Sci Eng Ethics (2013) 19:545–568
DOI 10.1007/s11948-011-9349-0

ORIGINAL PAPER

The Effectiveness of Ethics Education: A Quasi-Experimental Field Study

Douglas R. May · Matthew T. Luth

Received: 30 September 2011 / Accepted: 20 December 2011 / Published online: 3 January 2012

Abstract Ethical conduct is the hallmark of excellence in engineering and scientific research, design, and practice. While undergraduate and graduate programs in these areas routinely emphasize ethical conduct, few receive formal ethics training as part of their curricula. The first purpose of this research study was to assess the relative effectiveness of ethics education in enhancing individuals' general knowledge of the responsible conduct of research practices and their level of moral reasoning. Secondly, we examined the effects of ethics education on the positive psychological outcomes of perspective-taking, moral efficacy, moral courage, and moral meaningfulness. To examine our research hypotheses, we utilized a pretest–posttest quasi-experimental design consisting of three ethics education groups (control, embedded modules, and stand-alone courses). Findings revealed that both embedded and stand alone courses were effective in enhancing participants' perspective-taking, moral efficacy, and moral courage. Moral meaningfulness was marginally enhanced for the embedded module condition. Moral judgment and knowledge of responsible conduct of research practices were not influenced by either ethics education condition. Contrary to expectations, stand alone courses were not superior to embedded modules in influencing the positive psychological outcomes investigated. Implications of these findings for future research and practice are discussed.

D. R. May (✉)
International Center for Ethics in Business, The University of Kansas,
330 Summerfield Hall; 1300 Sunnyside Ave., Lawrence, KS 66045-7585, USA
e-mail: drmay@ku.edu

M. T. Luth
The University of Kansas, 102 Summerfield Hall; 1300 Sunnyside Ave.,
Lawrence, KS 66045-7585, USA
e-mail: mattluth@ku.edu

Keywords Ethics education · Responsible conduct of research · Positive organizational scholarship · Moral efficacy · Moral courage · Moral meaningfulness · Moral reasoning

Introduction

Recent highly publicized events of the falsification of data and embezzlement of government research funds by scientists in stem-cell research (Choe 2009), the wide-spread unethical research practices admitted by government-funded scientists (Cook 2005), and multiple instances of scientific misconduct by a Harvard professor studying animal and human cognition surrounding morality itself (Wade 2010) all heighten the need for more systematic attention to ethics education among scientists and engineers. Similarly, calls for engineering education reform note the need for greater emphasis on professional and ethical responsibilities as well as the societal and global contexts in which engineers operate (Galloway 2007). Indeed, Roach and Simon (2008) argue that educators do a disservice to future engineers, scientists, and society as a whole if we don't adequately train them to understand the ethical significance of the work they do in their professions.

The purpose of the research discussed here was to build on this past research by examining the relative effectiveness of ethics education courses created through a 3-year, multi-institutional faculty development program. We use the term "ethics education" here to refer to the delivery of ethically-relevant content to students which may include information on the responsible conduct of research as well as the ethical decision-making process. In the present study we are concerned with three important outcomes of such ethics education: (1) moral reasoning, (2) knowledge of responsible conduct of research, and (3) positive psychological outcomes.

To assess the effectiveness of ethics education, we used a rigorous pre/post-test control group research design to determine the effectiveness of a faculty development program in enhancing ethics-related outcomes in their students. Our research extended previous work in this area by: (a) examining the effects of ethics education within the context of a long-term faculty development program, (b) inclusion of psychological variables previously unexplored in the responsible conduct of research or ethics literature, and (c) the inclusion of engineering and science disciplines not previously examined in the responsible conduct of research or ethics literature.

Literature Review

Recent research has attempted to understand the effectiveness of ethics education in science and engineering through a variety of approaches. For example, Thomsen (2007) conducted an in-depth case analysis of one course in ethical issues in physics that he had taught for the last 15 years. He examined how the content had changed over time to include topics on the responsible conduct of research (RCR) and physicists' interactions with society at large. Thomsen noted that instructors should

tailor assignments to the career needs of students and attempt to help the students understand what ethical standards exist in the field, why they exist, and how to apply them to situations they are likely to face in their careers.

Other work by Plemmons et al. (2006) surveyed participants (e.g., undergraduate, graduate, post-doctoral students) at the end of eleven different courses on the RCR at ten different institutions. Qualitative and quantitative findings confirmed that the participants felt that their knowledge of such issues was enhanced, but that their skills and attitudes about the RCR were not necessarily influenced. Thus, additional research is needed that focuses on ways to develop specific ethical reasoning skills and attitudes concerning research conduct.

Powell et al. (2007) reported on the effectiveness of a RCR course with pre/post data to try to address some of these research needs. Specifically, Powell and his colleagues examined such outcomes as knowledge, ethical decision-making skills, RCR attitudes, and the frequency of discussions students had regarding RCR topics outside of class. Unfortunately, the only statistically significant improvement was in students' knowledge of RCR practices, but there was a positive trend toward an improvement in reasoning skills and RCR attitudes. Other research on the enhancement of moral reasoning skills with RCR courses in science and engineering has demonstrated similar mixed results (e.g., Bebeau et al. 1995; Heitman et al. 2002).

Most recently, Antes et al. (2009) addressed the effectiveness of ethics instruction in the sciences by conducting a meta-analysis of extant empirical studies on ethics education for scientists in the fields of medicine, health, and psychology. These researchers defined ethics education as "any instructional program or course, including single courses in ethics, multiple courses in a sequence covering ethics, or an entire curriculum, spread over time, that addressed scientific, research or medical ethics" (p. 385). Overall, these researchers found that ethics education did influence both students' moral development and "ethical analysis" (i.e., ethical decision-making and ethical sensitivity). Furthermore, when examining potential moderators in their research, Antes et al. (2009) found that courses held in a stand-alone fashion had greater overall effectiveness than those embedded in an existing course/curriculum. Also of interest is the fact that these scholars found that more rigorous research designs tended to find lower overall effects for ethics education efforts.

Faculty Development Workshop

This research was conducted within the context of a NSF-funded, 3-year faculty development project in ethics education for a major university located in the Midwest. Faculty from the host institution and two nearby universities were recruited through contacts with individuals in departments in the sciences and engineering. Interested faculty participated in a 5-day workshop that first gave them a firm grounding in the philosophical foundations of utilitarianism, rights, justice, virtues, and sample cases in the sciences and engineering. Case discussions were used to illustrate how to apply the material to specific problems faced by researchers

and practitioners in science and engineering. Participants were also exposed to the psychological foundations of moral development, the steps of ethical decision-making, and a series of biases that individuals may experience when processing ethical issues. Organizational dimensions that may influence ethical decision-making were also covered in the seminars (e.g., organizational culture, leadership, group norms, and reward systems). Finally, workshop participants were exposed to considerations to attend to when implementing an ethics module in their courses (goal, design, pedagogical method, etc.). All of the above content was covered during the first 2 days of the workshop. In the third day, participants received assistance from the University's Center for Teaching Excellence in helping them consider how to apply the material to their specific course or curriculum. Exemplars were shared of previous work by workshop participants. Participants came back after a few months to review of some of the topics covered during the first 3 days, discuss professional codes of conduct, and give advice on their progress in designing a module for their courses. Near the end of the semester, participants came together for the fifth day of the workshop to present their ideas to the group on the module they planned to implement in the curriculum they taught. Most of these plans were for graduate level courses.

Ethics Education Outcomes

Careers in engineering and science are very complex. Not only do practicing scientists and engineers require specific, and difficult to acquire, technical skills, they also must use effective interpersonal skills to navigate the organizational landscape. Similar to most professions in contemporary society, scientists and engineers must collaborate with others, and they must effectively communicate issues, ideas, and solutions. Moreover, engineers and scientists are often faced with ill-structured workplace problems (Jonassen et al. 2006) which may have ethical implications and they have a professional responsibility to both recognize and address such issues.

The complex nature of professions in science and engineering has made it difficult for researchers and practitioners to determine what processes to focus on to encourage ethical behavior in the workplace. Although recent years have seen progress in teaching ethics to science and engineering students, unfortunately there have been relatively few empirical findings suggesting how to improve ethical awareness, decision-making, and behavior. While empirical findings have been scant, there has been some conceptual work that suggests important objectives for science and engineering ethics education. For example, Harris et al. (1996) identified nine objectives including: helping students deal with ambiguity, improving ethical will-power, encouraging students to take ethics seriously, increasing student knowledge of relevant standards, and improving ethical judgment. Continuing this work on targeting outputs of ethics education, Newberry (2004) argued that objectives could be consolidated into three broad categories: emotional engagement (the willingness and courage to make ethical decisions), intellectual engagement (knowing how to make ethical decisions), and particular

knowledge (knowing the standards of ethical practices). Finally, Haws (2001) argued that engineering programs must encourage students to evaluate alternatives from other perspectives and understand issues from diverse stakeholder perspectives.

Using these conceptual developments as a starting point and building on ethics education research in other disciplines, we designed our study to capture several of the dimensions thought to be important for science and engineering ethics education. In the following sections we introduce this study's six targeted outcomes and discuss their rationale for inclusion.

Moral Judgment/Reasoning

Moral judgment reflects the process by which individuals determine whether a particular action is morally right or wrong (Rest 1986), and has been viewed as a foundation piece of ethical behavior in a variety of disciplines including science and engineering (Harris et al. 1996; Haws 2001). Moral judgment is the foundation of Kohlberg's theory of cognitive moral development (Kohlberg 1969), which argues that as individuals mature they move through increasingly sophisticated stages of moral development, and that individuals with higher levels of moral development should exhibit improved moral judgment. Therefore, consistent with previous research in other fields, we sought to examine the effects of ethics education on students' level of moral reasoning in the specific context of science and engineering. One of our goals in the faculty development workshops was to train faculty in the ability to teach students one or more of the ethical foundations for how to examine ethical issues.

Knowledge of Responsible Conduct in Research

Newberry (2004) maintains that particular knowledge, or knowing currently accepted ethical standards, should be a primary objective of ethics education. Therefore, another goal of ethics education efforts in science and engineering is to develop the students' knowledge of responsible conduct of research (RCR) practice. As noted above, Powell et al.'s (2007) examination of a short-term course in RCR showed that increased knowledge of RCR practices was the only statistically significant outcome of the course. Plemmons et al. (2006) similarly found that the impact of research ethics courses on knowledge outcomes was greater than changes in skills or attitudes in their multi-institution study. Other researchers have sought to develop an assessment tool of the core concepts and standards of RCR by doing a content analysis of 20 published RCR texts (Heitman et al. 2007). These authors demonstrated from baseline studies that the mean scores of new graduate students are around 60% correct of 30 questions that address such topics as falsification and fabrication of data, recording of data, plagiarism, responsibilities of authors, conflict of interests, coercion in human research, reviewer's responsibilities, informed consent, institutional review boards, submission of manuscripts, animal research policies, disclosure of conflicts of interest, and retention of data.

Positive Psychological Outcomes

Recent developments in engineering (Newberry 2004) echo those in social psychology (Haidt 2001), positive psychology (Handelsman et al. 2002), and management (Sonenshein 2007) that argue rational ethical decision-making models can be improved by focusing on the social-psychological and emotional nature of such decision-making. Therefore, another major purpose of this research was to expand the focus of typical ethics-related outcomes (i.e., moral judgment and knowledge of standards) by incorporating ideas on positive ethics from positive psychology. Positive psychology is generally concerned with the fostering the positive subjective experience (e.g., well-being, satisfaction, and flow), constructive cognitions about the future (e.g., hope), positive personal traits (e.g., the capacity for love, courage, perseverance, forgiveness) and fostering responsible citizenship (Seligman 2002). Positive ethics is focused on fostering ethical decision-making and behaviors, rather than constraining unethical behaviors (Handelsman et al. 2002).

Specifically, recent work by May et al. (2009, 2010) in the business ethics education literature suggests that future ethics education would benefit from examining such positive variables as *moral efficacy, moral courage, and moral meaningfulness*. Furthermore, we considered the effects of ethics education on individuals' abilities to take the perspective of others when considering their actions. Each of these is briefly reviewed below.

Perspective-Taking

Ethics education often aims at enhancing the ability of students to understand the consequences of their actions on others. In the engineering ethics literature, Haws (2001) argues that ethical behavior should be grounded in considering alternatives from different perspectives and communicating with divergent stakeholders. Such perspective-taking also should contribute to what Harris et al. (1996) refer to as increased "ethical sensitivity." When individuals take on multiple perspectives, it enables them to empathize with others and develop a deeper sensitivity to issues and decisions that affect others. Empathy has two fundamental components—cognitive and affective. We focus here on the cognitive component because it seems to play a more significant role in the ethical decision-making process (Mencl and May 2009). Cognitive empathy entails thoughts about the potential negative or positive effects that an action has on others; that is, attempting to take their perspectives. Such perspective-taking has been shown to result in better cooperation among team members in an organization (Parker and Axtell 2001). Within the ethics literature, cognitive empathy has been found to be more closely related to moral judgment than the emotional/affective dimension of empathy (Kalliopuska 1983; Leith and Baumeister 1998). Perspective-taking may even be a vital component to developing what Harris et al. (1996) and Lau and Devon (2001) refer to as ethical or moral imagination. When individuals take on the perspectives of others and engage with them in collaborative dialogue, it increases the potential to cognitively imagine new possibilities for ethical solutions.

Moral Efficacy

As noted above, one of Newberry's (2004) objectives of ethics education is intellectual engagement (i.e., knowing how to make ethical decisions). We extend this work beyond simple knowledge and argue for a social-cognitive perspective based in Bandura's work that maintains that individuals must have both competence and confidence in their ethical abilities. Specifically, moral efficacy is derived from the psychological literature on self-efficacy which is the belief that one can carry out a task successfully (Bandura (1997). Believing that you can do something plays a powerful positive force in one's life (Maddux 2002). Indeed, self-efficacy has been linked to a variety of behaviors, learning outcomes, and performance in a variety of environments (e.g., Judge and Bono 2001). Extending these ideas to the ethics field, May et al. (2009) defined moral efficacy as "an individual's confidence in one's ability to actively and positively deal with ethical issues that arise in the workplace and to overcome obstacles to developing and implementing ethical solutions to ethical dilemmas" (p. 7). These authors found that a course dedicated to business ethics education was successful in developing individuals' moral efficacy beliefs. Furthermore, subsequent work by these researchers found that moral efficacy influenced individuals' independently-rated moral behaviors in the workplace (e.g., raising ethical issues to management, making suggestions for solutions to ethical problems) through their own moral courage (May et al. 2010).

Moral Courage

Harris et al. (1996) maintains that increasing "ethical will-power" should be an important outcome of engineering ethics education. Will-power represents an aspect of self-control and suggests an unwavering commitment to carry out desired tasks. We use the concept of moral courage to represent this unwavering commitment to carry out tasks in an ethical manner despite potential negative consequences for oneself. Courage is a concept from positive psychology and one dimension, moral courage, has been argued to be fundamental to positive human mental health (Lopez et al. 2003). May et al. (2003) maintain that moral courage is "the fortitude to convert moral intentions into actions despite pressures from either inside or outside of the organization to do otherwise (p. 255)." Thus, individuals often face aversive consequences if they choose to act in a positive moral manner to correct an injustice or an unethical action. Moral courage helps explain how individuals translate their morally efficacious beliefs into actual actions or behaviors (Hannah et al. 2011). As noted above, recent research on moral courage suggests that it may influence peer ratings of positive ethical behaviors in the workplace (May et al. 2010) as well as peer ratings of ethical and pro-social behaviors in the military (Hannah et al. 2011).

Moral Meaningfulness

Instructors in all disciplines must integrate ethics effectively into the curriculum so that students see it as meaningful and therefore take it seriously. As human beings, we all strive to achieve meaning in our lives and individuals need values that lead to

a sense of goodness to their lives and themselves as human beings (Baumeister and Vohs 2002). Indeed, Blasi (1999) has argued that morality is critical to one's understanding of him/herself and other authors maintain that acting consistently with ones values brings meaning to individuals (Bergman 2004). Thus, *moral meaningfulness* represents the extent to which one gains meaning from behaving ethically (May et al. 2009). Engineering and science instructors who effectively build an awareness of the need to consider ethics in decision-making and apply it to real-life problems faced by practitioners should enhance the meaning that students see in their ethical behavior.

Research Hypotheses

Based on the above literature review, we expected that ethics education in science and engineering courses would positively influence students' knowledge of RCR practices as well as their level of moral reasoning (i.e., moral judgment). Drawing from recent research in the business ethics education domain, we also expected that ethics education initiatives would positively influence the ethically-relevant psychological variables of perspective-taking, moral efficacy, moral courage, and moral meaningfulness.

In the current study, we were particularly interested in a comparative analysis of the relative effectiveness of stand-alone versus embedded approaches to teaching ethics to scientists and engineers. Given the recent research review by Antes et al. (2009), we expected that the stand alone ethics courses would result in more effective outcomes than the embedded ethics module courses. We contribute to their research by examining the specific ethics-based criterion measures of knowledge of RCR practices and moral judgment since they were only able to provide an overall estimate for this comparison. Furthermore, our study extends the research in this area by examining the four positive psychological outcomes of perspective-taking, moral efficacy, courage, and meaningfulness.

Specifically, we maintain that in a stand alone ethics course much more time and interaction is spent with the students on the ethical issues in their profession. This additional "time on task" is likely to enhance students' knowledge of proper research practice. Furthermore, students in stand alone courses are able to repeatedly practice how they would handle different ethical issues which should both build their perspective-taking and moral judgment abilities as well as their confidence in such abilities (i.e., moral efficacy). As noted by previous authors (May et al. 2009), such confidence should be basis for the willingness to engage in future morally courageous actions to report and/or correct unethical actions in the research context. Finally, students in stand alone courses have more time to integrate the importance of ethical actions into their identities as engineers and scientists (i.e., moral meaningfulness). The study's specific hypotheses are listed below:

Hypothesis #1 *Individuals who receive ethics education in an engineering or science course should experience more improvement in their (a) knowledge of RCR*

practices and moral judgment and (b) positive psychological outcomes (i.e., perspective-taking, moral efficacy, moral courage, and moral meaningfulness) than those who do not receive such ethics education (i.e., the control group).

Hypothesis #2 *Individuals who participate in a stand alone ethics course should experience greater improvement in these effectiveness measures than those who receive ethics education in an embedded module condition.*

Methods

Participants and Setting

Participants were students enrolled in graduate and undergraduate engineering and science courses at three different Midwestern universities. Three treatment conditions were selected for this study: a control group, an embedded ethics module group, and a stand-alone ethics course group. The control group consisted of participants who were not enrolled in any ethics-based coursed during the current semester. The embedded group consisted of participants who were enrolled in a course where ethics was not the primary topic, but instead ethics was embedded in the curriculum. The stand-alone group consisted of participants who were enrolled in a stand-alone ethics course, where ethics content was the primary material for the course. In order to ensure the accuracy of classifying courses into their respective treatment condition, participating course instructors were asked to indicate whether ethics was the primary topic of the course (stand alone), embedded in the curriculum (embedded), or the course included no overt ethics content (control). All groups consisted of participants enrolled in programs in science, engineering, and technology.

The second author administered the survey instruments to the participants in the respective classes. Participants were invited to participate in a research project concerning education curricula, but were unaware that the research questions specifically focused on ethics education and were blind to the research hypotheses. In order to match pretest and posttest survey instruments, participants were asked to generate a unique identification number based on family information. All participants were assured of strict confidentiality and that only the research assistant would have access to individual-level data.

This study employed a quasi-experimental pretest–posttest with nonequivalent control group design. Dependent measures were collected at two points in time for the two treatment groups and the control group. Pretest measurement occurred during the first week of classes, before any course material was covered. Posttest measurement typically occurred the second to last week of the semester, after all the course materials were covered. For the treatment groups, this represents collecting the dependent measures before and after exposure to the ethics education content. By also collecting pretest and posttest measure for the control group at equal time intervals, we were able to control for the effects of repeated testing, history, and maturation in the sample (Cook et al. 1990).

As is common with pretest–posttest designs, some participants did not complete all the measures at both points in time. In addition the survey materials took over 1 h to complete, and although participants were given ample time to complete the survey, some participants did not complete all the measures. Of the 422 potential participants in this study, 150 (36%) completed at least one of the measures for both pretest and posttest conditions. Eighty-nine of the participants completed more two-thirds of the dependent measures (21%), while sixty-nine (16%) of the participants completed all of the dependent measures at both pretest and posttest conditions. Participants who did not complete any of the measures for either pretest or posttest were removed from the data analyses. These lower response rates were somewhat expected given the pretest–posttest design, the use of a time-intensive survey, and the volunteer nature of the survey at both the beginning and end of the semester.

To test whether the included respondents systematically differed from those excluded, we conducted a multivariate analysis of variance (MANOVA) using the socio-demographic variables collected in the study (gender, age, and education level). This omnibus test revealed that these socio-demographic variables varied somewhat as a function of inclusion/exclusion in the analyses, $F(3,334) = 3.44$, Wilks' Lambda = .97, $p < .05$. Follow-up tests revealed that there were no significant differences in age nor education level, but there were significant differences in gender, $F(1,334) = 8.83$, $p < .01$. In this sample, females were more likely than males to complete the survey instrument at both pretest and posttest conditions.

Of the total sample size of 150, 58.7% of the participants listed their current program as engineering, 20.0% were physical science (e.g., chemistry, physics, mathematics), 11.3% were natural sciences (e.g., biology, biochemistry, ecology), and the remaining 10% listed "other" as their current program. Participants' ages ranged from 18 to 43 years ($M = 25.1$ years, $SD = 4.4$ years). Slightly more than half (54%) of the participants were male. 50.7% of the sample was White/Caucasian, 16% of the participants were Asian, and 25.3% did not report their ethnicity. The percentage of undergraduates, masters/professional school, and doctoral students were 32.7, 26.7, and 40.7% respectively.

Measures

Moral Judgment

Consistent with researchers (Antes et al. 2009; Kraiger and Jung 1996) who advocate that the criterion measure selected to assess instruction should reflect the intended outcome, we used one of the most widely adopted measures of moral reasoning or moral development—Rest and colleagues' Defining Issues Test (DIT-2) (Rest 1976; Rest et al. 1999). Rest's instrument is based on the work that Kohlberg (1969) and Rest (1986) have done in the area of cognitive moral development. This measure entails a set of five stories about social problems. After each story participants are asked to answer a series of questions regarding the ethical issues raised by each story. First participants are asked to take the position of the protagonist and select an action from the three proposed alternatives. After selecting

the action for each story, participants are then asked to rate 12 items in terms of importance for their choice. Completed surveys were sent to the Center for the Study of Ethical Development at the University of Minnesota for the initial statistical analysis and scoring of the N2 Index.

The N2 Index provides an indication of the extent to which an individual is acquiring more sophisticated moral thinking and gaining clarity about ideas that should be rejected for their simplistic or biased solutions (Rest et al. 1999). The N2 score has two components: the degree to which post-conventional reasoning items are prioritized plus the degree to which the personal interest items (i.e., lower stage items) receive lower ratings than the ratings given to post-conventional items (i.e., higher stage items). *Personal interest* items focus on items that appeal to Stage 2 reasoning (i.e., focus on the direct advantages to the actor and on the fairness of simple exchanges of favor for favor) and Stage 3 reasoning (i.e., focus on the good or evil intentions of the parties, on the party's concern for maintaining friendships and good relationships, and maintaining approval) considerations. On the other hand, *post-conventional* items represent items selected that appeal to Stage 5 reasoning (i.e., focus on organizing a society by appealing to consensus-producing procedures, insisting on due process, and safeguarding minimal basic rights) and Stage 6 reasoning (i.e., focus on organizing social arrangements and relationships in terms of intuitively appealing ideal considerations).

The N2 score of moral judgment is based on the choice of action and the ratings of the 12 subsequent items. Cronbach alpha reliability scores for the N2 score for the pretest and posttest were 0.73 and 0.75 respectively.

Knowledge of Responsible Conduct of Research

Baseline knowledge of the responsible conduct of research was measured using a 30-question multiple-choice assessment of the core concepts and standards in responsible conduct of research developed by Heitman et al. (2007) after extensive review of the RCR literature. We chose to use this measure in our research due to the breadth of RCR topics covered given that the faculty selected to participate in the project were from a diverse set of departments (e.g., engineering, chemistry, physics, and pharmacy). The total number of correct answers was used as the participant's knowledge of RCR.

Perspective-Taking

We measured perspective-taking using a six-item measure developed for this study based on Davis (1980). Participants were asked to select the best response to a series of statements using a 7-point Likert scale from 1 *(strongly disagree)* to 7 *(strongly agree)*. Sample items include: "I try to look at everybody's side of an argument before I make a decision" and "I sometimes find it difficult to see things from the 'other person's' point of view (reverse-scored)." The Cronbach alpha for this measure of perspective-taking was 0.68 for the pretest and 0.61 for the posttest.

Moral Efficacy

Moral efficacy was measured using fourteen items based on Parker's (1998) self-efficacy scale. Participants were asked to indicate their confidence level in addressing each of fourteen tasks using a 5-point Likert scale from 1 *(not confident at all)* to 5 *(very confident)* including such tasks such as "making suggestions to management for an ethical problem" and "writing a proposal to resolve an ethical problem in your work unit." Scores from the fourteen items were averaged to form a single scale. The Cronbach alpha was 0.89 for the pretest measure and 0.87 for the posttest.

Moral Courage

Moral courage was measured using six items based on the work by Gibbs et al. (1986) and used by May et al. (2009). Participants were asked to select the best response to a series of statements using a 7-point Likert scale from 1 *(strongly disagree)* to 7 *(strongly agree)*. Sample items include: "I would stand up for my position even if it meant negative consequences" and "I would prefer to remain in the background even if a friend is being taunted or talked about unfairly (reverse coded)." The Cronbach alphas for the pretest and posttest measures of moral courage were 0.68 and 0.70, respectively.

Moral Meaningfulness

We measured moral meaningfulness using four items (May et al. 2009). Participants were asked to read a series of statements and select the best response on a 7-point Likert scale from 1 *(strongly disagree)* to 7 *(strongly agree)*. These items were "Maintaining high morals/ethics brings me meaning at work; I find that doing the right thing at work is personally meaningful for me; Doing the ethical thing gives me purpose at work; and, Behaving consistently with my morals is quite important to me." Cronbach alphas for the items were 0.82 for the pretest and 0.90 for the posttest.

Control Variables

We controlled for three additional variables that could influence the effects of ethics education. First, we controlled for the potential effect of gender because of our initial finding discussed above that females were more likely to fill out both pretest and posttest surveys. Second, we controlled for education level because our sample came from a wide variety of educational experiences (i.e., undergraduate, masters/professional school, and doctoral level).

Given the positive nature of the perceptual survey items (i.e., perspective-taking, moral efficacy, moral courage, and moral meaningfulness), we also controlled for impression management by using 10 items from the Balanced Inventory of Desirable Responding (BIDR; Paulhus 1991). Impression management is the deliberate and conscious self-presentation intended to present a more positive social

image. Since we were interested in how impression management might influence our dependent variables at the end of the semester, we controlled for the posttest measure (Chronbach alpha = .67).

Manipulation Check Variables

In addition, we included two independent items to assess the incorporation of the dimensions of ethics education in the courses across the conditions. Specifically, participants were asked to respond to two separate questions: (1) "to what extent has ethical decision-making been incorporated into your current coursework" and (2) "to what extent has knowledge of responsible conduct of research been incorporated into your current coursework." Participants responded to these items on a 7-point Likert scale ranging from 1 *(not at all)* to 7 *(a very great extent)*.

Results

Table 1 summarizes the internal consistency measures and bivariate correlations among the study variables.

Preliminary Analyses and Analytic Procedures

Tests for Selection Effects

Prior to evaluating our research hypotheses, we conducted a MANOVA to test for systematic pre-existing differences on our six dependent measures between the three experimental conditions. Results of this omnibus test revealed no significant differences between the three conditions (Wilks' Lambda = .728, $p > .05$), reducing the possibility that systematic pre-existing group differences could confound our examination of treatment effects in the data.

Analytic Procedures

In order to address our research hypotheses, we utilized a one-way analysis of covariance (ANCOVA) with our three experimental conditions as the independent variable as omnibus tests of overall group mean differences between our three experimental conditions. We conducted separate ANCOVAs for each of our six dependent measures. Gender, education level and the pretest score on the corresponding measure were included as covariates in each of the analyses, with posttest impression management added as a covariate to the models for perspective taking, moral efficacy, moral courage, and moral meaningfulness. As a test of group mean differences between our three experimental conditions on the outcome measures, we conducted pair-wise comparisons of means using Tukey's Honestly Significant Difference tests.

Table 1 Correlations and internal consistency measures

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Variables															
Covariates															
Gender[a]	–														
Education level	.21**	–													
Impression management	.07	.08	(.67)												
Pretest															
Moral judgment (N2)	.13	.06	−.07	(.73)											
Research knowledge	.13	−.01	.03	.21	–										
Moral efficacy	−.01	.07	.27*	−.08	.13	(.89)									
Perspective taking	.06	−.07	.27**	.17	.18	.40**	(.68)								
Moral courage	.11	−.11	.21*	.13	.31**	.28**	.50**	(.68)							
Moral meaningfulness	.01	−.21	.18	−.14	.10	.37**	.41**	.38**	(.82)						
Posttest															
Moral judgment (N2)	.21*	.13	−.11	.57**	.22	−.01	.23*	.18	−.01	(.75)					
Research knowledge	.11	.06	−.10	.44**	.60**	.16	.19	.24*	.05	.40**	–				
Moral efficacy	.00	−.17	.03	.02	.45**	.34**	.26*	.25*	.34**	.02	.38**	(.87)			
Perspective taking	.15	.08	.38**	.02	.24*	.34**	.67**	.34**	.29*	−.01	.08	.15	(.61)		
Moral courage	.19	−.10	.25*	−.01	.45**	.34**	.44**	.67**	.25*	−.01	.32**	.41**	.46**	(.70)	
Moral meaningfulness	.03	−.08	.08	−.22*	.26*	.29**	.38**	.30**	.51**	−.12	.18	.45**	.30**	.45**	(.90)

Internal consistency reliabilities appear in parentheses along the diagonal

* $p < .05$; ** $p < .01$

[a] *Dummy-coded* 0 for male, 1 for female

Manipulation Check

In order to verify the inclusion of elements of ethics education in the courses across the different conditions, we conducted two manipulation checks. Our first manipulation check item dealt with the extent to which ethical decision-making was incorporated into the participants' current course work. As expected, information on ethical decision-making did vary significantly as a function of the experimental condition, $F(2, 96) = 9.92$, $p < .001$, $\eta_p^2 = 17$. Post hoc tests revealed that both the stand-alone ($M = 5.56$, $SD = 1.33$, $p < .001$) and embedded ($M = 5.03$, $SD = 1.35$, $p < .001$) conditions rated the extent to which ethical decision-making was incorporated into the current coursework higher than participants in the control ($M = 3.88$, $SD = 1.90$) condition. Although the difference in means between the stand-alone and embedded conditions was in the correct direction, we did not find evidence for group mean differences ($p > .10$).

Our second manipulation check item dealt with the extent to which information on RCR was incorporated into the participants' course work. Results of this analysis indicated that RCR information varied marginally as a function of experimental condition, $F(2, 96) = 2.76$, $p < .10$, $\eta_p^2 = 05$. Post hoc tests revealed that participants in the stand-alone ($M = 4.93$, $SD = 1.79$, $p < .05$) rated the extent to which knowledge of RCR was included into the current coursework higher than participants in the control condition ($M = 3.92$, $SD = 1.85$). However, we found no differences between the embedded ($M = 4.68$, $SD = 1.51$, $p > .10$) condition and either the stand-alone condition or the control condition, although mean differences were in the expected direction.

Taken together, the results of these tests for the manipulation check items provide some assurance that information on ethical decision-making and knowledge of RCR were incorporated to the greatest extent in the stand alone ethics education condition, followed by the embedded and the control conditions, respectively.

Hypothesis Testing

Moral Judgment

In our sample, moral judgment did not vary significantly as a function of treatment condition, $F(2, 123) = 0.35$, $p > .10$, $\eta_p^2 = .01$. As indicated in Table 2, post hoc tests corroborated the omnibus tests and indicated that none of the treatment condition means were significantly different from one another. Thus, contrary to our predictions in H#1 and H#2, moral judgment did not increase as a function of the ethics education conditions and, hence, moral judgment did not increase more for the stand-alone condition than for the embedded condition.

Knowledge of Responsible Conduct of Research

Analyses revealed that knowledge of responsible conduct of research varied only marginally as a function of treatment condition, $F(2, 83) = 2.88$, $p < .10$, $\eta_p^2 = .07$. As indicated in Table 2, post hoc tests detected no statistically significant

Table 2 Mean differences by experimental group

	ANCOVA F	R^2	ΔR^2	Parial eta squared	Mean[b]	SD[b]	N
Dependent variable							
Moral judgment	.35	.35	.00	.06			
Control					42.51_a	12.19	43
Embedded					42.94_a	11.86	43
Stand-alone					40.84_a	12.19	43
Research knowledge	2.88*	.40	.04	.07			
Control					15.55_a	3.62	20
Embedded					14.47_a	3.31	31
Stand-alone					16.36_a	3.30	38
Moral efficacy	3.79**	.25	.08	.09			
Control					3.56	.48	22
Embedded					3.90_a	.46	32
Stand-alone					3.90_a	.46	27
Perspective taking	3.85**	.58	.04	.09			
Control					4.96	.52	22
Embedded					5.34_a	.51	29
Stand-alone					5.30_a	.50	39
Moral courage	3.81**	.53	.04	.08			
Control					5.13	.57	22
Embedded					5.58_a	.55	29
Stand-alone					5.46_a	.54	39
Moral meaningfulness	2.02	.31	.04	.05			
Control					$5.62_{a,\dagger}$	.90	22
Embedded					$6.13_{a,\dagger}$	.87	29
Stand-alone					5.83_a	.87	27

* $p < .10$; ** $p < .05$

[a] Means that do not share any subscript "a" are significantly different at $p < .05$, one-tailed test. Means that share a dagger (†) are significantly different at $p < .10$, one-tailed

[b] Means and standard deviations are adjusted for covariates

differences between any of the three experimental conditions. Again, contrary to our expectations, knowledge of responsible conduct of research did not increase as a function of the ethics education treatment conditions (H#1) and it did not improve more for the stand alone courses versus embedded module courses (H#2).

Perspective-Taking

Our analyses did demonstrate that perspective-taking varied significantly as a result of treatment condition, $F(2,\ 83) = 3.85,\ p < .05,\ \eta_p^2 = .09$). As indicated in Table 2, and consistent with Hypothesis #1, planned comparisons indicated that participants in the stand-alone and embedded conditions rated their posttest

perspective-taking ability higher than participants in the control condition. However, contrary to Hypothesis #2, we found no differences between the stand-alone and embedded ethics education conditions.

Moral Efficacy

Moral efficacy also varied significantly as a result of treatment condition ($F(2, 74) = 3.79$, $p < .05$, $\eta_p^2 = .09$). As indicated in Table 2, planned comparisons for Hypothesis #1 indicate that participants in the stand-alone and embedded conditions again rated their posttest moral efficacy higher than participants in the control condition. However, contrary to Hypothesis #2 expectations, we found no difference between the stand-alone and embedded module conditions.

Moral Courage

Consistent with our expectations (H#1), findings also revealed that moral courage varied significantly across treatment conditions ($F(2, 83) = 3.81$, $p < .05$, $\eta_p^2 = .08$). As indicated in Table 2, planned comparisons indicate that participants in the stand-alone and embedded rated their posttest moral courage higher than participants in the control condition. Hypothesis #2 was not supported, however, as there was not a statistically significant difference between the stand-alone and embedded conditions.

Moral Meaningfulness

Finally, our initial overall analysis did not reveal that moral meaningfulness varied as a result of treatment condition, $F(2, 71) = 3.81$, $p > .10$, $\eta_p^2 = .05$. Although the omnibus test did not produce significant results, we decided to conduct a priori planned tests to further evaluate the data. While these results should be interpreted as somewhat tentative, Table 2 indicates that participants in the embedded, but not the stand-alone condition rated their posttest moral meaningfulness *marginally* higher than participants in the control condition. However, we found no differences between the stand-alone and embedded conditions.

Finally, a summary of the mean differences by experimental groups discussed in the above sections is shown in Table 2. The covariate-adjusted group means for the significant findings for perspective-taking, moral efficacy, and moral courage are illustrated in Fig. 1.

Discussion

Summary of Results

Overall, we found partial support for Hypothesis #1 which predicted that any form of ethics education (i.e., embedded or stand alone courses) would result in positive ethics-related outcomes. Specifically, perspective-taking, moral efficacy and moral

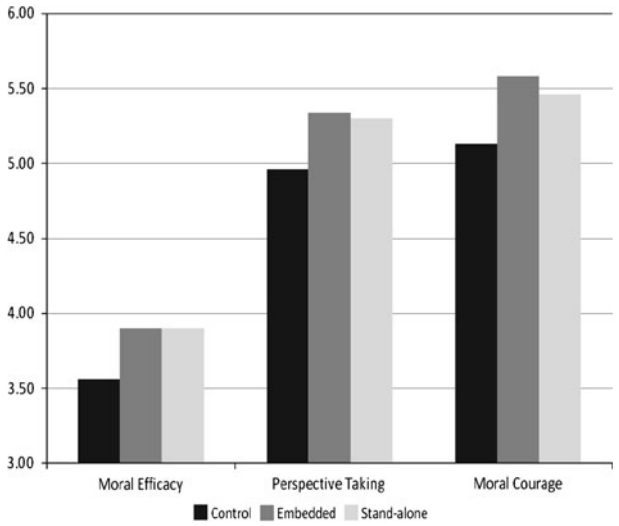

Fig. 1 Posttest group means adjusted for covariates

courage increased more for participants in the ethics education conditions (embedded and stand-alone) than for participants in the control condition. Second, we found marginal evidence that moral meaningfulness increased more for participants in the *embedded* condition when compared to the control group. However, we found no evidence in our research that either moral judgment or knowledge of responsible conduct of research increased in the expected direction for the ethics education conditions. Finally, we found no support for Hypothesis #2 which argued that stand-alone ethics education courses would provide better outcomes than embedded ethics module courses. The implications of these findings for future research and practice as well as the research study's strengths and limitations are discussed below.

Implications for Theory and Practice

First, our research findings reinforce recent calls in positive organizational psychology for more work that takes a positive approach to ethics (Handelsman et al. 2002). Combined with emerging research (May et al. 2009), our results demonstrate that ethics education can have positive effects on individuals' moral efficacy, moral courage, and moral meaningfulness across different disciplines (e.g., engineering, sciences, and business). As noted above, such effects are important because moral efficacy and courage have been linked to independently-rated moral behaviors in the workplace such as raising ethical problems to management and suggesting solutions even if such actions may have aversive consequences for their own careers (May et al. 2010). Such behaviors are critical to enhance the integrity and reputation of innovative R&D labs, scientific organizations seeking to advance knowledge, or engineering firms building new products that must meet stringent

safety guidelines. Individuals must be willing and able to discuss potential ethical problems before they occur and help solve them in order to build a strong ethical culture in their organizations.

Second, we also extend previous research in this area by demonstrating that ethics education can improve individuals' perspective-taking abilities which have been shown to be important for moral judgment (Kalliopuska 1983; Leith and Baumeister 1998) and cooperation in teams in organization (Parker and Axtell 2001). Our finding suggests that science and engineering programs would be well served to implement ethics education in their curricula in order to produce students who can work well together in organizations of the future. Since much of the work in organizations is project team-based, these skills are vital for successful careers. Future research may wish to explore the connections of perspective-taking to other positive employee attitudes and behaviors in the workplace. For example, perspective-taking may lead to higher levels of creativity or innovation as individuals are able to look at problems from multiple perspectives. Thus, perhaps such skills may generalize from the interpersonal domain to other areas.

Third, the findings for moral meaningfulness tentatively suggest that embedded ethics modules in the regular curriculum may provide better opportunities for students to integrate ethics into their professional identities than stand alone ethics courses. Such courses likely provide the appropriate professional context for discussions about relevant ethical issues. Students may be more engaged in such discussions given the meaningfulness they inherently possess because of their professional content. Future research may wish to explore which type of instructional method for ethics education leads to the most meaning individuals experience in the educational setting. Initial assessments of the successfulness of ethics education by Antes et al. (2009) suggests that interactive, case-based ethics instruction may hold the key to developing the meaningfulness individuals experience as they are able to more actively consider the importance of ethics to their professional identity.

Fourth, the lack of a significant effect for ethics education on students' general knowledge of the RCR was likely due to the diversity of the educational objectives that individual instructors used in their ethics education initiatives as well as the nature of the assessment of RCR knowledge. As noted above, the faculty development workshops gave the faculty participants much discretion how they chose to implement ethics into their curricula. Indeed, the results of the manipulation check for RCR knowledge integration suggested that only the stand alone courses appeared to address RCR knowledge in any systematic fashion; however, these courses may not have adequately addressed the type of knowledge assessed by Heitman et al. (2007) which tends to lean toward research conduct in the biomedical sciences. Given that Heitman and colleagues have developed one of the only scales in this area, future research should seek to develop another assessment instrument for RCR practices that addresses both general and discipline-specific research practices.

Finally, the ethics education initiatives in our study did not influence the moral reasoning level of students. Such a finding is consistent with previous research by Powell et al. (2007) and Plemmons et al. (2006) for responsible conduct of research

coursework. Indeed, Antes et al. (2009) found that such ethics education efforts are more effective at enhancing "ethical analysis" skills than moral development or abstract philosophical reasoning outcomes. Ethical analysis skills are those which focus on the cognitive nature of the ethical decision-making process and often acknowledge the individual, situational, and organizational influences on these processes (e.g., Treviño et al. 2006). Sensitivity to ethical issues and ethical problem-solving steps are likely to be emphasized in this form of ethics education.

The faculty development workshop that served as the initial context for this research project exposed instructors to both pedagogical approaches (philosophical and psychological), but the faculty workshop participants tended to adopt a cognitive-based, ethical decision-making skill development focus for their ethics education initiatives based on anecdotal evidence from their presentations and course portfolios. The ethics-related psychological outcome results discussed above are consistent with such an approach. Further research needs to be performed on the viability of enhancing students' moral development with embedded ethics modules in courses. It may be that a more discipline-focused assessment instrument is necessary to adequately engage students in the assessment process. Recent work in the business field has attempted to move away from the abstract scenarios in the Defining Issues Test (Rest et al. 1999) to ones more suited to the managerial context (Loviscky et al. 2007; Weber and McGivern 2010).

Finally, this research found no evidence that ethics education delivered in a stand alone course was more effective than modules embedded in science and engineering curricula. Much of this was likely due to the short-term nature or pedagogical approach used in such courses. Indeed, departments were reluctant to allocate more than 1–2 credit hours for students taking a research ethics course. Anecdotal evidence from the instructors suggests that the pedagogical approaches varied widely with some instructors using regular case instruction with weekly write-ups while others had relatively few written assignments and used guest speakers extensively. Still other courses were taught on-line over the internet. Thus, critical instructional methods such as time on task, level of participant interaction, and the use of cases varied considerably across the stand alone courses. Unfortunately, the relatively small sample size in this condition prevented us from teasing apart the effects of these differences from one another. Future research should more systematically try to decouple the impact of specific instructional methods versus the type of instructional program (stand alone or embedded) on the specific psychological, knowledge and moral reasoning outcomes examined here.

Future research should also consider investigating the efficacy of different models for integrating the current topics of sustainability and social responsibility into the engineering and science curricula (e.g., Conlon 2008; Lucena and Schneider 2008). While philosophical-based moral development may be best taught in stand alone course, sustainability and social responsibility may be topics that are particularly well-suited to being embedded in a context throughout the curriculum, particularly in the engineering field.

Future research may also wish to examine the relative influence of instructional objectives on specific ethics-related outcomes. That is, it may be that compliance-driven education with a goal of minimizing deviations from professional codes of

conduct may have positive effects on knowledge of appropriate RCR practices, but may have negative effects on levels of moral development. Emphasis on virtue ethics among engineers (Harris 2008) may also be most appropriate for the expression of positive professionalism in the engineering field.

Finally, future research should continue to examine the effectiveness of ethics education across different disciplines. Antes et al. (2009) examined primarily the medicine, health, and psychology fields, while we focused predominantly on the engineering, science, and technology fields. It may be that students in these different fields vary in their receptiveness to ethics-related concepts provided in ethics courses. Numerous anecdotal comments from faculty workshop participants suggested that students have a difficult time "switching gears" from quantitative material to the more abstract qualitative material involved in ethics education.

Strengths and Limitations

Each research project has its strengths and limitations. First, this research project was part of an extensive 3-year, multi-institutional faculty development project in ethics education. Second, the research employed a rigorous, pre/posttest research design with a control group. Third, a number of traditional and emerging ethics-relevant criteria were used (RCR knowledge, moral judgment, and positive psychological outcomes) to assess the effectiveness of the ethics education initiatives. Fourth, a diverse set of courses and pedagogical approaches were represented in the sample.

The diversity of disciplines, participants, and teaching methods used also served as a limitation in the research study. Such diversity in field research creates natural error in the data and prevents researchers from finding hypothesized effects. We believe an important next step for future ethics education research is to evaluate the unique and combined effects of instructors and instructional approaches. Second, the relatively small sample size in the stand alone course condition may have limited our power to detect differences between the ethics education treatment conditions. Thus, the findings of this research should be interpreted as preliminary. Future research utilizing larger samples should be conducted to confirm our findings. Third, as discussed above, the measures of RCR knowledge and moral reasoning could have been better tailored to discipline-related knowledge and ethical issues. One promising tool for future research in this area is the Engineering and Science Issues Test (ESIT) used to assess the ethical development of individuals in the science and engineering disciplines (Bornstein et al. 2010). Finally, the multiple effectiveness measures created a lengthy survey for research participants. The research team felt that a significant amount of mortality from pre to posttest occurred in the project because of the time needed to complete the assessment instruments. The length of the survey may have also influenced participants' focused attention to questions and impacted some of the scales' reliabilities. Although such desertion rates can potentially bias results, the researchers found that the included versus excluded groups differed only on gender, suggesting the bias may be minimal. Future research would do well to focus on just a few critical

outcome variables for investigation in order to minimize the effects of such lengthy assessment instruments.

Conclusion

In closing, we believe that the research reported here on ethics education in engineering and science courses demonstrates that ethics initiatives in these disciplines can have positive effects on students' ethics-related psychological outcomes. Specifically, the findings of this long-term study suggest that faculty can train students to (a) envision multiple perspectives of ethical issues, (b) develop their confidence in their abilities to handle ethical issues in their respective field of study, (c) be willing to raise the issue to management even if entails aversive consequences for themselves, and, (d) foster professional integrity in their work places by developing a professional identity that incorporates the importance of acting ethically. The engineering and scientific world can be a better place with greater attention to ethics education in their college programs!

Acknowledgments An earlier version of this manuscript was presented at the 2011 International Association for Business and Society (IABS) conference. This research project was funded by the National Science Foundation (NSF) over a 3-year period (NSF Grant #0629443). The authors would like to thank the faculty and students who participated in this project as well as acknowledge the on-going discussions about the project that we had with our colleagues Joshua Rosenbloom, Richard De George, Daniel Bernstein, and Saeed Fahroki.

References

Antes, A. L., Murphy, S. T., Waples, E. P., Mumford, M. D., Brown, R. P., Connelly, S., et al. (2009). A meta-analysis of ethics instruction effectiveness in the sciences. *Ethics and Behavior, 19*(5), 379–402.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Baumeister, R. F., & Vohs, K. D. (2002). The pursuit of meaningfulness in life. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 608–618). Oxford: Oxford Press.

Bebeau, M. J., Pimple, K. D., Muskavitch, K. M. T., & Smith, D. H. (1995). *Moral reasoning in scientific research: A tool for teaching and assessment*. Bloomington, IN: Indiana University.

Bergman, R. (2004). Identity as motivation: Toward a theory of the moral self. In D. K. Lapsley & D. Narvaez (Eds.), *Moral development, self and identity* (pp. 21–46). Mahwah, NJ: Lawrence Erlbaum.

Blasi, A. (1999). Emotions and moral motivation. *Journal for the Theory of Social Behaviour, 29*(1), 1–20.

Bornstein, J., Drake, M. J., Kirkman, R., & Swan, J. L. (2010). The engineering and science issues test (ESIT): A discipline-sepcific approach to assessing moral judgment. *Science and Engineering Ethics, 16*, 387–407.

Choe, S. H. (2009, October 27). Disgraced cloning expert convicted in South Korea. *New York Times.* http://www.nytimes/2009/10/27/world/asia/27clone.html. Accessed July 28, 2010.

Conlon, E. (2008). The new engineer: Between employability and social responsibility. *European Journal of Engineering Education, 33*(2), 151–159.

Cook, G. (2005, June 9). Surveyed scientists admit misconduct: One third cite research tactics. *Boston Globe.*

Cook, T. D., Campbell, D. T., & Peracchio, L. (1990). Quasi-experimentation. In M. D. Dunnette & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (pp. 491–576). Palo Alto, CA: Consulting Psychologists Press.

Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology, 10*, 85–104.
Harris, C. E. Jr., Davis, M., Pritchard, M. S., & Rabins, M. J. (1996, April). Engineering ethics: What? Why? How? And When? *Journal of Engineering Education*, 93–96.
Galloway, P. D. (2007, November). The 21st-century engineer: A proposal for engineering education reform. *Civil Engineering*, 46–51.
Gibbs, J., Clark, P., Joseph, J., Green, J., Goodrick, T., & Makowski, D. (1986). Relations between moral judgment, moral courage, and field independence. *Child Development, 57*(1), 185–193.
Haidt, J. (2001). The emotional dog and its rational tail: A social intutionist approach to moral judgment. *Psychological Review, 108*, 814–834.
Handelsman, M. M., Knapp, S., & Gottlieb, M. S. (2002). Positive ethics. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 731–744). Oxford: Oxford Press.
Hannah, S. T., Avolio, B. J., & May, D. R. (2011a). Moral maturation and moral conation: A capacity approach to explaining moral thought and action. *Academy of Management Review, 36*(4), 663–685.
Hannah, S. T., Avolio, B. J., & Walumba, F. O. (2011b). Relationships between authentic leadership, moral courage, and ethical and pro-social behaviors. *Business Ethics Quarterly, 21*, 555–578.
Harris, C. E., Jr. (2008). The good engineer: Giving virtue its due in engineering ethics. *Science and Engineering Ethics, 14*(2), 153–164.
Haws, D. R. (2001). Ethics instruction in engineering education: A (mini) meta-analysis. *Journal of Engineering Education, 90*(2), 223–229.
Heitman, E., Olsen, C., Anestidou, L., & Bulger, R. (2007). New graduate students' baseline knowledge of the responsible conduct of research. *Academic Medicine, 82*(9), 838–845.
Heitman, E., Salis, P. J., & Bulger, R. E. (2002). Teaching ethics in biomedical science: Effects on moral reasoning skills. In N. H. Stenack & M. D. Scheetz (Eds.), *Investigating research integrity. Proceedings of the first ORI research conference on research integrity* (pp. 195–202). http://www.ori.hhs.gov/documents/proceedings_rri.pdf. Accessed August 8, 2010.
Jonassen, D., Strobel, J., & Lee, C. B. (2006). Everyday problem solving in engineering: Lessons for engineering educators. *Journal of Engineering Education, 95*(2), 139–151.
Judge, T. A., & Bono, J. E. (2001). Relationship of core self-evaluations traits—self-esteem, generalized self-efficacy, locus of control, and emotional stability—with job satisfaction and job performance: A meta-analysis. *Journal of Applied Psychology, 86*, 80–92.
Kalliopuska, M. (1983). Relationship between moral judgment and empathy. *Psychological Reports, 53*, 575–578.
Kohlberg, L. (1969). Stage and sequence: The cognitive-developmental approach to socialization. In D. A. Goslin (Ed.), *Handbook of socialization theory and research* (pp. 347–480). Chicago: Rand McNally.
Kraiger, K., & Jung, K. M. (1996). Linking training objectives to evaluation criteria. In M. A. Quinones & A. Ehrenstein (Eds.), *Training for a rapidly changing workplace: Application of psychological research* (pp. 151–175). Washington, DC: American Psychological Association.
Lau, A. S., & Devon, R. (2001, June). Transformation: Ethics and design. In *ASEE annual conference proceedings*, Albuquerque, NM.
Leith, K. P., & Baumeister, R. F. (1998). Empathy, shame, guilt, and narratives of interpersonal conflicts: Guilt-prone people are better at perspective taking. *Journal of Personality, 66*, 1–37.
Lopez, S. J., O'Byrne, K. K., & Peterson, S. (2003). Profiling courage. In S. J. Lopez & C. R. Snyder (Eds.), *Positive psychological assessment: A handbook of models and measures* (pp. 185–197). Washington, DC: American Psychological Association.
Loviscky, G. E., Trevinio, L. K., & Jacobs, R. R. (2007). Assessing managers' ethical decision-making: An objective measure of managerial judgment. *Journal of Business Ethics, 73*, 263–285.
Lucena, J., & Schneider, J. (2008). Engineers, development, and engineering education: From national to sustainable community development. *European Journal of Engineering Education, 33*(3), 247–257.
Maddux, J. E. (2002). Self-efficacy: The power of believing you can. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 277–287). Oxford: Oxford Press.
May, D. R., Chan, A. Y. L., Hodges, T. D., & Avolio, B. J. (2003). Developing the moral component of authentic leadership. *Organizational Dynamics, 32*, 247–260.
May, D. R., Luth, M., & Schwoerer, C. E. (2009). The effects of business ethics education on moral efficacy, moral meaningfulness, and moral courage: A quasi-experimental study. In *Academy of Management best paper proceedings,* Chicago, IL.

May, D. R., Luth, M., & Schwoerer, C. E. (2010). The effects of moral efficacy, moral courage, and moral meaningfulness on moral behaviors at work. In *Paper presented at the 2010 Academy of Management meeting* in Montreal, Canada.

Mencl, J., & May, D. R. (2009). The effects of proximity and empathy on ethical decision-making: An exploratory investigation. *Journal of Business Ethics, 85*, 201–226.

Newberry, B. (2004). The dilemma of ethics in engineering education. *Science and Engineering Ethics, 10*, 343–351.

Parker, S. (1998). Enhancing role breadth self-efficacy: The roles of job enrichment and other organizational interventions. *Journal of Applied Psychology, 83*, 835–852.

Parker, S. K., & Axtell, C. M. (2001). Seeing another viewpoint: Antecedents and outcomes of employee perspective taking. *Academy of Management Journal, 44*, 1085–1100.

Paulhus, D. (1991). Measurement and control of response bias. *Measures of Personality and Social Psychological Attitudes, 1*, 17–59.

Plemmons, D. K., Brody, S. A., & Kalichman, M. W. (2006). Student perceptions of the effectiveness of education in the responsible conduct of research. *Science and Engineering Ethics, 12*(3), 571–582.

Powell, S. T., Allison, M. A., & Kalichman, M. W. (2007). Effectiveness of a responsible conduct of research course: A preliminary study. *Science and Engineering Ethics, 13*(2), 249–264.

Rest, J. R. (1976). New approaches in the assessment of moral judgment. In T. Lickona (Ed.), *Moral development and behavior: Theory, research, and social issues*. New York: Holt, Rinehart, & Winston.

Rest, J. R. (1986). The major components of morality. In W. M. Kurtines & J. L. Gerwitz (Eds.), *Morality, moral behavior, and moral development* (pp. 24–38). New York: Wiley.

Rest, J., Narvaez, D., Thoma, S., & Bebeau, M. (1999). DIT2: Devising and testing a revised instrument of moral judgment. *Journal of Educational Psychology, 91*(4), 644–659.

Roach, S., & Simon, J. (2008). Teaching and assessing graduate ethics in engineering, science, and technology. In M. Iskander (Ed.), *Innovative techniques in instruction, technology, e-learning, e-assessment, and education* (pp. 509–513). Netherlands: Springer.

Seligman, M. E. P. (2002). Positive psychology, positive prevention, and positive therapy. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 3–9). Oxford: Oxford Press.

Sonenshein, S. (2007). The role of construction, intuition, and justification in responding to ethical issues at work: The sensemaking-intuition model. *Academy of Management Review, 32*, 1022–1040.

Thomsen, M. (2007). A course treating ethical issues in physics. *Science and Engineering Ethics, 13*(1), 117–127.

Treviño, L. K., Weaver, G. R., & Reynolds, S. J. (2006). Behavioral ethics in organizations: A review. *Journal of Management, 32*, 951–990.

Wade, N. (2010, August 20). Harvard finds scientist guilty of misconduct. *New York Times*. www.nytimes.com/2010/08/21/education/21harvard.html.

Weber, J., & McGivern, E. (2010). A new methodological approach for studying moral reasoning among managers in business settings. *Journal of Business Ethics, 92*, 149–166.