"Scientific Integrity in a Politicized World"[1]

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Abstract: That politics has an influence on science is unavoidable. Political winds shape the amount and emphasis for research funding. Political discussions determine the ethical boundaries for research. When is a political influence a politicization of science? In this paper, I begin by defining scientific integrity, so that it can be both identified when present and defended when threatened. By delving into the roles for values in science (both acceptable and unacceptable), this paper presents a clear, albeit narrow, view of scientific integrity, and shows how common forms of politicization violate scientific integrity. I also argue that defending scientific integrity is not sufficient to prevent all politicization of science—it removes only the most egregious abuses. To address the full range of politicization concerns, we need to consider both the community of science and the reasons why we pursue science.

Introduction

When is a political influence on science a politicization of science? Politicization carries with it the connotation of serious trouble for science, of a dangerous corruption of science's nature and goals.[2] But not every political influence necessitates corruption. For example, the political forces that demanded the scientific community set up guidelines and oversight for human experimentation did not corrupt science (as much as scientists grumble about the resulting Institutional Review Boards). The political attention of

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[2] I will use "politicize" in this paper to mean problematic corruption, as opposed to political influence, which may not be problematic.

Congressional Committees, coverage of the horrors of Nazi doctors, the scandals at US hospitals, and the egregious Tuskegee experiments created external political pressure on scientists, at the same time as scientific leaders (e.g., Dr. H. K. Beecher) inside the scientific community pressed for reform. (McKay 1995) Without the external political pressure, it is doubtful that clear regulations and enforcement mechanisms for the ethical guidance of human subject research would exist.

Or consider the shaping of research funding in any modern state. In conversation with scientists, the state sets funding priorities for research, utilizing initiatives, areas of focus, and increased funding for some projects (with decreased funding for others). It is perfectly within the purview of the state to shape the scientific agenda in this way, creating financial incentives for the kind of work that looks to be most promising of some public or societal benefit. While the extent to which such efforts are successful is debatable, it seems a stretch to call this a politicization of science.

On the other hand, there are clear cases where political forces do politicize science. For the state to silence scientists with whom it disagrees, either through forced imprisonment (as in the Soviet era Lysenko case) or forced editing and gagging (as was charged under the Bush Administration with respect to climate change) is clearly politicization. (UCS 2004) For the state to ensure, through funding structures or harsher political means, that only predetermined results be produced (as opposed to focusing efforts on a particular topic and being open to whatever results are produced), is squarely in the realm of politicization.

In order to sort acceptable political influences from the politicization of science, we need to have some sense of what we want to defend from political forces. In this paper, I will identify one central thing to defend as scientific integrity. As of late, the term "scientific integrity" has been used as an overly broad slogan encompassing everything good in research ethics. If scientific integrity is to have a distinctive meaning above and beyond just "integrity" (as in moral uprightness), we need a narrower view. In this paper, I provide a more precise and narrow account, where scientific integrity consists of proper reasoning processes and handling of evidence essential to doing science. Scientific integrity here consists of a respect for the underlying empirical basis of science, and it is this scientists are often most concerned to protect against transgressions, whether those transgressions arise from external pressures (e.g., politicization) or internal violations (e.g., fabrication of data to further one's scientific career).

In elucidating the nature of scientific integrity, I will describe it as the adequate individual behavior and reasoning necessary to protect what we value about science. Once defined precisely, I will show how it can be defended. But the precise definition comes at some cost, narrowing what falls under the purview of scientific integrity. On my account, not everything about the responsible conduct of research (RCR) has to do with maintaining scientific integrity. The aspects of RCR that do not fall within scientific integrity *per se* arise from two additional bases for the moral responsibilities of scientists: 1) the proper functioning of the scientific community (which is ultimately essential to the production of reliable knowledge), and 2) the (legitimate) demands of the larger society for ethically and socially acceptable behavior from scientists. (Douglas 2013a) These two additional bases for responsible research are no less weighty than scientific integrity. A supportive and critical epistemic community is crucial for enabling individual scientists to be able to produce knowledge as reliable as they do. The demands of fostering that community—such as mentoring students and post-docs properly, doing timely and thorough peer reviews of each other's work, generating the forums which allow for critical discourse, etc.—are essential. Equally as important are the responsibilities scientists have to the broader society, which generate such demands as the ethical treatment of human and animal subjects. (See also De Winter & Kosolosky 2013) Narrowing the scope of scientific integrity is not meant to narrow the scope of scientists' responsibilities.

What do we gain with a narrow definition of scientific integrity? Such a definition will allow us to see how political pressures can threaten scientific integrity, either by putting pressure on scientists to violate integrity or by violating the integrity of scientific work directly (e.g., by changing scientific claims without consulting the scientists that produced the original work). Politicization of science consists in distorting the nature of science for one's political purposes. Once we have defined scientific integrity, it will be clear that damaging scientific integrity is certainly one way to politicize science. However, we will also find that science can be politicized in worrisome ways without threatening scientific integrity *per se*. Politicization concerns, we will see, are larger in scope than the defense of scientific integrity.

The Challenge of Defining Scientific Integrity

As noted above, views of scientific integrity today are frequently overly broad. Within the scientific community, scientific integrity is often equated with all concerns over RCR. For example, *Integrity in Scientific Research*, published in 2002 by the U.S. Institute of Medicine and the National Research Council, is subtitled "Creating an Environment that Promotes Responsible Conduct of Research." (IoM/NRC 2002) The report finds its motivation in cases of scientific fraud, and focuses on finding remedies for and ways to discourage "research misconduct," centered on fabrication, falsification, plagiarism, but also including issues concerning treatment of humans and animals, authorship, mentoring, peer review, collegiality, and conflicts of interest. (ibid., 34-40) It breaks new ground in focusing on the institutional context of misconduct and showing concern for educating developing scientists about misconduct, but its definition of scientific integrity itself lacks cohesiveness (an aspect of integrity). (Steneck 2006, 55) Scientific integrity, equated with all moral concerns, generates a laundry list of responsibilities. What one is trying to protect when protecting integrity becomes diffuse.

Other attempts at definition run into other problems. For example, the recent Singapore Statement on Research Integrity struggles with both circularity and long lists. It signals the importance of integrity in the preamble, which declares "the value and benefits of research are vitally dependent on the integrity of research." (2010) But in the resulting list of fourteen different responsibilities, the first is integrity, explicated like this: "Researchers should take responsibility for the trustworthiness of their research." (ibid.)

There is no further elucidation of what integrity is, nor how the value and benefits of research rest on it. Integrity, i.e., taking responsibility for the trustworthiness of research, is one of fourteen responsibilities that must be met (including adherence to regulations, keeping good research records, performing peer review properly, and reporting irresponsible research practices to the proper authorities) in order to protect the integrity of research. This opaque circularity obscures what scientific integrity is all about, or how we can construe it as an integral whole that we want to protect from political forces.

Discussions of scientific integrity in the political realm have similar problems. While the Obama Administration recently raised concern for protecting scientific integrity, definitions of what was to be protected are frustratingly unclear. One gets the sense that integrity is crucial for trustworthiness, and in order to have integrity, one needs to be trustworthy. While the policies being pursued under the efforts are laudable (e.g., whistleblower protection and freedom of scientists to speak to the press), the policies appear to be guided more by examples of past problems and concerns than a coherent understanding of scientific integrity. (Holdren 2010; Thomas 2012)

Finally, a recent attempt at a precise definition by De Winter and Kosolosky has a different problem. (De Winter & Kosolosky 2013) They define research integrity in terms of deceptiveness, and deceptiveness in terms of saying something false, or saying something from which others could legitimately derive false implications. But this definition demands too much of scientists, as scientists who are honestly mistaken (which would include many famous scientists historically) would then be found to be failing to have scientific integrity.

We need a different approach. I will start my discussion by first examining what we are trying to protect when we defend scientific integrity. To answer this question I begin with why we value science. From there, I argue that we can see which aspects of scientific practice and reasoning are essential for its proper functioning, for the achievement of what we value. We can also see how science can be properly ethically constrained by the society in which it functions. Finally, we can see when the constraints generated by the larger political context damage science by undermining the reason we value science, i.e., we can see when they politicize science.

The Value of Science and Values in Science

Why do we do science? Why is science such an important activity that politicization is a worry? Whether one is interested in science for a capacity to intervene in the world or for the pure joy of understanding, both those interests rest on the ability of science to produce reliable empirical knowledge. It is this ability that is at the heart of why we value science. Science manages this production of reliable empirical knowledge by being an iterative, ampliative process of developing explanations (including explanatory theories and models), using those explanations to produce further predictions/implications, and testing those predictions empirically. (Douglas 2009a) In light of the evidence produced by such tests, the explanations are refined, altered, or utilized further.

This iterative and ampliative process produces an ever-developing body of empirical knowledge, but one that is also endemically uncertain. We can never be completely sure our explanations or theories are correct, because we might encounter evidence as yet ungathered which will fundamentally challenge current views, including views on what it means to gather reliable evidence (e.g., what a method can and cannot accomplish). But this ability of new evidence and experience to overturn currently held belief makes science both exciting for the practitioner and robust for the user. Because any particular part of science can be held open to challenge, we can have *prima facie* confidence that it is the best we can currently do and that science provides our most reliable empirical knowledge available. It is *because* science is uncertain that it is robust; because it is empirical that it is reliable.

If this value of science is to be protected, evidence must be able to challenge currently held views. This requirement creates certain demands for the structure of how other values (whether ethical, social, political, or cognitive) can play a role in science.

Depending on where one is in the scientific process, values have different legitimate roles they can play, with legitimacy determined by the need to protect the value *of* science.

Consider the following two roles values can play in our reasoning: *direct* and *indirect*. In the *direct role*, values are a reason in themselves for our decisions. (Douglas 2009b, chap. 5) They evaluate our options and tell us which we should choose. For example, if I select a particular food because I value its health benefits, the value is playing a direct role in my choice. In the *indirect role*, values instead serve to assess the sufficiency of evidence for our choices. Values here evaluate whether we think the uncertainties concerning our choices are acceptable, by assessing the consequences of error rather than by assessing the choices themselves. For example, if I do not accept the claim that I need yearly mammograms between the ages of 40 and 50 because I do not think the currently available evidence is strong enough to support the claim, particularly given the known risk of cancer generated by the radiation needed to do the mammogram and the value I place on avoiding that risk, that is an indirect role for values in the judgment. If the evidence became stronger, I would reevaluate and change my mind accordingly. The value serves only to assess the acceptability of uncertainty, staying in the indirect role. If values served in the direct role (if, for example, I avoided x-rays at all costs) no amount of evidence of the benefits of mammograms would be sufficient to persuade me to get one.

An *indirect* role for all kinds of values (political, social, ethical, cognitive) is needed and acceptable throughout the scientific process. Science is thus a value-saturated process. The *direct* role, on the other hand, must be excluded at certain, crucial points, but is allowable at others. For example, a direct role for values is perfectly acceptable when a scientist is deciding which research projects to pursue. Perhaps the scientist has a personal interest in a particular species, or cares deeply about the geology of a particular location, or has a strong fascination in a particular chemical process. The value the scientist holds (whether ethically, socially, or cognitively based) is fine to drive the scientist to work in that area, to direct the scientist's attention and choices.

At other points, a direct role for value judgments would be deeply problematic and unacceptable. Consider the direct role in the following case: a scientist, in studying a particular ecosystem, really wants the ecosystem to show particular signs of health. Although not detecting these signs empirically, the desire for them to be there is so strong, the scientist begins to manufacture their presence, either by fudging the data or deluding him/herself into thinking they are there. Here, the same values so laudable in the choice of research project are damaging to the conduct of the research, undermining (indeed demolishing) the value of the science produced. If the values here serve as reasons in themselves for the decisions of the scientist, in the production, collection, characterization, and interpretation of the evidence, then the very value of the scientific enterprise is grievously damaged. We should have no confidence in the empirical basis of the scientist's claims, for there is no actual empirical basis. The values have replaced it, serving where evidential considerations should. It is for this reason that values, at the heart of the scientific process, should only serve an indirect role, *i.e.*, of helping to assess whether the gathered evidence is strong enough for a claim. Without this crucial constraint on the roles values can play, the value of science is lost.

Such a constraint is crucial at other points in the scientific process as well. For example, the decision of which methodologies to employ for a particular project require careful utilization of values. Values in a direct role can legitimately keep certain methodological options off the table. Because of our ethical values, we demand that scientists respect human autonomy and that human subjects for research projects be informed volunteers who freely agree to participate. We could surely learn many things if we relaxed this restriction, e.g., keeping people in controlled environments while they grew from infants into adulthood to examine the effects of the environment on development. But such experiments would be ethically abhorrent, and so the value of knowledge pales next to our ethical valuation of the methods that would be required. We find other ways, perhaps less methodologically robust, to study the impact of the environment on human development.

But the utilization of values in a direct role for methodological choice is not always legitimate. For example, if one wants a certain result, one can often rig the methodology to produce that result. One can, if one is testing the estrogenic action of a chemical, use an animal model that is estrogen insensitive to ensure negative results. (Wilholt 2009) If one picks a methodology to ensure a certain result, however, one is undermining the reason we value science—that is to allow evidence to speak to us about the way the world is, not the way we might wish it were. The value of a particular desired outcome should not cause the scientist to structure the research so that the particular outcome is assured. Such a direct role for values undermines the reason we value science, and is thus an illegitimate use of values in science, violating scientific integrity. It is, in a sense, another way to fudge the data.

The complex nature of values in methodological choices is thus unavoidable. A direct role for values that keeps scientists from performing ethically unacceptable research is both acceptable and laudable. Even if this is felt as an outside intervention on science, it is not a pernicious politicization, but instead an acceptable political influence on science. On the other hand, a direct role for values in methodological choice that generates a desired predetermined result does represent a violation of scientific integrity, for it clearly undermines the reason we value science. Every scientific study worth its name should have the possibility of producing surprising or challenging results, not merely the outcome that the scientist (or the funder) desires. It is in light of these considerations that the role of values, and the values themselves, in methodological choices should be assessed.

Schematically then, the following terrain can be laid out. Depending on where one is in the scientific process, different roles for values are acceptable or not. When deciding which research to pursue, a direct role of values is fine (although we might want to contest the values involved or the particular choices made). (*E.g.*, Reiss and Kitcher 2009) Once the scientist has moved on to the particular methodologies to be employed in the study, care must be taken that a direct role for values that undermines the value of science is not employed, even if some direct role for values (restricting the scientist to the conduct of ethical research practices only) is acceptable. When the research has begun, and data must be collected, characterized, and interpreted, an indirect role for values is the only acceptable role. A direct role for values here would undermine the reason we value science. Finally, once the research is complete, the data interpreted, and the findings made clear, how the scientist chooses to disseminate or utilize the research can be subject to a direct role for values again. Whether to conduct further research, apply the research in certain ways, or even withhold certain details—because making them public could be seriously harmful for a species, in the case of endangered but hunted species research, or for humanity as a whole, as was debated in the recent H5N1 case—all fall within the purview of a direct role for values. However, as with the methodological choices above, a direct role should not be used to undercut the value of science, by, e.g., withholding unwelcome results. A respect for the value of science, and the nature of the other values, are the crucial issues.

One might object at this point that I have made careful distinctions among the places and roles for values, but not among the kinds of values. The value-free ideal has held, in contrast to the view articulated here, that some values, namely epistemic and cognitive values, are fine throughout the scientific process, particularly at the heart of doing science, and that all other values should be excluded from scientific reasoning. (See, *e.g.* McMullin 1982, Lacey 1999) I disagree for several reasons.

First, the traditional characterization of epistemic/cognitive values is unrefined. Some of the so-called "values" are more minimum criteria for good scientific work, and as such, can serve as a direct reasons for accepting or rejecting scientific theories. (Laudan 2004) The "values" of empirical adequacy and internal consistency are better understood as minimal floors, below which a theory or explanation should not fall, and a failure to meet those demands is a good reason to reject a theory. Other cognitive values, such as simplicity, scope, explanatory power, and predictive power, have suffered from a conflation of two important senses, in that what instantiates them is crucially different, and the value of the cognitive value shifts accordingly. (Douglas 2013b) The two different senses are: 1) the value applies to the theory in relationship to the evidence which supports it, and 2) the value applies to the theory on its own. If we are considering the value instantiated in the first sense, where we are considering a theory that is simple with respect to the complex evidence it explains, or that predicts a wide array of evidence, or that explains a broad scope of evidence, etc., then that sense of the value does not fall under my discussion above. Indeed, this sense of value helps us to assess how much uncertainty we think is present in making a claim based on evidence, and thus does come conceptually prior to the indirect role for values described above.

But if we are considering the value instantiated in the second sense, that we have a theory that just appears simple and elegant (irrespective of the evidence that might support it) or that seems to have broad scope in that it might cover a wide swath of phenomena (but whether it actually explains the evidence in that broad swath is as yet undetermined), the account I give above does emphatically apply. This sense of cognitive value, which is the more usual one articulated in the literature (*e.g.*, Kuhn 1977, McMullin 1982) and which is the usual place for philosophers of science to note how they all "pull against each other" has no *epistemic* merit—it tells us nothing about how uncertain we should be or how reliable our inference likely is. It is more of a cognitively pragmatic consideration, that theories or explanations which instantiate these values are easier to work with and thus more likely fruitful. Because of the lack of epistemic bearing, such values should be constrained to the indirect role only at the heart of reasoning. We should use them to assess the acceptability of uncertainty in the following way: if we think the evidence moderate for a claim, and the claim instantiates one of these values in this second sense, we should then utilize this aspect of the claim (that it is simple and thus easy to work with, that it has broad potential scope and thus many potential areas for application and test, etc.) to develop tests quickly and thus either improve the evidential basis or show the flaws of the view. The values in this sense serve as a hedge against uncertainty, and thus might be a reason to find the uncertainty acceptable in the short term, but only if scientists actively utilize the valued aspect of the theory to reduce uncertainty through further development. Social and ethical values can trade against cognitive values in this indirect role. It would be acceptable for some scientists to find the social consequences of error too high and to reject a theory until the evidential basis is strengthened, while other scientists accept the theory because of its cognitive attributes and use them for further testing. In short, a more careful examination of the traditional epistemic/cognitive values reveals important texture with implications for their role in scientific reasoning. The value-free ideal glosses over this texture, and thus allows cognitive values (particularly in the second sense) to play an improper direct role in scientific reasoning.

This is not the only reason I object to the value-free ideal. I also object to it because it ignores scientists' basic general responsibility to carefully consider inductive risk and the consequences of error in their work. But delving into this objection takes us too far afield, and it is developed thoroughly elsewhere. (Douglas 2009b, chap. 4) With the value-free ideal set aside, the distinction between direct and indirect roles can articulate the proper functioning of values throughout the scientific process.

This view of values *in* science, developed in light of the value *of* science, can now provide us with a clear definition of scientific integrity. First, as described here, scientific integrity is a quality of individual scientists, their reasoning, and particular pieces of scientific work. Thus, a person, a paper, a report can all be said to have scientific integrity. The crucial requirement for scientific integrity is *the maintenance of the proper roles for values in science*. Most centrally, an indirect role only for values in science is demanded for the internal reasoning of science. When deciding how to characterize evidence, how to analyze data, and how to interpret results, values should never play a direct role, but an indirect role only. This keeps values from being reasons in themselves for choices when interpreting data and results. In addition, values should not direct methodological choices to pre-determined outcomes, nor should they direct dissemination choices to cherry-pick results. This restriction on the role of values, to the indirect role only at these crucial locations in the scientific process, is necessary to protect the value of science itself, given the reason we do science is to gain reliable empirical knowledge. We do science to discover things about the world, not to win arguments. Protecting scientific integrity as so defined thus protects the value of science.

With this definition of scientific integrity, it is clear that many of the classic concerns over scientific integrity in RCR fall under this definition. For example, data fabrication and falsification is the manufacturing of evidence because of a value playing an improper direct role. The scientist wants certain results, and rather than gather actual evidence, makes it up. The value of presenting certain results overrides the value of science, and serves in the direct role for the recording of data. Other ways to violate integrity include cherry-picking evidence when drawing conclusions, ignoring known criticisms, and ensuring that the methods used will produce the desired results. All of these violations involve a value (the value of getting a certain result, usually because of other strong value commitments) playing an improper direct role in the scientific process. Violations of integrity are clear reasons to dismiss the work of a scientist; a scientist that lacks integrity should have no epistemic authority whatsoever. But, conversely, the presence of integrity does not require that we accept the work as reliable. One can still disagree with science or scientists that have integrity; integrity is necessary but not sufficient for reliability.

Although many core concerns are captured by this definition of scientific integrity, other aspects of RCR are not. Plagiarism, for example, is less a violation of scientific integrity, as defined here, than a violation of the norms of assigning credit within the scientific community. As such, it is a violation of a scientist's responsibility to the epistemic community of science and a very serious matter. But it is not a violation of scientific integrity on the narrow view given here, as it does not harm the epistemic content of science. And, as noted above, the proper ethical treatment of human and animal subjects arises from the requirements of the broader society in which science functions, rather than a requirement of scientific integrity. Neither of these serious violations of ethical conduct harm directly the epistemic content of science. Maintaining scientific integrity is but one of the responsibilities of scientists, and is insufficient on its own for RCR. But having this precise and narrow view of scientific integrity can help us see more clearly what should count as politicization.

Politicization of Science as a Violation of Scientific Integrity

What does this view of scientific integrity mean for our understanding of the politicization of science? Clearly, political forces could cause a scientist, either voluntarily or through coercion, to violate the proper roles for values in science and thus violate scientific integrity. Examples of this include scientists pressured to (or for their own political purposes deciding to) fabricate evidence, cherry-pick evidence, distort results, or stick to a claim even when known criticisms which fatally undermine the claim remain unaddressed. The main intellectual fault in all these cases is failing to be responsive to genuine empirical concerns, because doing so would make one's political point weaker or undermine a cherished ideological perspective. It is to utilize a direct role for values and have that determine one's results. It is to use the *prima facie* reliability and authority of science, which rests on its robust critical practices and evidential bases, and to throw away a concern for the source of science's reliability in favor of the mere veneer of authority. It is to turn science into a sham. No wonder scientists get so upset when violations of scientific integrity occur.

One might worry that it is too difficult to detect this sort of politicization, as it rests on assessing the role of values in reasoning. Can we assess how someone else's reasoning works? Many cases of data falsification have been found looking at published work. (Goodstein 2010) Other violations of scientific integrity can be found as well in published or public work. To find such violations, we should examine patterns of arguments. For example, a failure to respond to criticisms raised repeatedly and pointedly is a clear indication of a problem. If a scientist, or a political leader using science, insists on making a point based on evidence even when clear criticisms undermining their use of that evidence have been raised, and they fail to respond to those criticisms, one is warranted in suspecting that the cherry-picked evidence is but a smokescreen for a deeply held value commitment serving an improper direct role, and that ultimately, the evidence is irrelevant.

Violations can also be detected in overt or covert interference with the activities of scientists. The rewriting of science advisory or summary documents so that unwelcome findings are buried and desired findings are generated is another clear, detectable way in which political forces can interfere with scientific integrity. Here, another actor's values run roughshod, in an improper direct role, over evidential considerations. Political actors may not like the results produced by scientists, but their response should not be to declare them by fiat to be otherwise. Instead, politicians can legitimately question whether the evidence is sufficient to support certain policies, whether other policy options might be preferable, or whether value commitments should demand contrary courses of action. One need not accept every piece of scientific work or every report as definitive. But to attempt to alter such findings so that they do support one's preferred political interests is to politicize science by violating scientific integrity.

Defending science from such attempts at politicization requires the kinds of institutional reforms now proceeding as a result of the Holdren Memo. (Thomas 2012) Political officials need to know that interfering with scientific reports is unacceptable politicization of science, and that it creates the same kind of damage to scientific integrity as scientists fabricating evidence. Institutional sanctions should be equally severe in both cases. In addition, scientists need to know that they can freely discuss their work and the actual content of it with both other scientists and the general public. Such discussions create the conditions for assessing expertise, its integrity, and its evidential basis.

In general, it would help if the value of science to society, to provide robust empirical knowledge, even if uncertain and changeable, were broadly accepted and understood. It is crucial to keep in mind: 1) that science generally provides the most reliable knowledge available, but also 2) that any given claim may prove mistaken and 3) that values are needed throughout science in the indirect role, to assess whether the evidence is sufficient. Understanding this puts a burden on public officials: if you want to ignore a piece of science, you should say why—what do you think is wrong with it or why it is not relevant to policy. If you want to use a piece of science, you should also say why—why is the study strong enough, what value considerations shape that assessment and the subsequent policy choices. If it were more broadly understood what the value of science is, and what the nature of science is, perhaps it would be harder for science to be successfully politicized, as the demands for public discourse would shift accordingly.

Politicization Beyond Scientific Integrity

With this narrow and clear definition of scientific integrity, we can identify politicization which violates scientific integrity. Is this the only way in which science can be politicized? If we maintain scientific integrity perfectly, are all attempts at politicization, of worrisome political influences on science, thwarted? I think the unfortunate answer is no. While many of the most blatant and disturbing efforts at the politicization of science have been targeted at scientific integrity, there are other ways to politicize science that do not strike at scientific integrity.

Consider the fact that a direct role for values is acceptable in the direction of research efforts and the selection and funding of research projects. Because of this fact, political forces could decide that rather than funding bogus research that is gerrymandered to produce desired results (a clear violation of scientific integrity), it would be better for political reasons to simply not fund any research on certain topics, thus discouraging research from being done. Such distortion need not occur through interference with funding agencies. Through the rubric of intellectual property rights, some research can be effectively quashed even if scientists have the needed funds. Biddle (2014) has raised concerns over GMO research in this regard. Restricting research through licensing agreements does not violate the narrow sense of scientific integrity defined in this paper, but it clearly does seem a politicization of science. Political forces can distort which science can and cannot be done.

In order to protect against this kind of politicization, through legitimate roles for values in science, a broader perspective on values in science and the proper functioning of the scientific community is needed. One issue is not just the roles values play but whether the values themselves are acceptable or defensible. In addition, one needs to assess whether a sufficiently diverse range of scientists (to ensure adequate criticisms of each other's work are being raised) are working on a range of projects that do not just serve a narrow set of interests. If power and money draw the efforts of scientists into a narrow range of projects (as seems to have happened in biomedical research, see Reiss and Kitcher 2009), society will not be well served. Even if the science being done is performed with perfect integrity, the results may be distorted and politicized simply because they are the only results available. This is a much harder problem to track and assess, and has not been the main area of concern with the politicization of science. But I suspect it will become a key area of debate in the coming decades.

Conclusion

By focusing on why we value science, I have provided a clear and coherent definition of scientific integrity. That definition of integrity is to maintain the proper roles for values in scientific reasoning. Values play an important role throughout science, but must be constrained to particular roles at key points in the process. Violations of integrity allow values to displace the importance of evidence in science, thus undermining the value of science. While this definition of integrity no longer encompasses all of the responsible conduct of research, it is sufficiently precise that we can see how science can be politicized through violations of scientific integrity.

With this clarity, we can see both how to detect politicization that violates integrity and how to discourage such politicization. But violating scientific integrity is not the only way to politicize science. One can politicize science at a broader level, by distorting which science is done, so that politically unwelcome projects are never begun. Both how to detect such politicization and what should count as such politicization, given the legitimate interests of society in shaping research efforts, must await further discussion and debate.

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