

# 14 Non-experimental Design

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Researchers who are simply interested in describing characteristics of people, describing relationships between variables, and using those relationships to make predictions can use non-experimental research. Using the non-experimental approach, the researcher simply measures variables as they naturally occur, but they do not manipulate them. For instance, research analyzing the number of traffic fatalities in America last year that involved the use of a cell phone would be of substantial importance. It would not be done by actually manipulating cell phone, but by collection of available data on accidents and would be categorized as non-experimental research. Alternatively, if a researcher stood at a busy intersection and recorded drivers' genders and whether or not they were using a cell phone when they passed through the intersection to see whether men or women are more likely to use a cell phone when driving, then this would also be non-experimental research. It is important to point out that non-experimental does not mean nonscientific. Non-experimental research is scientific in nature. It can be used to fulfill two of the three goals of science (to describe and to predict). However, unlike with experimental research, we cannot easily make causal conclusions using this method; we generally cannot confidently say that one variable causes another variable using this method.

In spite of the difficulty with causal inference, there are a wide range of

important questions in psychological science and related fields that depend on data about people that can only be addressed with non-experimental methods. One such area is questions about behavior that affect public health, such as during the COVID pandemic. Wallace, Goldsmith-Pinkham and Schwartz (2023) addressed the question of whether political party affiliation was a risk factor associated with COVID mortality during the pandemic. Using public health data from Florida and Ohio, they found that after vaccines became available, excess mortality was significantly higher for Republican voters than Democratic voters in these states. Although it is tempting to infer a causal relationship about political or personal beliefs that influence party membership, vaccine use and mortality outcome, even with a great deal of careful quantitative effort to measure and control for other extraneous variables, the authors final conclusions are stated cautiously:

*"In this cross-sectional study, an association was observed between political party affiliation and excess deaths in Ohio and Florida after COVID-19 vaccines were available to all adults. These findings suggest that differences in vaccination attitudes and reported uptake between Republican and Democratic voters may have been factors in the severity and trajectory of the pandemic in the US."*

We should note the careful use of reporting an association and "may have been factors" reflecting the challenges inherent to this approach. The research question is one of substantial practical importance and understanding the relationship requires consideration of the role of behavior, attitudes and beliefs on public health, which are questions related to psychological constructs.

Findings from large scale surveys are frequently encountered in public scientific reporting and these highlight a set of scientific disciplines related to psychological science. Much economic reporting data, such as the National Household Income and Expenditure Survey, is carried out with the same methods and analytical tools. We might more easily identify research like the National Survey of Mental Health and Well Being as being a psychological study but many fields depend on data collected from people, human research

participants, to assess scientific questions. Research in public health, sociology and educational research will have similar kinds of approaches.

In this chapter, we will generally focus on how to identify non-experimental methods and the inference challenges rather than the quantitative tools for tackling these questions. The analytical tools for large scale, multivariate data collection are beyond the scope of this text and class.

### **What do the following classic studies have in common?**

- Stanley Milgram found that about two thirds of his research participants were willing to administer dangerous shocks to another person just because they were told to by an authority figure (Milgram, 1963).
- Elizabeth Loftus and Jacqueline Pickrell showed that it is relatively easy to “implant” false memories in people by repeatedly asking them about childhood events that did not actually happen to them (Loftus Pickrell, 1995).
- John Cacioppo and Richard Petty evaluated the validity of their Need for Cognition Scale—a measure of the extent to which people like and value thinking—by comparing the scores of university professors with those of factory workers (Cacioppo Petty, 1982).
- David Rosenhan found that confederates who went to psychiatric hospitals claiming to have heard voices saying things like “empty” and “thud” were labeled as schizophrenic by the hospital staff and kept there even though they behaved normally in all other ways (Rosenhan, 1973).

The answer for purposes of this chapter is that they are not experiments. In this chapter, we look more closely at non-experimental research. We begin with a general definition of non-experimental research, along with a discussion of when and why non-experimental research is more appropriate than experimental research. We then look separately at two important types of non-experimental research: correlational research and observational research.

## ***Learning Objectives***

1. Define non-experimental research, distinguish it clearly from experimental research, and give several examples.
2. Explain when a researcher might choose to conduct non-experimental research as opposed to experimental research.
3. Define correlational research and give several examples.
4. Explain why a researcher might choose to conduct correlational research rather than experimental research or another type of non-experimental research.
5. Explain why correlation does not imply causation

## ***What Is Non-Experimental Research?***

Non-experimental research is research that lacks the manipulation of an independent variable. Rather than manipulating an independent variable, researchers conducting non-experimental research simply measure variables as they naturally occur (in the lab or real world). In many cases this kind of research depends on large scale data collection and quantitative techniques for assessing relationships among measurements.

Studies of differences in human personality, as noted in Chapter 2 on Measurement, also reflect the approach of measuring constructs that characterize consistent characteristics of human traits. This approach is often used to address questions about nature versus nurture, which also depends on variables that cannot be directly manipulated.

Non-experimental research techniques also include a range of observational and qualitative techniques that will be discussed in greater detail in Chapter 17. These approaches often involve simply observing behavior in context to identify features of behavior. Research in which aspects of the environment are manipulated outside the lab and behavior is measured can

look like observational research, but if the experimenter is manipulating an independent variable, this approach is a kind of Field Research, which will be discussed in Chapter 19.

Most researchers in psychology consider the distinction between experimental and non-experimental research to be an extremely important one. This is because although experimental research can provide strong evidence that changes in an independent variable cause differences in a dependent variable, non-experimental research generally cannot. As we will see, however, this inability to make causal conclusions does not mean that non-experimental research is less important than experimental research. It is simply used in cases where experimental research is not able to be carried out.

## ***When to Use Non-Experimental Research***

Experimental research is appropriate when the researcher has a specific research question or hypothesis about a causal relationship between two variables—and it is possible, feasible, and ethical to manipulate the independent variable. It stands to reason, therefore, that non-experimental research is appropriate—even necessary—when these conditions are not met. There are many times in which non-experimental research is preferred, including when:

- The research question or hypothesis relates to a single variable rather than a statistical relationship between two variables, e.g., how accurate are people's first impressions?.
- The research question pertains to a non-causal statistical relationship between variables, e.g., is there a correlation between verbal intelligence and mathematical intelligence?.
- The research question is about a causal relationship, but the independent variable cannot be manipulated or participants cannot be randomly assigned to conditions or orders of conditions for practical or ethical reasons, e.g., does damage to a person's hippocampus impair the formation of long-term memory traces?.

- The research question is broad and exploratory, or is about what it is like to have a particular experience, e.g., what is it like to be a working mother diagnosed with depression?.

Again, the choice between the experimental and non-experimental approaches is generally dictated by the nature of the research question. Recall the three goals of science are to describe, to predict, and to explain. If the goal is to explain and the research question pertains to causal relationships, then the experimental approach is typically preferred. If the goal is to describe or to predict, a non-experimental approach is appropriate. But the two approaches can also be used to address the same research question in complementary ways. For example, in Milgram's original (non-experimental) obedience study, he was primarily interested in one variable—the extent to which participants obeyed the researcher when he told them to shock the confederate—and he observed all participants performing the same task under the same conditions. However, Milgram subsequently conducted experiments to explore the factors that affect obedience. He manipulated several independent variables, such as the distance between the experimenter and the participant, the participant and the confederate, and the location of the study (Milgram, 1974).

## ***Types of Non-Experimental Research***

Non-experimental research falls into two broad categories: correlational research and observational research. In this chapter, we will focus primarily on correlational research. Methods related to observational research will be discussed further in Chapter 19, Qualitative Research.

The most common type of non-experimental research conducted in psychology is correlational research. Correlational research is considered non-experimental because it focuses on the statistical relationship between two variables but does not include the manipulation of an independent variable. More specifically, in correlational research, the researcher measures two variables with little or no attempt to control extraneous variables and

then assesses the relationship between them. As an example, a researcher interested in the relationship between self-esteem and school achievement could collect data on students' self-esteem and their GPAs to see if the two variables are statistically related.

Observational research is non-experimental because it focuses on making observations of behavior in a natural or laboratory setting without manipulating anything. Milgram's original obedience study was non-experimental in this way. He was primarily interested in the extent to which participants obeyed the researcher when he told them to shock the confederate and he observed all participants performing the same task under the same conditions. The study by Loftus and Pickrell (1995) is also a good example of observational research. The dependent variable was whether participants "remembered" having experienced mildly traumatic childhood events (e.g., getting lost in a shopping mall) that they had not actually experienced but that the researchers asked them about repeatedly. In this particular study, nearly a third of the participants "remembered" at least one event. As with Milgram's original study, this study inspired several later studies using experimental research methods on the factors that affect these phenomena.

## ***Internal Validity in Non-Experimental Design***

**Internal validity** is the extent to which the design of a study supports the conclusion that changes in the independent variable caused any observed differences in the dependent variable. Experimental research is highest in internal validity, when properly controlled, because the use of manipulation (of the independent variable) and control (of extraneous variables) help to rule out alternative explanations for the observed relationships. If the average score on the dependent variable in an experiment differs across conditions, it is quite likely that the independent variable is responsible for that difference. Non-experimental (correlational) research is lowest in internal validity because these designs fail to use manipulation or control. There are

also research approaches that blend both experimental and non-experimental approaches described as quasi-experimental research (which will be described in more detail in a subsequent chapter). This type of research contains some, but not all, of the features of a true experiment. For instance, it may fail to use random assignment to assign participants to groups or fail to use counterbalancing to control for potential order effects. Imagine, for example, that a researcher finds two similar schools, starts an anti-bullying program in one, and then finds fewer bullying incidents in that “treatment school” than in the “control school.” While a comparison is being made with a control condition, the inability to randomly assign children to schools could still mean that students in the treatment school differed from students in the control school in some other way that could explain the difference in bullying (e.g., there may be a selection effect).

## ***What Is Correlational Research?***

Correlational research is a type of non-experimental research in which the researcher measures two variables (binary or continuous) and assesses the statistical relationship (i.e., the correlation) between them with little or no effort to control extraneous variables. There are many reasons that researchers interested in statistical relationships between variables would choose to conduct a correlational study rather than an experiment. The first is that they do not believe that the statistical relationship is a causal one or are not interested in causal relationships. Recall two goals of science are to describe and to predict and the correlational research strategy allows researchers to achieve both of these goals. Specifically, this strategy can be used to describe the strength and direction of the relationship between two variables and if there is a relationship between the variables then the researchers can use scores on one variable to predict scores on the other (the specific analytic approach will be discussed in Chapter 16).

Another reason that researchers would choose to use a correlational study rather than an experiment is that the statistical relationship of interest is



thought to be causal, but the researcher cannot manipulate the independent variable because it is impossible, impractical, or unethical. For example, while a researcher might be interested in the relationship between the frequency people use cannabis and their memory abilities, they cannot ethically manipulate the frequency that people chronically use cannabis. As such, they must rely on the correlational research strategy; they must simply measure the frequency that people use cannabis and measure their memory abilities using a standardized test of memory and then determine whether the frequency people use cannabis is statistically related to memory test performance.

Another strength of correlational research is that it is often higher in external validity than experimental research. Recall there is typically a trade-off between internal validity and external validity. As greater controls are added to experiments, internal validity is increased but often at the expense of external validity as artificial conditions are introduced that do not exist in reality. In contrast, correlational studies typically have low internal validity because nothing is manipulated or controlled but they often have high external validity. Since nothing is manipulated or controlled by the experimenter the results are more likely to reflect relationships that exist in the real world.

Finally, extending upon this trade-off between internal and external validity, correlational research can help to provide converging evidence for a theory. If a theory is supported by a true experiment that is high in internal validity as well as by a correlational study that is high in external validity, then the researchers can have more confidence in the validity of their theory. As a concrete example, correlational studies establishing that there is a relationship between watching violent television and aggressive behavior have been complemented by experimental studies confirming that the relationship is a causal one (Bushman & Huesmann, 2001).

## ***Does Correlational Research Always Involve Quantitative Variables?***

A common misconception among beginning researchers is that correlational research must involve two quantitative variables, such as scores on two extraversion tests or the number of daily hassles and number of symptoms people have experienced. However, the defining feature of correlational research is that the two variables are measured—neither one is manipulated—and this is true regardless of whether the variables are quantitative or categorical. Imagine, for example, that a researcher administers the Rosenberg Self-Esteem Scale to 50 American college students and 50 Japanese college students. Although this “feels” like a between-subjects experiment, it is a correlational study because the researcher did not manipulate the students’ nationalities. The same is true of the study by Cacioppo and Petty (1982) comparing college faculty and factory workers in terms of their need for cognition. It is a correlational study because the researchers did not manipulate the participants’ occupations.

The statistical tool based on calculating a **correlation coefficient** (Chapter 16) does require having two variables that are quantitative and not categorical. While it is commonly the case that correlational research depends on calculating correlation coefficients, be aware that the terms are not actually synonymous. While it is technically possible to have an experimental design that is evaluated statistically with a correlation analysis (calculating a correlation coefficient), in practice this is extremely rare. It would require having a large number of possibilities across the manipulated independent variable, which is a very rare case. In all other cases, the term ‘correlation’ should be avoided in describing experimental research as the neither the statistical tool nor the general method applies (if necessary, the related word ‘associated’ should be preferred over ‘correlated’).

## ***Data Collection in Correlational Research***

Again, the defining feature of correlational research is that neither variable is manipulated. It does not matter how or where the variables are measured. A researcher could have participants come to a laboratory to complete a computerized backward digit span task and a computerized risky decision-making task and then assess the relationship between participants' scores on the two tasks. Or a researcher could go to a shopping mall to ask people about their attitudes toward the environment and their shopping habits and then assess the relationship between these two variables. Both of these studies would be correlational because no independent variable is manipulated.

## ***Correlation Does Not Imply Causation***

You have probably heard repeatedly that "Correlation does not imply causation." An amusing example of this comes from a 2012 study that showed a positive correlation (Pearson's  $r = 0.79$ ) between the per capita chocolate consumption of a nation and the number of Nobel prizes awarded to citizens of that nation. It seems clear, however, that this does not mean that eating chocolate causes people to win Nobel prizes, and it would not make sense to try to increase the number of Nobel prizes won by recommending that parents feed their children more chocolate.

There are two reasons that correlation does not imply causation. The first is called the directionality problem. Two variables,  $X$  and  $Y$ , can be statistically related because  $X$  causes  $Y$  or because  $Y$  causes  $X$ . Consider, for example, a study showing that whether or not people exercise is statistically related to how happy they are—such that people who exercise are happier on average than people who do not. This statistical relationship is consistent with the idea that exercising causes happiness, but it is also consistent with the idea that happiness causes exercise. Perhaps being happy gives people more energy or leads them to seek opportunities to socialize with others by going to the

gym. The second reason that correlation does not imply causation is called the third-variable problem. Two variables, X and Y, can be statistically related not because X causes Y, or because Y causes X, but because some third variable, Z, causes both X and Y. For example, the fact that nations that have won more Nobel prizes tend to have higher chocolate consumption probably reflects geography in that European countries tend to have higher rates of per capita chocolate consumption and invest more in education and technology (once again, per capita) than many other countries in the world. Similarly, the statistical relationship between exercise and happiness could mean that some third variable, such as physical health, causes both of the others. Being physically healthy could cause people to exercise and cause them to be happier. Correlations that are a result of a third-variable are often referred to as spurious correlations.

**User:** *give me an example of a research study where correlation does not imply causation*

**ChatGPT:** Certainly! Here's an example of a study where correlation does not imply causation:

**Example:** Ice Cream Sales and Drowning Incidents

**Scenario:** Researchers observe a strong positive correlation between ice cream sales and drowning incidents. They notice that as ice cream sales increase during the summer months, so do the number of drowning incidents.

**Correlation:** There is a positive correlation between ice cream sales and drowning incidents. As one variable (ice cream sales) increases, the other variable (drowning incidents) also tends to increase.

**Interpretation:** One might hastily conclude that eating ice cream leads to an increase in drowning incidents or vice versa.

## ***"Lots of Candy Could Lead to Violence"***

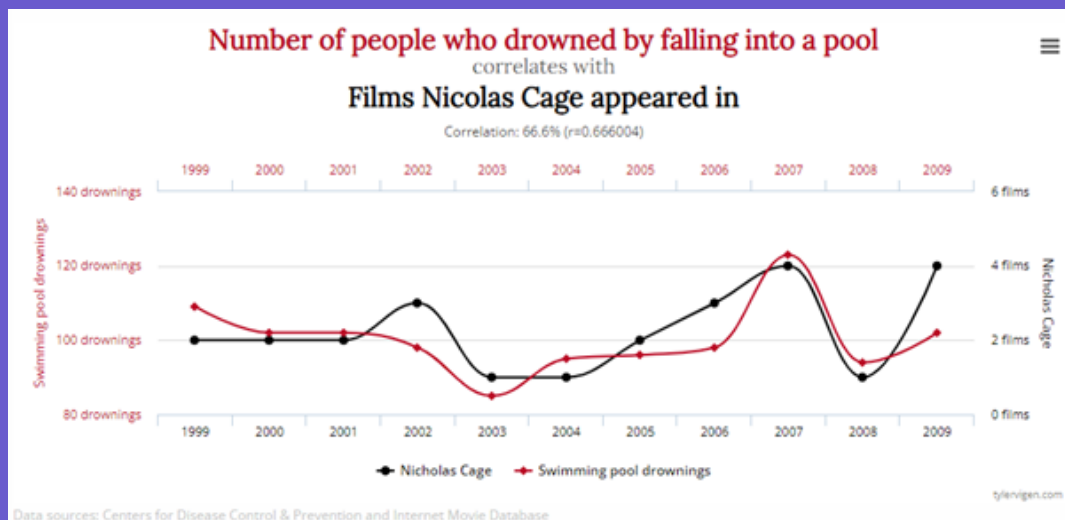
Although researchers in psychology know that correlation does not imply causation, many journalists do not. One website about correlation and causation, [http://jonathan.mueller.faculty.noctrl.edu/100/correlation\\_or\\_causation.htm](http://jonathan.mueller.faculty.noctrl.edu/100/correlation_or_causation.htm), links to dozens of media reports about real biomedical and psychological research. Many of the headlines suggest that a causal relationship has been demonstrated when a careful reading of the articles shows that it has not because of the directionality and third-variable problems.

One such article is about a study showing that children who ate candy every day were more likely than other children to be arrested for a violent offense later in life. But could candy really "lead to" violence, as the headline suggests? What alternative explanations can you think of for this statistical relationship? How could the headline be rewritten so that it is not misleading?

***Explanation:*** However, the correlation between ice cream sales and drowning incidents does not imply causation. In reality, both variables are influenced by a third factor: temperature. Warmer temperatures during the summer months lead to an increase in ice cream sales as people seek ways to cool down. Simultaneously, warm weather encourages people to engage in water-related activities such as swimming, which increases the risk of drowning incidents.

***Conclusion:*** In this example, while there is a correlation between ice cream sales and drowning incidents, it would be incorrect to conclude that one directly causes the other. Instead, both variables are influenced by a common factor, temperature, demonstrating that correlation does not imply causation. To establish causation, further research using experimental designs or controlling for other variables would be necessary.

As you have learned by reading this book, there are various ways that researchers address the directionality and third-variable problems. The most effective is to conduct an experiment. For example, instead of simply measuring how much people exercise, a researcher could bring people into a laboratory and randomly assign half of them to run on a treadmill for 15 minutes and the rest to sit on a couch for 15 minutes. Although this seems like a minor change to the research design, it is extremely important. Now if the exercisers end up in more positive moods than those who did not exercise, it cannot be because their moods affected how much they exercised (because it was the researcher who used random assignment to determine how much they exercised). Likewise, it cannot be because some third variable (e.g., physical health) affected both how much they exercised and what mood they were in. Thus, experiments eliminate the directionality and third-variable problems and allow researchers to draw firm conclusions about causal relationships.



Some other excellent and amusing examples of spurious correlations can be found at <http://www.tylervigen.com>.

## Personality Research

**Personality research** is a branch of psychology that focuses on understanding individual differences in patterns of thinking, feeling, and behaving. It is essentially research on the common kinds of participant variables we have considered as extraneous variables in experimental control and design. Personality researchers seek to explore and explain the characteristics that make each person unique, how these traits develop over time, and how they influence various aspects of life, such as relationships, career choices, and mental health.

The Big Five personality traits, also known as the Five Factor Model (FFM), are five broad dimensions of personality that are commonly used to describe and measure individual differences in personality. These traits have been identified through quantitative analysis of relationships among items from questionnaires asking about behavior, preferences and tendencies. The Big Five traits are:

- **Openness to Experience:** This trait reflects the extent to which individuals are open-minded, curious, imaginative, and receptive to new experiences. People high in openness tend to be creative, adventurous, and intellectually curious, while those low in openness may be more traditional, conservative, and resistant to change.
- **Conscientiousness:** Conscientiousness refers to the degree of organization, responsibility, dependability, and self-discipline exhibited by individuals. People high in conscientiousness are diligent, organized, and goal-oriented, while those low in conscientiousness may be more careless, impulsive, and prone to procrastination.
- **Extraversion:** Extraversion reflects the level of sociability, assertiveness, energy, and positive emotionality displayed by individuals. People high in extraversion are outgoing, talkative, and energetic, enjoying social interactions and seeking stimulation. In contrast, those low in extraversion tend to be introverted, reserved, and prefer solitary activities.
- **Agreeableness:** Agreeableness refers to the degree of warmth, kindness,

empathy, cooperation, and altruism exhibited by individuals. People high in agreeableness are compassionate, trusting, and cooperative, valuing harmony and interpersonal relationships. Individuals low in agreeableness may be more competitive, skeptical, and less concerned with others' welfare.

- **Neuroticism (or Emotional Stability):** Neuroticism reflects the tendency to experience negative emotions such as anxiety, depression, moodiness, and vulnerability to stress. Individuals high in neuroticism are prone to worry, rumination, and emotional instability, while those low in neuroticism tend to be emotionally resilient, calm, and emotionally stable.

Measures on these five traits are considered relatively stable over time and across situations, forming the core structure of personality. They provide a comprehensive framework for understanding and measuring individual differences in personality and have been widely used in research across various fields, including psychology, sociology, organizational behavior, and personality assessment.

Research based on these characteristics is necessarily non-experimental as participants cannot be assigned to conditions. Research in this area investigates the ways in which personality traits influence behavior, attitudes, and interpersonal relationships. They examine how different personality traits are associated with various outcomes, such as academic and occupational success, health behaviors, leadership styles, and susceptibility to mental health disorders. Personality disorders are characterized by enduring patterns of maladaptive behavior, thoughts, and emotions that cause significant distress or impairment in functioning. Researchers seek to understand the underlying mechanisms, etiology, and effective treatments for these disorders.

Personality research also is used in studies of cross-cultural and gender differences that appear in personality traits and patterns. Researchers investigate how cultural norms, values, and socialization practices shape personality development and expression across different societies and cultural groups. This approach can often lead to research questions based on



hypotheses about nature versus nurture. That is, the degree to which some aspects of behavior might be innate and observed differences arise from on genetic characteristics that vary across individuals. These questions are often contrasted with hypotheses that behavioral tendencies occur due to differences in experiences that might shape behavior over time.

Nature/nurture questions can easily become very contentious and become debates about core, immutable differences in behavior or cognition between people. It is important to remember in these debates that the research tools being applied to these questions are necessarily non-experimental (usually correlational) and the same careful inference framework need to be applied. As we have seen in several examples above, many spurious correlations occur in the world and many observed correlations occur due to unexpected third variables. While these are usually easy to spot as obvious errors in the amusing examples presented, many people overlook the inference problem when evaluating the same claims, for example, about observed differences between men and women.

## Key Takeaways

- Non-experimental research is research that lacks the manipulation of an independent variable.
- There are two broad types of non-experimental research. Correlational research that focuses on statistical relationships between variables that are measured but not manipulated; and observational research in which participants are observed and their behavior is recorded without the researcher interfering or manipulating any variables.
- In general, experimental research is high in internal validity, correlational research is low in internal validity, and quasi-experimental research is in between.
- Correlational research involves measuring two variables and assessing the relationship between them, with no manipulation of an independent variable.
- Correlation does not imply causation. A statistical relationship between two variables, X and Y, does not necessarily mean that X causes Y. It is also possible that Y causes X, or that a third variable, Z, causes both X and Y.
- While correlational research cannot be used to establish causal relationships between variables, correlational research does allow researchers to achieve many other important objectives (establishing reliability and validity, providing converging evidence, describing relationships, and making predictions)

## Exercises

1. Why are experimental studies higher in internal validity?
2. Why are nonexperimental studies higher in external validity?

For each of the following 3 examples, indicate what kinds of non-experimental design would be used to study the phenomenon and also outline a 2-group experimental approach that could answer a question that might be inspired by the non-experimental work.

- 3a. Pushing ahead in line
- 3b. Increased crime rates during higher temperature months
- 3c. Studiousness in college students

For each of the following statistical relationships, decide whether the directionality problem is present and think of at least one plausible third variable.

- 4a. People who eat more lobster tend to live longer.
- 4b. People who exercise more tend to weigh less.
- 4c. College students who drink more alcohol tend to have poorer grades.