Political Science and Beyond: Presidential Address to the American Political Science Association

Robert Axelrod

This is the Presidential Address delivered at the American Political Science Association Annual Meeting, Chicago, IL, August 30 to September 2, 2007. The theme is that the discipline of political science has benefited from imports from many other fields, but it also has a lot to offer in the way of exports to other fields. A personal example is the export of cooperation theory to cancer research. The main recommendation is to cultivate your curiosity by: reading up in a variety of fields so your mind will be well prepared, teaming up with others who can help you, loading up on research related to your problem, and lightening up when you need to escape from the problem for a while. Promising opportunities exist for political science to export to public health, cognitive and neuropsychology, and the design of web-based institutions.

I'd like to talk about one of my favorite subjects, interdisciplinary research. It's especially appropriate at this Annual Meeting whose theme is also "Political Science and Beyond." In fact, more than 300 participants at this meeting are from "beyond" political science, and they come from more than 30 different disciplines.

As you know, political scientists have a long and honorable tradition of *importing* ideas from other disciplines such as psychology, history, sociology, and economics. But historically, political science has not done as much *exporting* as we have importing. What I'd like to suggest today is that political scientists have a lot to offer many disciplines—that is to say, we have a lot worth exporting.

By "interdisciplinary research" I mean "a mode of research . . . that integrates information. . . techniques, perspectives, concepts and/or theory from two or more disciplines or bodies of organized or specialized knowledge."[1]

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Today, I'm going to focus on interdisciplinary research from the perspective of the individual. Of course, the institutional arrangements also matter a good deal. To explore institutional possibilities, I initiated an APSA Task Force to identify best practices in support of interdisciplinary teaching as well as research. The Task Force under the chairmanship of John Aldrich is presenting its preliminary results at a number of the theme panels at this annual meeting.[2]

Here's an outline of my talk. First, I'm going to tell you a few stories about importing and exporting. Then I'm going to offer some advice for anyone who is thinking of doing interdisciplinary research, and finally I'm going to tell you what I see as some opportunities to contribute to other disciplines by exporting some of the concepts and knowledge that political science has to offer.

Imports and Exports

Let me begin with my favorite story about *imports.*[3] It starts with Darwin who describes how he imported a key insight from Malthus, who was a political economist. Darwin had spent years collecting his data. Then, as he wrote in his autobiography,

> fifteen months after I had begun my systematic enquiry, I happened to read for amusement Malthus on *Population* and being well prepared to appreciate the struggle for existence which goes on everywhere . . . it at once struck me that under these circumstances favorable variations would tend to be preserved, and unfavorable ones to be destroyed. The result of this would be the formation of a new species. Here, then, I had at last got a theory by which to work.[4]

DOI: 10.1017/S153759270808002X

The really neat thing is that twenty years later, another political economist, namely Marx, imported Darwin's conception of struggle back into political economy. As Marx wrote in a letter to a colleague, "Darwin's book is very important and serves me as the basis in natural sciences for the class struggle in history."[5]

For a more recent example, this time of a political scientist importing from another discipline, I asked Bob Putnam how he came upon the concept of "social capital." Bob said he got it from sociology. He had never even heard of the term or the ideas behind it, until late one night in 1991 when he was finishing up his book on *Making Democracy Work.* He had been puzzling in vain for weeks over how to pull together the empirical threads of his Italy study, trying to write a book that would be interesting to social scientists who were uninterested in Italian local government. He reports that he happened to wander over to the library and noticed a new book called *Foundations of Social Theory* by Jim Coleman lying on the table. He idly leafed through it, noted a chapter on social capital, and sat down to read it. Bob says that his mind had been "prepared" by his interest in repeated games, and he saw pretty quickly that social networks could produce something directly analogous to the "shadow of the future." He says that like all insights, once he got it, it was terribly obvious.

As you see, Darwin, Marx, and Putnam all contributed to their own fields by importing from another field.

Another form of interdisciplinary research involves exporting. Had Malthus seen that his work was relevant to biological evolution, and published in biology journals, Malthus would have been exporting, rather than Darwin importing. Likewise if Darwin had written about biology's applicability to class struggle, he would have been exporting, rather than Marx importing. Importing, especially from the other social sciences, has clearly been extremely important for the advancement of political science. In Putnam's case he followed his importing of the concept social capital with a great deal of exporting. My argument today is that exporting can also be a productive way to do interdisciplinary research.

An Export to Cancer Research

Let me give you a personal example. Two years ago, after I had long since gotten weary of seeing the potential for cooperation everywhere I looked, I visited a colleague named Stephanie Forrest who is a computer scientist at the University of New Mexico. We caught up with each other, and talked about common interests, such as protecting people's privacy.

As an aside, she asked if I would be interested in seeing a computer simulation of tumor growth that she was working on. A student of hers had developed a very nice three dimensional visual display so that you could see how a tumor mass developed over time as cells divided and mutated. It was fascinating to watch the simulated blood vessels being recruited by the tumor cells to grow in their direction. As the blood vessels grew closer, the tumor cells were able to get more than their fair share of the oxygen and nutrients that all cells need to grow and divide.[6]

Having worked on computer simulations of human societies, I saw what a wonderful toy Steph had. I asked what assumptions were built into the simulation, and she told me it was based on a widely cited paper on the "Hallmarks of Cancer."[7]

When I went home I took a look at the paper. I was clearly in *way* over my head. But I did get the general idea, which is that cancer results from an accumulation of mutations in a single cell line.[8] These mutant cells achieve new capabilities, until eventually one cell type is able to reproduce completely out of control.

From my experience with the study of cooperation, I had the feeling that it didn't have to be that way. I couldn't articulate what it was, but I was curious to see if there might be some fruitful analogy to be made. Playing around with it for a few weeks gave me a sense of what the analogy might be.[9] It goes like this: Any multi-cellular organism—such as ourselves—is a bit like a society in which the various parts work pretty well with each other. But in any society, there are liable to be some anti-social types who steal rather than work for an honest living. In our society, we have several ways to protect against these robbers, such as alarms and locks. My thought was that cancer might operate like a gang of robbers that overcomes the various defenses society erects to protect itself.

Although I couldn't articulate it at the time, I had some vague idea that if different lines of tumor cells could overcome different defenses, they might be able to cooperate to overcome all those defenses together even though none of them would overcome *all* of the defenses on its own. It's like saying a pair of robbers can specialize: one knows how to disable the alarm, and the other knows how to break the locks. If the two robbers work together neither has to overcome all the defenses alone. The idea was that no single tumor cell line had to be able to overcome all the body's defenses either. Perhaps this is what accounts for how hard tumors are to control, and might even suggest a new approach to cancer therapy.

My brother Dave happens to be a cancer researcher. We have a longstanding joke about whether I could cure war before he cured cancer. Putting this sibling rivalry aside, the next time I saw Dave I tried out my nebulous idea.[10] Dave didn't laugh at me. And I'm grateful for that. Instead, he said my idea was not totally crazy. He then took the time to search the literature, and found that nobody had looked at cancer quite that way before.

With that encouragement, and with Dave's help, I decided to learn some of the basics about cancer, and the specialized language that cancer researchers use.[11] I found

that most cancer research is focused on the precise role of hundreds, if not thousands, of specific kinds of molecules. But as the details accumulate, some researchers are starting to express a real need for some additional organizing principles that could help make sense out of the details. Perhaps Dave and I could make some progress at that level. And perhaps I could export a little social science to medicine.

Since Dave was pretty busy, I approached an oncologist at my own university, Dr. Kenneth Pienta, someone I'd heard was receptive to new theoretical approaches to cancer. Like Dave, he didn't laugh when I told him my idea about cooperation among tumor cells.

It didn't take Ken long to understand that game theory could be applied at the cellular level. The idea is that when a cell produces diffusible products for its own needs, it automatically helps nearby cells as well. So if two different cell types can each overcome different defenses in each other's neighborhood, they might *both* be able to propagate faster than cells that don't cooperate. For example, one cell type might be able to overcome the control on how much blood is supplied to the neighborhood, and a nearby cell type might be able to elicit more than the normal amounts of a specific growth factor. In that case, both cell types could propagate faster than either could alone.

We still had to work out the specifics of cooperation among tumor cells. Our task got a lot easier once we realized that when a tumor cell protects itself by making some diffusible product, it not only necessarily helps the nearby cells, but it does so at no cost to itself. In other words, cooperation among tumor cells could result simply from each cell type doing what is best for itself. So we didn't have to worry about strategies or reciprocity or anything like that. In fact, the situation was about as conducive to cooperation as you can get: each cell just has to do what works for itself. In game theory terms, the interaction is not a Prisoner's Dilemma, but is simply bi-product mutualism.

So far, so good. But could the three of us refine our ideas enough to make them meaningful and perhaps even useful to others? After a lot of hard work, we were able to show that the cooperation hypothesis is consistent with known facts about cancer, it helps explain things that hadn't been understood before, and it suggest predictions that could be tested. We also showed that our approach had potential relevance to cancer therapy by suggesting the possibility of interrupting the cooperation between tumor cells.

We showed our paper to a few other cancer researchers and got very positive feedback. They said in effect, "Hey, it's obvious *after* you say it." But when we submitted it for publication, we got a flat rejection. I've gotten my share of rejections, but every time it seems like a kick in the stomach. In this case, one of the reviewers said everyone knew this already, and the other reviewer said it was absolutely impossible.

Well, after we picked ourselves up off the floor, we revised the paper to make clear exactly what was new, and why it wasn't impossible. The revised version came out last year in a different journal.[12] The jury is still out on whether it will prove to be helpful to cancer research.[13]

Cultivate Your Curiosity

Now I'd like to become avuncular, and offer some suggestions if you want to explore the possibilities of interdisciplinary research. Of course, interdisciplinary research is not for everyone, it's not for every problem, it's risky, and it has been criticized for sucking resources away from disciplinary departments.[14] But it can be worthwhile.

My suggestions are largely based on what I find, in retrospect, has worked for me. By the way, I don't claim to be inventing the wheel here, but only hoping that what I have to offer might be useful to you in your research, and especially in research that might become interdisciplinary. My basic theme is simple: cultivate your curiosity. But how can you do that?

Here's a piece of advice especially for students: *never let coursework interfere with your education.*

A recommendation I have for everyone is *get help.* When you become curious about something in a new field, finding what you need can be daunting. So, read a book, study a recent review of the literature, search on the web, and follow footnotes and citations. But best of all is to find a *person* who knows a lot about the field you are interested in, is willing to listen to your motivation for going there, and can tailor their recommendations to your interests and your current level of knowledge.

But how do you find interesting and potentially fruitful things to explore? Actually, this can be harder than it might seem. My answer is to *expose yourself.* Read widely outside as well as inside your discipline, use Google and Wikipedia shamelessly to get started on something that catches your fancy, make friends with different kinds of people, go to talks. For longer term exposure and interaction, join or form an interdisciplinary group of peers who want to learn from each other. Besides exposing the members to each other, an on-going study group can provide a good forum for trying out your half-baked ideas.[15] Following your curiosity will often take you far outside of your comfort zone, especially when you actually try to make a contribution using the results of your well-cultivated curiosity. When you are working far outside your specialty or even your discipline, you are bound to have feelings of confusion and inadequacy. It's not pleasant, but you'll need to tolerate these feelings from time to time.[16]

Another way to cultivate your curiosity is to *follow your nose.* In other words, pursue what really interests you.

> This too is easier said than done because it is not always obvious which way your nose wants to go. I realize I have an advantage over most people because my nose is so well developed. But even so, I find the best way to learn what I am interested in is to stand outside of myself and observe my own behavior. For example, one of my favorite activities is to take a break and go to the library about once a year to look at the table of contents of a very wide range of journals. If I find a title that looks interesting, I read the abstract, and if it still looks interesting, I read the article. And one new interest might lead to several other new interests. So cultivating your curiosity means not only getting good at growing more and more branches of your search tree, but also getting good at pruning the less promising branches.[17]

You may have noticed that there is something in common to the discovery of the key insight for each of the three examples I've been discussing. In each case, the interdisciplinary advance was made after curiosity led to a compelling problem, and after sustained struggle with the problem led to frustration. The insight came when they weren't looking! For example, Darwin said he read Malthus "out of amusement," and Putnam came across the concept of social capital when he leafed through a new book lying on the table at the library, and my foray into medicine started with a three-dimensional visual display I was invited to play with. What I take away from this is that after curiosity led to a compelling problem, and after hard work led to frustration, a decisive advance came while taking a break from the problem into the fun of exploring something new and different. In other words, when the going gets tough, lighten up.[18]

Now I can summarize my advice about cultivating your curiosity in what we may call "the four ups."

Read up in a variety of fields so your mind will be well prepared.
Team up with others who can help you.
Load up on research related to your problem.
Lighten up when you need to escape from the problem for a while.

Opportunities for Exports

My next question is whether political science can export to other disciplines as well as we import from them. My answer is "yes", but it's typically harder to export than to import for two reasons. It is harder because you typically have to learn more about the other field to contribute to it than you have to learn if you are importing a concept into your own discipline. But more important is the practical fact that academic careers are usually controlled by disciplinary departments—and disciplines generally care more about imports that advance their own discipline, than about exports that advance some other discipline. Fortunately, when I became an officer of the American Political Science Association, I didn't have to take a loyalty oath to the discipline.

Political scientists have a lot to offer other fields. Many of our core concepts and theories can help with research questions that are far removed from questions about the state, or even from politics as usually conceived. Examples of ideas that we work with all the time that might be helpful far beyond the study of politics include diversity, representation, rights, accountability, federalism, institutional design, free riders, log-rolling, coalition formation, political mobilization, aggregation of interests, the rule of law, and the pursuit of social justice.

Let me give several examples of opportunities I see to contribute to other fields by exporting what we political scientists know. Take public health for example.

If a serious threat to public health arises, an important problem will be getting people to trust the official recommendations about what to do. Well, when it comes to *understanding trust in government,* we political scientists have a lot to offer.

If we want to reduce behavior among teenagers that puts their health at risk, the problem might be the *strength of their social norms.* Well, we and our colleagues in sociology know a lot about how and when social norms can change over time.

If the most effective way to fight a potential epidemic is to vaccinate people near the site of the outbreak as soon as possible, then a problem is likely to be that other countries will hoard their stockpiles for their own citizens. To understand and overcome this suboptimal behavior, it would certainly help to know a lot about *how domestic politics affects foreign policy,* and *how effective international regimes can be built.* Well, when it comes to domestic politics and international regimes, political scientists have a lot to offer.[19]

When a study of over 100,000 nurses shows that those who took estrogen replacement therapy (ERT) had only about a third as many heart attacks as those who did not, respected medical authorities asserted that ERT was beneficial in reducing heart attacks. Yet, virtually any political scientist could have told them to *control for things like socioeconomic status* before assuming correlation implies causation. If the medical authorities realized the need for such controls, they could have avoided what turned out to be 17 years of unfounded advice.[20]

We, as political scientists, might also have a good deal to contribute to cognitive and neuropsychology. As you know, recent technological advances in brain imaging have allowed scientists to observe which parts of the brain are most active while a person is doing a particular activity.[21]

Neuropsychologists are beginning to understand that the perception of fairness can operate at the neural level. Political science has a lot to offer in understanding the *perception of fairness and justice in the real world.*

Neuropsychologists find that an individual's altruism can be sustained by inhibiting the selfish impulse to accept but not return an act of altruism.[22] Political science has a very long history of both theory and practical knowledge about *what it takes for cooperation between people to flourish.*

Neuropsychologists are finding that when someone is disgusted with the behavior of another person, the same part of the brain is active as when they are disgusted by an unpleasant odor.[23] That's fascinating, but frankly I don't know if political science has a lot to offer in the *understanding of* disgust. On second thought, every time we survey voters about the candidates, we get a lot of data about what disgusts people.

In my view, a particularly promising domain for political science exports is the new field of web-based institutions, particularly web-based institutions that use largely bottom-up forms of organization and governance. A good example is the success of the open software movement, especially the success of the Linux operating system. Linux is an operating system built largely by voluntary labor and is arguably superior to what Microsoft was able to do with hundreds of highly-paid specialists organized in more or less traditional hierarchical organization relying mainly on top-down governance.[24] How does open software development get by with such little governance? The same question could be asked of eBay's reputation reports, Amazon's book advice, Google's search engine,[25] Wikipedia's encyclopedia editing,[26] Facebook's networking,[27] and even the governance of the web itself. As far as I know, the people who designed each of these web-based institutions were innocent of political science. I wonder whether exporting some of what we know about political mobilization, governance, social movements, control of free riders, norms, and trust could suggest ideas that would be helpful in designing the "next big thing."

In sum, political scientists owe a lot to imports from other disciplines, but we also have a lot we can export to them.

Notes

1 See National Academy of Sciences et al. 2005, 26.

2 For helpful work on interdisciplinary teaching and research specifically in the social sciences, I recommend Aldrich et al. (forthcoming); Pellmar and Eisenberg 2000; Kessel, Rosenfield, and Anderson 2003; Pierce 1999; Easton and Schelling 1991; Rigney and Barnes 1980; and Baer, Jewell, and Sigelman 1991. For other useful works, I highly recommend National Academy of Sciences et al. 2005, as well as Rhoten and Parker 2004, Salter and Hearn 1996, Klein 1996, Lattuca 2001, and Weingart and Stehr 2000.

3 The terms "import" and "export" were introduced by Pierce 1999.

4 Quoted in Barlow 1958, 22.

5 Letter from Marx to Lassalle, London, Jan 16, 1861. See Marx 1942.

6 Each different kind of mutant cell was represented with a different color. You could rotate the image in three dimensions. Neatest of all, when you clicked on a cell, all the cells of that type would become transparent so that you could see inside the simulated tumor.

7 See Hanahan and Weinberg 2000.

8 The literature typically does not explicitly say that a single cell needs to have all the hallmarks of cancer, but this seems to be the tacit assumption.

9 My first analogy was inspired by Hobbes' idea that a healthy society is analogous to the healthy body of an individual that he called the Leviathan. The analogy was that cooperation among healthy cells would help the body suppress tumors. But that didn't get me beyond what biologists already know, e.g., how multicellular organisms sustain cooperation among their more or less specialized cells. When that approach didn't take me to new territory, I tried another approach, namely to think about the possibility of cooperation among the mutant cells rather than among the normal cells.

10 At that point, the best I could do was to ask why if robbers don't have to go it alone, why should tumor cells? Just as robbers cooperate with each other, why couldn't tumor cells cooperate with each other?

11 Dave's first recommendation was Greaves 2000.

12 Axelrod, Axelrod, and Pienta 2006.

13 Note added October 1, 2007. Dr. Pienta has developed a drug inspired by our cooperation approach, and his lab has demonstrated that in mice, "an interaction between tumor-derived chemokines and host-derived chemokines acting in cooperation produce tumor cell survival, proliferation and metastasis" (Loberg et al. 2007). The University of Michigan has received a patent for its use in prostate cancer. Phase I trials are now underway with human subjects.

14 For data about interdisciplinary research comparing ranks and frequency of boundary crossing between political science and sociology, see Pierce 1999. For impact of interdisciplinary work on careers, see Rhoten and Parker 2004. See also the other references on interdisciplinarity cited above.

15 For example the emergence of behavioralism was fostered by a discussion group of young faculty

members from nine different disciplines at the University of Chicago. Its focus was on the then-emerging field of systems analysis. It met weekly for five or six years, and a number of its founders went on to become leaders their own fields, such as political scientist David Easton who was then in his early thirties and later became president of APSA (interview by Kristen Monroe for Aldrich, forthcoming). Other future leaders from this study group included Donald Campbell, president of the American Psychological Association; James Miller, president of the International Society for the Systems Sciences; Jacob Marschak, president-elect of the American Economic Association and president of the Econometric Society; and Ralph Gerard, president of the American Physiological Society; Sherwood Washburn, president of the American Anthropology Society and of the American Association of Physical Anthropologists; and Roger Sperry, 1981 Nobel Laureate in Medicine.

Speaking personally, I've benefited tremendously from BACH, a faculty study group at the University of Michigan on the subject of complex adaptive systems. It name derives from its founding members, Arthur **B**urks (Computer Science and Philosophy), Bob **A**xelrod (political science and public policy), Michael **C**ohen (organization theory and information science), and John **H**olland (Computer Science and Psychology). Other long term members include Carl Simon (Mathematics), Rick Riolo (Computer Science), and William Hamilton (Evolutionary Biology). The group has met once or twice a month for over thirty years. The group eventually developed a more institutionalized structure now known as Center for the Study of Complex Systems of the University of Michigan.

16 In addition to feelings of confusion and inadequacy, when doing interdisciplinary research, you may well get scorn from people who think you have not learned the most elementary things about their field, even if you have done so and your work has gone further.

17 How do you decide if something that intrigues you if really worth pursuing? One way is to keep an eye out for problems that *you* find compelling. A compelling problem is often based on an empirical puzzle, i.e., something that happens but can not be explained very well by existing theory. For example, Darwin was puzzled by the diversity of species of finches he saw in the Galapagos Islands, and was seized by the problem of where new species come from. As we saw, Bob Putnam was finishing a book and was struggling with the problem of what makes democracy work. In my case, when I thought that cooperation was no longer a compelling problem for me, I was wrong.

18 The value of taking a break is that it allows you to step back from the problem at hand. I think of a dog who tried to get through a fence by pushing, and digging, and jumping, and winds up frustrated. But if the dog had only lightened up a bit and backed off, the poor dog might have seen that the fence ended in a hundred feet and it would be easy to just walk around it.

19 I thank Joshua Epstein and Ross Hammond for these examples of potential exports.

20 I thank Jasjeet Sekhon for bringing this example to my attention. For retrospective academic analyses see Humphrey, Chan, and Sox 2002 and Freedman and Petitti 2005. After giving this address, a good introduction to this sad story appeared in the *New York Times Magazine* (Taubes, 2007).

21 The leading form of brain imaging today is functional magnetic resonance imagery (fMRI). For an introduction to fMRI see Devlin 2007. For a review of neuroeconomics see Camerer, Loewenstein, and Prelec 2005, and for a review of social cognitive see Lieberman 2007. For examples of fMRI used to study trust and cooperation see McCabe, Rigdon, and Smith 2003; Rilling et al. 2002; Singer et al. 2006; Tankersley, Stowe, and Huettel 2007.

22 See Rilling et al. 2002.

23 See Sanfey et al. 2003.

24 See Weber 2004

25 See Battelle 2005.

26 I realize that the value of Wikipedia is still in dispute. A study by Giles 2005 found Wikipedia almost as accurate as the *Encyclopedia Britannica.* See also the 2006 *Nature* article, "Britannica Attacks . . . and We Respond."

27 Be clear that the voluntary work is in the building of the data base, including the network, rather than in the design of the system (also in the conventions that have arisen).

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