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Thematic Section  
*Argumentative Processes and Communication Contexts*

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WHEN SCIENCE GOES PUBLIC:  
FROM TECHNICAL ARGUMENTS TO APPEALS  
TO AUTHORITY\*\*

Recent calls for increased public participation in technical decision-making have brought to the fore argumentation between scientists and citizens. In this paper, we examine what happens as arguments travel from the technical to the public sphere. Based on a case study of a U.S. debate over the net energy balance of corn-based ethanol, we show how the evidence-based technical arguments are transformed into appeals to expert authority.

*Keywords:* argumentation, argument from expert opinion, appeal to authority, science communication, public participation.

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Policy-making involving scientific knowledge has become increasingly prominent in both the United States and Europe – in decisions about the location of nuclear waste sites, for example. At the same time, there have been calls for enhanced public participation in this decision-making. Such participation is seen not only as serving the cause of democratization, but also as improving the quality of the scientific knowledge. Collaboration between credentialed experts and ordinary citizens promises to produce a “socially robust knowledge” (Nowotny 2003) or a “public knowledge” (Rehg 2009) which has shown its worth by surviving scrutiny across diverse and demanding settings. As Kutrovátz has noted, “recent scholarship in the public understanding of science” has called “for mutual communication between the needs and opinions of the public and the needs and opinions of scientific experts [...]. These scholars propose that the relationship between science and the public should be placed in a discursive place where both parties are active” (Kutrovátz: 244). Thus communication scholars have been involved in developing “citizens’ juries” or “consensus conferences” to promote interactions across the expert/lay divide.

Such interactions invite attention from argumentation scholars, since discourse between scientists and citizens on contested issues of public policy will almost inevitably involve arguments. Previous studies of such discourse have sometimes focused on “demarcation” – that is, on the arguments scientists use to protect the integrity of science from the intrusion of politics (Gieryn 1983; Lessl 2008). The new emphasis on integrating science with public decision-making, however, invites a new focus. Argumentation scholars will need to examine what happens when scientists leave what Thomas Goodnight (1982) has called the “technical sphere” and enter the “public sphere.” Or to adopt the terminology recently proposed by William Rehg (2009), argumentation scholars will need to explore what happens as arguments “travel” between these contexts. Rehg explains that “if an argument is a good one and addresses a matter of general concern – e.g., a good scientific argument about the natural world – then it would seem to merit acceptance beyond its point of origin: it ought to travel, one might say” (*ibid.*: 40). In this view, a good scientific argument should not only travel to relevantly related fields (as for example, from physics to chemistry), but also from technical to appropriate policy contexts. The fact that lay decision-makers, with inter-

ests and expertise vastly different from that of scientists, can nevertheless understand, assess, and accept a technical argument demonstrates that argument's cogency (what Rehg calls its "public merits"), and thus tends to legitimate both the scientific knowledge and policy decisions the argument supports.

As Rehg recognizes, an argument's travel from technical to policy contexts is not without difficulties (*ibid.*: 55). To contribute to our understanding of how arguments travel, we take up here a case study from a controversy in the United States over whether corn-based ethanol is a sustainable alternative to gasoline. One long-standing issue within the scientific context has been the question of ethanol's "net energy balance": whether the energy we can obtain from the biofuel is greater (all factors considered) than the energy we put in to produce it. Net energy balance is what has been called a "boundary object" (Star & Griesemer 1989): a concept which inhabits both scientific and public contexts. On the one hand, ethanol's energy balance is determined by elaborate calculations requiring expert judgments about which energy costs to include and how to measure them. On the other hand, the concept has a strong intuitive appeal that even non-experts can grasp: the "bounce" or extra energy derived from the plant's absorption of sunlight, which (if true) promises to make biofuel both cost-effective and sustainable.

For this paper, we analyze the discourse from one event where public and scientific contexts came into contact over the issue of ethanol's energy balance. In August, 2005, the National Corn Growers Association (NCGA) sponsored a debate at the National Press Club in Washington, D.C. On one side were arrayed Dr. David Pimentel, an entomologist and the leading spokesman for the view that corn-based ethanol takes more energy to produce than it yields, together with his long-time co-author Dr. Tad Patzek, a petroleum engineer. Speaking in defense of ethanol were Dr. Bruce Dale, a chemical engineer, and Dr. John Sheehan, a biochemical engineer. The one-hour debate was broadcast live over radio and made available for download in digital audio format from the NCGA website (National Corn Growers Association 2005). Each scientist was allowed a five-minute opening statement before taking questions from trade journalists and others physically present or speaking by phone; the event then closed with brief final statements. Our analysis is based on

a transcript made from the debate's digital recording and on copies of presentation slides for three of the four speakers obtained either from the website or from participants themselves (Dale 2005; Patzek 2005; Sheehan 2005).

Although later developments in both the policy and scientific controversies over ethanol have eclipsed this particular debate, and indeed the significance of corn-based ethanol's energy balance generally, the discourse remains significant because it exemplifies what can happen to arguments as they travel across the boundary between scientific and public contexts. In the following discussion, we show how the discourse moved from a focus on the analysis of evidence to a focus on the trustworthiness (or not) of scientists: that is, from a technical argument to an appeal to expert authority. We close with some remarks on the significance of these results.

Consider first this representative passage from Patzek, the scientist who spent the most effort trying to involve his lay audience in the merits of the technical case (for him, against ethanol):

To the right [of the projected slide], you see a very optimistic estimate of biomass energy across the U.S. Over three-quarters of this energy is committed to food and feed production, wood for lumber, paper, and fiber [...]. The green strip at the bottom can produce biomass for energy, but one-half to three-quarters of it would be used to service biofuel production. Therefore, biomass cannot displace the astronomic quantity of fossil fuels we devour every year.

Note how the speaker here invites audience to join him in attending to the data being displayed. He directs them to what they in fact "see," indexing features he expects are evident to him ("to the right [...] the green strip at the bottom") while also explaining what those features mean (the green strip represents "biomass for energy"). Based on their own vision, members of the audience are then in a position to draw the conclusion, signaled by an explicit indicator ("therefore").

Patzek here construes the immediate speech event as an expert/lay collaboration in constructing a *technical argument*. Indeed, both he and other presenters occasionally use the pronoun "we" to mean "you and I, co-investigators," as for example in saying "here we see in red the average mileage of the US passenger car fleet" (Patzek). Of course, within this

collaboration the scientist remains the senior partner; it is he who guides the lay audience's vision and provides the needed interpretation. Occasionally the direction is heavy-handed, as when one scientist says imperatively "Here's the petroleum number. This is the important issue that we need to focus on" (Sheehan). But once the evidence is seen, the conclusion is equally available to all, as is suggested by its impersonal and absolute statement. In such discourse, although the technical argument may be simplified, it appears to preserve its identity as it travels from the scientific to the public context.

This sort of collaborative analysis of evidence is not the only argumentative strategy a scientist can adopt when addressing the public, however. A quite different discourse emerges in Dale's pro-ethanol opening statement:

I hope this is the last debate that we have on ethanol's net energy so we can get on to more realistic and more important discussions. This is the reason I believe that ethanol is now and is going to be in the future an important part of ending our dependence on petroleum. What we need is substitutes for petroleum. We need solutions here. Ethanol is one of the very few real solutions available to us. It gives us about a 700 percent to 2,000 percent return on our petroleum investment, that is for every BTU of oil we invest, we get 7 to 20 BTUs of ethanol out the other end.

The "we" here is not the "we" of scientific co-investigators, looking at evidence in order to draw a conclusion. Instead, this is the "we" of co-citizens in the public sphere, sharing an experience of a problematic situation, seeking "solutions" for it, and undertaking "discussions" to choose these solutions. The speaker, emphasizing his distinctness by repeated "I"s, offers to his audience his own "hope" and his own "reason" (or elsewhere, repeatedly, his own "belief") and at the end asserts his pro-ethanol conclusion, without having shown evidence for it.

The opening statement of another scientist contains an even heavier focus on the speaking "I" and that "I"s opinions. Pimentel, the leading anti-ethanol speaker, begins:

Well, I did want to mention that I was born and brought up on a farm and have dedicated my research and teaching to agriculture and the farmers for the last 40 years. And so I do understand some of the problems

we're facing. Now, we just heard that I did chair an ethanol panel for the Department of Energy, and also...also...and have been involved with [...] and various others [...]. I've been involved with this issue of life-cycle analysis in corn and other crops for umpteen years.

Pimentel here essentially repeats the introduction the moderator had just given him, in an attempt to bolster what in classical rhetoric would be called his ethos. He appears to be trying to legitimate the opinions this "I" can offer to the "we" which is here again spoken of as "facing [...] problems." And indeed, in the rest of his presentation Pimentel does not share evidence, but instead makes strong assertions about what is the case.

Note the differences between these two strategies for addressing lay audiences on scientific issues. Whereas the first strategy, that of technical argument, involves the scientist *showing* the lay audience evidence, this alternative strategy involves the scientist *telling* the lay audience the conclusion. The speakers using this strategy invite the audience not to share attention to evidence and to draw a conclusion, but to trust the speaker and the conclusion he has drawn for his own reasons. Thus when this second strategy is adopted, the technical, evidence-based argument does not travel beyond the scientific context; instead, it is transformed in the public context into a new argument, which we can recognize as an *appeal to expert authority*.

The two strategies can of course be mixed. In the initial passage from Patzek, for example, the "we" of the last sentence hints at his stance not only as a scientist, but also as a fellow citizen. Other speakers mix the two strategies even more thoroughly. For example, contrast the "*tell you* [...] the technical solutions" because "I have spent a good bit of my career looking at" them, with the "*show you* the numbers" in the following passages from Sheehan's presentation:

I have spent a good bit of my career looking at the details of these issues, and I can tell you that the key in looking at these technologies is not just to focus on the problem issues, but to look for the technical solutions that are out there [...]. So let me race through some of these charts to show you the numbers we have developed at USDA and the Department of Energy to look at that energy balance question.

However, overall in this debate, the appeal to authority tends to dominate. This is evident first in the way the scientists frame their disagreement; second, in the questions the audience poses; and lastly, in the scientists' final perspective on the debate.

When they present their own cases, the scientists adopt both the strategy of technical argument and that of appeal to expert authority. But when they speak against their opponent's cases, they often treat each other as having made appeals to authority, and tend to focus more on the opponent than on the opponent's evidence. Consider the following passage from Sheehan:

The differences you see from the most recent numbers from Pimentel and Patzek show that they assume or have assessed much higher energy requirements for both the farm and for the fuel processing or conversion facility, the ethanol plant. I believe those are based [pause] those have problems of methodology, they have problems of the quality of the data, the age of the data that's being used. We need up-to-date information to understand what the ethanol industry looks like today, which when in 1981, Dr. Pimentel may have looked at it as a member of a committee for DOE [the Department of Energy], it looked one way.

Notice here Sheehan's inability to maintain attention to the "numbers" offered by his opponents. After struggling to find the right words, he shifts focus from "those [numbers]" to the "problems of methodology" that brought the wrong numbers about, and finally to the "they" who were implementing the faulty methodology. By the end of the passage, his primary criticism is directed not to his adversary's evidence, but to his adversary himself: Pimentel, he implies, has not kept up with the scientific developments which occurred after his first involvement in the issue a quarter century before.

The contrast being drawn here is between an untrustworthy "they" and the "I" who "believes" on better grounds. Whatever the opposing speaker has actually done, it is being refuted as if it were an appeal to authority, with an attempt to undermine the speaker's personal credibility. The speaker subject to such an attack frequently replies to it by asserting again his own authority. Dale, for example, after noting a gap in his opponent's calculations, details the different results "we've found" when

applying the same methods, and elsewhere replies starkly, “that’s simply not true.”

The four scientists are not alone in construing the entire event as a contest of authorities, as opposed to a contest of evidence. The questions from the audience provide a second indication of the dominance of the appeal to authority in this debate, in that they also focus on the personal failings of the scientists. Consider the very first interaction:

*[Question]* Dr. Sheehan, can you elaborate on how Dr. Pimentel’s analysis of energy costs in producing corn ethanol are flawed?

*[Sheehan]* Yes, as to the flaws in the analysis by Dr. Pimentel and Patzek on, on their, I assume you’re asking on the corn ethanol data in particular. Again, and we have people here from USDA [Department of Agriculture]. I have looked at the data that has been collected by Dr. Hosein Shapouri, an agricultural economist at USDA who has done an outstanding job ... And what we get out of that is what we’ve seen, a savings in energy ...

*[Pimentel]* I object to the statement that we were using old data, we were incomplete. We have complete data in our analysis and it’s well documented and what the USDA, Dr. Shapouri and the others are looking at, they have omitted several different important inputs in the production.

Here, the questioner draws immediate attention to the “flaws” in the scientists’ approach. Sheehan replies rather non-confrontationally, implicitly contrasting his opponent’s analysis with what he has done (“looked at the data”), and bringing in an outside authority whose qualifications are meticulously described. Pimentel also interprets the question clearly and correctly as an attack on his credibility as a scientist, and responds with a counter-accusation.

After a series of additional audience interventions aimed at exposing the “flaws” in the scientists’ efforts, the penultimate question makes another direct attack on personal credibility, aiming this time at Patzek:

I think you have published or co-authored over 100 papers. Could you tell us how many of those were financed by private grants from the petroleum industry and do you feel that had any influence on the results of those papers?

The implication here is clear: the scientist's association with anti-ethanol oil companies biases his claims. The final question from the audience follows up this theme, as another member of the audience asks each of the scientists to reveal their funding sources.

Many in the audience use their speaking turns to try to reveal potential weaknesses, not in the *scientific evidence*, but in the *scientists* arrayed on both sides. This suggests that they construe the event as a contest between competing authorities. By the end of the debate, the scientists themselves seem to agree with that construction. Patzek, who, as we saw above, is the scientist most concerned with accurately presenting a technical argument to a lay audience, by two-thirds of the way through the event encourages his audience to ignore the “numbers being thrown your way,” and just pay attention to his asserted conclusion. In his closing statement, Patzek calls for a more complete separation of scientific and lay discussions. “What I see here from this discussion,” he says, “is that the US needs an independent organization that will coordinate the thinking and planning of a new energy policy [...]. I propose to create such a center at Berkeley, and reach out to the responsible scientists across the world.” Sheehan similarly cautions his audience that “an awful lot of what we’ve heard today is mired in the details of sort of the nuts and bolts of what’s in front of us.” Instead, he avows his personal “passion for what the technology can do,” and reiterates that “studies I have been involved in recently with colleagues [listed] [...] have [...] been able to construct powerful visions for the technologies’ future.” The choice he presents for his audience to make is simple: between the “vision” set out for them by himself and his expert “colleagues,” and that offered by the opposing experts, Pimentel and Patzek.

In sum, we have identified in this debate two distinct strategies that scientists use when they enter the public policy context. First is the strategy of technical argument, in which the speaker ostends evidence, directs the audience’s attention to it, and explains its meaning. Second is the strategy of the appeal to authority, in which the speaker presents his qualifications and asserts his conclusions. As argumentation theorists have long recognized, such appeals to authority are not *per se* fallacious (Walton 1997; van Eemeren & Grootendorst 1992). They are, however, functionally quite different from technical arguments. The appeal to authority

does not invite the lay audience to become co-investigators, nor to draw conclusions based on their own analysis of the evidence. But it does invite the audience's full participation. As we have seen, the appeal to authority is commonly embedded in discourse which construes the immediate situation as one where a "we" – an active public – is facing a serious common problem and deliberating on a solution. The appeal to authority thus maintains a sharp boundary between technical and public contexts. While insisting on the scientist's right to make assertions on scientific matters, the speaker of the appeal to authority as developed in this debate also insists on the lay public's right to make policy decisions.

This observation leads to our second conclusion. From the speech of the scientists themselves, from the audience construal of the event, and from the scientists' own construal, it appears that the strategy of authority dominated in this debate. A full evaluation of the cogency of these appeals in this debate is beyond the scope of this paper. Instead, let us return to return to the question with which we began this paper: the ways that arguments travel across the boundary between scientific and public contexts. In this case, we can conclude, technical arguments did *not* readily travel. But scientists personally, and their conclusions, did travel, and their technical arguments were transformed into appeals to authority.

It could be that the inability of technical arguments to travel in this debate was due to unique circumstances, such as the conspicuously adversarial character of the debate and the tactical rhetorical choices made by the scientists, especially by Pimentel. There are, however, several factors which suggest that our results may be generalizable. The scientists themselves repeatedly emphasize that they turn to authoritative pronouncements because they lack the time to develop a technical argument fully. But time is always a constraint in public contexts; as Collins & Evans (2002) put it, "the speed of science is slower than the speed of politics." The epistemic inequalities in this debate between the scientist-speakers and their lay audience are also typical of the public context; not everyone is an expert, so at some point, the expert must start simplifying, perhaps to the point of bald assertion. Finally, the orientation towards solving immediate practical problems, so evident in this debate, is also characteristic of public contexts generally. Policy-making must proceed, even

in the face of scientific controversy and uncertainty (Pielke 2007), where technical arguments remain unresolved.

Other studies have also found that it is difficult to break down expert/lay role expectations and to encourage collaboration between citizens and scientists as equals in technical policymaking (Kerr et al. 2007; Rayner 2003). If this is the case, then it is unlikely that speech events such as “citizen juries” will work as desired. Instead, the results of this case study suggest that communication scholars should focus on how scientists can maintain their legitimate public authority (Shapin 1995). And if so, argumentation theorists can help by sharpening our understanding of the rational basis of appeals to authority in public contexts.

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