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Plagiarism, Education, and Information Security

From 1997 to 2002, I caught an average of 18 percent of the students in my graduate-level information security classes plagiarizing large portions of papers (some copied in full) and turning them in as class assignments. This doesn't include students who plagiarized small

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portions of papers or who were guilty of plagiarism by paraphrasing. Since 2002, the percentage has declined and the style of plagiarism has changed. At first blush, it appears to be an encouraging trend, but students' attitudes and opinions haven't changed much at all. On the contrary, very few students actually appreciate the need for academic integrity, specifically in writing, whereas the pervasive attitude appears to be that the checks performed on papers is simply a game—indeed, it's one that many feel they can play successfully.

Even when confronted with real-world examples of plagiarism and consequences, students tend to interpret the activities in terms of legal technicalities rather than intellectual honesty. Such attitudes are disturbing in the academic context, but they're even more disturbing in the context of innovation, intellectual property development, competency assessment, and global competitiveness. Addressing this issue comprehensively requires cooperation at every level of education and perhaps a specific assessment of institutional commitment to teaching critical thinking and self-expression. Serious consideration of behavioral standards could similarly benefit the information security profession.

The data described in this column is solely representative of my direct experience; I don't intend to make general statements about all students or institutions. Yet, I've had enough conversations with other professors to confirm that the problem is widespread. Moreover, the problem isn't characteristic of a certain type of student in any variable description—background, ethnicity, culture, religion, and gender don't seem to matter. Although I teach courses primarily in information security, my experiences don't suggest that information security students' attitudes are any different toward intellectual property theft. In fact, among my most blatant offenders was a practicing, certified security professional. A call to arms is needed in the classroom and in the profession regarding this problem.

Plagiarism in the classroom

Plagiarism in the classroom has changed since the period of 1997 to 2002, during which I saw predominately word-for-word plagiarism in papers in my classes. Some came from single sources, but more often they came from two or more. With that kind of plagiarism, it was fairly easy, although time-consuming, to detect copying. Most students

engaging in such behaviors believed their professors knew little about the World Wide Web, and many believed that few, if any, professors spent the time needed to check for plagiarism.

Students' attitudes about professors' abilities to use the Web were well-founded in the early years. Although the Internet had been around for some time, the WWW interface's ease of use enabled a level of information sharing that was largely unimagined prior to 1989.[1] Professors used the Web primarily for information sharing, rather than policing student activities. Only once the awareness emerged that students were using this wonderful tool as a shortcut did professors start to explore using it for academic-integrity purposes.[2,3] The development of widely available plagiarism-detection tools also helped raise awareness and make it easier to check papers against online sources (see www.web-miner.com/plagiarism).

Still, when I first started catching students, many colleagues directly told me that the time I put into plagiarism checking would be better spent on the vast majority of students who didn't cheat. Such attitudes have changed over time as increasing evidence of widespread plagiarism has surfaced in journalism,[4,5] history,[6] physics,[7] and politics.[8] The media has widely presented surveys of reported student behaviors,[9] and term paper mills have faced litigation.[10]

On the other hand, the cheaters have developed more sophisticated techniques. One student who was passionately trying to explain why his

writing wasn't plagiarized showed me a technique I call two-step source laundering. He launched a word processor and a Web browser and proceeded to copy and paste material of interest from Web pages into his document. Once he had compiled his material, he massaged the words using a thesaurus and changed sentence structures by moving phrases around. He then showed me that his work was nothing like the source material, and thus argued that it wasn't plagiarized. I've seen evidence that this method is becoming commonplace.

One of my tasks is to check every dissertation in our department for plagiarism. I rely heavily (though not totally) on Turnitin.com to assist me. The service captures every source document submitted for comparison checking, including those that students submit under personal licenses or other teachers' accounts. I watch with some amusement as students check their own works repeatedly to make sure that they've changed enough words and phrases to get past the automated checks—one student submitted his dissertation 12 times before he was content with the results.

Term-paper mills have also become more sophisticated. One interesting trend is to offer embargoes—that is, if the student is willing to pay a premium, the company agrees not to sell the paper again for a certain amount of time. Another trend among online services is to offer allegedly one-time-only sales of papers. The way that term-paper mills market their products has also evolved somewhat, so that rather than simply saying, "buy a term paper" they now offer to "help you do research." For example, AcademicIntegrity.com, a site that belongs to the Paper Store, which offers term papers and custom services, states on its (copyrighted) entrance page:

"AcademicIntegrity.com comes through for those students who need honest assistance and who are ready to use the works of others as a beneficial tool to augment their understanding of a particular subject area. By providing student customers with a viable source of exemplary term papers, reports, and essays from which they can learn, study, and find information to further their research, AcademicIntegrity.com is essentially employing fundamental principles associated with the concept of learning by example."

Of course, the Internet makes cheating easier and faster, but the old-fashioned techniques still exist. I caught one student turning in term papers that were copies of chapters from *Computer Security Basics* (O'Reilly, 1991).[11] Another student turned in a dissertation that was 99 percent the same as one submitted several years earlier, including identical data to three significant digits. In each of these cases, using Turnitin.com alone wouldn't have revealed the cheating: in the first case, I discovered it because I was the professor and recognized the material, and in the second, I discovered it only after receiving an anonymous phone call with enough details to help me discover the source.

In all of this, it soon feels like trying to prevent students from cheating is a hopeless endeavor. Indeed, some of my colleagues have simply given up on written assignments and other research efforts in favor of in-class exercises and closed-book tests. Yet, such choices cheat the student of more complex learning opportunities, cheat society of citizens who are capable of the complex reflection that comes from research and writing, and cheat businesses of employees who can communicate coherently in writing. Given language's importance to human intelligence, it seems key to establish a systematic approach to both minimize plagiarism and achieve legitimate academic goals.

A model of plagiarism behavior

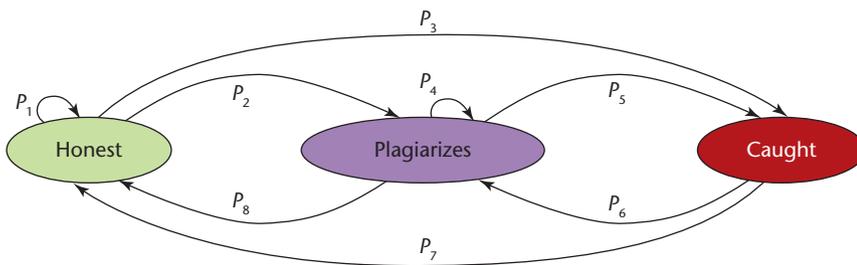To approach curbing plagiarism, I propose the model in Figure 1,

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Figure 1. Markov chain model of plagiarism behavior. While in the *honest* state, the student is writing without plagiarizing. While in the *plagiarize* state, the student is plagiarizing some or all writing. While in the *caught* state, the student is accused of plagiarism, and authorities, such as professors, administrators, or peers, examine the student's writings. Modeling the behavior in this way allows examination of the influences that affect the probability that an author will move from one state to another.

which shows a Markov chain with three states: *honesty*, *plagiarism*, and *caught*. Students move between states with probabilities. For simplicity, let's assume that all students start in the honesty state:

- They can remain in that state with P1 or move to the plagiarism state with P2; they could also move to the caught state with P3, which reflects the false-positive problem.
- Students can stay in the plagiarizing state with P4 or return to being honest with P8.
- From the plagiarizing state, students can move to the caught state with P5.
- From the caught state, students can move to the plagiarizing state with P6 or to the honesty state with P7.

The following matrix represents these state transitions with hypothetical probabilities:

	H	P	C
H	0.69	0.30	0.01
P	0.01	0.79	0.20
C	0.50	0.50	0.00

It's tempting to add absorbing states of *graduated* and *left without graduating* to the chain, but that would obscure the larger reality, which is that plagiarism regularly occurs in nonacademic settings, as

well. This is a particularly problematic issue in professions such as journalism and information security, which are charged with the protection or safe treatment of intellectual capital. We thus need to consider the behavior in the context of all situations, rather than simply academic settings. In fact, I find it necessary and important to tell students on the first night of class that academia includes no such thing as "boilerplate" or "standard" language because plagiarism is apparently so rampant in industry today that many students consider it not only normal but necessary.

To understand what could affect these probabilities, we should examine the influences on the students. If they look around and see classmates plagiarizing without getting caught, they might be influenced to plagiarize, too. Alternatively, seeing classmates plagiarizing and getting caught might influence students to stay honest. Honest students wrongly accused of plagiarism could be influenced to think they might as well plagiarize, or they might become even more diligent in staying honest. Other people's attitudes might have the strongest effect on future behavior.

Anecdotally, what seems to work in my environment is a combination of elements: discussion of plagia-

rism, exemplars, strong enforcement, and continual reminders. In discussing plagiarism, I include definitions and examples of historical cases. This process can take quite some time, but it ensures that students understand what plagiarism is and how it relates to intellectual property rights. Using exemplars has turned out to be extremely important. By talking about current student cases (without specific identifying information), we demonstrate the seriousness and reality of the situation to the students. In discussing the cases, step-by-step explanations of how the university handles academic integrity violations seem to really grab students' attention. Showing them the form used, describing the hearing process, and talking about case outcomes increases their level of awareness that the subject isn't just talk. Even with all these efforts, I get the occasional violator who invariably tries to talk his or her way out of a charge. Because I refer each and every case to the Academic Integrity Council, I've developed a well-known reputation among students. (It was because of my reputation that I was the one who received the anonymous call about the plagiarized dissertation.)

Implications for the profession

Abstractly speaking, an information systems security professional's job is to protect and defend information assets. Stealing and abusing such assets through plagiarism hardly fits that definition. The challenge facing the profession is that a generation of students has grown up during the turmoil of the commercialized Internet. Many of these students freely share copyrighted material, such as music, insisting that doing so is both appropriate and legitimate. A doctoral student once defended his use of information from a Web site (plagiarized completely without source citation) in this manner: "The au-

thor intended for the material to be used because he put it on the Internet." I've caught many other students who were baffled that anyone would consider it plagiarism to use encyclopedia-type data without source citations or quotes.

The business community seems to mirror these attitudes. Consider the scandal that raged very, very briefly regarding the plagiarism in *The Official (ISC)^2 Guide to the CISSP Exam* (Auerbach, 2003).[12] On 12 February 2006, Michael Workman, a professor at Florida State University, posted a message to the Information Security News list-serv pointing out that large parts of the text appeared to come, without modification or attribution, from other sources (www.infosecnews. org/hypermail/0602/11232.html). Workman notified the publisher and (ISC)^2 of the problem. Rumors about plagiarism in the book had been swirling for several years, with one early reviewer glibly stating in 2004 that, "taking material from one source is copying, taking material from two sources is plagiarism, and taking material from many sources is research. This volume has not only research but direct input from a great many sources."[13]

The plagiarism was extensive. All the authors are (ISC)^2-certified information systems security professionals and thus bound by the (ISC)^2 code of ethics, which requires members to "act honorably, honestly, justly, responsibly, and legally" (www. isc2.org/cgi-bin/content.cgi?category =12). To its credit, (ISC)^2 immediately launched an investigation, removed its official endorsement of the text, and eventually released a replacement book. Yet, although the (ISC)^2 site no longer features it as an official textbook, the book was still listed as in stock and available for sale on Amazon.com as of June 2007, with reader reviews as current as May 2007 (www.amazon.com/ Official-ISC-Guide-CISSP-Exam/ dp/084931707X/ref=pd_bbs_sr_3/

002-5603183-0777618?ie=UTF8 &s=books&qid=1182547469&sr =8-3).

The scandal broke briefly, generated some discussion, and then disappeared with only Internet archives to testify to the fact that it ever happened. No discernable mention of the scandal appears on either the Auerbach or (ISC)^2 Web sites. No sign exists of what penalty, if any, the authors paid. There's not even any way to tell if only one of the authors was guilty or if all three were complicit. It just seems to have disappeared like a small pebble in a large pond.

I t's tempting to consider this episode an isolated incident chiefly characterized by excellent crisis management. Unfortunately, the message it seems to have delivered is that plagiarism isn't a huge offense (certainly not big enough to lose your CISSP certification). If you get caught, you can manage the problem. As an interesting thought exercise, imagine the same scenario but with a different crime. Would certified public accountants caught cooking the books be allowed to keep their CPA designations? It hardly seems likely.

A defining characteristic of a profession is that its members adhere to and enforce a standard of behavior. For information security, it seems right and proper that the standard should include respect and protection of information assets and intellectual capital beyond what seems to be the norm today. □

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