Distinguishing Correlational vs. Experimental Research

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Overview

Students are presented with five examples of research. For each study students identify if the study is correlational or experimental. If correlational, they draw a scatter plot and predict the correlational coefficient (r). If experimental, they draw a bar graph and label axes. As a possible extension, students can explain what conclusions the researchers can make regarding the relationship between the variables (i.e. causal inference or correlational).

Alignment with APA's Guidelines for the Undergraduate Psychology Major

Goal 2 Scientific Inquiry and Critical Thinking

Outcomes

2.2 Demonstrate psychology information literacy
2.4 Interpret, design, and conduct basic psychological research

Indicators

2.2a Read and summarize general ideas and conclusions from psychological sources accurately
2.4a Describe research methods used by psychologists including their respective advantages and disadvantages

Alignment with APA's National Standards for High School Psychology

Domain

Scientific Inquiry

Content Standard Area

Research Methods, Measurement, and Statistics

Anticipated Time (*estimate of time needed)*

If the teacher collects the assessment from students, it could be as short as 10-15 minutes. If teacher goes over the assessment in class, it could take 15-25 minutes.

Purpose

Formative Student *(teacher provides feedback to students for the purpose of revision)*

Students use five studies to practice distinguishing correlational research from experimental. After getting teacher feedback, the students can make revisions and identify areas where they need more work or practice.

During class/outside of class

During class

Timing *(when should this assessment be used during the unit)*

After students have learned about types of research methods, this assessment of 5 short answer questions can help them distinguish between causal and correlational research. Students could have been explicitly taught about the types of conclusions researchers can make after correlational and experimental research.

Instructions

1. Teacher provides sample psychological studies from recent research (see sample below).
2. Students are given instructions to decide whether the research is correlational or experimental.
    a. If correlational, they should predict a sample coefficient (r-value) or they should draw a sample scatter plot.
    b. If experimental, they should illustrate a bar graph and label the axis. The y-axis represents the dependent variable. The x-axis represents the levels of the independent variable.
3. Teacher can give students correct answers through discussion or presentation of rubric. Students can revise answers accordingly.

Sample Studies

Analyze the following and determine if they are correlational or experimental and WHY. If experimental, illustrate a bar graph and label axis. If correlation, what would the sample coefficient (r) or scatter plot look like?

1. Participants were asked to measure their steps over a month using an electronic device. Those subjects who took more steps were **associated** with better memory on a facial recognition task. This was true of participants age 55 and up, but not the younger ones. (See Ellis, 2015, for additional details.)

2. Elderly participants with mild cognitive impairments were **randomly assigned** to one of two groups: a moderate exercise group (45-60 minutes supervised by a trainer) or a stretching group. Pre and post MRI scans were taken and after six months and participants were given a battery of cognitive tests. Participants in the aerobic exercise group showed

higher cognitive scores, faster walk times, and improved glucose tolerance. **Aerobic exercise also led to significant increases in blood flow to certain areas of the brain**, not when participants were exercising, but when they were at rest via brain imaging technology. This blood flow is associated with better health and activity. (See Medical News Today, 2015a, for additional details.)

3. Over a 15-year period, 2,000 older Australians were observed. Researchers took note of depressive symptoms as well as other life situations, like medical conditions and physical impairments (e.g. arthritis). **As people aged (especially those nearing death or experiencing chronic illness), more depressive symptoms were noted**. (See Medical News Today, 2015c, for additional details.)

4. Male rats were **assigned to one of four situations**: a) a cage with a wheel to run on; b) a resistance ladder to climb with weights placed on tail; c) an interval regimen that included sprinting on a treadmill; and d) no exercise equipment. **The rats who ran on wheels showed the greatest amount of neurogenesis (new neurons) in their hippocampus.** The weight lifters were strong, but had no neural growth, similar to the sedentary rodents. The interval/anaerobic condition showed more neural growth than sedentary rodents; however, not as much as the aerobic/wheel running. (See Nokia et al., 2016 for additional details. Sample video of rat using resistance training is available here: https://www.youtube.com/watch?v=4XBXUlvpeh4.)

5. A new drug was tested on a group of aging mice. Three groups of mice were used: A young set, an old one, and an old one that was fed the new drug as they aged. The male and female "old mice" were 20 months old and **randomly assigned** to regular diet or one enhanced with a new drug "J147." **The old mice that received the new drug performed better on cognition/memory tests (e.g., a maze).** The old mice with the new drug had biological similarities to the young mice: They had increased metabolism and reduced brain inflammation. Researchers believe this drug has anti-aging effects. (See Medical News Today, 2015b, for additional details.)

**Extra: Explain the conclusions researchers can make for each study and if it is a cause-and-effect conclusion, what aspects of the design permit this type of conclusion?

Materials

Questions on handout for students.

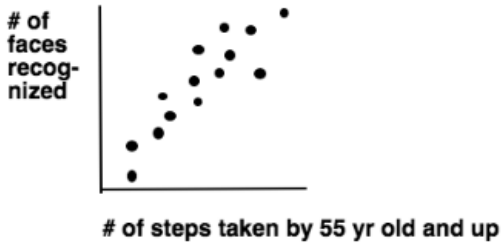
The following chart was created after multiple emails with professor Jon Mueller (personal communication, September 9-13, 2010) and the use of his website: Correlation or Causation? (2017). This could be provided to students and/or student could be asked to memorized it prior to activity. This is a useful way to explicitly teach students what researchers can conclude after using specific research methods.

Associative terms Correlational research	Causal terms Experimental controls
GET	CAUSES
HAVE	INCREASES/DECREASES
MORE/MORE; LESS/MORE	BENEFITS
TIED	IMPACTS
CONNECTED	ENHANCES/UNDERMINES
TEND	EFFECTS
LINKED	IMPROVES/BOOSTS
RELATED	IF > THEN statements (one direction)

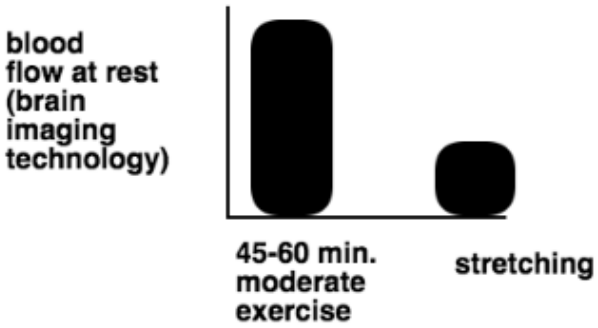
Scoring Criteria

Answers

1. **Correlational**: Even though the participants were given "devices," the independent variable of exercise was not manipulated by experimenters. There was a relationship or association or connection made between the number of steps the devices reported (a real-time way to observe participants) and their ability to recognize faces in a memory task. *r value is positive; scatter plot slopes up*



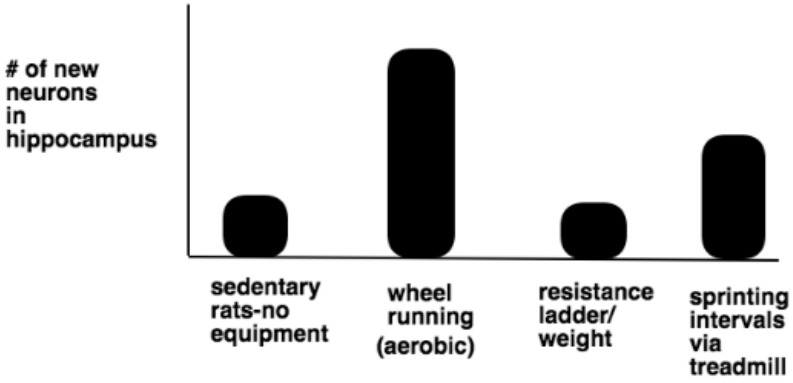
1. **Experimental**: participants were randomly assigned -this ONLY happens during an experiment. The researchers manipulated the independent variable of exercise - making one group have 45-60 minutes and the other only stretching.
    a. IV: Exercise (operationalize 45-60 minutes) vs. stretching (x-axis);
    b. DV: Blood flow at rest (y-axis)



2. **Correlational**: Nothing was manipulated. Using descriptive research, the researchers documented through observation/questions the experiences of elderly. For those who reported or had near-death/chronic illness, more depression was reported. *r value is positive; scatter plot slopes up*

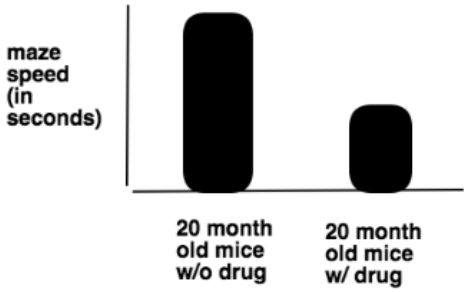
3. **Experimental**: Male rats split into one of three conditions/treatments: running or weight lifting or interval/Sprint training. Then, there was a fourth group with no treatment or the control group. By manipulating the type of exercise, researchers are able to determine which caused the most neurogenesis in rats.
    a. IV: type of exercise (i.e., running, weight lifting, or interval/sprint) (x-axis)
        i. Control group had no treatment

    DV: neurogenesis - (operationalize: number of new neurons in hippocampus



2. **Experimental**: There are groups where experimenters manipulate the independent variable (i.e., the drug). The independent variable is administered to one group and not others, so that a comparison/control group can exist.

a. IV; drug (x-axis)
    i. Control group had no treatment
b. DV: cognitive or memory tasks (operationalize: maze speed)



**Extra: Explain the conclusions researchers can make for each study. If it is a cause-and-effect conclusion, what aspects of the design permit this type of conclusion?

_____ ***predicts*** _____ *(correlation)*
OR
_____ **CAUSES** _____ (experimentation)

1. Possible answer 1: Physical activity ***predicts*** recognition memory in elderly. Possible answer 2: In old age, ***the more*** one walks, ***the more*** accurate is one's recognition memory. Possible answer 3: Walking is ***tied*** to memory.

2. Possible answer 1: Moderate to intense exercise **CAUSES** changes in mental and physical cognition. Possible answer 2: Moderate/intense exercises **IMPROVES** thinking and brain activity.
    a. Aspects of the design that permit cause-and-effect conclusion
        i. Random assignment
        ii. Manipulation of variables (e.g. moderate exercise for 45-60 minutes)

3. Possible answer 1: Age ***predicts*** feelings of depression. Possible answer 2: The ***more one*** ages (and experiences chronic illness/near-death), ***the more*** depressed one feels. Possible answer 3: Chronic illness/near-death experiences ***linked*** to depression

4. Possible answer 1: Running or aerobic activity **CAUSES/PRODUCES** neurogenesis in hippocampus. Possible answer 2: Anaerobic activity/sprinting **PRODUCES LESS** neurogenesis in hippocampus ***than*** aerobic/running.
    a. Aspects of the design that permit cause-and-effect conclusion
        i. Random assignment
        ii. Manipulation of variables (e.g. running, weight resistance, etc.)

5. Possible answer 1: A new drug **CAUSES** anti-aging effects in mice (e.g., better memory, increased metabolism and reduced brain inflammation). Possible answer 2: A new drug **IMPROVES** memory, metabolism, and reduces brain inflammation in mice.
    a. Aspects of the design that permit cause-and-effect conclusion

i. Random assignment
ii. Manipulation of variables (e.g., the drug)

Accommodations/Modifications

Some students with additional needs may require modifications to this assessment as listed below:

- Some students could benefit from having the correlational/causation terms in front of them as guidance throughout this assessment. This could serve as a memory aid or cue sheet which can be a testing accommodation. *See materials section for chart.*
- For students who need a reduced amount of reading, the teacher could have them work backwards from the answer key. Rather than have students draw graphs, the teacher could present the graphs and ask students to write about the research and what type of research method was used.

Why is this Science?

During this lesson, students are interpreting research in psychological science. In the *Next Generation Science Standards (*NGSS Lead States, 2013), students analyze and interpret data as part of scientific practice. The NGSS practices (2013) state that in grades 9-12, students should "apply concepts of statistics … (...slope,... correlational coefficient…)" Also, scientists "organize and interpret data" through graphs. In this lesson, students are presenting data in the form of a scatter plot or bar graph.

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