AC 2011-1937: DOES A STEM RESEARCHER’S ROLE ORIENTATION PREDICT HIS OR HER ETHICAL SENSITIVITY TO RESPONSIBLE CONDUCT OF RESEARCH?

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Does a STEM Researcher’s Role Orientation Predict His or Her Ethical Sensitivity to Responsible Conduct of Research?

I. Introduction

To a significant extent, ethics education in science and engineering (EESE) has emphasized, many times exclusively, the teaching and acquisition of the skills associated with discursive reasoning regarding ethical principles and the formation of ethical judgment, including the application of ethical principles and codes of conduct to concrete situations by means of case studies. Bebeau notes, “the major focus of research on ethical development in the professions has been on moral judgment” (pg. 283). And Huff and Frey remark, “there are precious little data on the three processes other than judgment” (pg. 391). The three processes mentioned are ethical sensitivity, ethical motivation and ethical implementation. The focus of the present paper concerns the general question of whether or not there exists a correlation between an individual’s ethical motivation, or more specifically, an individual’s professional motivation, and his or her ethical sensitivity and, if so, what is the nature of this correlation?

Research has shown that many courses in responsible conduct of research (RCR), while successfully imparting knowledge of RCR, fail to affect students’ attitudes about it. Newberry has argued that ethics education in engineering has three primary objectives, namely, emotional engagement, intellectual engagement, and particular knowledge. He respectively summarizes these as follows: “to help students i) want to make ethical decisions, ii) know how to make ethical decisions, and iii) be aware of the currently accepted guidelines for ethical practice”. (pg. 344) Imparting particular knowledge simply requires informing the student of the guidelines governing ethical practice, e.g., professional codes of conduct. Secondly, intellectually engaging science and engineering students is relatively straightforward since, as Newberry argues, they are “typically adept at manipulating facts, rules, and logic” (pg. 347). However, there seems little prima facie evidence to believe that science and engineering students are any more adept at emotional engagement than anyone else. In fact, Newberry points to a trend toward the “engineer-ization of ethics,” i.e., the tendency “to force square pegs of non-technical knowledge into round holes of technical learning, in order to accommodate the thinking preferences of engineering faculty and students” (pg. 350). One would expect that such a trend would have the inadvertent and unfortunate consequence of engendering an emotionally detached and non-committed attitude toward the material.

In fact, as Rest and others have pointed out, knowledge of ethical principles and the ability to make ethical judgments is just one determinant of ethical behavior. However, as others have shown, the ability to engage in ethical reasoning alone is not necessarily correlated with ethical behavior. An equally important determinant of ethical behavior is ethical motivation, especially the motivation to engage in professionally responsible behavior, which is indicated by an individual’s attitudes toward his or her professional role (“role orientation”). A second important element is the ability to recognize given situations as ethical and the relevant ethical elements of such situations (“ethical sensitivity”).

While learned behavior can occur in the absence of motivation, the probability of engaging in a learned behavior increases when an individual is also motivated to engage in the behavior. In
addition, the motivation to engage in ethical behavior as well as the ability to apply the discursive skills necessary for ethical judgment require that an individual recognizes that he or she faces an ethical situation. And the possibility that an individual will make correct judgments about a situation and/or take the correct course of action when faced with a situation should increase with an increased sensitivity to the ethical elements of the situation.

Being able to induce the motivation to engage in ethical behavior will doubtless promote ethical behavior, although how this is to be accomplished remains an important area of philosophical, psychological and pedagogical research. Likewise, being able to train an individual to be more sensitive to ethical situations and their elements will undoubtedly help that individual to behave in an ethical fashion, although it is an open question whether and how it is possible to increase an individual’s ethical sensitivity. If ethical sensitivity is comparable to other forms of sensitivity, which are capable of being enhanced through practice, experience, training, etc., then there is hope for influencing this element of ethical psychology. For instance, researchers are trained to be sensitive to many things that the average person is unable to see, e.g., to be able to see whether or not a given cell is cancerous, to be able to “read” a spectrograph, etc.

Beyond (and perhaps before) tackling these important and difficult pedagogical issues, much work still needs to be done in order to understand the connections that exist between the different elements of the underlying psychology of ethical behavior. Perhaps the most basic questions involve the issue of whether or not correlations exist between these different elements and, if so, what these correlations are.

There seems to be prima facie evidence that some such correlation should exist. Namely, one’s values and motivations should influence what one sees in any given situation. For instance, if a person were driven by egoistic values and motivated by self-aggrandizement then one would expect that that person would be more sensitive to the elements of a situation that will either positively or adversely affect him or her. On the other hand, if a person were driven more by altruistic motivations and values, then that person should be more sensitive to the aspects of a given situation that benefited or hurt others. One recent study has tackled this issue empirically and experimentally. This study found evidence that a correlation exists between the professional values and the ethical sensitivity of students studying to become social workers.

The specific question that the present paper attempts to answer is whether or not there is a correlation between a STEM (Science, Technology, Engineering and Mathematics) researcher’s professional motivation, as indicated by his or her research role orientation, and that researcher’s ethical sensitivity to situations that involve RCR.

Examining this question requires instruments that are capable of assessing an individual’s research role orientation and measuring a person’s ethical sensitivity to situations involving RCR. In separate papers, the present authors have described the design and validation of two instruments for doing just this. A description of these two instruments, including their further validation within the context of more recent research, is detailed below.

We used these instruments to assess the research role orientation and to measure the ethical sensitivity to situations involving RCR of STEM graduate students. Using this data we
examined correlations between the different elements of research role orientation and ethical sensitivity to RCR. The goal of the present study is to determine whether or not a researcher’s role orientation is predictive of that researcher’s ethical sensitivity to RCR. For example, is a researcher’s acute understanding, or lack thereof, of his or her responsibility to use STEM research for the general welfare predictive of that researcher’s ethical sensitivity to RCR? Or is a researcher’s sense of duty to objective ethical principles, regardless of the impact on the general welfare, more predictive of that researcher’s ethical sensitivity to RCR? More concretely, would a researcher who is willing to “bend the rules,” if doing so has the possibility of benefiting the general welfare, be more sensitive to RCR than a researcher who believes that ethical principles are not to be sacrificed at any cost? Is it the case that a researcher who feels more comfortable working within a group is more sensitive to RCR than one who prefers to work alone? Etc.

If certain elements of a person’s research role orientation is predictive of his or her ethical sensitivity to RCR, then this will help us to better understand why certain researchers are more likely to engage in unethical research practices while others are not. And in the long run it will provide us with insights as to how to approach research ethics training that goes beyond simply providing people with the principles of RCR and the skills required for ethical reasoning. In other words, we can begin to examine ways in which we can educate and train people to acquire a research role orientation more likely to increase that person’s ethical sensitivity to RCR.

II. Methods

Instruments:

Research Role Orientation Inventory
Previous research and pilot testing by our group led to the development and pilot testing of the Research Role Orientation Inventory (RROI). The instrument, designed to assess a researchers sense of responsibility, authority, agency, autonomy, and duty, utilized a 6-point Likert-type scale requiring participants to rate their level of agreement (ranging from strongly disagree to strongly agree) to 26 items designed to measure the role constructs (See Tables 1 and 2). Using a factor analytic approach, the 26 items in the RROI included approximately 5 items found to measure each construct. Participants were instructed to respond to each statement as though they were an active faculty researcher.

<table>
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<th>Construct</th>
<th>Example Inventory Items</th>
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<td>Agency</td>
<td>Refers to the extent to which an individual feels a sense of control and power in his or her life as a practicing researcher. A person with a strong sense of agency would feel that he or she has the ability to control his or her own destiny, to effect significant changes in his or her research discipline, and to play an active role in making things happen. Those feeling a lower sense of agency feel comparatively powerless and feel that they lack the ability to effect significant change.</td>
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Authority | Refers to the degree to which a person sees themselves as knowledgeable, a good judge of outcomes, respected, and deferred to for expertise. Persons having a strong sense of their own authority believe that their judgments and opinions ought to be respected and given weighty consideration. They believe that they typically know "what's best" for themselves and others in matters dealing with their research. Persons for whom authority is not a critical component of their cognitive-moral makeup tend to believe that other people's judgments are as deserving of consideration as their own.

Responsibility | Refers to the breadth of an individual's commitment to others. The notion of "sense of responsibility" represents a continuum. At the strong end, we find individuals who typically see their role as including some direct or indirect caretaking of the disadvantaged and the public at large. In contrast, at the weaker end, we find individuals who tend to believe that each individual is fully capable of taking care of him or herself and that if people look after their own affairs, then society will function most effectively.

Autonomy | Refers to the extent to which an individual feels freedom and independence in his or her role. A person with a strong sense of autonomy feels comfortable acting on his or her own judgment without the approval of others. In contrast, a person with a low sense of autonomy would feel most comfortable operating with organizational support, and would tend to seek approval of others.

Duty | Refers to the breadth of an individual's commitment to absolute principles and/or values, i.e., principles and/or values that should not be sacrificed regardless of the cost or benefit of doing so. A person with a strong sense of duty believes that there are absolute principles and/or values and feels obligated to follow those principles and realize those values regardless of the cost or benefit of doing so. A person with a weak sense of duty views all action through a "cost-benefits" analysis and is motivated accordingly.

| Table 2. Role Orientation Constructs and Example Inventory Items |
|---|---|
| **Construct** | **Example Inventory Items** |
| Agency | • I am reluctant to criticize bad research ideas or practices  
• I believe that competition for research funds would make it difficult for me to pursue important research. |
| Authority | • When interpreting research results, no one should question the lead researcher’s authority.  
• Regarding the conduct of my research, I should have to answer only to myself. |
Responsibility

- My discipline should be more concerned with the well-being of those impacted by our research.
- I engage in research primarily for my own benefit.

Autonomy

- As the sole principal investigator on a project I would feel confident following my own best judgment even if others on my research team disagreed with me.
- I would feel more comfortable working with a group of people on a research project rather than working alone.

Duty

- A researcher has an obligation to publicize proven results of his or her work even if doing so would lead to negative social consequences.
- Science and engineering research is valuable for its own sake regardless of whatever personal or public benefits it may have.

**Ethical Sensitivity Test**

Previous research\(^{12}\) led to the development and assessment of the reliability of scoring of the Ethical Sensitivity Test (EST). The EST is comprised of 3 research-related vignettes (See table 3 for sample vignette) in which both research-related and non-research related ethical situations are presented. Participants are asked to “identify all of the ethical situations in this story and describe the ethically relevant elements of each of these situations in as much detail as possible”. Scores were assigned based upon recognition of the action, consequences, accountability of perpetrator, rights of the victim, and duties of those involved as provided in the written responses by participants. Scores were assigned to responses from both RCR-related (RCR scores) issues present in the vignettes as well as non-RCR related ethical issues presented. In addition, a total Ethical Sensitivity Scores was calculated (sum of RCR and non-RCR sensitivity scores; ES Score).

<table>
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<th>Table 3. Sample Ethical Sensitivity Vignette</th>
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<td>Dr. Xiao has a rather heavy accent. When Dr. Xiao was a fellow university colleague of Dr. Willard, Dr. Willard would continually ridicule Dr. Xiao's English, joking with others about how difficult it was to understand him. As a result many graduate students would avoid taking Dr. Xiao's classes or having him on their committees. Partly because of this, Dr. Xiao eventually left to take a job at another university. Several years later, Dr. Xiao finds himself on a NSF review panel that is reviewing one of Dr. Willard's grant proposals. Of all of the members of the review panel, Dr. Xiao is the most knowledgeable in the area of research that Dr. Willard is proposing to study and, consequently, the other members of the panel look to him as the expert on the committee. Without telling anyone about his past association with Dr. Willard, Dr. Xiao suggests that the review panel reject Dr. Willard's proposal even though Dr. Xiao recognizes that it represents important research.</td>
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Participants:

Participants were recruited from all students who were admitted into graduate programs in STEM areas at a medium sized Midwestern University. All admits were sent an email solicitation requesting their participation in the study. The surveys were delivered in an online format. The resulting sample represented a culturally diverse group of students entering either their first year of graduate study, or pursuing a Ph.D. following the receipt of a Masters degree. While this study was part of a larger study, in which various versions of instruments were tested to further establish their reliability and validity, the results presented below were obtained from participants who completed both of the instruments.

Statistical Procedures:

We obtained n = 66 completed responses to the Ethical Sensitivity Test. From the n= 66 responses we calculated each subjects’ RCR and non-RCR ethical sensitivity score by summing the RCR and non-RCR ethical situation scores across the 3 vignettes presented in the test.

To correlate the RCR vignette scores and RROI responses, adjusted for non-RCR scores, we first correlated the RCR and non-RCR scores, and then conducted a separate multiple regression analysis for each of the 5 professional attribute constructs. We used the subject’s RCR score as the dependent variable, their non-RCR score as a covariate, and the scores of the construct items as additional explanatory variables. For example, for Agency, we fit the model containing the non-RCR score as a covariate and the 6 items purportedly measuring Agency as additional variables. We then conducted an F-test (α = 0.05) to determine if the Agency variables significantly contributed to the regression model given the non-RCR score covariate. We conducted a parallel analysis for each of the 5 professional attributes. If we found a statistically significant relationship we then conducted a stepwise selection method to determine which of the professional attribute items contributed to the model.

The purpose of using the non-RCR score as a covariate is two-fold. First, ethical sensitivity to RCR is dependent upon an individual’s general ethical sensitivity, the latter of which is indicated by an individual’s ethical sensitivity to everyday, ordinary, non-RCR related ethical situations, e.g., making fun of someone’s accent. In order to isolate correlations between the RROI constructs and sensitivity to RCR required that we use the non-RCR score as a covariate. In this way, we could examine whether or not the RROI constructs were correlated with greater or lesser ethical sensitivity to RCR. Secondly, we had a diverse, multi-national group of participants. We had to account for various levels of English proficiency and comprehension considering that in the ethical sensitivity test the participants were asked to read a vignette written in English and provide a written response in English. Since differences in English proficiency and comprehension would manifest themselves equally in the participant’s response to non-RCR situations and the RCR situations within the vignette, by using the non-RCR score as a covariate we could minimize the impact of such differences when analyzing the correlation between the RROI constructs and an individual’s RCR ethical sensitivity score.
III. Results

Correlations between the scores produced from each of the RROI constructs and the Ethical Sensitivity vignette RCR scores revealed significant correlations between an individual’s sense of agency and authority and their RCR scores on the 3 vignettes. These correlations were small (ranged from -.22 to +.29), yet significant at an alpha level of .05. Significant correlations were not found between RCR scores and the scores associated with the Responsibility, Autonomy, and Duty constructs of the RROI.

Similar findings are revealed in a regression analysis. The regression analyses indicated that after adjusting for non-RCR effects, RCR scores were related only to Authority variables (p = 0.03) and Agency variables (p = 0.05). Responsibility (p = 0.37), Autonomy (p = 0.26) and Duty (p = 0.44) items were not related to RCR scores adjusted for non-RCR score. In the Authority stepwise regression analysis only one item (“Researchers should be allowed to self-regulate responsible conduct of research in their field without external interference or oversight”) contributed, although the increase in $R^2$ due to its inclusion was small at 0.045 and its coefficient was negative. In the Agency regression analysis two variables (I am reluctant to criticize bad research ideas or practices; I allow my peer's opinions of my work to influence me too much.) were both positively correlated with RCR score but again the increases in $R^2$ were small at 0.04 and 0.01 respectively.

IV. Discussion

The constructs of responsibility, authority, agency, autonomy, and duty were assessed in an effort to measure an individual’s research role orientation. Additionally, one’s sensitivity to both research-related and non-research ethical situations was measured. The purpose of the study was to determine if certain elements of a researcher’s role orientation could be predictive of their ethical sensitivity. After adjusting for the effects of participants’ non-RCR related ethical sensitivity, the constructs of agency and authority were predictive of RCR ethical sensitivity.

Interpretation of these results must also consider several other factors. First, these results are based upon preliminary work with only 66 participants. With low power, the significance of the RROI variables in predicting ethical sensitivity may be undiscovered. Secondly, it may not be correct to assume that the RROI variables of responsibility, autonomy and duty are not predictive of a researcher’s sensitivity to RCR. Our analysis simply indicates that these variables provide no added predictive value when one’s non-RCR sensitivity is controlled for.

The fact that responsibility, autonomy and duty are not predictive of a researcher’s sensitivity to RCR was initially quite surprising, since these constructs embody overtly ethical connotations. However, upon second thought and for the reason just specified, it could very well be that what the constructs of responsibility, autonomy and duty are measuring equally determines one’s sensitivity to situations involving non-RCR and RCR, and so tend not to differentiate the two. On the other hand, the constructs of agency and authority were correlated with differences in ethical sensitivity to RCR even when ethical sensitivity to non-RCR is accounted for. It is perhaps the case that the constructs of agency and authority are distinctively characteristic of a
STEM researcher’s role orientation and thus relatively more predictive of ethical sensitivity to situations involving RCR.

Our findings do suggest that there may be value in utilizing dimensions of one’s Research Role Orientation as predictors of their sensitivity to RCR issues. Further analyses are required, along with testing on a larger sample of subjects, to further elucidate the value of understanding one’s role orientation. These further analyses should include statistical analysis of correlations between the individual elements of both the RROI, e.g., individual response items, and the ethical sensitivity test, e.g., the individual situations within each vignette.

Moreover, our present findings suggest that special attention needs to be paid to agency and authority. However, as has been suggested, responsibility, autonomy and duty should not be neglected. Perhaps with a greater power, the significance of these RROI constructs for predicting ethical sensitivity to RCR will become significant. Additionally, our participants consisted of newly admitted graduate students. Perhaps an absence of experience and background in research among participants led to a flattening out of differences between RCR and non-RCR ethical sensitivity scores.

V. Conclusion

In conclusion, we have shown that a correlation exists between elements of a STEM researcher’s Role Orientation and his or her ethical sensitivity to situations involving RCR. However, more research needs to be done to determine the exact nature of this correlation, including examining correlations between the individual elements of research role orientation and ethical sensitivity, both to RCR and non-RCR.

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