

# Teaching Case Analysis through Framing: Prospects for an ITS in an ill-defined domain

**Ilya M. Goldin**

Intelligent Systems Program  
Learning Research &  
Development Center  
University of Pittsburgh  
goldin@pitt.edu

**Kevin D. Ashley**

Intelligent Systems Program  
Learning Research &  
Development Center  
University of Pittsburgh  
ashley@pitt.edu

**Rosa L. Pinkus**

Neurosurgery/Medicine School of Medicine  
University of Pittsburgh  
pinkus@pitt.edu

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# Overview

- Example of sources of ill-definedness in bioengineering ethics.
- Framing, a strategy to deal with ill-definedness.
- LDA Assessment Instrument to assess framing ability.
- Sketch tutoring system idea to use peer review to help authors learn to frame cases.
  - Adapts SWORD, an instructional program for teaching writing.
- Possibility of using AI for guiding peer reviewers on framing.
  - Machine learning and corpus of student papers, annotated with LDA Assessment Instrument,

# Sample Bioengineering Ethics Problem

From capstone exercise in bioengineering ethics class in which students create and analyze their own cases...

- Student-authored case facts:
  - ...Joe, a commercial airline pilot in his late 50s, participates in a research study that bioengineering graduate student Jeff was running in the Balance Lab....After Joe's second loss of balance, Jeff stops the experiment and advises Joe to see a participating neurologist....Neurological tests reveal Joe has a potentially serious inner-ear infection. Joe decides not to tell his employer...
- Proposed solution:
  - “Jeff's interaction with Joe's doctor and his insight into the limits of confidentiality ultimately [may] lead him to warn the airline...”

# Sources of Ill-definedness in Ethics Problem-Solving

- Problems rarely have definitive answers.
  - Only “paradigm” cases have clear-cut definitive answers.
  - Realistic problems have wide range of acceptable responses.
- Answers depend on how problem is conceived or “framed”.
  - Problem solver constructs (i.e., *frames*) representation of problem
  - Problem “morphs” as solver adds constraints and conditions to better define it.
- Ethics codes and principles use open-ended concepts.
- Justifying answers involves interpretive mapping of concepts.
  - Solver needs to identify relevant moral principles, *and* to
  - map principles’ concepts to problem situation, aka framing.
- Free-form text is most appropriate for representing problems.
  - Need to consider implications of particular details on alternative resolutions.

# Framing: a strategy to deal with ill-definedness

- Students frame problems by selecting moral concepts to articulate the ethical dilemma and by using professional knowledge to add constraints to the case facts that relate to the concepts and suggest alternative resolutions.
- **Labeling:** Students assert that certain concepts are framework for viewing the case.
  - e.g., responsibility of bioengineer, safety, or confidentiality
- **Defining:** They define the issue abstractly based on concepts' properties removed from case details.
  - e.g., safety versus confidentiality
- **Applying:** Explain how concept definitions map to case at hand
  - Connect definitions to specific facts
  - e.g., if the infection cannot be cleared up in a few days with antibiotics, or has lasting effects that may affect Joe's balance in flight...
- Definitions important since concepts are open-ended: "safety"
  - "acceptable risk" posed by an engineer's creation
  - "the public" whose safety the engineer ought to hold paramount.

# LDA Assessment Instrument: a way to assess framing

- Comprises questions about labeling, defining, and applying more than 40 concepts
- Concepts derived from bioengineering ethics text and student essays.
  - Includes concepts from moral reasoning methods, moral theories, ethics principles, codes of ethics, and common, personal, and role moralities.
- Glossary plus examples.
  - Safety: Safety is a core value in all engineering. ... In philosophical terms, this can be described as beneficence or “doing good”. It also covers non-maleficence or “do no harm.” To fulfill this safety requirement, engineers must possess an ability to assess the potential risks of technology. (See also ... beneficence and non-maleficence)
  - **Example:** Engineers use “safety” factors when designing components to attempt to insure that components are a factor “x” times stronger than necessary. They conduct tests to determine the “mean time to failure” statistic for components and systems. These practices assist engineers in framing issues of risk and safety.
- Implemented with GATE text annotation software.
- Two main kinds of annotations for concepts (in addition to labeling):
  - Definitions: `<c-def=“concept”> ... </c-def>`
  - Applications: `<c-app=“concept”> ... </c-app>`

# Example of Framing the Problem

Jeff - the bioengineering student - is concerned for the safety of the pilot and of his future passengers since he plans to continue flying despite the doctor's advice to stop. Jeff wonders whether he is responsible for telling the airline of Joe's condition since the neurosurgeon and his advisor will not. Would Jeff be breaching the confidentiality constraints set by the IRB form if he informed the airline? Is there a solution to this issue that would serve the best interests of all parties? .... Researchers have various obligations and prerogatives associated with their profession, and these responsibilities can be referred to as their role morality. [1] For example, researchers have responsibilities to their experimental subjects mandating that the subjects' safety be of utmost importance. Furthermore, researchers should respect their subjects' autonomy, allowing them to decide if they want to participate and allowing them to discontinue the experiment at any point. Furthermore, a subject's identity should be kept as confidential as possible. Except under unusual circumstances, the only people who should have access to the subject's records are the investigators and staff who run the experiments. According to the Bioethics Advisory Commission (of August 2001), "Protecting the rights and welfare of those who volunteer to participate in research is a fundamental tenet of ethical research". [2] When deciding whether or not to inform the airline of Joe's condition, Jeff needs to be cognizant of the responsibilities he has toward his subjects, particularly his responsibility to respect their confidentiality. However, he also has to consider his responsibility to protect Joe's safety, which may be in danger if he continues to fly despite his medical condition. In addition to researchers' obligations to their subjects, they also have obligations to society.

# Framing the problem: **labeling** concepts

Jeff - the bioengineering student - is concerned for the **safety** of the pilot and of his future passengers since he plans to continue flying despite the doctor's advice to stop. Jeff wonders whether he is **responsible** for telling the airline of Joe's condition since the neurosurgeon and his advisor will not. Would Jeff be breaching the **confidentiality** constraints set by the IRB form if he informed the airline? Is there a solution to this issue that would serve the best interests of all parties? .... Researchers have various obligations and prerogatives associated with their **profession**, and these **responsibilities** can be referred to as their role morality. [1] For example, researchers have **responsibilities** to their experimental subjects mandating that the subjects' safety be of utmost importance. Furthermore, researchers should respect their subjects' **autonomy**, allowing them to decide if they want to participate and allowing them to discontinue the experiment at any point. Furthermore, a subject's identity should be kept as **confidential** as possible. Except under unusual circumstances, the only people who should have access to the subject's records are the investigators and staff who run the experiments. According to the Bioethics Advisory Commission (of August 2001), "Protecting the rights and welfare of those who volunteer to participate in research is a fundamental tenet of ethical research". [2] When deciding whether or not to inform the airline of Joe's condition, Jeff needs to be cognizant of the **responsibilities** he has toward his subjects, particularly his responsibility to respect their **confidentiality**. However, he also has to consider his responsibility to protect Joe's **safety**, which may be in danger if he continues to fly despite his medical condition. In addition to researchers' obligations to their subjects, they also have obligations to society.

# Framing the problem: **defining** & **applying** concepts

- **<c-app="safety">** Jeff - the bioengineering student - is concerned for the safety of the pilot and of his future passengers since he plans to continue flying despite the doctor's advice to stop. **</c-app>**
- **<c-app="responsibility-of-bioengineer">** Jeff wonders whether he is responsible for telling the airline of Joe's condition since the neurosurgeon and his advisor will not. **</c-app>**
- **<c-app="confidentiality">** Would Jeff be breaching the confidentiality constraints set by the IRB form if he informed the airline? **</c-app>** Is there a solution to this issue that would serve the best interests of all parties? ....
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- In addition to researchers' obligations to their subjects, they also have obligations to society. **</c-app="responsibility-of-bioengineer">**

# Evaluating LDA Assessment Instrument

- Experimentally demonstrated instrument's validity and reliability.

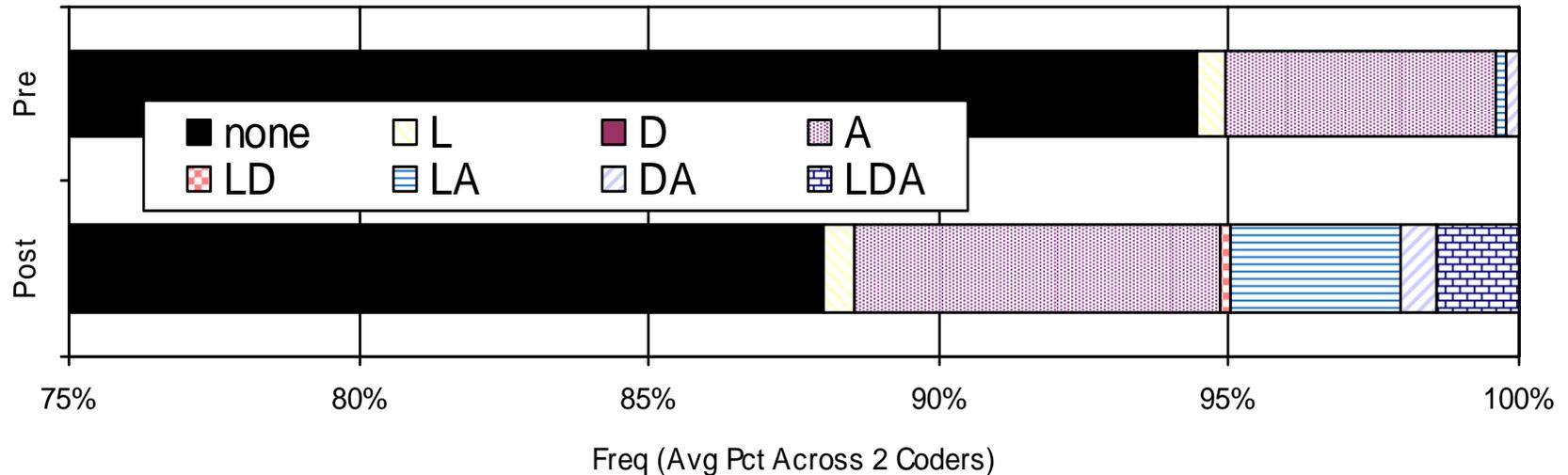


Figure : Change in concept LDA scores from pre- to posttest; LA is Labeled and Applied, not Defined, etc.

Coder Pair	Label	Define	Apply	Other 4 HLMRS
Trained vs. trained (N=12)	0.893	0.892	0.868	0.324
Naïve vs. trained (N=29)	0.626	0.472	0.577	0.158

Table 1: Agreement between coders (Cohen's Kappa) on Assessment Instrument annotations

# Adapting SWORD to Peer Review of Ethics Case Analyses

- Since case analysis is a writing task, ask student peer reviewers to provide feedback to each other.
- SWORD, web-based writing instructional system (Cho & Schunn, 2005)
  - supports reciprocal student authoring and peer reviewing.
  - So far, focuses reviewers on prose flow, logical argument, and insight.
- Can SWORD focus reviewers on reasoning skills (e.g., significance of framing case in one way rather than another?)
- Can concept classifier learn to identify LDA from coded corpus?

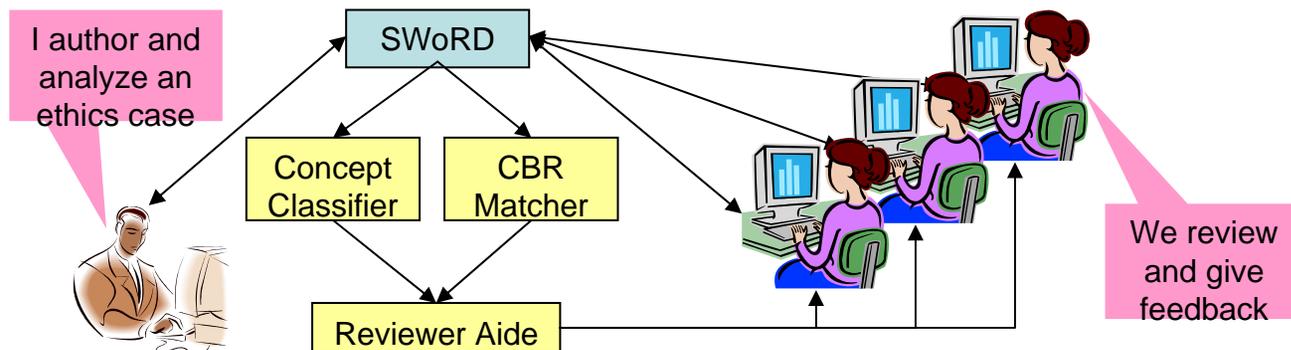


Figure : System architecture: SWORD plus Reviewer Aide with Concept Classifier and CBR Matcher

# Moral reasoning skills feedback form for SWoRD peer reviewers

## 4. Evidence of moral reasoning skills

This dimension is about the evidence of moral reasoning skills in the author's case analysis. Did the author appear to: ... (5) employ a method of moral reasoning in conducting the analysis? In connection with (5), **did the author identify moral reasoning concepts relevant to analyzing the case? Did the author label, define, and apply these concepts?**

**Your Comments:** Provide specific comments about the paper's evidence of moral reasoning skills. If the author ... *used a moral reasoning method in conducting the analysis*, point that out and congratulate them! If the author did not do so, try to suggest potential fixes to these problems. **In looking for evidence of a method of moral reasoning, look to see if the author identified relevant moral reasoning concepts in analyzing the case, or labeled, defined, and applied such concepts. Suggest relevant concepts and how to label, define, and apply them in the case. (The Glossary defines and provides examples of many concepts from this course.)**

*<Peer reviewer writes free-form comments here>*

**Your Rating:** Based on your comments above, how would you rate the evidence of moral reasoning skills in the author's case analysis?

7. Excellent: The paper shows strong evidence of all five moral reasoning skills. **The author labels, defines, and applies relevant concepts in his/her case analysis.**

...

1. Disastrous: The paper shows no evidence of any of the first four moral reasoning skills. **Regarding the fifth, the author does not label, define, or apply any relevant concepts in his/her case analysis.**

# Feedback Form with AI input

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### Notes from the Reviewer Aide:

- This paper refers to 'safety' on lines 220 and 225, but there doesn't seem to be a definition. Here is a definition and example of safety from the Glossary.
- This paper defines 'responsibility of a bioengineer'. Here are some sample definitions of responsibility of a bioengineer from similar case analyses. Does your author get it right?

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# Conclusions

- Sources of ill-definedness in bioengineering ethics:
  - lack of definitive answers for complex problems,
  - dependence of answer on how problem framed,
  - open-ended concepts and the need for interpretive mapping,
  - need for textual problem representation.
- ITS approach employs peer review with SWORD to help authors frame cases.
- Explore AI/machine learning to identify labeling, defining, applying concepts.
  - Based on corpus of student papers annotated with our Assessment Instrument.
  - Direct feedback on labeling, defining, and applying concepts through peer reviewers.
  - Peer reviewers filter out inapplicable feedback, and may learn by selecting feedback.
- How general is our approach to ill-defined bioengineering ethics case analysis?
  - LDA operationalizes only one of five Higher Level Moral Reasoning Skills
  - Assessment Instrument and SWORD can be tailored to other engineering ethics.
  - Case analysis / argumentation tasks in rhetoric, law, history, problem-based learning.

# Higher-Level Moral Reasoning Skills (HLMRS)

1. Employing professional engineering knowledge to frame issues.
2. Viewing the problem from multiple levels.
3. Flexibly moving among the multiple levels.
4. Identifying analogous cases and explaining the analogies.
5. Employing a method of moral reasoning in conducting the analysis.
  - Operationalized by LDA

## ... Framing the problem ...

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