Barriers in Communicating Science for Policy in Congress

Karen L. Akerlof*

American Association for the Advancement of Science, George Mason University

Maria Carmen Lemos

University of Michigan

Emily T. Cloyd and Erin Heath

American Association for the Advancement of Science

Selena Nelson, Julia Hathaway, and Kristin Timm

George Mason University

*Correspondence should be addressed to Karen L. Akerlof, AAAS, 1200 New York Ave., NW, Washington, DC 20005; kakerlof@gmail.com; (703) 282-1289.

Abstract

How does Congress use science? And what are the challenges that congressional staff members experience in finding, interpreting, and using scientific information in energy, environment, and science portfolios? This qualitative study of 16 interviews with Republican and Democratic staff members from the House and Senate applies a science usability model to the hyper-polarized legislative context, finding similarities, and some potential differences, in the communication barriers that inhibit the “strategic” use of science to support or defend policy positions and “substantive” use of science for decision-making.

Barriers in Communicating Science for Policy in Congress

Successful communication of science serves as a prerequisite for successful use of science in policy (Akerlof, 2018), but which forms of communication and for what types of use? This study explores the ways in which Congress presents different contexts for the use of science in policy and associated sets of communication challenges, or barriers. Theoretically, this research builds on the literature of supply and demand for the use of science in policy (Sarewitz & Pielke Jr., 2007) and knowledge usability (Lemos, Kirchhoff, & Ramprasad, 2012; Lemos & Morehouse, 2005) that has emerged in the past three decades, focused on environmental policy. Yet, the implications are no less important for science communication than science policy. Scholars point to few emergent recommendations for the communication of science to decision-makers that are universally generalizable across a wide diversity of circumstances, or even to certain types of contexts (Contandriopoulos, Lemire, Denis, & Tremblay, 2010; National Research Council, 2012). A 2017 report on the science of science communication similarly found that evidence on communicating with policymakers is lacking (National Academies of Sciences, Engineering, and Medicine, 2017).

We employ a science usability model that is based on three dimensions of communication barriers (Lemos et al., 2012) to explore its functionality and implications in a very specific context: the politically polarized environment of the U.S. Congress. By applying the model to two types of science use for policy (Whiteman, 1985), we seek to assess whether there are differences in science communication barriers across diametrically opposite forms of science use by decision-makers: 1) supporting or defending a previously established policy ("strategic" use), and 2) substantiating a new policy decision ("substantive" use). We carry out a qualitative study of interviews with 16 staff members in House and Senate personal offices, for the purpose of answering: 1) Does the science usability model of communication barriers hold in Congress, despite broad differences in policy context and information needs?; and 2) Within Congress, do the model's communication prescriptions and areas of emphasis differentially apply depending on the form of use? By analyzing differences due to context within one institution, albeit one of significant decision-making importance, we seek to address the claim that there is an overall "lack of evidence that can adequately inform what [knowledge transfer and exchange] strategies work in what contexts" (Mitton, Adair, McKenzie, Patten, & Perry, 2007, p. 756).

Communication is the crux of science usability

Usability is defined as "a function of both how science is produced (the push side) and how it is needed (the pull side) in different decision contexts" (Dilling & Lemos, 2011, p. 681). The study of usability arises from the observation that the conventional "loading dock approach" to producing science (e.g. peer review publications, professional communication) does not take into account potential users' needs, thereby failing to produce usable knowledge (Cash et al., 2003). Lemos and colleagues (2012) specifically distinguish between science that is useful (what scientists believe is needed) and usable (what users know they can use). Their conceptual model proposes three main drivers of knowledge use: *fit*, or how users perceive knowledge would meet their needs; *interplay*, or how new knowledge intersects with existing decision routines (negatively and positively); and *interaction*, or how the collaboration between scientists and decision-makers in producing knowledge increases its use. Each represents a dimension of communication hypothesized to impede—or facilitate—the transfer of scientific knowledge to the policymaker. Notably, information content, context, and the relationship between communicators similarly appear in communication theory as key to message receptivity (McCombs & Becker, 1979; Windahl, Signitzer, & Olson, 1992).

Governmental mandates spur studies of science usability

While decades old, the study of science usability has gained new prominence with the development of information systems to create and deliver usable climate science to decision-makers, including local, state, and federal policymakers (Dilling & Lemos, 2011). The U.S. Global Change Research Program (USGCRP) and National Climate Assessment are congressionally mandated to provide usable scientific information, including to Congress itself (Global Change Research Act of 1990; Pielke, 1995, 2000). The USGCRP—through the National Climate Assessment (Melillo, Richmond, & Yohe, 2014) and federal agencies like the National Oceanic and Atmospheric Administration (NOAA) —have sought to facilitate the production and communication of scientific information to narrow the gap between the generation and use of science, and better meet the needs of decision-makers (Cloyd, Moser, Maibach, Maldonado, & Chen, 2016). Studies of science usability, such as through NOAA's Regional Integrated Sciences and Assessments (RISA) and Sectoral Applications Research Program (SARP), have sought to explore different ways in which information fit, interplay, and interaction shape use (Lemos & Morehouse, 2005; Meadow et al., 2015; O'Connor, Yarnal, Dow, Jocoy, & Carbone, 2005; Rayner, Lach, & Ingram, 2005). In an in-depth analysis of research developed within one of the RISAs (Climate Assessment for the Southwest), Lemos and Morehouse (2005) found that iteration—the meaningful interaction between scientists and users in which both sides are willing to change and be changed by their collaboration—depended on three factors: interdisciplinarity, stakeholder participation, and the production of usable science.

More recently, in a study of the use of longer term outlooks and climate forecasts by crop advisors, Lemos, Lo, Kirchhoff and Haigh (2014) quantitatively demonstrated that perceived information accuracy and availability (*fit*) predicted use, as did individual- and organizational-level characteristics (*interplay*), and trust in information sources.

Barriers to the use of science

One of the focal areas of the supply and demand literature—and the related emergent field of evidence-based policy—is identifying barriers that impede the use of science (Cairney, 2016). A number of reviews have synthesized this literature (Cairney, 2016; Innvær, Vist, Trommald, & Oxman, 2002; Lemos et al., 2012; Mitton et al., 2007; Oliver, Innvar, Lorenc, Woodman, & Thomas, 2014). To the best of our knowledge, there have been no systematic reviews of barriers to the use of science in legislative contexts, likely because few studies of science use in legislatures exist (Geddes, Dommett, & Prosser, 2018; Kenny, Washbourne, Tyler, & Blackstock, 2017; University of Cambridge's Centre for Science and Policy; Science Policy Research Unit (SPRU) and ESRC STEPS Centre at the University of Sussex; Alliance for Useful Evidence; Institute for Government; and Sciencewise, 2013). In the U.K. Parliament, Kenny et al. (2017) conducted one of the most extensive studies of factors related to research use. They found that the credibility of the information source was a particularly important factor, as were the availability and accessibility of the information, and the policymaker's attitudes and time limitations. Table 1 presents the barriers they found along with those identified in the review conducted by Lemos et al. (2012). In the U.S., Kingdon's (1984) and Whiteman's (1995) studies of information use in Congress—while not specific to science—are among the most illustrative, and demonstrate the importance of policy process dynamics, such as the stage of policymaking. Kingdon described a confluence of parallel streams of problem awareness, policy solutions, and politics that join to create—or inhibit—opportunity windows for policy change, and use of information.

In Oliver and colleagues' systematic review (2014) of the most frequently cited barriers to the use of evidence (primarily for health policy), availability and access to information were the most frequently cited (63 studies out of 145 total), followed by clarity/relevance/reliability of findings (54), timing/opportunity (42), policymaker research skills (26), and costs (25). These findings largely align with other studies. In their review, Lemos and colleagues (2012) assigned commonly found barriers in the literature to the categories of information fit, interplay, and interaction (Table 1), and found that they do not act independently, but "shape each other to increase or constrain usability" (p. 791).

The purpose of identifying barriers is to develop strategies to address them, as Cairney (2016, p. 57) notes. For example, in response to the problems of information availability/accessibility, relevance, and limited resources, he suggests the following communication tactics: "1) Adopt framing strategies; 2) Recognize complexity; 3) Become part of advocacy coalitions; 4) Be clear on: (a) why actors should pay attention to the problem raised by the evidence; and (b) how feasible is the solution."

[TABLE 1]

All science "use" is not the same

The use of science for policy—sometimes also termed "evidence-based" or "evidence-informed" policy (Cairney, 2016)—has been studied predominantly within governance or decision-making networks that operate close to the resources that they manage, and may even exist for that sole purpose, such as crop advisors and stakeholders within NOAA RISA programs. One well-known review of case studies of use of science for policy explored the mobilization of science and technology for sustainable development, finding that information salience, credibility, and legitimacy served as key factors (Cash et al., 2003). These cases ranged from the collaboration of scientists and farmers on development of agricultural technology to a decision-support system to institutionalize use of science for transboundary air pollution. In 2016, one of the first quantitative studies to model factors that influence information use for policy found that legitimacy—defined as perceptions of lack of bias and representation of multiple points of view—was most important for the use of ecosystem services data (Posner, McKenzie, & Ricketts, 2016).

Congress often addresses the same types of policy issues described above, but is an institution of generalists, not specialists, and set at much greater remove from specific management decisions. Furthermore, the assumption in most of these studies of knowledge exchange, or evidence-based policy, is that the purpose of the use of science is to inform policy decisions. But use of research can take many forms. Weiss (1979) identified seven meanings of research utilization, ranging from a linear “knowledge-driven” model in which basic research informs applied research, development, and application, to a “research as part of the intellectual enterprise” model in which science and policy mutually influence each other, and are influenced by, societal trends. Whiteman (1985) developed a simpler typology for the use of information in Congress that recognizes that the use of information may actually occur *after* the decision has been made, not *before*. His three categories relate information use to the state of a policy decision (1985, p. 298). *Substantive* use helps to develop a policy position in the absence of a strong prior commitment. *Elaborative* use extends or refines a position that has already been formed. In *strategic* use, information serves to advocate for or reconfirm a position which has already been defined.

This study focuses on the two ends of the spectrum—substantive and strategic use—because of the similarities of the conditions under which elaborative and substantive use occur. In his analysis of use of information from the Office of Technology Assessment (OTA) in congressional committees (1985), Whiteman found that strategic use of information from the assessments occurred at all stages of the policy process—formulation, information gathering, modification, and deliberation—and was the most common form of use. Substantive use, alternately, only occurred during the formulation and information gathering stages. Thirteen cases of substantive use were observed, compared to 35 cases of strategic use (p. 299). Moreover, strategic use was most common in high-conflict issue areas, while substantive and elaborative use occurred predominantly under low-conflict conditions. More use of OTA reports in all forms—strategic, elaborative, and substantive—occurred for issues of higher salience, as judged by committee staff.

These findings align with the work of Contandriopoulos and colleagues (2010) in identifying that two of the largest sources of variation in how science is used for policy are the dimensions of political polarization, and science producer and user willingness to contribute time and resources to knowledge exchange. By overlaying Whiteman's typology with a similar figure Contandriopoulos et al. developed based on Weiss's research utilization categories, Figure 1 demonstrates the conditions under which substantive and strategic use are most likely to occur in Congress. Communication between policymakers and scientists—and/or intermediary organizations that convey scientific information—serves as the third dimension, reducing the costs of knowledge exchange for the decision-maker.

[FIGURE 1]

This study poses the following research questions using the framework of *fit*, *interplay*, and *interaction* set within the context of strategic and substantive use in Congress.

RQ_1—Attitudes and expertise are identified by Kenny et al. as barriers in the UK Parliament to the use of science. Are staffers supportive of the need for scientific expertise in policy, do they understand what it means to conduct a scientific study, and do they feel efficacious in assessing the credibility of scientific information?

RQ_2—Do barriers to use of science in policy identified by congressional staffers fall within the communication categories of information *fit*, *interplay*, and *interaction*?

RQ_3—Are the identified barriers for strategic use of science different than those of substantive use? Do the differences align with dimensions of issue politicization, time and resource allocation, and communication?

RQ_4—What is the relative proportion of substantive to strategic use of science by congressional staffers with energy, natural resources/environment, and science portfolios?

Methods

We conducted structured interviews with staff members (i.e. staffers) who are employed in the personal offices of members of Congress. The names of the staff members were obtained from their offices, which identified them as serving as the lead in covering a natural resources/environment, energy, or science committee on which the member of Congress sits.

Sampling

The House and Senate each have an energy, natural resources/environment, and science committee. The staffers that support the work of the members of those committees served as the population for the study because of the relevance of science to their portfolios and to limit the range of potential issues addressed within the study. In order to include a broad range of offices, the study sample recruitment was stratified to achieve roughly equal proportions from four types: House Democrat, House Republican, Senate Democrat, and Senate Republican. The recruitment list within each of these groups was randomized; potential respondents were contacted systematically by phone and email until the quota of about 4 per group was achieved. The relatively small sample number was chosen for two reasons: 1) to conduct longer, more in-depth interviews to explore the full extent of the study's research questions; and 2) to restrict sampling of the limited study population in the qualitative stage of a two-step research design of a broader study of knowledge use in Congress. A second phase of this study (not included in this paper) will develop a wider survey of staffers to further explore our research questions.

Sample characteristics

The study focuses on the use of science by the policy staff in personal offices who develop legislation and advise the members of Congress. All but one of the respondents contacted for interviews serve a member of Congress that sits on an energy, natural resources/environment, or science committee, but does not either chair the committee or serve as ranking member (in the latter cases, majority and minority committee staff are employed by, and represent, their respective member of Congress). Due to difficulty in recruiting Senate Republican offices during a busy legislative period following the new year, one of the Senate Republican staffers interviewed addresses science issues for their member of Congress, but the member does not sit on the relevant committee.

The final sample was 81% male, and included policy staff members of varying seniority: legislative correspondents/aides (3), legislative assistants and senior policy advisors (10), counsel (1), and legislative directors (2). The offices were equally split between party affiliation, and slightly more weighted toward the House (5 House Republican offices; 4 House Democratic offices; 3 Senate Republican offices; 4 Senate Democratic offices). The sample of offices was well-distributed across the ideological spectrum, including both highly liberal and highly conservative members of Congress (Appendix A).

Protocol

The recruitment materials invited staff members to “discuss how scientific information has—or has not—been helpful in the context of [their] work.” The study protocol was approved by George Mason University’s Institutional Review Board [1150984-1]. Sixteen interviews were conducted between December 14, 2017 and March 12, 2018. They ranged in length from approximately 30 minutes to more than one hour. The interview script began with questions about the staffer’s educational and professional background, and broad questions about science and its use in policy, then moved to a description of current policy issues in the staffer’s portfolio that were relevant to the committee. The end of the interview addressed the staffer's use of science in regards to specific issues. Fourteen interviews were audiotaped and transcribed; additional notes from the interviews were entered into a database. Notes were taken for the other two interviews; they were not recorded.

Study limitations

This study was conducted for the purposes of determining which barriers to the use of science are applicable in the context of congressional policymaking. The small sample size is suitable for developing the range of likely difficulties in the use of science experienced by staffers, including across different use contexts, but cannot be generalized to all 535 member offices. While respondents do not appear to have selected into the study as a function of office political ideology, there may have been a selection bias towards staffers who felt more affiliation with science.

Measures

Importance of scientific expertise. One of the first question sets in the interview was derived from a measure used with congressional staff members by the Congressional Management Foundation (Goldschmidt, 2017), adapted to compare the perceived value of policy versus scientific expertise in Congress. The closed-ended question was asked twice, varying the form of expertise: In your opinion, how important is the following for the effective functioning of Congress? Members and staff have access to high-quality, non-partisan, [policy/scientific] expertise within the legislative branch *(Very important, somewhat important, somewhat unimportant, very unimportant, don't know, no opinion)*

Definition of a scientific study. The National Science Foundation's biennial report to Congress of science and engineering indicators includes public survey questions of science understanding (National Science Board, 2016). The following question used in the indicators was also asked of staff members: In your own words, could you tell me what it means to study something scientifically? The response was coded according to NSF's definition: a) formulation of theories/test hypothesis, b) experiments/control group, or c) rigorous/systematic comparison (2018, p. 748).

Efficacy in assessing scientific information. A closed-ended question asked staffers how capable they felt regarding assessing scientific information: To what extent do you feel capable of assessing the credibility of scientific information? (*Not at all, very little, somewhat, to a great extent*)

Strategic and substantive use of science. In the second portion of the study, congressional staffers were asked to identify which issues they were working on (What are the top 5 major problems that you and others on [X committee] are most occupied with these days?). They were asked to categorize them as to whether the office policy position was already established (For each of these areas, did the office have a clear position on the issue at the start of the discussion?), and whether scientific information was relevant (For which—if any—of the major problems or project areas you just listed has scientific information come up in either your discussions or background reading of issue materials?). Only issues for which scientific information was relevant were categorized as "use of science"—these were further divided by whether the office had an established position (strategic use), or not (substantive use). In order to probe for longer-term policy research projects which might not be currently before the committee, staffers were also asked a follow-up question: Are there any additional projects that you are currently working on in which you are evaluating policy alternatives on which the office doesn't have a prior position? This response would also indicate examples of substantive use. These measures employ a minimal threshold for use based on the "interactive" meaning that Weiss (1979, p. 429) gives for knowledge utilization: "It describes a familiar process by which decision makers inform themselves of the range of knowledge and opinion in a policy area."

Barriers to use of science. Following the discussion of committee-related issues with which the staffer was concerned, they were asked to think about the specific cases of strategic and substantive use that they mentioned, and were prompted for barriers. The question included two parts to cover both forms of use: What—if anything—makes it difficult for you to use scientific information in those cases when the office already as a position on an issue? How about in conducting policy research in areas where the office does not have a position?

Content analysis

Three graduate students coded the variable constructs using a codebook developed both from previous literature and a close reading of the texts. They obtained a Krippendorff's α of 0.82 or greater across all variables, measured using a program for intercoder reliability analysis developed by Hayes and Krippendorff (2007) (see Appendices B, C). To ensure consistent interpretability across studies, reliabilities of $\alpha \geq 0.800$ have been recommended (Krippendorff, 2004).

Results

Staffer attitudes toward use of science for policy, understanding of science, and efficacy in evaluating scientific information (RQ_1)

Barriers to use of science for policy can exist both at individual and organizational levels. Kenny et al. (2017) identified staff attitudes and expertise as potentially limiting factors in the use of science in the U.K. Parliament. Thus, the first research question asks how supportive staff are of the need for scientific expertise in policy, do they understand what it means to conduct a scientific study, and how efficacious to they feel in assessing the credibility of scientific information?

All 16 of the staffers interviewed said that it is very important that staffers have access to high-quality, non-partisan policy expertise within the legislative branch, and 12 (75%) said that access to scientific expertise was also “very important.” The remaining quarter said that scientific expertise was “somewhat important.”

Twelve of the 16 respondents were correctly able to describe the nature of a scientific study using NSF’s definition (Figure 2; codebook and reliability statistics located in Appendix B). Interestingly, more than half of the staffers (9) also described a social—as opposed to methodological—dimension of science, such as the use of peer-review (5 respondents), unbiased nature of the research (4), and that scientists and scientific organizations conduct them (3). Moreover, almost all of the interviewed staffers—14 of 15 who answered the question—said they felt somewhat or to a great extent capable of assessing the credibility of scientific information.

[FIGURE 2]

Barriers to use of science by congressional personal office staff members (RQ_2)

In answering the question whether barriers to use of science in policy fall within the communication categories of information fit, interplay, and interaction, we assessed a total of 28 responses from examples of challenges to strategic and substantive use collected from 15 study participants. In coding the interview responses, almost all observed barriers can be explained by these categories (codebook and reliability statistics located in Appendix C). Table 2 describes the difficulties in using science detailed by staff members across both strategic and substantive use; the following section will describe the results broken down by these two types.

Two of the variables—untrustworthy and biased—could describe either fit or interaction depending on whether they referred to the information or its source. Because it was difficult to separate trust and/or bias of the source from the information in coding the interviews, they fall under "other." Legitimacy falls under information fit in the analysis because the coding refers to characteristics of the scientific process such as transparency and verification that do not have any connection to the relationship between the staffer and provider of scientific information.

In addition, we coded difficulties staffers described in communicating science with the public, within the office, and inside Congress. A third of the respondents mentioned communication of science as a constraint. Because interaction only describes communication between science producers and users, staffer communication of science does not fall within this category, and was also placed under "other."

The most frequently mentioned barriers fall under information fit and interplay between the decision-making context and the information. Informational complexity (9 respondents), the inconclusive nature of the evidence (9), the availability or ability to access the information (8), and lack of time and/or resources to use scientific information (8) were each cited as barriers by more than half of the 15 respondents. Table 3 displays some of the quotes that illustrate barriers to use of scientific information because of poor fit; lack of time and resources is described in the following section.

[TABLE 2]

[TABLE 3]

Differences in barriers between strategic and substantive use (RQ_3)

The third research question asked whether difficulties in using science for policy are different because of the type of use and its context, corresponding to the dimensions of issue politicization, time and resource allocation, and communication (Figure 1). Each respondent was asked to describe difficulties in using science from experiences they had had recently with strategic and substantive use, as denoted by whether scientific information was relevant to the issue, and whether the office was considering, or had already decided, their policy position. Of the 28 responses coded, 15 were for strategic use, and 13 substantive use. The sample number was lower for substantive use because of the infrequency with which staffers experienced this form of use.

The small sample size does not permit statistical comparisons across the two categories, but it does allow us to observe and characterize general patterns. First, only one variable—legitimacy—occurs as a barrier in one type of use (strategic), and not in the other (substantive). All other variables are represented in both types of use, though in differing frequencies. Moreover, six of the 15 respondents said that there were similarities in the barriers between both types of use, or that they were the same. This suggests that, indeed, there are many parallels.

The most frequently mentioned barriers—mentioned by at least four respondents—for strategic use were: evidence inconclusive (6 respondents), time/resources (6), complexity of science (5), other decision factors (5), policy conflict (4), not legitimately generated (4), and difficulty for the staffer to communicate the science (Figure 3). For substantive use, they were: availability/accessibility of the information (5), expertise/research skills (4), complexity of science (4), low or lack of contacts (4), and presentation of the information (4) (Figure 4). Information fit and interplay predominate among the difficulties that staffers experience in both cases. The complexity of scientific information in particular is mentioned frequently across both forms of use. However, some potential differences can be observed in the interviews regarding the three important dimensions that define strategic and substantive use, as demonstrated in Figure 1: 1) who contributes time and resources to facilitate knowledge exchange (users or producers), 2) issue politicization, and 3) communication.

Time/resources. Limits in time and resources are more frequent barriers to using scientific information when interviewees described looking for information to support a previously made decision (strategic) (6), than to make a new decision on a position (substantive) (2). The descriptions of why time and resources are a limitation sound remarkably similar across both types of use: the tight timelines in which congressional staffers operate, the time-consuming nature of interpreting academic studies, and deciding which information is actually useful.

Reading academic literature is time-consuming. One Senate staff member described the problem of little time and resources to delve deeply into academic literature as such: “Oftentimes it’s not sufficient to just read the abstract. It’s like you have to dig deeper to look at what are the parameters, and the assumptions, and the data, and how they’re defining things. That just takes a lot of time. When you’re doing a thousand things at once, and this maybe speaks to just a broader problem in the Senate, and I’m sure it’s even worse in the House, resources are stretched too thin oftentimes to really go as deeply as you might want to go.”

Information abounds—but it takes time to figure out whether it is the right information and to find unbiased sources. A House staff member pointed to the problem of trying to vet all the information that flows into the office: "I think a lot of times, too, there's a lot of information that comes in where it's just somebody walks by and drops it off, or people mail it in and there's a question of is this good material? How much time do I have to figure out whether or not this is good material?" A Senate staffer highlighted the difficulty in finding time to find information that is not being pushed by interest groups: "The highest difficulty is having the time to find it. There are so many demands on our time, and it's not fed to us in the way that the industry-preferred information is fed to us."

Policy conflict and other decision factors. Once a congressional office makes a policy decision, as in the case of strategic use of science, it can be difficult for the member to change their position. Policy conflict (4 respondents) and other decision factors (5) are discussed more often by interviewees in regards to strategic use than substantive (2 respondents each). Policy conflict was coded when scientific evidence is in conflict with the office policy agenda; "cherry-picking" data to support a position; and when the office policy is already decided and can't be reversed. The two (unexpected) cases of policy conflict under substantive use refer to a situation in which the office was trying to establish a policy, but was experiencing conflict due to historic jurisdictional issues in Congress that constitute prior policy. The staff member was emphasizing the importance of the stage in policymaking for when substantive use of scientific information is most likely to occur.

Cherry-picking science isn't anti-science. A House staffer related, "What—if anything—makes it difficult for you to use scientific information in those cases when the office already as a position on an issue? There is nothing difficult about it. Sometimes you come up against facts that are against the boss's arguments. You might have to counter them. … We aren't going to wave [information countering the office position] around, but I have to think about how we rebut it. I don't consider that to be anti-science. … The facts to this particular instance are only one of the facts … ."

Substantive use of science is prohibitive after a certain stage of policymaking. A Senate staffer described a point at which it becomes difficult to change the office's direction: "I mean, sometimes ... you're in the position that … is almost set in there after a certain point, like the point of no return when you've either cosponsored a piece of legislation, or you're on it. Any new scientific information past that point maybe might be a little bit irrelevant, once you're on bill."

Science isn't the only factor in congressional decisions. Science is just one of many pieces of information that Congress has to consider. The "other decision factors" code references other forms of information—such as local knowledge, politics, the economy, and values—and that are equally or more important than science. A Senate staff member indicated that an economic argument might win the day even if science demonstrated detrimental environmental effects from the Renewable Fuel Standard: "Like when it comes to the Renewable Fuel Standard. I don't know that [scientific information] would be the sole determinant of the boss's position, it could very well be the economic opportunity." Similarly, a House staffer found science frequently at odds with the knowledge of fisheries presented from fishermen: " … like when you talk about the Magnuson Stevens Act, that has a lot to do with science, but sometimes the problem is we hear a lot from fishing groups, whether it's recreation or commercial, that say like, 'Yes, the science says this, but the reality is X,' you know, so sometimes what is correct on the books, like can we prove scientifically, also isn't necessarily reflective of how to best go about producing a result."

Lack of contacts. Lack of interaction with contacts appears more frequently among the transcripts as a difficulty for substantive use (4) than strategic (1). This is the only variable representing interaction, and is defined as lack of contact or relationships with scientific information providers, including not knowing who to contact, or talk to, and lack of established relationships.

In new policy areas, finding contacts is harder. A House staff member—relatively new to the Hill—described the problem for strategic use as one of building relationships: "A lot of it is, can I build a relationship with someone who can get me the information I need, and I trust them? That's just all relationship driven." Substantive use of science occurs for new policy areas in which the office does not have prior experience. This aspect of the problem was described succinctly by another House staffer: "And so it just is a challenge to learn, which research tools to use and to talk to who the trustworthy sources of information are. But I think you encounter those challenges every time you wade into a new field, so not problems per se, but challenges."

[FIGURES 3 & 4]

Prevalence of strategic and substantive use in science-heavy portfolios (RQ_4)

The final research question asked about the relative proportion of substantive to strategic use of science by congressional staffers with energy, natural resources/environment, and science portfolios. Whiteman's 1985 study of congressional committee use of five Office of Technology Assessment reports identified 25 committees where they were used and that strategic use occurred almost three times as frequently as substantive use. This study similarly tried to capture the relative frequency of forms of science use in Congress, but in personal offices by staffers with heavy science-related portfolios. By asking the staffers to identify at least five issues that they were working on as relevant to the committee, what was the status of the office's policy position, and whether scientific information was relevant, we were able to establish the relative frequency of strategic vs. substantive use by staffers during the period in which they were interviewed, including for longer-term policy research projects (winter 2017-2018). A total of 97 issues across the 16 respondents were identified. An average of 6.1 committee issues and research projects were listed by the respondents—an average of 3.1 examples of strategic use, 1.8 substantive, and 1.1 in which scientific information had not been discussed or read. More substantive use occurred in long-term policy research than for issues that were currently of interest to the committee, supporting the finding in the previous section that time was less likely to be an issue in these contexts. Of the 29 total cases of substantive use, 18 were in this exploratory stage (62%). Overall, 52% of cited policy issues involved strategic use of science, 30% substantive, and 19% in which scientific information was not relevant.

Discussion

This qualitative study suggests that among the congressional staff members interviewed—from offices representing a range of political ideologies—there was support for the use of scientific expertise in policymaking, a general understanding of what it means to study something scientifically, and overall feelings of efficacy in assessing scientific information. Yet staff members cite many barriers to their use of science for policy, and while some of those are consistent across different forms of "science use," there are also some differences. The most obvious of these is that when offices have already chosen a policy position, scientific evidence can come into conflict with the decision. Thus, the predominance of strategic use of science, compared to substantive use, among the staffers interviewed has significant implications.

Importance of information fit and interplay with contextual factors

The findings from this study support the use of a general science usability model driven by fit, interplay and interaction, even within a heavily politicized policymaking environment. In addition, staffer difficulty in communicating science within the office, within Congress, and externally with the public and stakeholders is a critical barrier for knowledge use. Variables from the categories of information fit and interplay appear the most commonly among interview participants: informational complexity, the inconclusive nature of the evidence, the availability or ability to access the information, and lack of time and/or resources to use scientific information. Barriers such as policy conflict in use of scientific information, and the importance of other factors than science in decision-making, highlight the very nature of Congress: the defining of members by their political and policy positions, and their role in weighing a wide array of information, not just research evidence. Interestingly, these difficulties in using science did not appear to the same extent in the study of U.K.'s Parliament, though the importance of when information was introduced in the policy process was emphasized (Kenny et al., 2017).

Differences between strategic and substantive use

In this sample of congressional staff members, more than half (53%) cited use of science in cases where the office already had a policy position. Only 29% of the issues on which staffers were working were ones in which the office did not have a position and science was relevant, and of those, more than half were in the form of longer-term policy projects (18 projects; 11

within current committee issues). Almost all barriers to the use of science appeared both in discussions of strategic and substantive use. The sole exception was the legitimacy of scientific processes, which was cited as a problem only for strategic use. Some of the differences in relative frequencies of the types of barriers—lack of time and resources, policy conflict and other decision factors, and lack of contact with information sources—reflect the theorized dimensions of time and resources, issue politicization, and communication (Contandriopoulos et al., 2010) likely to affect strategic versus substantive use.

Communication strategies for evidence-based policy

The barriers to science use identified in this study include many already identified in the literature aimed at helping scientists communicate with policymakers, such as information complexity and presentation, that can be addressed by simplifying concepts and making materials for congressional staff short and easy to read (White & Carney, 2011). The larger question of how science can inform policy positions that have already been established is a more complex one, but perhaps also more important. When issues are politicized, coalitions with shared core beliefs—including scientific and technical information— seek to influence the policy system (Jenkins-Smith, Nohrstedt, Weible, & Sabatier, 2014; Sabatier, 1988). Learning occurs easily within coalitions, but with more difficulty across coalitions with different core beliefs. In cases where offices already manifest policy positions (strategic use), scientists who wish to influence them may be most effective in working through these coalitions. Indeed, joining advocacy coalitions is one of the communication tactics for information dissemination recommended by Cairney (2016).

Further research is needed to understand how science communication and use that occurs within policy coalitions differs—both in its form and impact—from other types of science producer and user relationships, especially for direct resource management, that are more commonly the focus of these types of studies. The question whether—and if so, how—scientists should participate in advocacy is the subject of considerable academic and practical interest to the science community (Kotcher, Myers, Vraga, Stenhouse, & Maibach, 2017; Pielke., 2007).

Conclusion

Congress is a unique institution, and the way it uses science might be expected to be unique as well. Instead, some general themes in barriers to the use science seem to persist: the information is not what people need, their circumstances influence how and when it can be used, and having help in finding and using the information can be critical. It is the specifics of barriers that may be somewhat different, particularly in hyper-polarized environments with high rates of strategic use of science in policy. The path forward is through more comparative studies that apply quantitative analyses to be able to distinguish these conditions and their implications for communication.

Author note:

This research was supported by the National Oceanic and Atmospheric Administration.

References

Akerlof, K. (2018). *Congress's use of science: Considerations for science organizations in promoting the use of evidence in policy*. Washington, DC: American Association for the Advancement of Science.

Cairney, P. (2016). *The politics of evidence-based policy making*. Springer.

Cash, D., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., … Mitchell, R. B. (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences of the United States of America*, *100*(14), 8086–8091. https://doi.org/10.1073/pnas.1231332100

Cloyd, E., Moser, S. C., Maibach, E., Maldonado, J., & Chen, T. (2016). Engagement in the Third U.S. National Climate Assessment: commitment, capacity, and communication for impact. *Climatic Change*, *135*(1), 39–54. https://doi.org/10.1007/s10584-015-1568-y

Contandriopoulos, D., Lemire, M., Denis, J.-L., & Tremblay, E. (2010). Knowledge exchange processes in organizations and policy arenas: a narrative systematic review of the literature. *The Milbank Quarterly*, *88*(4), 444–483. https://doi.org/10.1111/j.1468-0009.2010.00608.x

Dilling, L., & Lemos, M. C. (2011). Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. *Global Environmental Change*, *21*(2), 680–689. https://doi.org/10.1016/j.gloenvcha.2010.11.006

Geddes, M., Dommett, K., & Prosser, B. (2018). A recipe for impact? Exploring knowledge requirements in the UK Parliament and beyond. *Evidence & Policy: A Journal of Research, Debate and Practice*, *14*(2), 259–276.

Global Change Research Act of 1990, Pub. L. No. 101–606, 104 Stat. 3096-3104.

Goldschmidt, K. (2017). *State of the Congress: Staff perspectives on institutional capacity in the House and Senate*. Washington, DC: Congressional Management Foundation.

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures*, *1*, 77–89.

Innvær, S., Vist, G., Trommald, M., & Oxman, A. (2002). Health policy-makers' perceptions of their use of evidence: a systematic review. *Journal of Health Services Research & Policy*, *7*(4), 239–244. https://doi.org/10.1258/135581902320432778

Jenkins-Smith, H. C., Nohrstedt, D., Weible, C. M., & Sabatier, P. A. (2014). The Advocacy Coalition Framework: Foundations, evolution, and ongoing research. In P. A. Sabatier & C. M. Weible (Eds.), *Theories of the policy process* (pp. 183-). Avalon Publishing.

Kenny, C., Rose, D. C., Hobbs, A., Tyler, C., & Blackstock, J. (2017). *The role of research in the UK Parliament, volume one* (p. 64). London, UK: Houses of Parliament.

Kenny, C., Washbourne, C.-L., Tyler, C., & Blackstock, J. J. (2017). Legislative science advice in Europe: the case for international comparative research. *Palgrave Communications*, *3*.

Kingdon, J. (1984). *Agendas, alternatives, and public policies*. Boston: Little, Brown.

Kotcher, J. E., Myers, T. A., Vraga, E. K., Stenhouse, N., & Maibach, E. W. (2017). Does engagement in advocacy hurt the credibility of scientists? Results from a randomized national survey experiment. *Environmental Communication*, *11*(3), 415–429. https://doi.org/10.1080/17524032.2016.1275736

Krippendorff, K. (2004). *Content Analysis: An Introduction to Its Methodology* (2nd ed). Thousand Oaks, Calif: Sage.

Lemos, M. C., Kirchhoff, C. J., & Ramprasad, V. (2012). Narrowing the climate information usability gap. *Nature Climate Change*, *2*(11), 789–794.

Lemos, M. C., Lo, Y.-J., Kirchhoff, C., & Haigh, T. (2014). Crop advisors as climate information brokers: Building the capacity of US farmers to adapt to climate change. *Climate Risk Management*, *4*, 32–42. https://doi.org/10.1016/j.crm.2014.08.001

Lemos, M. C., & Morehouse, B. J. (2005). The co-production of science and policy in integrated climate assessments. *Global Environmental Change*, *15*(1), 57–68. https://doi.org/10.1016/j.gloenvcha.2004.09.004

McCombs, M. E., & Becker, L. B. (1979). *Using mass communication theory*. Englewood Cliffs, NJ: Prentice-Hall.

Meadow, A. M., Ferguson, D. B., Guido, Z., Horangic, A., Owen, G., & Wall, T. (2015). Moving toward the deliberate coproduction of climate science knowledge. *Weather, Climate, and Society*, *7*(2), 179–191. https://doi.org/10.1175/WCAS-D-14-00050.1

Melillo, J. M., Richmond, T., & Yohe, G. W. (2014). *Climate change impacts in the United States: The Third National Climate Assessment*. Washington, DC: U.S. Global Change Research Program.

Mitton, C., Adair, C. E., McKenzie, E., Patten, S. B., & Perry, B. W. (2007). Knowledge transfer and exchange: Review and synthesis of the literature. *The Milbank Quarterly*, *85*(4), 729–768. https://doi.org/10.1111/j.1468-0009.2007.00506.x

National Academies of Sciences, Engineering, and Medicine. (2017). *Communicating science effectively: A research agenda*. Washington, DC: The National Academies Press. Retrieved from https://www.nap.edu/catalog/23674/communicating-science-effectively-a-research-agenda

National Research Council. (2012). *Using science as evidence in public policy*. Washington, DC: The National Academies Press. Retrieved from https://www.nap.edu/catalog/13460/using-science-as-evidence-in-public-policy

National Science Board. (2016). Chapter 7. Science and technology: Public attitudes and understanding. In *Science & Engineering Indicators 2016* (pp. 7/1-7/101). Alexandria, VA: National Science Foundation, National Center for Science and Engineering Statistics (NCSES).

O’Connor, R. E., Yarnal, B., Dow, K., Jocoy, C. L., & Carbone, G. J. (2005). Feeling at risk matters: water managers and the decision to use forecasts. *Risk Analysis*, *25*(5), 1265–1275.

Oliver, K., Innvar, S., Lorenc, T., Woodman, J., & Thomas, J. (2014). A systematic review of barriers to and facilitators of the use of evidence by policymakers. *BMC Health Services Research*, *14*, 2. https://doi.org/10.1186/1472-6963-14-2

Pielke, R. A. (1995). Usable information for policy: An appraisal of the U.S. Global Change Research Program. *Policy Sciences*, *28*(1), 39–77. https://doi.org/10.1007/BF01000820

Pielke, R. A. (2000). Policy history of the US Global Change Research Program: Part II. Legislative process. *Global Environmental Change*, *10*(2), 133–144. https://doi.org/10.1016/S0959-3780(00)00007-8

Pielke, R. A. (2007). *The honest broker: making sense of science in policy and politics*. Cambridge; New York: Cambridge University Press.

Posner, S. M., McKenzie, E., & Ricketts, T. H. (2016). Policy impacts of ecosystem services knowledge. *Proceedings of the National Academy of Sciences*, *113*(7), 1760–1765. https://doi.org/10.1073/pnas.1502452113

Rayner, S., Lach, D., & Ingram, H. (2005). Weather forecasts are for wimps: Why water resource managers do not use climate forecasts. *Climatic Change*, *69*(2–3), 197–227. https://doi.org/10.1007/s10584-005-3148-z

Sabatier, P. A. (1988). An advocacy coalition framework of policy change and the role of policy-oriented learning therein. *Policy Sciences*, *21*(2–3), 129–168. https://doi.org/10.1007/BF00136406

Sarewitz, D., & Pielke Jr., R. A. (2007). The neglected heart of science policy: reconciling supply of and demand for science. *Environmental Science & Policy*, *10*(1), 5–16. https://doi.org/10.1016/j.envsci.2006.10.001

University of Cambridge's Centre for Science and Policy; Science Policy Research Unit (SPRU) and ESRC STEPS Centre at the University of Sussex; Alliance for Useful Evidence; Institute for Government; and Sciencewise. (2013). *Future directions for scientific advice in Whitehall*. London.

Weiss, C. H. (1979). The many meanings of research utilization. *Public Administration Review*, *39*(5), 426–431. https://doi.org/10.2307/3109916

White, K. S., & Carney, J. P. (2011). *Working with congress: a scientist's guide to policy*. Washington, DC: American Association for the Advancement of Science. Retrieved from https://mcmprodaaas.s3.amazonaws.com/s3fs-public/AAAS_Working_with_Congress.pdf

Whiteman, D. (1985). The fate of policy analysis in congressional decision making: Three types of use in committees. *Western Political Quarterly, 38*(2), 294–311.

Whiteman, D. (1995). *Communication in Congress: members, staff, and the search for information*. Lawrence, KS: University Press of Kansas.

Windahl, S., Signitzer, B., & Olson, J. T. (1992). *Using communication theory: an introduction to planned communication*. London: Sage.

Tables and Figures

Table 1. Comparison of barriers to use of science for policy across contexts

	Fit	Interplay	Interaction
Lemos et al., 2012 *Generic context*	• Inaccurate/ unreliable • Not credible • Not salient • Not timely • Uncertain	• Professional context • Previous experiences • Decision routine • Difficulty using information • Insufficient capacity	• Not legitimate • Infrequent communication • One-way communication • Relationship with the end-user
Kenny et al., 2017 *Legislative context*	• Availability/ accessibility • Presentation style • Relevance • Alignment with other sources • Complexity	• Scheduling/time • Awareness of information • Resources • Attitudes/experience/ expertise • Topic area • Coinciding with policy window	• Credibility/bias/ peer recommendation

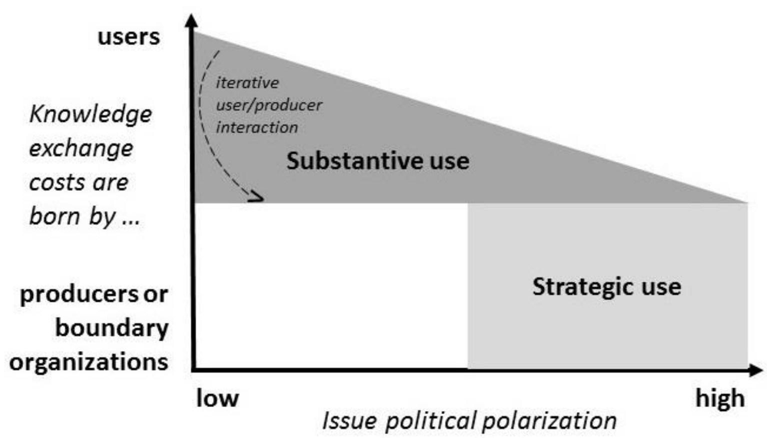


Figure 1. The costs to acquire knowledge and the degree of political polarization are believed to influence the type of information use (adapted from Contandriopoulos, D., Lemire, M., Denis, J.-L., & Tremblay, E., 2010). Communication acts as a third dimension, reducing the costs of knowledge gain through interaction.

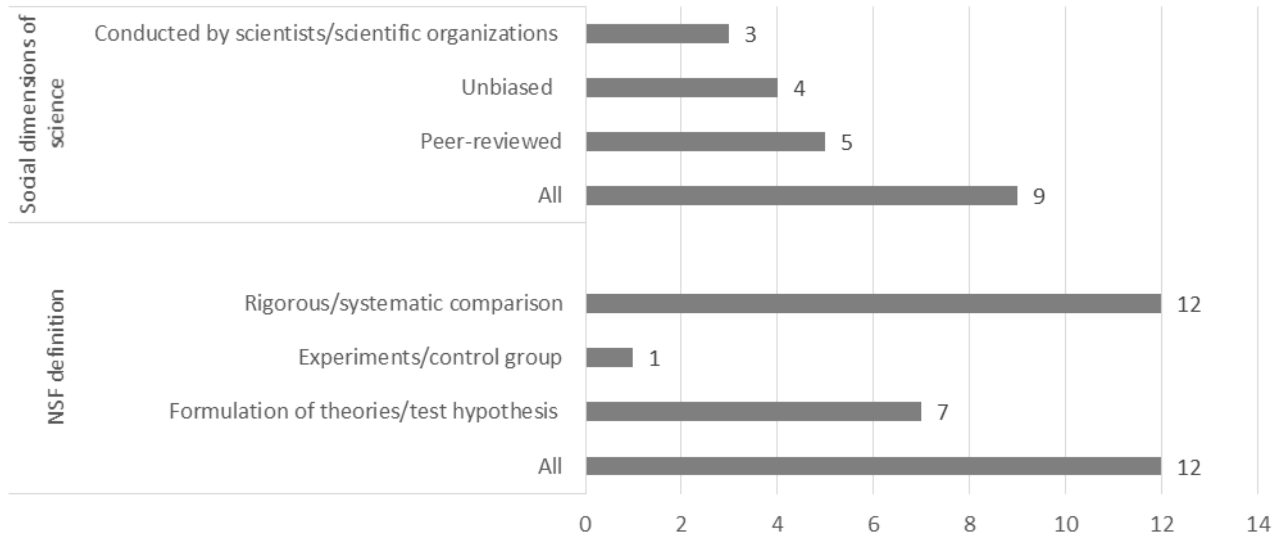


Figure 2. Twelve of the 16 congressional staffers interviewed correctly provided a definition of what it means to study something scientifically. (*n=16*)

Table 2. Barriers to the use of science for policy identified by House and Senate staffers (*n=15).* The numbers refer to how many respondents cited the barrier.

Fit	Interplay	Interaction	Other
• Complexity (9) • Evidence inconclusive (9) • Availability/ accessibility (8) • Presentation (7) • Not legitimately generated (transparency/ lack of verification) (4)	• Time/resources (8) • Expertise/ research skills (7) • Other decision factors (7) • Policy conflict (6)	• Lack of contact or relationships (5)	• Untrustworthy (information or source) (5) • Staffer communication of science (5) • Biased (information or source) (3)

Table 3. Staffer quotations illustrate the most frequently cited barriers to use of science.

Barriers	Issue/Context	Quote
Complexity	The nature of science as complicated and difficult to understand was described as a pervasive problem in Congress.	• "How do you get an entire system to understand scientific data if they don't understand science? You can't, and you can't require them to understand science." • "I mean, just understanding what science is saying, like charts and tables. If you don't have a background in how these studies are put together, sometimes the nomenclature is difficult to understand, or the margin of error." • A staffer noted that it wasn't just the complicated nature of the science that was difficult, but that policy is also complicated: " …particularly when you're trying to support an already complicated policy with even more complicated science … ."
Inconclusive evidence	This variable included statements that the evidence exists, but is not good enough regarding the problem, decision, or solution, and that this could be due to uncertainty, conflicting findings, or conflicting use of the science.	• "Science at its heart is about uncertainty. Politics at its heart is about certainty. It does not mesh. So, you cannot come to the Hill and say, 'Well, we think that the sea is rising, but we're not sure, and it seems like it's rising here but not there, and it could be some subsidence that's left over from spring-back from the Ice Age … .' Well, what am I supposed to do with that?" • " ... at the staff position it's 'How do I play referee between these two competing studies that seem to contradict each other?' And I don't have the science background to prove one methodology over the other."
Availability/ accessibility	The difficulty in locating scientific information was described as the first challenge that staffers have to surmount.	• "Accessibility, both in a technical sense of just knowing what's out there and being able to read it." • "I think the barrier is that, that if you're coming in with unbiased science, it's frequently done in a way that's not accessible. Other people have figured out how to make the information accessible, but they're doing it from a biased perspective."

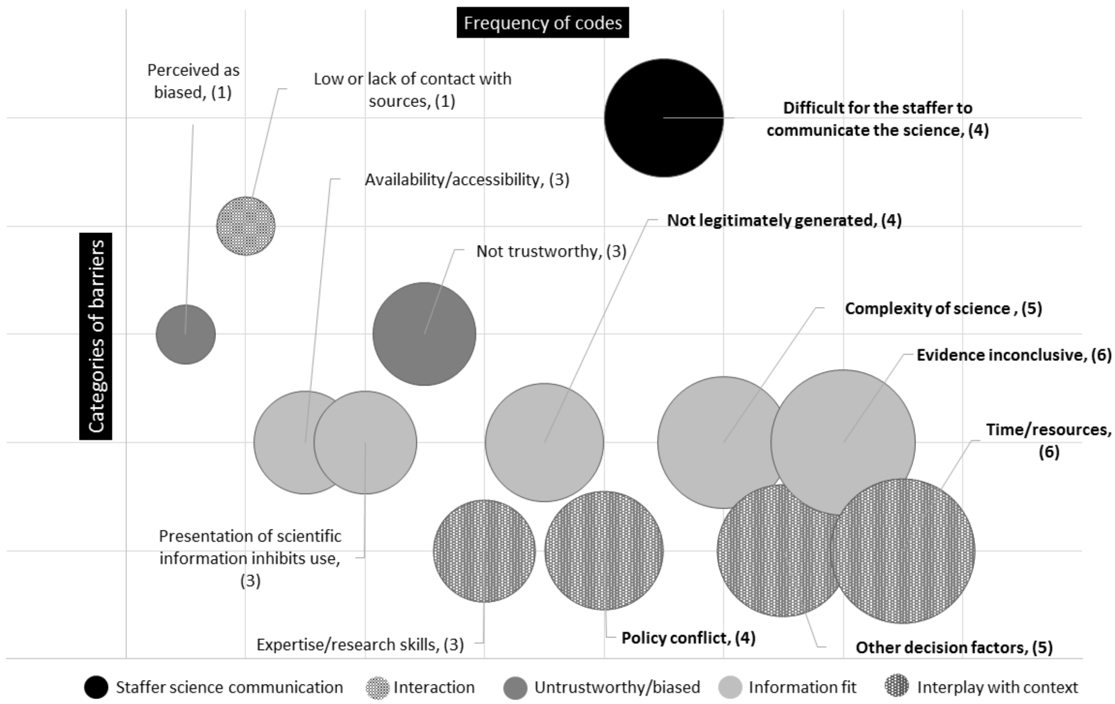


Figure 3. In the context of *strategic use of science for policy*, the most frequently mentioned barriers are those of information fit and interplay, particularly the staffer's lack of time and conclusive evidence. (*n=15*)

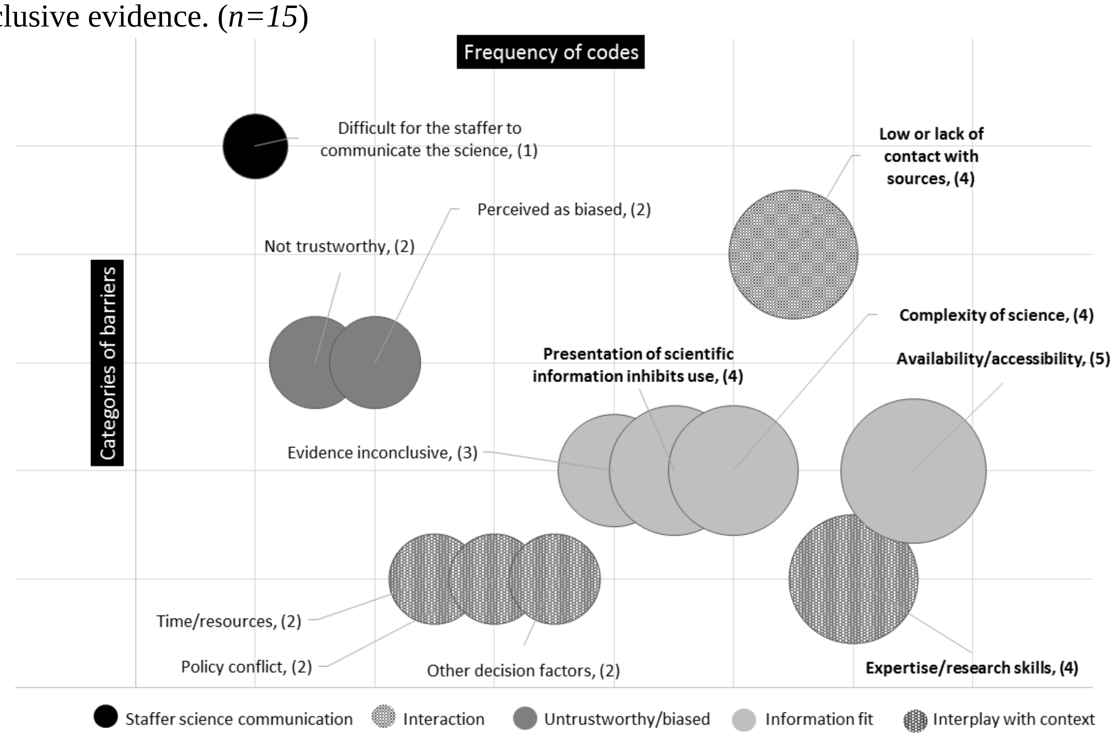
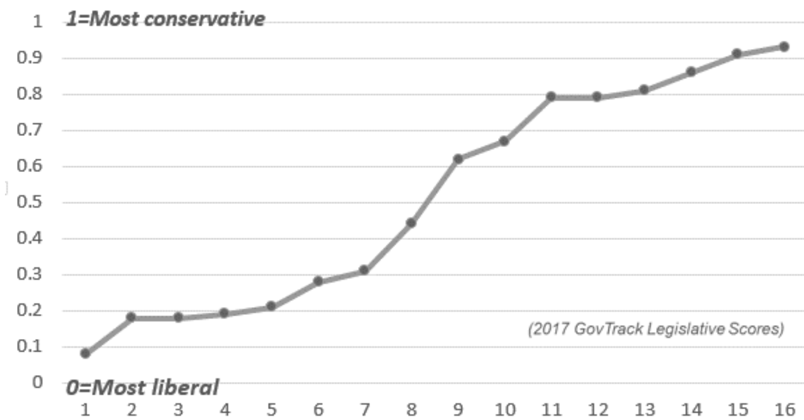


Figure 4. In the context of *substantive use of science for policy*, the most frequently mentioned barriers are again those of information fit and interplay, but also interaction. The focus shifts to the staffer's capacity to locate information. (*n=13*)

Appendices

Appendix A. Office political ideology scores



Appendix B. Codebook for definition of scientific study

Ƙ-alpha	
	1. NSF definition of scientific study
1.0	a. Formulation of theories/test hypothesis
1.0	b. Experiments/control group
1.0	c. Rigorous/systematic comparison
	2. Social dimensions of science
1.0	a. Peer-reviewed
1.0	b. Unbiased
1.0	c. Conducted by scientists/scientific organizations

Appendix C. Codebook for barriers to use of science in policy

Ꮶ-alpha	
	1. Fit *(of information)*
0.84	**a. Availability/accessibility** *(information not available and/or easy to find)* key words=access, find *(but both must relate to locating information)*
0.86	**b. Evidence inconclusive** *(evidence exists, but not good enough regarding the problem, decision, or solution; this may be due to uncertainty, conflicting findings, or conflicting use of the science)*
1.0	**d. Not legitimately generated** *(process of generating the scientific information is suspect, not transparent, not verified, deficient in some way; must refer to the process, not just statements that the science is not trustworthy or suspect)*
0.91	**e. Presentation of scientific information inhibits use** *(not easily used due to writing style, such as jargon and use of data/numbers; format of publication, including the nature of journal articles; and length of information)* Does not refer to staffer difficulties in communicating science.
1	**f. Complexity of science** *(difficult to understand for anyone)* key words = understand, complicated *(but only in correct context)*
	2. Untrustworthy/biased *(information or source)*
0.84	**a. Perceived as biased** *(source perceived as having an agenda)* key word=bias
0.9	**b. Not trustworthy** *(either information itself or the source of information)* key word=trust
	3. Interplay *(of information and context)*
1.0	**a. Time/resources** *(not enough time/resources)* key word=(not enough) time
0.82	**b. Expertise/research skills** *(clear statement that staffer or office does not have enough expertise/research skills)*
0.88	**c. Policy conflict** *(scientific evidence is in conflict with the office policy agenda; "cherry-picking" data to support a position; office policy is already decided and can't be reversed)*
0.85	**d. Other decision factors** *(other forms of information are in conflict, and are equally or more important: non-scientific/non-technological information like observational data, politics, the economy, values, including preferences for market vs. regulatory approaches; these can be explicitly stated or demonstrated in examples)*
	3. Interaction *(between information users and providers)*
0.91	Lack of contact or relationships with scientific information providers *(not knowing who to contact, or "talk to," and lack of established relationships)* key word=relationship
	4. Barriers same
0.82	It must be stated by the respondent that the barriers they discuss in part A and part B are the same or similar. The references may be in response to a direct question or refer back to previous their comments that the barriers are similar, or an acknowledgement that the speaker is repeating themselves.
0.84	***5. Difficult for the staffer to communicate the science***