
Moral Pedagogy and Practical Ethics

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Keywords: Moral Psychology, Computer Ethics, Online Education

ABSTRACT: *Online science and engineering ethics (SEE) education can support appropriate goals for SEE and the highly interactive pedagogy that attains those goals. Recent work in moral psychology suggests pedagogical goals for SEE education that are surprisingly similar to goals enunciated by several panels in SEE. Classroom-based interactive study of SEE cases is a suitable method to achieve these goals. Well-designed cases, with appropriate goals and structure can be easily adapted to courses that have online components. It is less clear that exclusively online methods can support the wide range of goals necessary to good moral pedagogy in SEE, though there seems no a priori reason to rule this out. Only careful, goal-based assessment of online case study SEE teaching can resolve this question.*

Moral Pedagogy and Practical Ethics

Online course delivery magnifies bad pedagogy.

-A participant in the 2002 NSF teaching online ethics workshop

If one asks whether science and engineering ethics (SEE) can be taught well online, the question should be cast in terms of whether good pedagogy in SEE can succeed online. The case against online course delivery is often based in how bad a poorly delivered online course can be. However, this blames the technology for what is already bad pedagogy. A positive way to frame the question of online ethics education is: "Can online SEE education support appropriate goals for SEE and the highly interactive pedagogy that attains those goals?"

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Paper received, 21 November 2002; revised, 19 October 2004; accepted, 20 June 2005.

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This paper grounds presentation of appropriate goals for SEE education in a review of the recent literature on moral psychology and compares the results of that review with the goals for SEE education enunciated by several panels in the area. These goals can be achieved by using the highly interactive case study method of teaching, though it is less clear that *online* SEE education can support the goals and methods needed for successful SEE education.

Moral Pedagogy

Moral psychology is clearly post-Kohlberg today. Lawrence Kohlberg's¹ (1969) paradigm of moral development over a series of stages toward a principle-based ideal reigned for at least two decades, but has now fallen prey to increasing anomalies in prediction (particularly at higher levels) and to the increasing influence of cognitive models of affect and reason. This is by and large a good thing since it avoids the constraints of foundationalist and rationalist theory that viewed affect and cognition as opposing forces. It is, however, also a confusing time in that now a plethora of approaches are being advanced with different assumptions and agendas. While the complexities of this field are beyond the scope of this paper, a review of some of the current approaches allows some insights into teaching ethics, especially science and engineering ethics, and particularly online.

Neo-Kohlberg. There is a group of researchers who call themselves neo-Kohlbergians.² They have tried to modify Kohlberg to keep up with current theory and data, and have been particularly concerned with practical applications of the approach. These theorists view Kohlberg's stages as a series of overlapping moral schemata that underlie moral judgment. These schemata inform and structure moral judgment, and can each be brought into play once they have been acquired. Most of the neo-Kohlbergians claim that these schemata form a hierarchy from primitive to complex and that they are comprehensive, although most other researchers in the field are unconvinced of, or uninterested in, these claims.

In addition to viewing moral judgment stages as schemata, the neo-Kohlbergians also view moral judgment as only one piece of the puzzle in moral psychology. Their four-component model consists of:

- *Moral Sensitivity.* The ability to perceive and understand the moral content of situations. This involves more than mere empathy; it also includes sensitivity to the variety of perspectives, and available actions and their moral implications.
- *Moral Judgment.* This is the process Kohlberg emphasized, in which the individual uses principles of moral reason to judge what is right in a situation.
- *Moral Motivation.* Individuals will have a multiplicity of concerns, not all of them related to being moral in their actions. A moral choice may be well understood, but still have a low priority in an individual's motivation.

- *Moral Character.* This centers on strength of will or the abilities to construct and maintain an appropriate course of action, avoid distraction, and exercise sufficient courage to continue in the moral choice.

An advantage of this breaking out of the process of moral perception, judgment, and decision is that it shows the complexity of getting from a perception of a moral issue to appropriate action. However, there are precious little data on the three processes other than judgment. What data there are remain scattered across a variety of literatures including pro-social development, aggression, prejudice, altruism, dissonance, and social influence. Alternative models from outside the Kohlberg tradition³⁻⁵ conflate one or more of the four components. At the same time, it is clear at least that moral judgment is reliably but weakly related to moral action (see Blasi³ for a review), and there must, therefore, be some additional influences we need to take into account.

Neo-Kohlbergians have made one other contribution which comes from their dedication to teaching ethics to professionals (e.g., dentists, teachers). They have identified an important category of moral knowledge they call “intermediate concepts.” This is schema-based knowledge about concepts such as informed consent, confidentiality, paternalist/agent/fiduciary roles, intellectual property etc. These important intermediate concepts will differ from one profession to another. Muriel Bebeau and Stephen Thoma⁶ have convincing evidence that knowledge of intermediate concepts influences professionals’ ability to correctly identify the ethical issues in a new case and to judge the appropriateness of various actions in response to those issues. This presents a picture of ethical knowledge structures that occur on several levels (underlying understandings of fairness and other principles, intermediate concepts, and specific details of similar cases). Not surprisingly, this is similar to the sorts of knowledge structures we have in many other areas of life.

Post-Kohlberg. There are a variety of other approaches in the field of moral psychology today that share little in common with the Kohlberg dynasty. Some are theoretically based in research on self-concept³ and moral action. Others are more empiricist and a-theoretical, and concentrate on describing the moral careers of moral exemplars.^{4,7} Still others emphasize the importance of moral imagination⁸ and virtues specific to professions.⁹ Jonathan Haidt’s⁵ approach brings together current cognitive and social psychology and emphasizes the intertwining of affect and reason in all judgment (and by explicit implication, in moral judgment).

In the early 1980s, Augusto Blasi³ reviewed the literature showing that scores of Kohlberg-style moral judgment were only moderately correlated with actual moral behavior. That the correlation was moderate was heartening, but its small size left a great deal of room for the question, “What drives moral behavior if it is not reasoned moral judgment?” Blasi’s answer, based on a program of research primarily with adolescents, was that it was the way in which moral judgment was incorporated as a part of the self-concept. While most people have moral commitment as a part of their self-concept, few individuals have their moral commitments as such a central part of

their self-concept that to do something that was wrong would be to deny who they are in a fundamental sense. Thus, for Blasi, a fundamental aspect of moral judgment and action is its relationship to the self. This is reminiscent of virtue theory approaches in which it is not actions that are regarded as moral, but people.

Both Anne Colby and William Damon⁴ and Samuel and Pearl Oliner⁷ have done extensive study of highly moral or virtuous people. Colby and Damon studied moral exemplars in the U.S. They chose their exemplars based on criteria designed by a panel of ethicists, social scientists, theologians, and historians. The group of moral exemplars they studied had a diverse range of income, religious background, education, and mission (e.g., poverty, education, peace, alcoholism, health care, civil liberties, business ethics, environment, etc.). Two primary characteristics of these exemplars emerged from their interviews. First, all the exemplars had their sense of moral commitment as a core part of their sense of self. Second, all were supported in their “moral career” by other individuals who both encouraged and challenged them in their commitments.

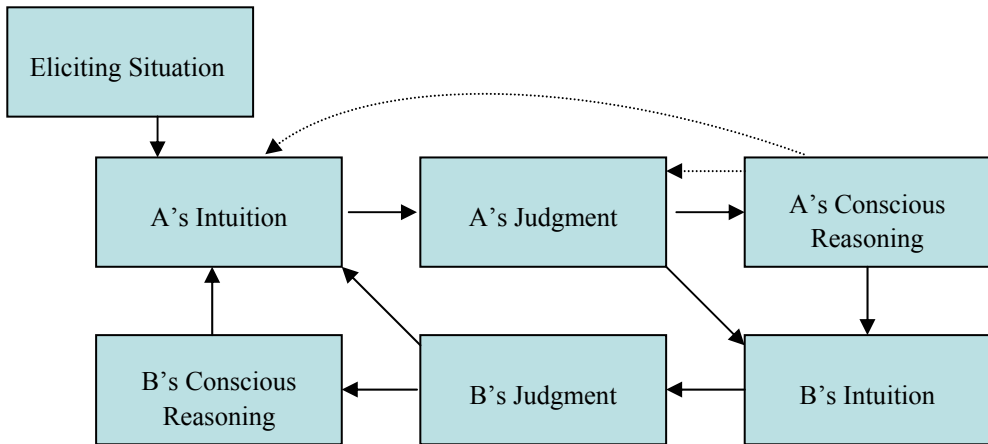
The Oliners interviewed 406 authenticated rescuers of Jews during the Nazi Holocaust. These individuals (along with 126 non-rescuers and 150 rescued survivors) also filled out an extensive questionnaire. Relevant to the task here, the Oliners provide evidence of what they call a “normative catalyst” that “translates predisposition into action.” Potential rescuers who were significantly committed to a social group responded to events that emphasized the normative demands of that group (e.g. a valued member of the group asked them to help). These individuals helped others without taking a principled stand independent of their group (called principled helping) or being particularly struck by the suffering of individuals (called empathic helping). Most of the helping that the Oliners document (52%) was of this “normative” kind, based in the values and call of an important social group.

Two philosophers whose work is partly based in psychological theory emphasize the importance of moral or ethical imagination. Michael Pritchard,⁹ in a discussion of the virtues associated with ethical engineering, calls ethical imagination an important characteristic of the virtuous engineer. The ability to see the range of alternatives available, to see potential hazards, and to see a problem from multiple perspectives is a critical skill/virtue/excellence in the making of a virtuous engineer. Mark Johnson⁸ presents a critique of rule-based ethical theories that is based in current cognitive psychology. He presents moral imagination as a centerpiece for a new understanding of what it means to make moral judgments. Moral judgment is, like much other reasoning, based in metaphor, analogy, prototypical categories, and narrative.

Finally, Haidt⁵ provides a model of moral judgment that is also based in current theories of cognition, specifically, “two-process” theories. Two-process theories are a rigorously empirical cognitive incarnation of the Freudian dichotomy between conscious and non-conscious processing. The two processes have evolved in humans as part of separate systems and the rational (or propositional) and the emotional are mixed in each of these kinds of processing. One process is quick to action, slow to modify itself and results in intuitions that are presented whole to conscious awareness (e.g., “I know this is wrong”). This intuitive process works most of the time for most

judgments, but is slow to adapt to changes in circumstance. Conscious processing is very slow (several seconds) compared to the intuitive process (milliseconds) but is quite flexible, can adapt quickly to changes, and is under conscious control. Since the intuitive process is so much quicker, its outcomes are presented to the conscious process with the force of matters of fact (e.g., “That’s disgusting!” to a picture of homosexual sex) and the conscious process is usually engaged in developing reasons for why the clearly obvious intuitive judgment is correct. The conscious process may develop reasons that are unconnected to the actual discriminations made by the intuitive process, but these may be strongly held as the reasons for the intuitive judgment.

Figure 1: An adaptation of Haidt’s⁵ two-process model of moral judgment.



Haidt’s (2001) model of moral intuition and social influence.

A experiences the situation, has a moral intuition, makes a judgment based on that, searches for reasons for that judgment. The reasons are communicated to B, who follows the same process. (1) is the intuitive judgment link, (2) is the post-hoc reasoning link, (3) is the reasoned persuasion link, (4) is the social persuasion link. Two other links occur less often: (5) the reasoned judgment link and (6) the private reflection link. *This figure is adapted from Figure 2 of Haidt, J. (2001) The emotional dog and its rational tail: A social intuitionist approach to moral judgment, Psychological Review, Vol. 108(4): 815.*

Of particular relevance here is Haidt’s presentation of the social context in which the intuitive and the conscious processes operate (see Figure 1). The conscious process is easily influenced by conversation and reason, but the important target for persuasion is the intuitive process. The intuitive process can be influenced directly by argument, but analogical, metaphorical, and narrative argument is likely to be more effective than rule-based reasoning in changing the intuition. In addition, simple social influence (e.g., by contagion or conformity) can also influence the intuition.

An adequate approach to a moral psychology is a long way off, but it is likely to be a synthesis of these and other similar approaches. It will treat moral judgment as the product of a dual processing system that mixes affect and cognition in both processes.

It will treat moral action as the interaction of situational pressures, personal moral commitments (of various kinds), and the social moral-support system. An appropriate moral pedagogy will address all these issues within the practical context of the discipline being taught.

A final point on moral pedagogy: it is not an impossible task. Many faculty will respond negatively to the proposal that ethics be integrated into a curriculum (any curriculum). The usual defense for this principle is that “student’s moral/ethical approaches are formed early, and we cannot change them at the late date that college represents.” The empirical research done by psychologists provides resounding evidence that this is simply wrong. People can and do make changes in their moral commitments, understanding, and skills even into later life.⁴ There is an extensive literature using the neo-Kohlbergian Defining Issues Test that even one college course in ethics can produce moderate change in the level of moral reasoning in college students.¹⁰ In fact, students who are older than college age (e.g. non-traditional students) are more likely to experience moral growth in an ethics class than college-age students. One reason people might adopt the “moral character is defined early” defense is that it is congruent with the popularized version of Freudian psychology that emphasizes early childhood development as crucial. Again, this popular conception has little empirical evidence to support it. Childhood patterns are notoriously poor predictors of adult patterns (see Seligman¹¹ for a review of this misconception and the empirical evidence against it).

Moral Pedagogy in Science and Engineering

One straightforward implication of the work in moral psychology for SEE education is that there is clear evidence that increases in moral development on several dimensions can be obtained. That is, moral pedagogy is likely worth the time. This point should be emphasized specifically because many practitioners often dispute it. There is clear evidence that the moral reasoning of experts in SEE is advanced over that of undergraduates in engineering, and that even small interventions can have some effect in increasing the complexity and quality of moral reasoning among undergraduate engineering students.¹² In addition, several of the ideas from moral psychology can help guide the process of thinking through the pedagogical goals of SEE. Some of the ideas suggest kinds of moral skill or knowledge that can be acquired. Others indicate the most effective means of persuasion for changing the moral intuition or for supporting moral action.

The following goals for ethical education in science and engineering are derived from the psychological literature and are a way of simplifying the issues.

1. *Mastering a knowledge of basic facts and understanding and applying basic and intermediate ethical concepts.* For all professional areas, things like various ethical systems, stakeholder analysis, and informed consent may be appropriate. Other intermediate concepts will be specific to the area, for engineering ethics, the socio-technical system (the complex system in which technology is

embedded), for research ethics, scientific fraud. Mastering these concepts and using them to sort out the particulars presented in concrete situations is an essential part of moral education. Examples of basic ethical concepts would include justice, right, duty, utility, and virtue. Examples of intermediate concepts in science and engineering ethics would include privacy, intellectual property, conflict of interest, informed consent, scientific misconduct, data cooking, etc. Intermediate concepts often take on new shades of meaning when applied to new areas of practical and professional ethics such as environmental or computer ethics. Deborah Johnson argues that computer ethics concepts—like intellectual property—are new species of a common genus.¹³ Such treatment requires approaching the new species through analogies and dis-analogies with the better known generic versions.

Gareth Matthews¹⁴ identifies different activities through which we learn basic and intermediate ethical concepts. They are:

- *“Enlarging the stock of paradigms for each moral kind”* One first comes to grips with intermediate ethical concepts like lying by means of acquiring paradigms or ideal instances that embody all or nearly all of the key features. (These paradigms are often conveyed through stories like George Washington and the cherry tree.)
- *“Developing better and better definitions”* One’s understanding of key concepts is deepened by developing a list of features that usually cluster together in the specific instances of the concept. (For example, intentional deception characterizes most instances of lying.) Plato, in the early and middle dialogues, was one of the first to portray the activity of defining moral concepts in terms of genus and species, for example, piety in the *Euthyphro* and justice in the *Republic*. While Socrates set a very high standard for definition (one his interlocutors never met), it is possible to identify characteristics sets or clusters that are useful in most everyday situations. It is also possible to learn ways of dealing with problematic or borderline instances.
- *“Appreciating the relation between straightforward instances of the kind and close relatives”* As individuals assemble more and more instances of a concept, they find that some more closely resemble the paradigms than others. This collecting of instances and arranging them in terms of analogies and dis-analogies with the paradigms provides a map of the concept and its instances that further deepens our understanding.
- *“Learning to adjudicate competing claims from different moral kinds”* Concepts frequently make competing claims that one must harmonize or trade off. A client might order an engineer to withhold information about risks to public health or safety; hence the engineer must adjudicate between the conflicting claims of informed consent and confidentiality.
- *“Moral Imagination”* The last activity described by Matthews, moral imagination, is our next ethics education goal.

2. *Practicing moral imagination.* Moral imagination may be an “excellence” in the Aristotelian sense in that it is both a virtue and a skill that can be practiced. It is certainly one of the most talked-about and exciting areas of moral psychology.^{8,14-16} Psychological work suggests that this skill may be more central to supporting moral virtue than learning particular rule-systems of ethics. Most lists of the constituents of moral imagination center around the two identified in Pritchard.¹⁴ (pp. 144-145)
 - *Taking the perspective of the other.* Moral imagination enables us to achieve distance both from ourselves and from the situation in which we stand. Part of this distancing involves the ability to occupy the standpoint of others and see ourselves and our actions through their eyes. This is, in part, what is meant by Rest and colleagues^{2, 10} when they talk about moral sensitivity—the ability to recognize that a situation calls for moral judgment (see point 3 below).
 - *The ability to generate novel solutions to problems.* For Patricia Werhane¹⁵ and Mark Johnson⁸ this involves breaking out of situation framings that limit both our view of ethical problems and the solutions available. Moral imagination allows us to step back and play over alternative ways of framing a situation. Moral imagination also includes the ability to design non-obvious solutions to problems. These solutions integrate ethical and practical considerations and simultaneously satisfy conflicting constraints by synthesizing them into novel forms or by trading them off. (Rose Lynn Pinkus and colleagues call this process “satisficing”.¹⁷ (pp.82-83) Anthony Weston presents several different activities that help us to step back to reframe situations and to brainstorm non-obvious solutions to vexing problems.¹⁸
3. *Learning moral sensitivity.* This may be a subset of moral imagination, but the work by the neo-Kohlbergians points it out as an important issue. It is the skill to recognize when a situation with moral import has occurred. Whether being able to take the perspective of others is a core skill that allows for moral sensitivity is an empirical question. Moral sensitivity in all likelihood mixes this ability with the *motivation* to scrutinize one’s everyday choices from a moral perspective. This motivation can be influenced by the adoption of moral standards associated with a particular role or profession.
4. *Encouraging adoption of professional standards into the professional self-concept.* Work by Blasi,³ Colby & Damon,⁴ and the Oliners⁷ suggests that as students begin to view themselves as engineers or scientists or computer scientists, they are adopting a professional self-concept that may (or may not) have ethical standards as a central item.
5. *Building ethical community.* Much of the work reviewed above suggests the importance of the moral community in guiding moral development and action. Adopting this as a goal leads us to think about moral pedagogy on more than an individual level. In addition to building the skills and knowledge above, moral pedagogy should be designed to help build an ethical community of students and

practitioners. It can do this first by fostering solidarity, which Larry May describes as “conscious group identification, bonds of sentiment, interest in the group’s well-being, shared values and beliefs, and a readiness to show moral support.”¹⁹ (p.44) Ethical communities are also built and sustained by the cultivation of virtues like integrity, honesty, cooperativeness, courage, and the ability to communicate clearly and effectively (borrowing from Pritchard’s list).⁹

This can be done on local, professional, national, and international levels. Building local communities is, of course the easiest way (and perhaps the most effective way) to start. The resulting communities will have significant influence on moral development and practice.

Although this list is clearly incomplete, both from the perspective of moral psychology and from that of SEE, it is suggestive of the range and richness of the ideas that moral psychology can bring to the table. Comparing these ideas to those already extant in the SEE literature provides a way to test both convergent and divergent validity. We would hope to see some convergence—that is, it would be disappointing (and likely disastrous for the project) if there were no overlap in goals. But we would also hope to see some divergence—moral psychology should not only reinforce current SEE goals, but should also bring additional ideas that are congruent. The specific comparisons we will make include a highly generalized set of goals first enunciated by the Hastings Center and a very specific set of curriculum guidelines for ethics in computer science.

Dan Callahan and colleagues at The Hastings Center have recommended a highly generalized set of goals that are similar to the ones we have just derived from the psychological literature. Teaching practical ethics should:

1. Stimulate our ethical imagination
2. Help us recognize ethical issues
3. Help us analyze relevant ethical concepts
4. Elicit from students a sense of responsibility
5. Help us deal with ethical ambiguity and disagreement²⁰

A very specific set of moral pedagogical goals for computer science has been outlined by the three reports of the ImpactCS project headed by Dianne Martin.²¹⁻²³ Table 1 presents the one portion of this large project that attempted to define in detail the content of ethical issues in computing for computer science undergraduate programs. This table presents the ethical principles and skills identified in the first report. Another attempt to define the area of computer ethics was that of the Social and Professional Issues Knowledge Area Focus Group for the ACM/IEEE Computer Curriculum 2001. It can be found at (<http://www.computer.org/education/cc2001/steelman/cc2001/SP.htm>). In addition to the principles and skills that ImpactCS lists, it also provides an overview of the intermediate concepts in the field, like intellectual property and privacy.

Table 1: Ethics Goals Listed in ImpactCS.

ImpactCS Principles and Skills

Ethical Principles [EP]

- 1) Ethical claims can be discussed rationally.
- 2) Ethical claims must be defended with reasons.
- 3) Ethical choices cannot be avoided.
- 4) Some easy ethical approaches are questionable.

Ethical Skills [ES]

- 1) Arguing from example, analogy, and counter-example.
- 2) Identifying ethical principles and stakeholders in concrete situations.
- 3) Identifying and evaluating alternative courses of action.
- 4) Applying ethical codes to concrete situations.

The goals from moral psychology overlap in many ways with the high-level goals of the Hastings Center. Moral sensitivity and moral imagination are either explicitly mentioned or implied in the Hastings Center goals. The moral psychology goals mention the importance of intermediate concepts, and the computer science goals provide one instantiation of those intermediate concepts in a discipline.

The moral psychology goals also diverge in interesting ways. They emphasize the importance of incorporating professional values into the professional self-concept and the building of moral community as important goals in moral pedagogy. Eliciting from students a sense of responsibility—Hastings goal number four—could serve as a bridge here since aspects of responsibility—such as role-responsibility—have ties to both the individual and community aspects mentioned above. But this is only if responsibility is understood in its richer, moral sense rather than the narrow legal sense. (See Ladd²⁴ and May²⁵ on this issue.) Curriculum committees may be unwilling to incorporate these sorts of goals directly into SEE curricula, but we would argue that the minor advantage that the skills in reasoning produce for moral behavior will be swamped in the field unless SEE pedagogy achieves goals like these. This is an empirical question and research to investigate it would be helpful indeed. There is at least one instance of moral-psychology-based research that applies the knowledge of the psychology of moral reasoning directly to an SEE context.¹² We hope to find much more in the coming years.

SEE pedagogy and teaching with cases

Work from several areas of moral psychology has converged on the conclusion that moral judgment is not a rule-based affair, but is deeply steeped in metaphor, analogy, and narrative. Cases can help in many of the goals listed above by:

- Motivating students to learn the basic concepts so they can talk about an interesting case
- Putting students in roles where they are likely to experience different moral intuitions as they take different positions in a case

- Putting lessons in narrative form so that they can be remembered more easily
- Providing specific instances that can be used as metaphors or analogies for new instances
- Providing practice in safe-but-realistic simulations for ethical problem solving
- Providing a venue for students to hear the moral intuitions of others, intuitions that can come from several perspectives
- Providing an opportunity to build moral consensus and moral community both by coming to agreement and by agreeing to disagree about realistic moral problems in the field

More than a traditional lecture or didactic approach, cases provide the opportunity for the manifestly social sorts of activities that the work in moral psychology suggests are important. When discussing, debating, constructing, or trying cases, students actively disagree with each other and, in Haidt's model,⁵ influence each other's intuitions about what is and is not the right thing to do. They are not only learning explicit knowledge (like intermediate concepts, or ethical skills) but also tacit knowledge, such as when to be suspicious, how to respond to disagreement, etc. In this way case-based pedagogy engages more of the systems/levels/processes of moral reasoning than do more passive instructional methods.

Taking various positions in a case can help students learn moral sensitivity and practice identifying moral issues from different perspectives. Moral imagination can be extended by wrestling with the complexities of a case and a variety of solutions. Haidt's⁵ views on how moral behavior can be changed support using case discussion as a means of introducing ethics into the classroom. For Haidt, self-reflection is largely ineffectual because it tends to produce only rationalizations for existing moral intuitions; it does not provide reasons strong enough to motivate self-reform. However, moral intuition can be influenced and shaped through our interactions with others. Hence, case discussion provides an ideal tool for promoting this interaction. Students put forth unexamined opinions and find that they fail to convince others; they listen to the views and reasons offered by others and, through this, learn to reexamine their own views from a different, broader perspective. Consequently, case discussion develops the habit of putting forth rational arguments for one's moral views.

It also develops other moral habits. Properly monitored discussion of cases habituates students to listening to others, being open to revising their own positions in light of good reasons, showing respect for the views of others (even if they disagree), and learning to search for common ground and consensus.

Moreover, cases that are written to reflect real world situations help students to practice moral decision making in safe, but realistic, settings. This realism can not only motivate the student to do the work to understand the issues, but it also begins the subtle process of having the student take on the role of the professional in making a decision. For example, an engineer provided us with a case based on a problem that he had encountered in his work. We wrote out a narrative that stopped the case at a moment of decision. Then we presented several alternatives, among which was the action actually taken. The following is the result (the decision actually taken is letter c):

Your company has recently entered into a cooperative venture with a Japanese firm. A team of engineers from this firm has come to your plant to teach your engineers a new manufacturing process. However, a member of this team, a Japanese engineer with very traditional cultural views, refuses to work with your team because one of the members is a woman. He persists even though you tell him that she is a highly qualified engineer. What should you do?

- a. Reassign the woman engineer. Explain to her that it is in the best interests of the company that they not offend the cultural sensitivities of the Japanese team.
- b. Tell the Japanese engineer that he must work with all the members of your team or go back home.
- c. Try to reason with the Japanese engineer by telling that in your culture women are highly qualified and work side by side with men. If this doesn't work, discuss the issue with another member of the Japanese team asking him to convince the Japanese engineer that it would be a good idea to work with the whole team including the woman.
- d. Contact the supervisors of the engineers back in Japan and have them send a different team that is better prepared to deal with matters specific to Puerto Rican culture.

Students took on the role of professional engineer and made a decision; they chose from the above alternatives, the one they thought best. (Some designed their own solution.) After discussing their choices, we presented them with the decision actually taken. We found that students were eager to benchmark their decision-making skills against those with the real world experience. Cases such as this provide students with opportunities to try on the role of professional engineer, practice identifying ethical issues in concrete situations, apply codes to these situations, and identify and evaluate alternative courses of action.

Notice, however, that in this discussion, cases are being used for a range of goals and that these goals require different approaches to the case and uses of the case material. There is no one correct way to use a case, though there are likely incorrect ways to attempt to achieve a particular goal with a case.

A Taxonomy of cases in SEE

To say that one plans to use “the case method” in a project only introduces a minor bit of constraint on what will in fact be done. Cases can be used simply as lecture illustrations, or an entire class can go through cases in a very interactive manner. Cases can take 10 minutes or a semester to discuss. In order to provide some understanding of the range of cases and case methods available, below is a taxonomy of both the types of cases and the types of methods that might be used with cases.

There are other case taxonomies (see Davis^{26(pp. 148-159)} and Herreid²⁷). The approach presented here seeks to separate the type of case from the purpose for which the case is used. This highlights several important distinctions. Below, is a taxonomy of case types. The next section addresses the uses to which any case may be put.

- *Historical vs Hypothetical cases.* Many cases are based in actual experience in the field. These provide the sort of excitement and immediate relevance that help students recognize the importance of ethical enquiry. Cases that are hypothetical, fictional, or abstract remove much of the impact of the historical case, though they allow the case writer the freedom to structure, abstract, and focus the discussion on precisely the issues of concern. Neither approach is better than the other, but their usefulness depends on the goal. The emotional impact of historical cases is helpful in connecting students to their real responsibilities as professionals, while the flexibility and focus of hypothetical cases is helpful in introducing students to specific issues and their variations.
- *Thick or Thin cases.* Cases can range from very simple half-page or one paragraph descriptions (e.g., <http://www.uprm.edu/ethics>) to cases with enormous detail (e.g., <http://www.computingcases.org>). The cases at [computingcases.org](http://www.computingcases.org) have from 40-60 pages of information each. Thin cases are useful for abstracting a single point and focusing work on that point. Thick cases can give the student practice in making ethical decisions in the full context of the messy real world. Of course, one cannot simply dump students into a thick case to sink or swim (sink will be the outcome). These can be introduced piecemeal, as “thinner” cases and have the complexity built up slowly. Again, neither approach is better, and usefulness depends on the particular goal.
- *Good vs. Bad News cases.* The tendency in ethics cases is to have only bad news cases, cases in which some bad outcome occurs because of poor choices.^{26 (pp.155-156)} This can grab students’ imaginations (people are highly motivated to avoid bad outcomes) but can also give students the impression that SEE is primarily about avoiding harm. Bad news cases should be balanced with cases of morally exemplary scientists and engineers as well as with good choices toward good outcomes made by ordinary scientists and engineers. Again the point is to choose the approach based on the purpose.
- *Big vs. Small News cases.* Many cases available are about big news, about things that show up in the newspaper.^{28 (p.23)} Almost by definition these are rare events, and it can be hard for students to imagine themselves caught in a widespread fraud or catastrophic software safety case. Small news cases are about the everyday decisions that scientists and engineers make in the way they handle reporting, data collection, process management, personnel and other day-to-day issues. Again there is a tradeoff. Students can more easily imagine this happening to them, but the cases can be about less exciting issues. In both good vs. bad and big vs. small, the real determinant of success is often in the framing of the case for the student.
- *Evaluative vs Participative cases.* There are two perspectives from which to write and discuss scenarios: the evaluator or judge perspective and the participant perspective.^{26 (pp.153-154)} In the evaluator perspective, the student takes up a standpoint from outside the case and evaluates the participants and their deeds. In the participant perspective, the student takes on the role of one of the participants and makes a decision from that perspective. Participative cases are

written differently; they end abruptly at a moment of decision. This encourages the students to resolve the case by making and defending some decision. Evaluative cases are useful for introducing and practicing different ethical principles and concepts. Participative cases help students to practice integrating ethical considerations into designing and implementing solutions to real world problems; they also allow students to practice making decisions under real world constraints such as uncertainty and time pressures. Either type of case can be used with a range of pedagogical methods.

All cases fall on one point of each of these dimensions. For instance, Rich Epstein's *Case of the Killer Robot*²⁹ is a hypothetical, thick, big/bad news case, framed from the evaluator point of view. The Therac-25 case (as presented at www.computingcases.org) is historical, thick, big/bad news, and framed from the evaluator point of view. But, one can use it for a wide range of pedagogical purposes, particularly if one breaks the case up into smaller pieces done consecutively. For example, on pages 403-404 the Therac-25 case is divided up and just one decision situation is examined; this segment is now classified as an historical, thin, small/bad news, participant case.

Practical Suggestions for Planning Case-Based programs

We provide some practical suggestions here for implementing case-based teaching in a programmatic way. These suggestions are based in part in our own experience in implementing case-based projects at University of Puerto Rico Mayagüez (see www.uprm.edu/ethics) and on computingcases.org.

Case methods may look free form, but require extensive preparation and structure. It is a standard rule of teaching that the more free-form the approach looks, the more preparation is hidden behind it. In any use of a case, the likely outcome is disaster if one simply walks into the classroom and hands out a case (or shows up virtually with a posted case to discuss online). Science and engineering faculty are more used to teaching subjects in which answers are somewhat easily derived and are clear-cut. SEE, and cases in SEE in particular, require discussion and active approaches, and this can be intimidating for the lecture-based teacher. Those implementing case-based programs will need to provide extensive workshops and support material to make a case-based program work. Instructors who are new to the approach should start with more structure and gradually reduce reliance on it as comfort increases. Different structures will be required for the different approaches.

Case methods should be integrated with more traditional approaches. What the moral psychology literature calls intermediate concepts may be more easily introduced in reading and lectures than in case materials. Students can elaborate on their knowledge of these concepts by later using them in cases, either by explicit assignment, or by the judicious use of meta-comments by the instructor during a case discussion. Here are some examples of meta-comments that can help structure a discussion:

- “Your approach might be framed in terms of respect for the person. Could you try to reword it that way for us?” Here the meta-comment brings out an ethical approach implicit in the discussion.
- “Your comment assumes that reliability and safety are the same thing in a system. Could this system be reliable but unsafe?” Here the meta-comment raises an issue relating to the distinction between two important intermediate concepts.
- “So far we have been discussing only two alternatives to this problem and both of them seem bad. Is this a true dilemma, i.e., a problem that allows only two courses of action, both of them bad?” Here the meta-comment provides an invitation to reframe the problem being discussed to open new possibilities for consideration.

These instructor comments about the process and content of the discussion can lead back to material covered in text or lecture. They can be equally effective in face-to-face and online venues. Assignments to argue two sides of a case could explicitly require students to frame their arguments in terms of philosophical positions or intermediate concepts taken from the book or lecture. The main point here is that case-based teaching is not usually a stand-alone method.

There are numerous ways to use any one case. Cases provide a flexible, highly adaptable tool for raising ethical and technical issues. Take the following scenario from the Therac-25 case as presented at www.computingcases.org:

You are a service engineer who works for AECL, a company that manufactures and sells the Therac-25 machine that administers doses of radiation to cancer patients to kill cancer cells. Your supervisor asks you to investigate a Therac-25 unit in a hospital in Hamilton, Ontario. According to the hospital physicist, this unit has administered a massive overdose to a patient. The designers claim that such an overdose is impossible. Nevertheless, you examine the unit at the Hamilton hospital. In spite of several attempts, you are unable to duplicate the accident the operator claims has occurred.

This is a specific scenario from a very detailed case, but there are still many different ways to approach it:

1. *Discuss it in an unstructured, spontaneous, and informal way.*
2. *Hold a structured discussion of the case using ethical approaches and a case analysis framework.* For instance, take the case through the five “informal ethics tests” framework presented on computingcases.org. Use the ethics tests to evaluate and rank possible solutions.
3. *Role-play.* Students could approach the case from the participant perspective by recreating the meetings held between AECL and the Therac-25 operators. The class could be divided into groups and assigned the following stakeholder roles:
 - a. AECL (management, legal department, board of directors, software design team)

- b. FDA officials
 - c. Operators from the hospitals who have purchased the machine
 - d. The AECL team charged with writing a Corrective Action Plan
4. *Approach the case from a judge's perspective.* Students could study the decisions actually made in the Therac-25 case, their consequences, and then assess these as though they were members of an external review panel.
 5. *Have students write a dialogue that dramatizes the problems presented by the case.* Have them act it out/videotape it.
 6. *Have students write a dialogue that dramatizes how they would carry out the solution they have devised.* Have them act it out/videotape it.
 7. *Use cases to practice making decisions.* The above scenario presents the Therac-25 case at a key moment of decision for one actor, an AECL service engineer. Students can be placed in this role and asked to provide a decision and a memo that defends the decision. The instructor could bring about closure by presenting the decision actually made and then comparing this with the decisions the students offered.
 8. *Have a structured controversy.* Have students defend and prosecute the actual decision that was made in the case.

This really is just a starter list for how this case might be used. Each approach assumes different instructional goals (e.g. practicing moral imagination vs. learning intermediate concepts) or could be modified in its structure to achieve different goals. And each approach will require different kinds of preparation for the instructor and structure in the classroom.

There is no definitive or objective way of writing a case. As the previous section makes clear, there is no single best, or even most objective, presentation of a case for the classroom. Michael Davis²⁶ (pp.172-174) provides some rough guidelines for case writing, but instructors from different specialties (computer science, social science, philosophy) who use these guidelines to present a structured controversy of the same specific thin, historical case will still likely approach it differently depending upon what they want to emphasize. The important point is that the case and its presentation and structure must fit the purposes of the instructor.

Concluding Comments about Online SEE education

Discussion of moral psychology and of the practical pedagogy of case teaching makes it clear that a broad range of goals and approaches falls within the framework of case-based education. Some of these goals are custom-made for online implementation. Certainly the acquisition of relevant intermediate concepts and basic facts can be accomplished online. It is also likely that online learning can exercise the moral imagination and help to produce moral sensitivity, particularly in the specific areas that the online class targets. Structured exercises like those mentioned in this text and in other case-based teaching resources can, with care and attention to structure and goals,

be adapted to online presentation. The important point here is that cases poorly conceived and developed offline will be poorly done online.

Well designed cases, with appropriate goals and structure can be adapted to online courses in a variety of ways. Some instructors may use online discussion forums to continue face-to-face classroom discussion. Others may simply present materials on the web (in the spirit of computingcases.org). Others may place the entire course experience online. Some students may even take an SEE course as a part of a primarily online engineering program.

Computingcases.org provides case material online but the material is primarily designed for use in the traditional offline classroom. Online discussion forums, however, allow—and even facilitate—interactive exercises such as case discussion, role playing, structured controversies, etc. So there are no *a priori* barriers to effective online SEE education, even when using highly interactive case-based methods.

It is less clear that online education, without the social influence of direct contact with other students and professionals, can encourage students to adopt ethical standards into their professional self-concept or encourage the formation of ethical communities. For instance, as mentioned earlier, well led discussions can help students learn the habit of listening to each other, even when they disagree. We suspect, though, that the habits/skills used in online discussion differ from those used in face-to-face discussions in offline settings. Those who learn to listen in an online forum may find themselves falling into old habits in the heat of a face-to-face interchange. In the end, it is an empirical question whether skills learned online will generalize to the face-to-face situations where scientists and engineers will need them.

It is also an empirical question whether online discussion can enhance or supplement offline, classroom discussion. We suspect that it can. At the very least, there is no reason why online discussion should be pursued to the exclusion of face-to-face discussion. We cannot treat the online world as though it were isolated from the face-to-face one. Most online interaction is, in fact, a complement or adjunct to face-to-face interaction, even in our highly electronic world. The articles in the volume on online interaction edited by Sara Kiesler³⁰ show that the online world is in regular interaction with the “real” world. Students in online classes often show up (or are required to show up) for face-to-face classes over the course of their career. The volume provides powerful evidence that online interaction can supplement face-to-face interaction to form collectives that look suspiciously like communities, with all the affective and social aspects one might expect. This same process can happen in learning communities that share both physical and online space. In the end, those who plan instructional programs should think about how they will take advantage of this interaction to serve the set of goals they have designed for an instructional program in SEE. Empirical work might focus on which sorts of skills (or which places in the learning curve of a skill) are best supported by face-to-face vs. online instruction.

Viewing online, case-based activities as an extension and supplement to regular classroom activities opens up all sorts of interesting and fruitful possibilities. Two of these are using online forums to present thick case projects, and creating online case

repositories that students themselves set up and that accumulate from semester to semester.

1. Online forums such as computingcases.org provide an organic format for developing and presenting large cases. Cases can be introduced through a short general summary. Students can be guided through the case in different ways by pursuing structured sets of links provided by the instructor. Supporting materials can be linked to the case narrative to provide students with dramatically different views of the action and intentions of the actors in a case. This differential experience of a complex case mimics the real-life experience of those in the case itself; no one has the complete overview and students must piece their understanding of the case (and their ethical response to the case and to each other) together by negotiation.
2. Online forums can also serve as repositories in which students can post cases, bibliographies, summaries, presentations, analyses, useful articles, and other materials related to course study. One such model is Ethics in Computing developed by Edward Gehringer.³¹ (See www2.ncsu.edu/eoos/info/computer_ethics). At the University of Puerto Rico, Mayagüez, we will be developing case repositories linked to our ethics center's home page. Students in engineering and computer ethics classes will consult these repositories when working on different cases assigned in class. There are two advantages to using online web sites to house case repositories: many students can access the cases at the same time (as opposed to, for example, the library's reserve reading room) and students have the opportunity to view and build upon the work of students from previous semesters.

Certainly, online course delivery can magnify bad pedagogy. Online activities can also magnify, enhance, and supplement good pedagogy. The results of recent work in moral psychology can clarify just what is involved in good pedagogy in ethics. Moreover, case-based moral education can be a means of achieving many of the goals outlined by moral psychology. To help guide the effective implementation of case-based moral education, this paper includes a taxonomy of types of cases, the pedagogical goals they can promote, and the ways in which they can be presented in the classroom. Our conclusion is that good moral pedagogy in SEE can be enhanced by online methods. Our own choices have been to support face-to-face pedagogy with online access to material.

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