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Testing the Waters and Your DNA: Things Are Not Always What They Seem

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In this experiment, students choose cups of "unknowns"--both tap water (poured into odd-numbered cups) and bottled water (poured into even-numbered cups) from trays. The students then record their names and guesses on index cards, before placing their cups back on the trays. You next tell them, "Now I have your DNA!" You ask them how this makes them feel and why, and if they think that everyone's DNA should be placed in a database. This leads to discussions about the Fourth Amendment, DNA and abandonment, DNA and privacy, the Genetic Information Non-discrimination Act, Direct-to-consumer genetic testing kits, DNA databases, and other topics.

Keywords: DNA testing, DNA privacy, DNA databases

Introduction

When we heard Albert Scherr, Professor of Law at the Franklin Pierce Law Center (aka. "Buzz") deliver a talk at St. Francis College, "The Constitution and Genetic Privacy: Do You Know Where Your DNA Is?" we started thinking about ways to teach this topic to students. We first met Buzz when we took a course titled, "The Ethical, Legal and Social Implications of the Human Genome Project" or "ELSI" at Dartmouth University ten years ago. DNA and privacy was a topic that we discussed and debated constantly. (For ideas on how to use ELSI in your teaching see Mathur and Nolan (2010). Buzz reached out to us and offered to come to St. Francis College to deliver a talk on DNA and privacy for free of charge. It was an offer we could not refuse!

Professor Scherr focused on obtaining DNA that has been "abandoned". An example of this would be what one views in a crime show when a police officer offers a can of soda to a "suspect" and then keeps the can to test for DNA that can be extracted from epithelial cells in saliva. We were fascinated by the concept of abandonment and was trying to think of a way in which we could "surreptitiously" obtain DNA from my students. We first "experimented" with middle school kids in an after-school program in which we were about to use an Edvotek™ "Introduction to DNA Electrophoresis" kit. We gave the students cups of soda and asked them to write their names on the cups. One of the ten students "guessed" what we were up to: "You want our DNA, don't you?" We lied and said, "No, not at all—we are doing a test to see if you can tell the difference between Coke and Pepsi." When we did reveal our "true intent", we had approximately three different reactions. Some students felt "tricked" or deceived, others seemed amazed and excited that I would want their DNA, and still others said "they did not care." We pondered a more "full-proof" way to obtain their DNA without their knowledge, and devised the idea of testing if the students could differentiate spring from New York City tap water. One of the ideas that we conceived of was collecting the PTC taste papers used in a typical genetics lab, but we thought that that might be too cumbersome.

In this procedure, one set of cups is labeled with odd numbers, and placed on a tray. Another set is labeled with even numbers. A small amount of tap water is poured into the odd-numbered cups and a similar volume of spring water is poured into the even-numbered cups. Each student picks out an odd and an even-numbered cup and writes the numbers down on an index card, along with their name and date. They taste the water, and record their guesses next to their numbers. The professor collects the cards, and to add a little levity, places the cards in a bag for a choice of a prize. This creates a festive atmosphere and sets the tone for what will happen next. The students place the cups back on the trays. The instructor then passes out a piece of paper to each student. Then the

instructor next surprises the students by saying, “I now have your DNA.”

The students are then asked four questions:

1. What was your initial response when your instructor said, “I now have your DNA.”
2. Why did you have the reaction you did?
3. Do you think that everyone’s DNA should be put into a database?
4. Why or why not?

If you desire to use a control group, ask the same questions, but without taking the students’ DNA. Change question #1 slightly by saying:

1. Do you think someone should be able to take someone’s abandoned DNA?

Discard the cups in front of the students so that they realize after they have answered the questions that you are not really going to isolate or use their DNA for anything.

Student Outline

Materials

- Index cards
- Odd-numbered cups of unknown type of water (either tap or bottled) on trays
- Even-numbered cups of unknown type of water (either tap or bottled) on trays
  (NOTE: Only your instructor knows the type of water, which he or she poured out before class.)

Methods

1. Obtain one odd-numbered and one even-numbered cup of water.
2. Write you name down on the index card provided and the number of each cup with a space after the number.
3. Taste each type of water, and record after each number whether you think it is “tap” or “bottled” water. NOTE: the odd-numbered cups contain the same type of water and the even-numbered cups contain the alternate type.
4. Return your cups to the trays.

Notes for the Instructor

This background and subsequent references are provided in order to facilitate a discussion on DNA testing and abandonment, as well as a host of other topics that might arise with respect to DNA in general.

The Fourth Amendment protects one against unlawful searches and seizures, but this does not apply to property that has been thrown away or "**abandoned**". This well might apply to a paper cup tossed into a basket, or put back on a tray. Collins (2013) points out that the Fourth Amendment does not apply to property that has been "voluntarily abandoned, because society does not recognize an expectation of privacy in abandoned property as being objectively reasonable".

Is it really abandonment? Should there be laws against taking a soda can of a suspect? In general, my guess is that people do not know all the information that DNA can reveal about themselves, and that this might constitute an "informed consent" issue. Surreptitious taking of DNA can really mean two things: 1. The taking of one's "abandoned" DNA without the knowledge of the person whose DNA it is and 2. Using the knowledge contained in the DNA without the person's consent.

Collins (2013) focuses on "theft" of abandoned DNA when this information is used for malicious purposes, such as retrieving from the trash dental floss from a movie star and then identifying paternity of this person by publicizing it. Hernandez (2005) also explores this topic.

There are no federal laws on such DNA theft; however a few states do have laws protecting DNA privacy (once the DNA has been obtained by the authorities) and other states have genetic bills of rights. However, Prince (2012) reveals that 21 states have no laws regulating surreptitious DNA testing. Collins (2013) does not address police or other official treatment of "abandoned" DNA. "However, just because an individual "abandons" DNA in a public place does not mean that the individual has abandoned interest in maintaining the privacy of the data that sample contains" (Gunther and Wagner, 2013). These authors note that informed consent for research using DNA sequences should be obtained and they reveal that individual unique sequence identifiers have also been found on the Web.

Joh (2006) says that there should be a "genetic exceptionalism" to the Fourth Amendment, as people do not realize that DNA reveals much information about themselves—much more than a mere fingerprint. Scherr (2013) proposes that the police continue to be allowed to take "abandoned" DNA, but that they need to get a search warrant to mine the DNA for genetic information. Scherr (2013) does not feel that the courts have separated one's relinquishment of "reasonable expectation of privacy" (Fourth Amendment wording) if one abandoned a physical item, i.e. a cup or a fork from perhaps a "reasonable expectation of privacy" they might have if they knew what this genetic information could reveal. Another stipulation of the Fourth Amendment is whether there is a "reasonable recognition of privacy by society".

The answers to question 3 and 4 might be enhanced by a little knowledge about:

1. What DNA databases are currently in use and for what purpose?
2. What information is contained in your DNA?
3. How could one use the information contained in your DNA?

What DNA Databases Are Currently in Use And for What Purpose?

In 1994, the Combined DNA Index System (CODIS) was established in the United States in order to help solve violent crimes. Sugzda (2013) noted that CODIS originally stipulated that DNA samples were to be collected from the convicted, but was changed in 2006 to include anyone that was arrested. Sugzda (2013) ruminates on differences in state laws regarding DNA extraction procedures. Gruber (2014) notes that the CODIS database has reached over ten million profiles, and notes some state differences where even a speeding ticket can result in a mandatory swab for DNA. Gusella (2013) is troubled by this and questions the ethics of keeping DNA in a law enforcement database after the person has finished serving the sentence for the crime. He feels that stronger privacy protection legislation will need to be developed as DNA reveals more information about the individual.

Gruber (2014) asks, does taking DNA samples protect us against criminals? Does it protect the innocent? Innocence Project (http://www.innocenceproject.org).

(We should also ask, "Does it protect children against kidnapping or things such as the sex trade if their DNA was in a database?")

Familial profiling can be introduced to the students as a way in which officials have circumvented the fact that not everyone's DNA is in the federal database. Suter (2010) points out competing goals of familial DNA profiling, which are apprehending and deterring criminals against privacy constraints, and racial profiling.

Other databases that focus on ancestry include:

1. deCODE---Iceland
2. HapMap project
3. National Geographic

What Information Is Contained in DNA?

The CODIS miner sequences 13 different regions of non-coding DNA that contain different numbers of short tandem repeats (STR's). The likelihood of two people (other than identical twins) having the exact same number of repeats for all 13 regions is 1 out of billions. Gusella

(2013) gives a good overview of the science behind DNA and its different uses, in addition to STR's. One's DNA also contains:

1. Information about personality
2. Medical information
3. Hereditary information

Gutmann and Wagner (2013) mention how much easier it is to find parents (especially with adoptive children, and/or through sperm donations) because the Y chromosome is passed down father to son, and we are traditionally named paternally.

How Could One Use the Information Contained in Your DNA?

The Genetic Information Non-discrimination Act (GINA) was passed 2008. However, GINA has caveats. Its narrow scope protects the individual from disclosing genetic information to health insurance companies and employers ONLY. Physicians as well as insurance companies can still acquire medical histories, and it is common knowledge that many disorders have a genetic component. In addition, here is a short list of the kind of information found in one's DNA and a few possible uses of that information:

1. STR's for criminal profiling
2. New born screening as for PKU
3. Cloning—feasible? Maybe. Legal? No.
4. Are identical twins clones?
5. Patenting DNA—Myriad is a company that patented a sequence for a BRCAI gene, but then their patent was overturned in 2013.
6. Search and find sequences on internet (Gutmann and Wagner (2013))
7. Genes for diseases---GINA, only protects from Health Insurance companies, and employers; others might find a way to discriminate against someone because of this information
8. Ancestry—The company 23RMe provides direct-to-consumer DNA testing and originally the company gave users a print-out of health as well as ancestry information. However, a law passed Nov., 2013 that indicated that 23R Me could NOT give out health information; they can reveal ancestry information only. You might ask the students, "Why do you think this is so?" One answer would be that there might be unknown psychological consequences if you reveal to a person that they might have an incurable disease. This topic might be a lead-in to the topic of genetic counseling.

Conclusion

We have now tested this experiment with a wide range of students, ABLE professors, and ages, and have found that there is a mixed response. In each case, however, it generated great discussions of DNA and privacy. This is a good way to lead into a discussion of DNA and the information that it might reveal.

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