the executive branch is different from the party controlling at least one chamber in Congress (Bessette & Pitney 2013). Because the dummy variable cannot gauge the extent of divided government, but simply indicates its presence, the percentage of seats in Congress occupied by a member of the president's political party is also used to measure divided government (Light, 1982). The political party of the president during each Congress and the presence of divided government are both made into dummy variables (0=Democrat, 1=Republican; 0=undivided, 1=divided).

3. External Mood and Support

As review of literature indicates, both the president and the public likely influence congressional policy decisions in specific issue areas. Gelman et al. (2015) assembled a dataset of unique presidential policy proposals between 1947 and 2008, constructed from the *Public Papers of the President* and coded according to the PAP codebook. Using the coding definitions described earlier, I select the total number of presidential policy proposals in each issue area per

Congress to quantify the president's legislative issue agendas, such as his science legislative agenda. I also use the total number of presidential policy proposals in all issue areas per Congress to measure the president's overall legislative activity.

I also include electoral margin, or the difference between electoral votes the president won in his election and those of the losing presidential candidate as a measure of public support for the president, which likely influences congressional responses to presidential policy proposals (Gelman et al., 2015; Leip, 2015). For years during which presidents came to office due to presidential death or impeachment, I use the electoral margin earned by the previous president.

Using Stimson and Coggins' (2014) Policy Moods dataset and custom series application, I aggregate mood scores for each topic into an average general score per Congress between 1947 and 2010. This score estimates broad public support for overall congressional policy activity. I also measure the effects of removing general mood score or replacing it with issue-specific mood score, but note that issue-specific data is often only available starting in the 1970s and is therefore less useful for this study.

As previously determined, religiosity is an indirect measure of public support for certain issue areas, such as health and education. Consequently, I include the average percentage per Congress of Americans who "would say religion is [very important] in [their] life" as a measure of public religiosity (Gallup, 2015).

4. Federal Budget

Lastly, the study includes the size of the federal budget, by recording the average federal surplus/deficit in millions of dollars during each Congress between 1947 and 2010 (Federal Reserve Bank of St. Louis, 2014).

Statistical Models

I use multiple regression models to determine the effects of these independent variables on topic-specific policy change. For each issue area (science, health, transportation, education and CD&H), I develop a model with CQ topic coverage as the dependent variable, by examining 1,224 CQ records of public law. Each CQ record discusses only one public law, since the Policy Agendas Project separates articles containing multiple laws into unique records. I include the eleven aforementioned independent variables and identify significant predictor variables for each topic, based on a significance threshold requiring the p-value to be below 0.05.

Although social scientists occasionally use lagged dependent variables in time series analyses, I choose to exclude this variable from the model. I do so, because scholars increasingly contend that "the lagged dependent variable specification is too problematic for use in most situations," as it underestimates the effects of explanatory variables, while overestimating its own effect (Keele, 2005, p.1). Achen (2001) argues that lagged investigations of the federal budget and nuclear arms race, for example, have produced artificial and inaccurate results. In turn, I omit the lagged DV, because it would likely underestimate the explicatory power of the independent variables, making the results unreliable.

Results

Table 1: Predictors of Topic-Specific Policy Change between the 80th and 111th Congress

Independent Variable	Science	Health	Transportation	Education	CD&H
Committee Activity (Referral Hearings)	14.05*	1.22	7.87	8.38	8.62
Democrat Percentage of Congress	1896.00	4987.00	7139.00	11890*	10930.00
Divided Government	-311.0	-337.4	-336.8	-242.8	-182.9
Presidential Party Congressional Seats Percentage	-3864.00	-15720.00	-9028.00	-4185.00	-4704.00
Presidential Party	39.87	-681.50	-391.60	-290.40	-1618.00
Total Presidential Proposals	-0.38	12.30	22.46**	-3.67	10.68
Topic-Specific Presidential Proposals	16.86	-7.06	177.6*	71.23*	-64.91
Mood Score	-89.79	84.39	307.10	-73.86	-205.60
Religion	-10030.00	-56170**	-59210*	-38900**	-17810.00
Electoral Margin	-0.38	7.33	7.27	4.40	7.81
Federal Surplus/Deficit	0.00	0.01	0.01	0.007501*	0.00
Multiple R-squared	0.61	0.68	0.68	0.70	0.72
Adjusted R-squared	0.38	0.43	0.44	0.47	0.49
N	31	31	31	31	31

Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1
N=observations (number of congressional terms)

Explanatory Variables of Science Policy Change

Results reveal that only committee activity, or the amount of days Congress dedicates to science referral hearings, significantly correlates with CQ coverage of science laws. Controlling for all other variables, meaningful science policy increases when committee activity increases, thereby confirming original expectations and substantiating existing science policy theories arguing that Congress depends on expert knowledge for science policy decisions. Contrary to the original hypothesis, partisan characteristics, external support, and the federal budget lack any appreciable impact on science policy change.

Comparison of Science Indicators to those for Other Issues

Not only does committee activity exclusively shape science policy, rather than any of the other four issue areas, but explanatory variables also differ for all examined topics. Unlike original predictions, even science, health and education are determined by different factors,

despite the seeming overlap of subtopics. Health policy negatively and significantly correlates with public religiosity alone. Committee activity, partisan characteristics, budget size and other measures of external support all fail to explain health policy change. However, as religiosity decreases, health policy increases, suggesting that these topics conflict and that congressmen are willing to prioritize religion over healthcare.

The sizes of the president's general policy agenda and transportation-specific policy agenda significantly and positively correlate with transportation policy change, while American religiosity negatively and significantly correlates. All other factors are insignificant. While the president's policy agenda is an expected indicator, religion does not have an apparent causal relationship with transportation policy and is thus likely reflecting the effect of another factor not included in this study.

Education policy change requires the most congressional consideration of political environment, as measures of partisan dynamics, external support, and the federal budget all play a significant role. Specifically, the increased percentage of Democrats in Congress amplifies education legislation. Likewise, presidential support of education and larger federal budgets additionally increase education policy initiatives. Similar to health and transportation policy, public religiosity negatively correlates with education policy, indicating that congressmen will not forego support from religious constituents for education that threatens their beliefs.

Community development and housing policy is the only issue area for which none of these independent variables are significant. In turn, specialized knowledge, partisan dynamics, external support and size of the federal budget all fail to explain this topic. It is thus likely that environmental events, such as housing crises, provide the most impact on this topic.

The only overlap between issue areas occurs when religion negatively correlates with health, transportation and education, suggesting that American religiosity plays a broader role in policymaking. However, congressional behavior is almost entirely unique for each issue area.

Appendix A examines how results change when issue-specific mood score replaces general mood score. Topic mood score removes the effects of all significant variables, as none of the factors substantially explain any of the five topics. However, this set of models investigates nearly half the number of CQ records of public law and considerably shorten the examined period of time, due to lack of available topic mood data. In turn, results from this set are unreliable and should not override conclusions emerging from Table 1, which has a much broader scope.

Appendix B reveals that when both topic-specific and general mood score are excluded from the model, the only differences that arise occur with transportation policy, as presidential support for transportation policy and religion are now insignificant explanatory factors. Because the significance of religion is likely reflecting another factor not included in this study, the most significant finding that emerges when mood is included is that the president's transportation agenda influences policy change in this area.

Discussion

Two especially noteworthy implications transpire from the results. First, Congress relies almost exclusively on specialized knowledge when making science policy decisions and ignores pressures from party leaders, the president, and the public. Policymakers likely justify this behavior by acknowledging that science is too technical for average citizens, or even themselves, to properly understand without the aid of experts. This trend validates the concern of policy theorists that "as decision-making [grows] more technical and expert-driven, citizens [are]

progressively distanced from the process…that form[s] the backbone of…[policy] decisions" (Jasanoff, 2005, p. 386). One might intuitively wonder why Congress has not produced more laws that beneficially expand scientific efforts, if scientific knowledge seemingly determines policy decisions in this area. Weingart (2002) explains that "the demand for scientific expertise" in politics diminishes the legitimacy of science as an objective, disinterested field by introducing political pressures into their work (p.704). In turn, scientists shape their findings in a way that supports political goals, thus resulting in irrational policy decisions.

Despite the negative side effects, it is apparent that the involvement of expert knowledge in politics increases science policy outputs, given the positive correlation between the two. One would therefore be amiss to eliminate expert opinions from policy decisions, and this type of knowledge is of course valuable. However, science policy is distinctive from most of the other issue areas in that it does not culminate from conventional democratic pressures, such as public opinion or presidential support that either shapes or reflects that opinion (Gelman et al., 2015). Perhaps this distancing of citizens from science policy decisions explains the narrow range of science policy change compared to that of the other issue areas (Figures 1-5). Results in fact demonstrate that pressures from the public, the president, political parties, or a combination of all three shape health, transportation and education policy, which have more than double the amount of maximal policy change than does science and higher averages of policy change per Congress.

Conceivably, these conventional policy actors refrain from advocating science policy action, because they lack the knowledge to support their claims as well as the experts upon whom Congress so faithfully relies. If party leaders, the president, or the public were encouraged to participate more in science policy promotion and to give those with specialized knowledge a less authoritarian role, there would be a larger impetus for policy change, simply because there is

strength in numbers. One might attempt to counter this claim by observing that CD&H has larger outputs than science but also seems to ignore these same pressures. However, various environmental circumstances, such as housing crises, force legislators to act immediately in this issue area, and legislators can easily gain electoral support by improving communities in which their constituents live, even if their voters do not deliberately request these improvements. In turn, it would make sense for Congress to produce large policy change in CD&H without having to gauge public support.

Contrarily, most circumstances that require scientific assistance, such as global warming, appear less urgent to Congress, because effects are more long-term in their exposure. Likewise, congressmen will not easily gain support from most of its constituents by improving science, because effects are less direct and immediate. Therefore, Congress has no reason to produce large policy outputs in science unless the public begins to ask for them. It is therefore necessary for Congress to make science policy deliberations less technical and less expert-reliant, so that citizens will be more willing to get involved. To substantially drive science policy change, expert advise is not enough.

The second meaningful conclusion developing from the results is that Congress relies on diverse factors when approaching policies of different issue areas. This observation is important for political scientists, as it requires new research initiatives that investigate trends in specific issue areas, rather than overall congressional policy. To demonstrate the need for this type of research, I will provide examples of two variables that predict general policy trends but not issue-specific trends.

Divided Government Influences General Policy but not Issue-Specific Policy

A number of scholars have aggregated issue areas into general congressional policy and found that divided government either hinders or aids policy productivity (Mayhew, 1991; Howell, Adler, Cameron & Riemann, 2000; and Maltzman & Shipan, 2008; Nicholson-Crotty & Miller, 2011). Yet, divided government does not have a significant impact on any of the examined issue areas, one way or the other. This finding does not mean that divided government has no influence on any issue areas; however, it is clear that generalizations of this relationship do not reflect all topics. In fact, the differences between these scholars' findings might result from the potentially varying impact of divided government across issue areas. Evidently, researchers need to investigate the effect of divided government on other topics this study does not examine, in order to obtain a complete picture of this variable's weight.

Presidential Agendas Impact General Policy, but not Science, Health, and CD&H

By examining general policymaking, undistinguished by topic area, scholars find that the president's policy agenda substantially influences congressional legislation (Adler & Lapinski, 2012; Cohen, 2012; Edwards & Barrett, 2000; Peterson, 1990). Yet, this study reveals that the president's policy agenda, whether general or topic-specific, only significantly influences transportation and education policy change, but has no considerable effect on science, health or CD&H. This is not to say these scholars had incorrect findings, but rather had incomplete findings, which exaggerate the influence the president has on policy change.

Undoubtedly, political scholars must analyze policy change in each issue area, in order to obtain a comprehensive picture of the dynamics that result in policy change. However, the question then is: why is congressional behavior issue-dependent? While it is not that surprising that Congress relies on specialized knowledge for convoluted science policy, the finding that

predictors vary so drastically between the other issue areas is not necessarily intuitive. For instance, why do partisan factors, external support, and the federal budget influence education policy, but health policy initiatives primarily depend on American religiosity? For that matter, why would Congress not consider partisan characteristics, external support, and the federal budget for all policy areas?

It is necessary to conduct in-depth studies within each of these issue areas to fully answer these questions; however, I will offer a possible explanation, by first analyzing why education policy change depends on a broader range of factors than do the other areas. According to the Policy Agendas Project (2014), Americans frequently classify health as a "most important problem" and practically never characterize transportation, CD&H and science as such. In turn, it is clear that health is consistently of high citizen high priority, while the others are of visibly low priority. The prioritization of education, however, is less straightforward, since a modest proportion of the public only sometimes characterizes education as a "most important issue". It thus makes sense that, since public prioritization of health, transportation, CD&H and science is well known, Congress only needs to assess a small number of political factors when making policy decisions in these areas. Contrarily, public prioritization of education is less obvious, since it is neither extremely high nor extremely low, so Congress must consider four factors: the party composition of Congress, presidential agenda, religion, and budget size.

Assuming this explanation is correct, why do the issue areas with obvious levels of public prioritization also vary by predictor variables? One apparent reason is that health is the only consistently high priority issue area. Given this regularly high prioritization of health, it is unnecessary for Congress to gauge public, presidential, or party support. Likewise, legislators do not need to consider the budget, because they theoretically would not want to sacrifice health

initiatives for lower priority policy initiatives. Consequently, Congress only needs to identify types of health policy that will be controversial, which often occur when laws conflict with religion, such as the AIDS policies discussed earlier. Congress thus focuses primarily on American religiosity when addressing this topic.

For similar reasons, Congress does not need to assess many of these political factors for low priority issue areas, because their lower urgency is consistent and well known. Most likely, Congress relies more on circumstantial events that provide rare impetuses for policy change. For example, the surge in housing foreclosures between 2007 and 2009 forced Congress to change CD&H policy (Immergluck, 2009). It would make sense that only environmental factors influence CD&H policy, since no political variables are significant, which indicates that further research in this topic is necessary.

Transportation is likewise a low priority issue area for the public, which is why only presidential support and religion are significant predictors of policy change. As previously mentioned, religion has no clear relationship with transportation, so it is likely representative of another significant indicator not included in this study. I will therefore focus more on explaining the relationship between presidential support and transportation policy change. Notably, presidents have made executive orders in transportation, ranging between 0 and 20 per year since the 1940s, while the other four examined issue areas have only received a maximum of 5 executive orders per year during the same time period (PAP, 2014). Furthermore, there was a much larger number of executive orders in this topic compared to the other four topics between the 1940s and the 1980s (PAP, 2014). Mayer & Price (2002) propose that presidents use executive orders to cause significant policy change. Because transportation has historically been a relatively popular issue area in which presidents pursue policy change, Congress may have

developed the behavior of looking to the president's agenda for this topic, to avoid the president circumventing their legislation. Given the low public priority of this issue area, it would make sense if environmental events shape this policy area, as well. In fact, an escalation in aviation policy occurred in the 1970s, right after the Boeing 747 was created, the first jet capable of seating 450 passengers, and after the Soviet Union made the first supersonic commercial aircraft, driving American competitiveness (NASA, 2010).

As previously discussed, science focuses primarily on expertise, because it has been characterized as a technical issue area that is too complicated for average citizens to understand. Its low prioritization among the public could be a cause or result of this dependence on expertise. Most likely, this relationship is mutually causal. Congress established this area as a technical one during the 1970s when scientific experts began participating much more in political debates (Weingart, 2006), thereby distancing citizens from the topic. This distancing likely made citizens feel powerless when it came to science advocacy, resulting in their apathy and long-term low prioritization of the issue. This apathy then only fortified the original reliance of Congress on expertise, creating a cycle of citizen distancing and apathy.

Conclusion

This paper has demonstrated the importance of investigating issue-specific trends in congressional behavior, by revealing that the factors influencing change in each topic vary not only with those shaping general policymaking, but also with those influencing other issue areas. Results also validate concerns of science policy theorists, who argue that science policy processes have become too complex and consequently exclude conventional democratic pressures. This finding simultaneously provides an enduring theory of science policy change in response to the shortage of existing explanations. Lastly, the study has provided a promising

explanation for differences between issue-area predictors, primarily based on historical public prioritization of policy topics.

The paper urges political scientists to coordinate future studies focusing on specific issue-areas, in order to produce a more comprehensive understanding of legislative behavior. To supplement this study, future research should investigate the role external circumstantial factors play in the five observed issue areas and identify other variables that might further demonstrate legislative reliance upon expertise in science.

By highlighting Congress's nearly exclusive dependence upon specialized knowledge when contemplating science policy change, the analysis most importantly emphasizes the need to reform the way lawmakers decide on science policy. Specifically, researchers must identify methods that combine expertise with citizen involvement, so that advocacy for science policy increases, compelling Congress to produce more substantial science policy changes. While scientific knowledge is always valuable, some form of citizen, presidential, or party participation is essential for significant policy change in a democratic society.

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Appendix A: Predictors of Topic-Specific Policy Change (with Issue-Specific Mood Score)

Independent Variable	Science	Health	Transportation	Education	CD&H
Committee Activity (Referral Hearings)	7.73	142.00	-773.90	11.80	7.73
Democrat Percentage of Congress	-1971.00	-319400.00	310800.00	22320.00	-1971.00
Divided Government	-471.40	-26530.00	42120.00	-2657.00	-471.40
Presidential Party Congressional Seats Percentage	-5455.00	-83010.00	-28630.00	-2133.00	-5455.00
Presidential Party	-578.70	18640.00	-25770.00	679.40	-578.70
Total Presidential Proposals	2.82	3.01	-65.53	-4.81	2.82
Topic-Specific Presidential Proposals	44.43	-1444.00	-2140.00	112.4 .	44.43
Topic Mood Score	-85.72	5890.00	-11410.00	27.83	-85.72
Religion	-11800.00	803000.00	435300.00	-61530.00	-11800.00
Electoral Margin	0.67	85.50	-237.90	3.81	0.67
Federal Surplus/Deficit	0.00	0.03	0.04	0.01	0.00
Multiple R-squared	0.91	0.8276	0.9054	0.6771	0.91
Adjusted R-squared	0.7349	-0.8964	0.7702	0.2824	0.7349
N	18	12	12	26	18

Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1
N=Observations (number of congressional terms)

Appendix B: Predictors of Topic-Specific Policy Change between 80th and 111th Congresses (without Mood Score)

Independent Variable	Science	Health	Transportation	Education	CD&H
Committee Activity (Referral Hearings)	15.06*	-1.59	4.40	9.46	9.10
Democrat Percentage of Congress	452.10	6297.00	9520.00	11250*	8170.00
Divided Government	-384.00	-3242.00	-2620.00	-2569 .	-2000.00
Presidential Party Congressional Seats Percentage	-3710.00	-14610.00	-5570.00	-4629.00	-5230.00
Presidential Party	160.00	-839.40	-542	-200.40	-1500.00
Total Presidential Proposals	0.69	11.24	16.81*	-3.99	13.5
Topic-Specific Presidential Proposals	7.57	-5.04	-115.9 .	76.27*	-86.1
Religion	-9450.00	-56400**	-55700.00	-39170**	-13400.00
Electoral Margin	-0.15	7.77	7.05	4.26	8.14
Federal Surplus/Deficit	0.00	0.01	.00978	0.00779*	.00237
Multiple R-squared	0.5827	0.6714	0.6439	0.69	0.6877
Adjusted R-squared	0.3741	0.4523	0.4213	0.49	0.4647
N	31	31	31	31	31

Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1
N= Observations (number of congressional terms)