ETHICS ACROSS THE CURRICULUM:
Ethics in Geographic Information Science

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SECTION 1:
Lesson Plan

Geographic Information Science (GISc) is the study of the development and application of Geographic Information Systems (GIS) and geospatial technologies. GIS is a computerized approach to collecting, manipulating, visualizing, and displaying spatial data. It is most commonly thought of as mapping software, such as ESRI’s ArcGIS or Intergraph’s GeoMedia. GIS and allied geospatial technologies, such as satellite remote sensing and Global Positioning Systems (GPS) are used in a wide variety of disciplines (e.g., geology, geography, public health, anthropology, business, psychology, environmental science, sociology, political science, journalism, etc.). However, regardless of the field in which it is applied, common ethical concerns surround GISc. GIS and geospatial technologies have enabled powerful insight into human and physical processes, but these powers have also raised ethical concerns, particularly the ways in which spatial data are acquired, utilized, and then displayed in publicly accessible formats.

Ethics in GISc is a topic that, though widely acknowledged to exist, is not comprehensively addressed in textbooks for undergraduate or graduate students. As a result, this topic is an overlooked component in the GISc curriculum. This situation has resulted in the creation of a generation of Geographic Information Systems (GIS) analysts in academia, government, and in the private sector who have not been educated on the implications of the way they collect and display spatial data, and the way these data may be used unintentionally. For example, it is not uncommon in scholarly journals to see researchers including maps of locations of their participants. These are generally displayed as a map of points (participant residences) at a city- or county-wide scale and therefore it may be considered not possible to know the real-world location of these people. However, with basic GIS skills, these data can sometimes be re-engineered to identify the coordinates of these residences. This situation is even more problematic when considering that the participants in these studies are often vulnerable to predatory actions due to age (e.g. study participants on adolescent female physical activity and obesity) or due to a health condition. Though the Health Insurance Portability and Privacy Act (HIPPA) provides some guidance on the display and dissemination of spatial health data, it is not widely known throughout the GISc community. Many more examples exist where spatial data have been inappropriately collected, utilized, and displayed. However, no formal resource exists in which to educate students on these ethical concerns. Indeed, as geospatial technology improves and changes from year to year, the ethical concerns continue to grow. Students at all levels continue to receive instruction on the use to GIS software and geospatial technologies, such as GPS, but without education on the potential unintended consequences of their newly acquired technical knowledge.

This module will address the three areas that raise ethical questions regarding the use of Geographic Information Systems and geospatial technologies: 1) data collection, 2) data use, and 3) data display. In essence, these topics address what we map, how we map it, and how our maps may be used. The module will be scalable for use in both undergraduate and graduate courses and will be composed of readings, discussion, and applied exercises. As outlined in the following section, graduate students will have additional readings and an exercise that requires an advanced technical skill-set beyond the undergraduate level.
The following section outlines the most commonly encountered ethical issues that arise in research, and in public and private sector uses of GISc, which will comprise the lecture material for the module. The following readings (found in Section 2) and exercises will be used to engage students in the real-world implications of these issues.

**ETHICAL ISSUES:**
1) Data Collection
   a. GPS as a surveillance tool
   b. GPS-enabled biosensors
   c. GPS-enabled video (the Google Maps Street View question)

2) Data Use
   a. Liability for specific data uses (e.g., hazard zones) and repurposing datasets
   b. Appropriate representation of data quality through metadata
   c. Availability to marginalized populations

3) Data Display
   a. Guidelines provided by the Health Insurance Portability and Privacy Act (HIPPA)
   b. Methods for Masking Spatial Data and subsequent concerns
   c. Implications of converging technologies: Google Earth and GIS

**EXERCISES:**

Graduate
1) Georegistering: Developing an Awareness of Re-engineering Spatial Data
2) Case Studies: Discussion of Ethical Issues from Real-World Situations

Undergraduate
1) Analysis of Published Maps: Can the Data be Re-engineered?
2) Case Studies: Discussion of Ethical Issues from Real-World Situations

**TIMELINE**
Performance of the module will occur in three sections:
Part 1: Lecture
   a. Data Collection – 30 minutes
   b. Data Use – 30 minutes
   c. Data Display – 30 minutes
Part 2: Discussion
   a. Prior to this class meeting, students will be given questions to guide their reading of assigned articles. The articles will be read and questions answered before class. These readings will be selected based on the background of the instructor and the interests of the students. The Readings section (Section 2) provides a breadth of cases from which to select.
   b. Discussion of articles – 30 minutes
   c. Discussion of case studies – 30 minutes. Students will be placed into groups of four and will be assigned news stories (undergraduate) or scholarly articles (graduate) on real-world ethical

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1 Depending on the background of the instructor and the interests of the students, a variety of case studies may be used for discussion. Select from those listed in the Case Studies and Exercises sections that follow.
issues with GIS and geospatial technologies. They will then read these cases and present them to the class, along with concrete actions they could take to ethically manage the situation.

Part 3: Introduction of Exercise

a. (30 minutes) The instructor will introduce students to their outside exercise, which will require them to critically analyze data and/or maps and utilize their technical skills in GISc. Undergraduate students will perform a search for published maps and will then analyze the risk of the mapped data being re-engineered. The graduate students will use their advanced technical skills to attempt re-engineering of spatial data. They will then write their findings as a one-page paper that will accompany their resulting dataset.
SECTION 2: Readings

This section provides a breadth of readings on background to the issue of ethics in GISc, methods, and cases from which instructors may make selections for discussion and for use in class exercises.

Undergraduate


Graduate


Case Studies: Discussion of Ethical Issues from Real-World Situations


Exercises: Georegistering (graduate), Map Analysis (undergraduate)

Readings from the following selection may be used in a graduate class for background in spatial confidentiality and for extracting maps from these articles to assess their ability to be georegistered and the data re-engineered. For the undergraduate exercise, maps in these readings may be used to assess the likelihood of re-engineering data in each case.


Module Overview:

• This module is designed to be scalable to undergraduate and graduate courses. Instructors may select only those sections which are applicable to the particular level of GISc being taught.

• This module is divided into the following sections:
  - Introduction to Geographic Information Science
  - Existing Ethics Guidelines for Users of GIS and Geospatial Technologies
  - Ethical Issues in Data Collection
  - Ethical Issues in Data Use
  - Ethical Issues in Data Display
  - Georegistering Exercise
  - Map Analysis Exercise
INTRODUCTION TO GEOGRAPHIC INFORMATION SCIENCE

Introduction:

• Geographic Information Science (GiSc) is the study of the development and application of Geographic Information Systems (GIS) and geospatial technologies.

• GIS is a computerized approach to collecting, manipulating, visualizing, and displaying spatial data.

• It is most commonly thought of as mapping software, such as ESRI’s ArcGIS or Intergraph’s GeoMedia.

• GIS and allied geospatial technologies, such as satellite remote sensing and Global Positioning Systems (GPS) are used in a wide variety of disciplines (e.g., geology, geography, public health, anthropology, business, psychology, environmental science, sociology, political science, journalism, etc.).
Introduction (cont’d):

• However, regardless of the field in which it is applied, common ethical concerns surround GISc.

• GIS and geospatial technologies have enabled powerful insight into human and physical processes, but these powers have also raised ethical concerns, particularly the ways in which spatial data are acquired, utilized, and then displayed in publicly accessible formats.

EXISTING ETHICS GUIDELINES FOR USERS OF GIS AND GEOSPATIAL TECHNOLOGIES
Existing Ethics Guidelines for Users of GIS and Geospatial Technologies:

• Ethics in GISc is a topic that, though widely acknowledged to exist, is not comprehensively addressed in textbooks for undergraduate or graduate students. As a result, this topic is an overlooked component in the GISc curriculum.

• This module will address the three areas that raise ethical questions regarding the use of Geographic Information Systems and geospatial technologies: 1) data collection, 2) data use, and 3) data display.

• In essence, these topics address what we map, how we map it, and how our maps may be used.

• We will now look at a main source for ethical guidelines and then discuss specific issues regarding data collection, data use, and data display.

Existing Ethics Guidelines for Users of GIS and Geospatial Technologies (cont’d):

• As users of GIS and geospatial technologies, one main source exist to guide use of geographic data:

  The GIS Code of Ethics (suggestions, not law)
The GIS Code of Ethics:

- The GIS Code of Ethics is available online:
  http://www.urisa.org/about/ethics/
  http://www.gisci.org/Ethics_and_Conduct/CodeOfEthics_PR.pdf

Obligations to Society

Obligations to Employers and Funders

Obligations to Colleagues and the Profession

Obligations to Individuals in Society

Obligations to Society:

- Do the Best Work Possible

- Contribute to the Community to the Extent Possible, Feasible, and Advisable

- Speak Out About Issues
Obligations to Employers and Funders:

• Deliver Quality Work
• Have a Professional Relationship
• Be Honest in Representations

Obligations to Colleagues and the Profession:

• Respect the Work of Others
• Contribute to the Discipline to the Extent Possible
Obligations to Individuals in Society:

- Respect Privacy
- Respect Individuals

ETHICAL ISSUES IN DATA COLLECTION
1a) GPS as a Surveillance Tool

- With decreasing cost, decreasing size, and increasing accuracy, GPS is becoming a popular data collection tool.

[Figure 1 showing data collection locations]

http://www.ii-healthgeographics.com/content/8/1/66

1b) GPS-enabled Biosensors

- GPS can now easily be converged with other technologies, such as accelerometers (physical activity), galvanic skin response monitor (stress), etc.

[Map showing emotion map]

http://emotionmap.net/
1c) GPS-enabled video

- Geospatial video is composed of video cameras mounted on vehicle windows, and a GPS receiver that places a stream of coordinates on the audio track of the video. The result is that each image in the video is linked to its real-world location.

- In this example, the geospatial video was used to collect damage in the Lower Ninth Ward after Hurricane Katrina. What you see in this image is, of course, no longer there.

Debris has been cleared and, in this particular block, vegetation has become overgrown to the point where it is now difficult to remember that this was once a populated neighborhood.

In this respect, geospatial video also serves as a method for archiving field data within a geographical context.

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An Example: Recovery Score

1: damaged structure/ remains

2: cleared lot

3: structure under construction

4: complete structure

A recovery score can be coded using spatial video. From these images we can see the stage of rebuilding after a disaster, but what else can we see... people? License plates?
In this case, data from the spatial video is used to code locations where houses burned and then where they are in various stages of rebuilding.

Though there are ethical questions about the use of such technology, these must be balanced with the power of new data sets that can also be provided.

**Rancho Bernardo**
(San Diego County 2007)

Burned homes

* Damage status obtained from SanGIS, the San Diego Union Tribune, and aerial imagery

**ETHICAL ISSUES IN DATA USE**
2a) Liability for specific data uses and repurposing datasets

- Often you will be given data sets to use for specific projects, but only for use in that case alone.

- Data may only be used for the intended purpose.

- In this figure, we are looking at a map of the homeless population in Los Angeles. This is a density map, but the GIS analyst has used individual point data of actual locations of homeless people to create this map.

- The intent of this map is to help understand the pattern, but how could the individual data be misused?

2b) Appropriate representation of data quality through metadata

[Image with text: Geospatial Metadata]

[Text: What are Metadata?
A metadata record is a file of information, usually presented as an XML document, which captures the basic characteristics of a data or information resource. It represents the who, what, when, where, why and how of the resource. Geospatial metadata are used to document geographic digital resources such as Geographic Information System (GIS) files, geospatial databases, and earth imagery. A geospatial metadata record includes core library catalog elements such as Title, Abstract, and Publication Data, geographic elements such as Geographic Extent and Projection Information, and database elements such as Attribute Label Definitions and Attribute Domain Values.

The FGDC is tasked by Executive Order 13066 to develop procedures and assist in the implementation of a distributed discovery mechanism for national digital geospatial data. Geospatial metadata are critical to data discovery and serves as the fuel for both the Geospatial One-Stop data portal and the NSDI Clearinghouse.

http://www.fgdc.gov/metadata]
2c) Availability to marginalized populations

- One ethical issue is who data are released to and in what format, with the concern being protection of sensitive data and/or people. However, what rights do people have to data that impacts them?

- Therefore, another ethical concern is making sure that data are made available in accessible formats, particularly for educational and decision-making purposes. Rather than using GIS data, you can convert these to Google Earth or other formats.


http://www.google.com/gadgets/directory?synd=earth&prog=view-on&cat=outreach

ETHICAL ISSUES IN DATA DISPLAY
3a) Guidelines provided by the Health Insurance Portability and Privacy Act (HIPPA)

http://www.hhs.gov/ocr/privacy/hipaa/understanding/summary/index.html

3b) Methods for Masking Spatial Data and subsequent concerns

3c) Implications of converging technologies: Google Earth and GIS

*As previously mentioned, Google Earth can be a way to disseminate data to non-GIS users. This can be helpful in providing data for education, but it also makes it easy to publicly post spatial data. What are the benefits and limitations of this technology?

GEOREGISTERING EXERCISE
• Read the following article:

• Select a published map from your local area and replicate the Curtis et al. methods of georegistering the map, digitizing the spatial data, and assessing the accuracy of these data to their real world locations.

MAP ANALYSIS EXERCISE
• Select 10 articles from the Exercises section of the Reading list provided in the lesson plan.

• Analyze the maps in these articles to assess what data are displayed, how they are displayed, and whether these maps may reveal any confidential information (real world location of an event, e.g. participant house address).

• Write a one-page, single-spaced paper discussing the results of the visual analysis and why you have arrived at these particular results.