

Author's Commentary on "Vote Early and Often"

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The basic issue addressed in this case is the integrity of the researcher: Under what conditions does changing a *model* violate that integrity? The case also touches on the conflict that sometimes arises between the client's wishes and the engineer's responsibility to the first canon of the Engineering Code of Ethics. ("[H]old paramount. . . the welfare of the public").

Most scientists and engineers recognize that fabricating data is clearly dishonest, and they rarely encounter clients who ask them to falsify or modify data outright. When they are confronted with such a client, they generally recognize the ethical issues involved and make choices with knowledge of right and wrong.

However, in a world where models are used to represent and predict reality, the line between what is right and what is wrong can be more blurred. It may not always be clear that one model is superior to another one, or that a particular model does not represent reality. Of course, it would be nice to verify all models by experimental results, but that may not always be possible.

Models are a scientist's best attempt at representing or predicting reality. They are only as good as the data that is fed into them and the assumptions used to create them. They are also only as good as the motives and purposes of the researchers creating them.

Is it wrong to change a model? It depends. If the purpose in changing the parameters or operation of a model is to better reflect reality, then it seems clear that there is no dilemma. However, it is a different matter if the purpose is to mold the model to predict a pre-determined conclusion.

It is bad science to create or modify a model or process specifically to predict a desired conclusion. That violates the integrity of the scientific process, which allows evidence or experiments to point scientists to truth, and ultimately violates the

integrity of the researcher making the changes. Imagine a world in which all researchers followed such practices. No one would ever be able to trust models' predictions.

Even after noting the potential practice of bad science, it changing the model still may be justified. A question that goes unanswered in the text of this case is what the true purpose of the model is. Is it to predict the location with the greatest need? Is it to predict the location with the lowest building and operating cost? Clearly, models for those two purposes could result in different predictions. Much of the time, both purposes cannot be served simultaneously; the modeler must decide which purpose is more important and how much so. Is the purpose of the model to predict the *best* location? If so, who defines what "best" means? That is something that needs to be worked out by the researcher and client. Once the definition of "best" has been determined, the researcher should have some flexibility to work within that definition.

A second issue that arises in the case is the potential conflict between the engineering code of ethics and the client's wishes. A code of ethics that is bent or broken at will based on the client's wishes is not much use as a code of ethics.

However, Landers should still be careful about interpreting the first canon too liberally. If she has traditional liberal leanings, she may want to locate the transit station in the poorer community with the most need for it, regardless of the cost. She should not let her research results be biased by personal views, however. Does this option best serve the welfare of the public? Who defines the public? What is the "welfare" of the public in this situation? Adherence to the code is important, but there are many cases where its application may not be clear-cut.

Potential future projects or grants should never influence one to make a wrong decision over a right decision. A good test may be to examine the potential decisions given that there are no future grants or money-making opportunities to hazard, and see whether a decision still seems like a viable option. Of course, given two "equally ethical" possibilities, future projects may be one factor among others to use in making a decision.

Certainly as a researcher, even one involved in seemingly innocuous activities like mathematical modeling, Landers bears responsibility for the outcome of her recommendations. All scientists, engineers, mathematicians, etc., should consider

what potential benefits or harm their research can produce. Holding "paramount" the safety and welfare of the public should always be a consideration, as well as practicing "good science."

As Landers makes her decision, she should keep several things in mind. She should attempt to practice good science. In this case, that can be interpreted to mean not changing a process to arrive at a pre-determined conclusion. She should also consider the welfare of the public. However, this ambiguous term does not always have clear interpretations. Probably meeting with the mayor would yield more insight into the purpose of the model and how the public can best be served. Once she has determined the best model (and the corresponding location of a transit facility), she should not be swayed by such influences such as money for the department.

As a guide in making her decision, she can continue to ask herself, "Would I want to live in a world where everyone made decisions based on these principles?" Just imagine - if everyone in a community believed in both practicing good science and "holding paramount" the welfare of the public, wouldn't we all want to live there?