LECTURE

09-03-2021

LECTURE

Module 4.2.

08-03-2021

The Introduction: Key Terms

Key Research Definitions and Research Typology basics

RESEARCH

- Broadly defined, the purpose of research is to answer questions and acquire new knowledge.
- Research is the primary tool used in virtually all areas of science to expand the frontiers of knowledge.
- For example, research is used in such diverse scientific fields as psychology, biology, medicine, physics, and botany, to name just a few of the areas in which research makes valuable contributions to what we know and how we think about things.
- Among other things, by conducting research, researchers attempt to reduce the complexity of problems, discover the relationship between seemingly unrelated events, and ultimately improve the way we live.

RESEARCH

- In all types of science, research is frequently used for describing a thing or event, discovering the relationship between phenomena, entailing making predictions about future events.
- In short, research can be used for the purposes of description, explanation, and prediction, all of which make important and valuable contributions to the expansion of what we know and how we live our lives.
- In addition to sharing similar broad goals, scientific research in virtually all fields of study shares certain defining characteristics, including

(1) testing hypotheses, (2) careful observation and measurement,

(3) systematic evaluation of data, and (4) drawing valid conclusions.

SCIENTIFIC RESEARCH

- In simple terms, *science* can be defined as a methodological and systematic approach to the acquisition of new knowledge. This definition of science highlights some of the key differences between how scientists and nonscientists go about acquiring new knowledge. Specifically, rather than relying on mere casual observations and an informal approach to learn about the world, scientists attempt to gain new knowledge **by making careful observations and using systematic, controlled, and methodical approaches.** By doing so, scientists are able to draw valid and reliable conclusions about what they are studying.
- In addition, scientific knowledge is not based on the opinions, feelings, or intuition of the scientist. Instead, scientific knowledge is based on **objective data** that were **reliably obtained** in the context of a carefully designed research study. In short, scientific knowledge is based on the accumulation of empirical evidence.

SCIENTIFIC RESEARCH METHODOLOGY

- Research methodology simply refers to the practical "how" of any given piece of research. More specifically, it's about how a researcher systematically designs a study to ensure valid and reliable results that address the research aims and objectives.
- For example, how did the researcher go about deciding:

- What data to collect (and what data to ignore)
- Who to collect it from (in research, this is called "sampling design")
- How to collect it (this is called "data collection methods")
- How to analyse it (this is called "data analysis methods")

SCIENTIFIC RESEARCH METHODOLOGY

- Importantly, a good methodology chapter in a research paper or thesis explains not just **what** methodological choices were made, but also explains **why** they were made.
- In other words, the methodology chapter should **justify** the design choices, by showing that the chosen methods and techniques are the best fit for the research aims and objectives, and will provide valid and reliable results. A good research methodology provides scientifically sound findings, whereas a poor methodology doesn’t.

SCIENTIFIC RESEARCH METHODS

- Qualitative, quantitative and mixed-methods are different types of methodologies, distinguished by whether they focus on words, numbers or both.
- **Qualitative research** refers to research which focuses on collecting and analysing words (written or spoken) and textual data, whereas quantitative research focuses on measurement and testing using numerical data.
- **Qualitative analysis** can also focus on other "softer" data points, such as body language or visual elements.

SCIENTIFIC RESEARCH METHODS

- Qualitative, quantitative and mixed-methods are different types of methodologies, distinguished by whether they focus on words, numbers or both.
- It's quite common for a **qualitative methodology** to be used when the research aims and objectives are **exploratory** in nature. For example, a qualitative methodology might be used to understand peoples' perceptions about an event that took place, or a candidate running for president.

SCIENTIFIC RESEARCH METHODS

- **Qualitative, quantitative and mixed-methods** are different types of methodologies, distinguished by whether they focus on words, numbers or both.
- **The mixed-method** methodology attempts to combine the best of both qualitative and quantitative methodologies **to integrate perspectives and create a rich picture**

SCIENTIFIC RESEARCH METHODS

- **Qualitative, quantitative and mixed-methods** are different types of methodologies, distinguished by whether they focus on words, numbers or both.
- Contrasted to this, **a quantitative methodol**ogy is typically used when the research aims and objectives are **confirmatory** in nature. For example, a quantitative methodology might be used to *measure the relationship between two variables* (e.g. personality type and likelihood to commit a crime) or *to test a set of hypotheses.*

SCIENTIFIC RESEARCH METHODS

Quantitative: distinct methods Inductive, apriori hypotheses, Positivism, Durkheim, functionalism, researcher separate from participants	Qualitative: fluid lines btw methods Deductive, no apriori hypotheses, Interpretivism, Weber, Symbolic Interactionism, researcher interacts with participants
Experiments: true, quasi quasi ['kweɪzaɪ], ['kwɑːzɪ]	Observation: participant, non-participant
Surveys: f-to-f, mail, phone	In-depth interviews: structured, unstructured
Cross-sectional vs. Longitudinal	Advanced Qualitative Methods
Longitudinal:	case study, extended case study
a. trend: follow 1 variable over time	Ethnography (critical observation of a culture)
b. cohort: follow a pop over time c. panel: follow same group over time	ethnomethodology: study small interactions (moments, situations), look for rules/methods of interaction
d. Time series	phenomenology: study experiences

	Qualitative Research	Quantitative Research
Purpose	Discover ideas/To gain a qualitative understanding of the underlying reasons and motivations	Test hypotheses or specific research questions/To quantify the data and generalize the results from the sample to the population of interest
Approach	Observe and interpret	Measure and test
Data Collection Methods	Unstructured; free- forms	Structured; response categories provided
Researcher Independence	Researcher is intimately involved; results are subjective	Researcher is uninvolved; results are objective
Sample	Small samples – often natural setting	Large samples to allow generalization
Most often used in:	Exploratory research designs	Descriptive and causal research designs
Outcome	Develop an initial understanding	Recommend a final course of action

SOME SCIENTIFIC RESEARCH METHODS

Surveys

Surveys involve collecting information, usually from fairly large groups of people, by means of questionnaires but other techniques such as interviews or telephoning may also be used. There are different types of survey. The most straightforward type (the "one shot survey") is administered to a sample of people at a set point in time. Another type is the "before and after survey" which people complete before a major event or experience and then again afterwards.

SOME SCIENTIFIC RESEARCH METHODS

Questionnaires

Questionnaires are a good way to obtain information from a large number of people and/or people who may not have the time to attend an interview or take part in experiments. They enable people to take their time, think about it and come back to the questionnaire later. Participants can state their views or feelings privately without worrying about the possible reaction of the researcher. Unfortunately, some people may still be inclined to try to give socially acceptable answers. People should be encouraged to answer the questions as honestly as possible so as to avoid the researchers drawing false conclusions from their study.

SOME SCIENTIFIC RESEARCH METHODS

Interviews

Interviews are usually carried out in person i.e. face-to-face but can also be administered by telephone or using more advance computer technology such as Skype. Sometimes they are held in the interviewee's home, sometimes at a more neutral place. It is important for interviewees to decide whether they are comfortable about inviting the researcher into their home and whether they have a room or area where they can speak freely without disturbing other members of the household.

SOME SCIENTIFIC RESEARCH METHODS

Case studies

Case studies usually involve the detailed study of a particular case (a person or small group). Various methods of data collection and analysis are used but this typically includes observation and interviews and may involve consulting other people and personal or public records. The researchers may be interested in a particular phenomenon (e.g. coping with a diagnosis or a move into residential care) and select one or more individuals in the respective situation on whom to base their case study/studies. Case studies have a very narrow focus which results in detailed descriptive data which is unique to the case(s) studied. Nevertheless, it can be useful in clinical settings and may even challenge existing theories and practices in other domains.

SOME SCIENTIFIC RESEARCH METHODS

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SCIENTIFIC METHOD

SCIENTIFIC METHOD AND ITS KEY ATTRIBUTES

SCIENTIFIC METHOD

- The defining characteristic of scientific research is the scientific method. First described by the English philosopher and scientist Roger Bacon in the 13th century, it is still generally agreed that the scientific method is the basis for all scientific investigation.
- The *scientific method* is best thought of as an approach to the acquisition of new knowledge, and this approach effectively distinguishes science from nonscience.
- To be clear, the scientific method is not actually a single method, as the name would erroneously lead one to believe, but rather an overarching perspective on how scientific investigations should proceed. (This is normally called methodology in Russian). It is a set of research principles and methods that helps researchers obtain valid results from their research studies.
- Because the scientific method deals with the general *approach* to research rather than the *content* of specific research studies, it is used by researchers in all different scientific disciplines. The biggest benefit of the scientific method is that it provides a set of clear and agreed upon guidelines for gathering, evaluating, and reporting information in the context of a research study.

SCIENTIFIC METHOD

The development of the scientific method is usually credited to Roger Bacon, a philosopher and scientist from 13th-century England, although some argue that the Italian scientist Galileo Galilei played an important role in formulating the scientific method. Later contributions to the scientific method were made by the philosophers Francis Bacon and René Descartes. Although some disagreement exists regarding the exact characteristics of the scientific method, most agree that it is characterized by / composed of the following key elements: an empirical approach, observations, questions, hypotheses, experiments, analyses, conclusions, and replication.

SCIENTIFIC METHOD

- Empirical approach
- Observations
- Questions
- Hypotheses
- Experiments
- Analyses
- Conclusions
- Replication

SCIENTIFIC RESEARCH

SCIENTIFIC RESEARCH	
CORRELATIONAL RESEARCH	EXPERIMENTAL RESEARCH

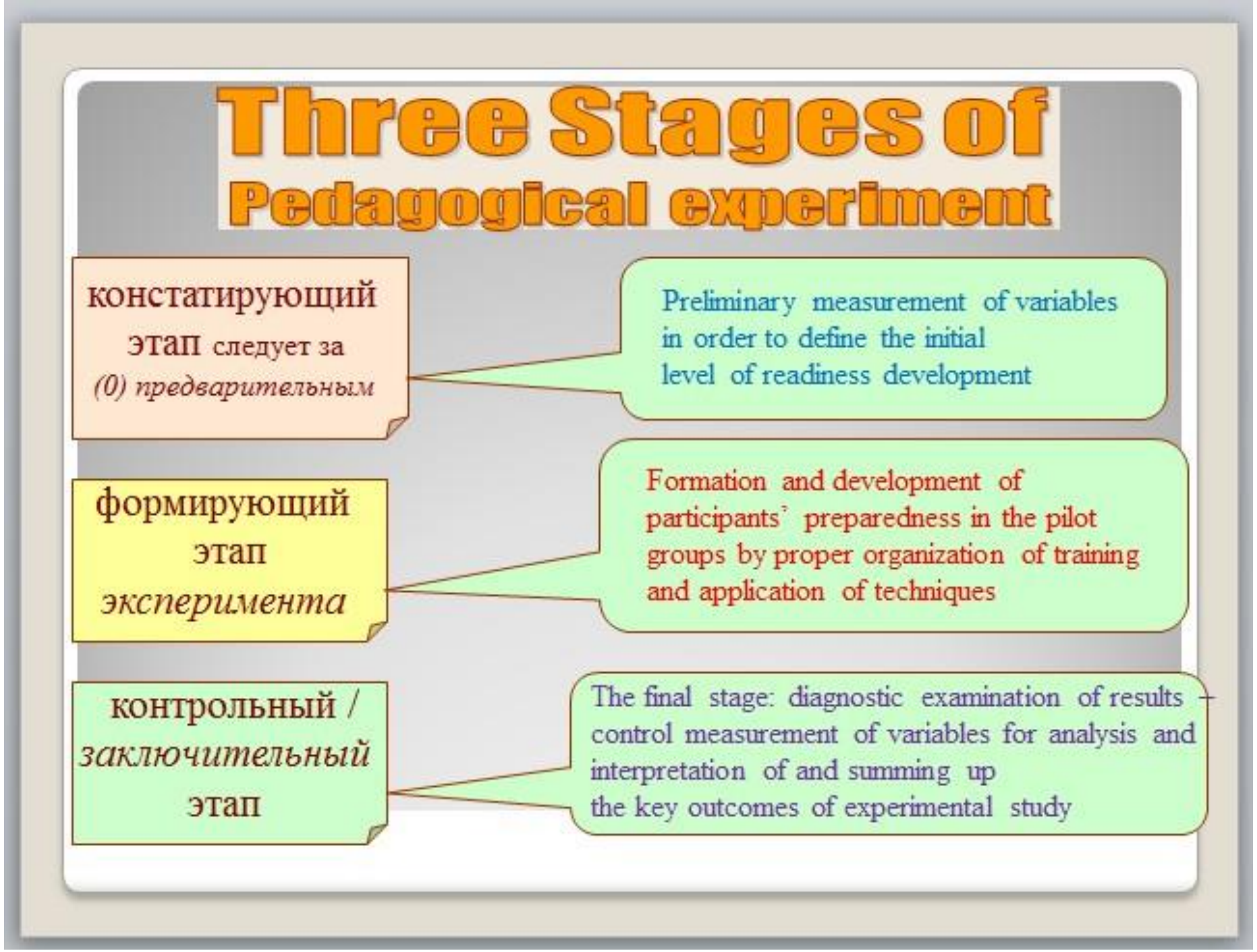
CORRELATIONAL RESEARCH

- In *correlational research,* the goal is to determine whether two or more variables are related.
- (By the way, "variables" is a term with which you should be familiar. A *variable* is anything that can take on different values, such as weight, time, and height.). For example, a researcher may be interested in determining whether age is related to weight. In this example, a researcher may discover that age is indeed related to weight because as age increases, weight also increases.
- If a correlation between two variables is strong enough, knowing about one variable allows a researcher to make a prediction about the other variable.
- There are several different types of correlations.
- It is important to point out, however, that a correlation— or relationship—between two things does not necessarily mean that one thing caused the other.
- To draw a cause-and-effect conclusion, researchers must use experimental research.

EXPERIMENTAL RESEARCH

- In its simplest form, *experimental research* involves comparing two groups on one outcome measure to test some hypothesis regarding causation. For example, if a researcher is interested in the effects of a new medication on headaches, the researcher would randomly divide a group of people with headaches into two groups. One of the groups, the *experimental group*, would receive the new medication being tested. The other group, the *control group*, would receive a placebo medication (i.e., a medication containing a harmless substance, such as sugar, that has no physiological effects). Besides receiving the different medications, the groups would be treated exactly the same so that the research could isolate the effects of the medications from any external influence. After receiving the medications, both groups would be compared to see whether people in the experimental group had fewer headaches than people in the control group.
- Assuming this study was properly designed, if people in the experimental group had fewer headaches than people in the control group, the researcher could conclude that the new medication reduces headaches.

EXPERIMENTAL RESEARCH



EMPIRICAL APPROACH

Empirical Approach

The scientific method is firmly based on the empirical approach. The *empirical approach* is an evidence-based approach that relies on direct observation and experimentation in the acquisition of new knowledge.

In the empirical approach, scientific decisions are made based on the data derived from direct observation and experimentation. The empirical approach, with its emphasis on direct, systematic, and careful observation, is best thought of as the guiding principle behind all research conducted in accordance with the scientific method.

Quantitative research

Quantitative research

Quantitative research “describes, infers, and resolves problems using numbers. Emphasis is placed on the collection of numerical data, the summary of those data and the drawing of inferences from the data”.

Types of research methods

Types of research methods

Types of research methods can be broadly divided into two quantitative and qualitative categories.

Qualitative research

Qualitative research

Qualitative research, on the other hand, is based on words, feelings, emotions, sounds and other non-numerical and unquantifiable elements. It has been noted that “information is considered qualitative in nature if it cannot be analysed by means of mathematical techniques. This characteristic may also mean that an incident does not take place often enough to allow reliable data to be collected”

Observations

Observations

Observation refers to two distinct concepts— (a) being aware of the world around us and (b) making careful measurements.

Observations of the world around us often give rise to the questions that are addressed through scientific research.

For example, the Newtonian observation that apples fall from trees stimulated much research into the effects of gravity. Therefore, a keen eye to your surroundings can often provide you with many ideas for research studies.

Observations

Observations

Observation refers to two distinct concepts— (a) being aware of the world around us and (b) making careful measurements.

In the context of science, observation means more than just observing the world around us to get ideas for research. *Observation* also refers to the process of making careful and accurate measurements, which is a distinguishing feature of well-conducted scientific investigations.

Observations

Observations

Observation refers to two distinct concepts— (a) being aware of the world around us and (b) making careful measurements.

When making measurements in the context of research, scientists typically take great precautions to avoid making biased observations. For example, if a researcher is observing the amount of time that passes between two events, such as the length of time that elapses between lightning and thunder, it would certainly be advisable for the researcher to use a measurement device that has a high degree of accuracy and reliability. Rather than simply trying to "guesstimate" the amount of time that elapsed between those two events, the researcher would be advised to use a stopwatch or similar measurement device. By doing so, the researcher ensures that the measurement is accurate and not biased by extraneous factors.

Observations

Observations

Observation refers to two distinct concepts— (a) being aware of the world around us and (b) making careful measurements.

- Rather than simply trying to “guesstimate” the amount of time that elapsed between those two events, the researcher would be advised to use a stopwatch or similar measurement device.
- By doing so, the researcher ensures that the measurement is accurate and not biased by extraneous factors. Most people would likely agree that the observations that we make in our daily lives are rarely made so carefully or systematically.

Operational definition

Operational definitions

- An important aspect of measurement is an *operational definition.* Researchers define key concepts and terms in the context of their research studies by using operational definitions. By using operational definitions, researchers ensure that everyone is talking about the same phenomenon.
- For example, if a researcher wants to study the effects of exercise on stress levels, it would be necessary for the researcher to define what "exercise" is. Does exercise refer to jogging, weight lifting, swimming, jumping rope, or all of the above? ***By defining "exercise"*** for the purposes of the study, *the researcher makes sure that everyone is referring to the same thing.*

Operational definition

Operational definitions

- Having a clear definition of terms also ensures that the researcher’s study can be replicated by other researchers.

Questions

Questions

After getting a research idea, perhaps from making observations of the world around us, the next step in the research process involves translating that research idea into an answerable question. The term “answerable” is particularly important in this respect, and it should not be overlooked.

It would obviously be a frustrating and ultimately unrewarding endeavor to attempt to answer an unanswerable research question through scientific investigation. An example of an unanswerable research question is the following: “Is there an exact replica of me in another universe?” Although this is certainly an intriguing question that would likely yield important information, the current state of science cannot provide an answer to that question. It is therefore important to formulate a research question that can be answered through available scientific methods and procedures.

Hypotheses

Hypotheses

Scientific research presupposes coming up with a hypothesis, which

is (put simply) an educated—and testable—guess about the answer to your research question.

A hypothesis is often described as an attempt by the researcher to explain the phenomenon of interest.

Hypotheses can take various forms, depending on the question being asked and the type of study being conducted.

Hypotheses

Hypotheses

Hypotheses attempt to explain, predict, and explore the phenomenon of interest. In many types of studies, this means that hypotheses attempt to explain, predict, and explore the relationship between two or more variables.

To this end, hypotheses can be thought of as the researcher's educated guess about how the study will turn out. As such, the hypotheses articulated in a particular study should logically stem from the research problem being investigated.

Hypotheses

Hypotheses

A key feature of all hypotheses is that each must make a *prediction.* Remember that hypotheses are the researcher's attempt to explain the phenomenon being studied, and that explanation should involve a prediction about the variables being studied.

These predictions are then tested by gathering and analyzing data, and the hypotheses can either be supported or refuted (falsified in terms of Karl Popper) on the basis of the data (analysis).

Hypotheses

Hypotheses

In their simplest forms, hypotheses are typically phrased as "if-then" statements. For example, a researcher may hypothesize that "*if* people exercise for 30 minutes per day at least three days per week, *then* their cholesterol levels will be reduced."

This hypothesis makes a prediction about **the effects of exercising** on levels of cholesterol, and the prediction can be tested by gathering and analyzing data.

Hypotheses in quantitative research

Hypotheses in quantitative research

Hypotheses in quantitative research:

1) Conceptual hypotheses follow from research question:

ex. The more experiences a person has with taking the role of other, the less prejudice they are.

2) Operationalized hyps follow from conceptual ones after methods are selected:

Ex. Respondents who have higher scores on the role taking scale will have lower scores on the prejudice scale than respondents who have lower scores on the role taking scale.

3) Statistical hypotheses follow from operationalized hyps: mean group 1 < mean group 2.

Hypotheses in **qualitative research**:

Do not have hypotheses. You may have expectations.

Hypotheses

Hypotheses

- Two types of hypotheses with which one should be familiar are the null hypothesis and the alternate (or experimental) hypothesis.
- The *null hypothesis* always predicts that there will be no differences between the groups being studied.
- By contrast, the *alternate hypothesis* predicts that there will be a difference between the groups.

Hypotheses

Hypotheses

- In our example, the null hypothesis would predict that the exercise group and the no-exercise group will not differ significantly on levels of cholesterol.
- The alternate hypothesis would predict that the two groups will differ significantly on cholesterol levels.

Hypotheses

Null Hypotheses and Alternate Hypotheses

The first category of research hypotheses includes the *null hypothesis* and the *alternate* (or *experimental*) *hypothesis.*

In research studies involving two groups of participants (e.g., experimental group vs. control group), the null hypothesis always predicts that there will be no differences between the groups being studied

If, however, a particular research study does not involve groups of study participants, but instead involves only an examination of selected variables, the null hypothesis predicts that there will be no relationship between the variables being studied.

By contrast, the alternate hypothesis always predicts that there will be a difference between the groups being studied (or a relationship between the variables being studied).

Hypotheses

Null Hypotheses and Alternate Hypotheses

Let’s look at an example to clarify the distinction between null hypotheses and alternate hypotheses. In a research study investigating the effects of a newly developed medication on blood pressure levels, the null hypothesis would predict that there will be no difference in terms of blood pressure levels between the group that receives the medication (i.e., the experimental group) and the group that does not receive the medication (i.e., the control group). By contrast, the alternate hypothesis would predict that there will be a difference between the two groups with respect to blood pressure levels. So, for example, the alternate hypothesis may predict that the group that receives the new medication will experience a greater reduction in blood pressure levels than the group that does not receive the new medication.

Hypotheses

Null Hypotheses and Alternate Hypotheses

It is not uncommon for research studies to include several null and alternate hypotheses. The number of null and alternate hypotheses included in a particular research study depends on the scope and complexity of the study and the specific questions being asked by the researcher. It is important to keep in mind that the number of hypotheses being tested has implications for the number of research participants that will be needed to conduct the study. This last point rests on rather complex statistical concepts that we will not discuss in this section. For our purposes, it is sufficient to remember that as the number of hypotheses increases, the number of required participants also typically increases.

Hypotheses

Null Hypotheses and Alternate Hypotheses

In scientific research, keep in mind that it is the null hypothesis that is tested, and then the null hypothesis is either confirmed or refuted (sometimes phrased as rejected or not rejected). Remember, if the null hypothesis is rejected (and that decision is based on the results of statistical analyses), the researcher can reasonably conclude that there is a difference between the groups being studied (or a relationship between the variables being studied).

Rejecting the null hypothesis allows a researcher to not reject the alternate hypothesis, and not rejecting a hypothesis is the most we can do in scientific research. To be clear, we can never accept a hypothesis; we can only fail to reject a hypothesis. Accordingly, researchers typically seek to reject the null hypothesis, which empirically demonstrates that the groups being studied differ on the variables being examined in the study.

This last point may seem counterintuitive, but it is an extremely important concept that you should keep in mind.

Nondirectional Hypotheses vs. Directional Hypotheses

Nondirectional Hypotheses vs. Directional Hypotheses

A reliable way to tell the difference between directional and nondirectional hypotheses is to look at the wording of the hypotheses.

If the hypothesis simply predicts that there will be a difference between the two groups, then it is a nondirectional hypothesis. It is nondirectional because it predicts that there will be a difference but does not specify how the groups will differ.

If, however, the hypothesis uses so-called comparison terms, such as "greater," "less," "better," or "worse," then it is a directional hypothesis.

It is directional because it predicts that there will be a difference between the two groups and it specifies how the two groups will differ.

Nondirectional Hypotheses vs. Directional Hypotheses

Nondirectional Hypotheses vs. Directional Hypotheses

A simple example should help clarify the important distinction between directional and nondirectional hypotheses. Let’s say that a researcher is using a standard two-group design (i.e., one experimental group and one control group) to investigate the effects of a memory enhancement class on college students’ memories.

Nondirectional Hypotheses vs. Directional Hypotheses

Nondirectional Hypotheses vs. Directional Hypotheses

At the beginning of the study, all of the study participants are randomly assigned to one of the two groups.

Subsequently, one group (i.e., the experimental group) will be exposed to the memory enhancement class and the other group (i.e., the control group) will not be exposed to the memory enhancement class. Afterward, all of the participants in both groups will be administered a memory test. Based on this research design, any observed differences between the two groups on the memory test can reasonably be attributed to the effects of the memory enhancement class.

Nondirectional Hypotheses vs. Directional Hypotheses

Nondirectional Hypotheses vs. Directional Hypotheses

In this example, the researcher has several options in terms of hypotheses. On the one hand, the researcher may simply hypothesize that there will be a difference between the two groups on the memory test. This would be an example of a nondirectional hypothesis, because the researcher is hypothesizing that the two groups will differ, but the researcher is not specifying how the two groups will differ.

Nondirectional Hypotheses vs. Directional Hypotheses

Nondirectional Hypotheses vs. Directional Hypotheses

Alternatively, the researcher could hypothesize that the participants who are exposed to the memory enhancement class will perform better on the memory test than the participants who are not exposed to the memory enhancement class.

This would be an example of a directional hypothesis, because the researcher is hypothesizing that the two groups will differ and specifying how the two groups will differ (i.e., one group will perform better than the other group on the memory test).

Research Methods and Research Design

Research Methods and Research Design

Data Collection + Data Analysis

= Research Methods and Research Design

Relationship Between Hypotheses and Research Design

Hypotheses

Hypotheses can take many different forms depending on the type of research design being used. Some hypotheses may simply describe how two things may be related. For example, in correlational research, a researcher might hypothesize that alcohol intoxication is related to poor decision making. In other words, the researcher is hypothesizing that there is a relationship between using alcohol and decision making ability (but not necessarily a causal relationship).

However, in a study using a randomized controlled design, the researcher might hypothesize that using alcohol *causes* poor decision making. Therefore, as may be evident, the hypothesis being tested by a researcher is largely dependent on the type of research design being used.

Falsifiability of Hypotheses

According to the 20th-century philosopher Karl Popper, hypotheses must be *falsifiable* (Popper, 1963).

In other words, the researcher must be able to demonstrate that the hypothesis is wrong. If a hypothesis is not falsifiable, then science cannot be used to test the hypothesis. For example, hypotheses based on religious beliefs are not falsifiable. Therefore, because we can never prove that faith-based hypotheses are wrong, there would be no point in conducting research to test them. Another way of saying this is that the researcher must be able to reject the proposed explanation (i.e., hypothesis) of the phenomenon being studied.

Experiments

Experiments

After articulating the hypothesis, the next step involves actually conductingthe experiment (or research study). For example, if the study involves investigating the effects of exercise on levels of cholesterol, the researcher would design and conduct a study that would attempt to address that question.

A key aspect of conducting a research study is measuring the phenomenon of interest in an *accurate* and *reliable* manner. In this example, the researcher would collect data on the cholesterol levels of the study participants by using an accurate and reliable measurement device. Then, the researcher would compare the cholesterol levels of the two groups to see if exercise had any effects.

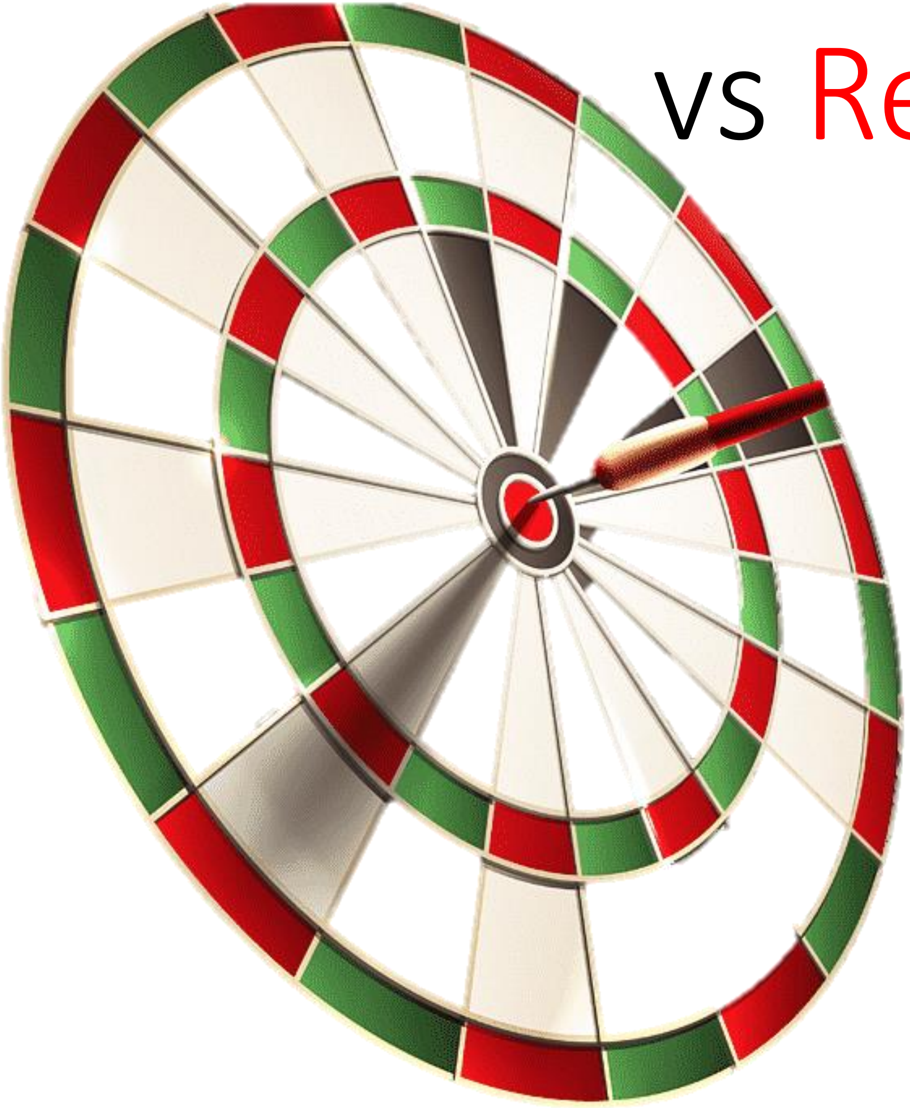
Accuracy vs. Reliability

Accuracy vs. Reliability

When talking about measurement in the context of research, there is an important distinction between being accurate and being reliable. *Accuracy* refers to whether the measurement is correct, whereas *reliability* refers to whether the measurement is consistent. An example may help to clarify the distinction. When throwing darts at a dart board, "accuracy" refers to whether the darts are hitting the bull's eye (an *accurate* dart thrower will throw darts that hit the bull's eye)."

Accuracy vs Reliability

Accuracy vs. Reliability



Accuracy vs. Reliability

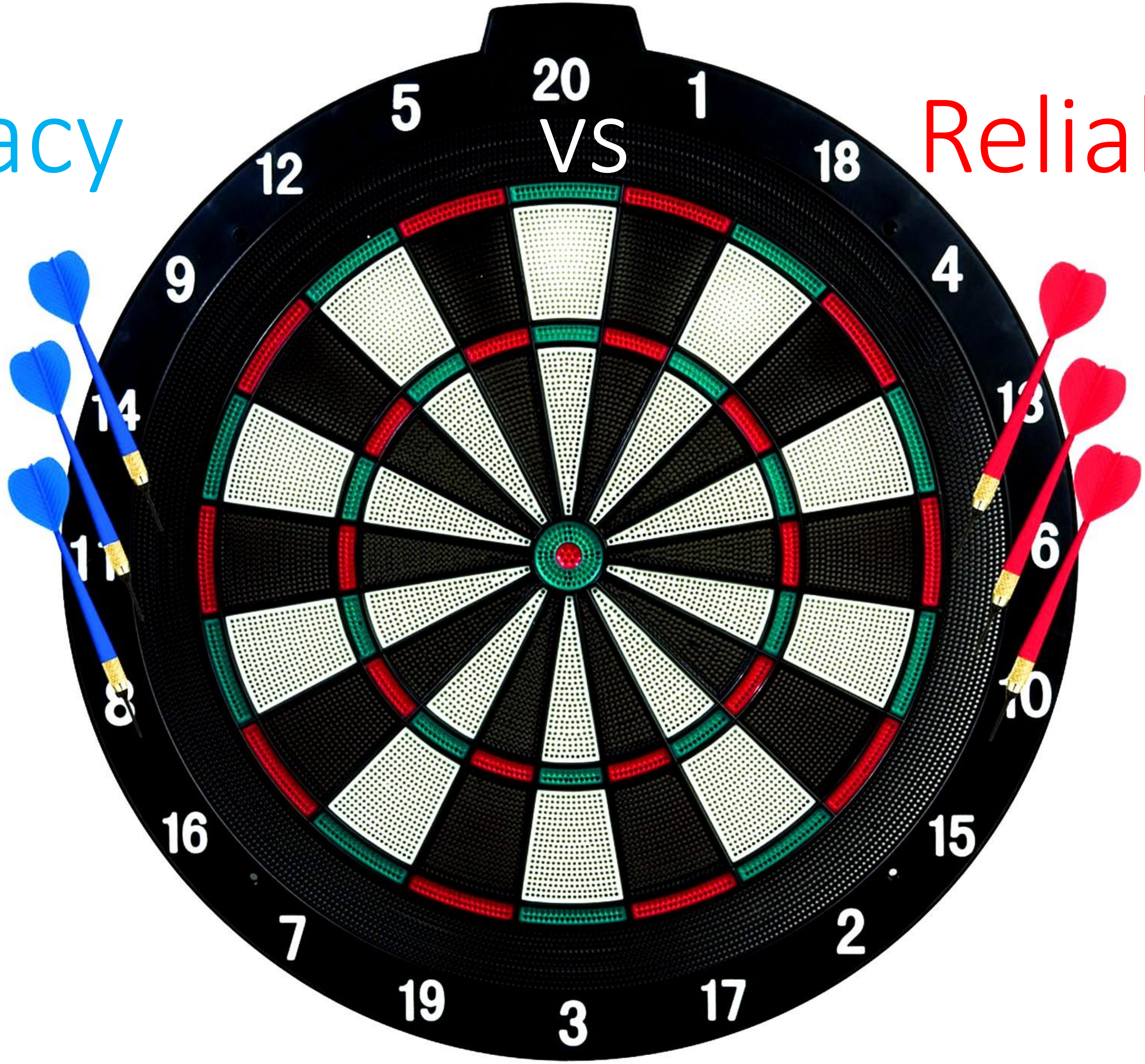
Accuracy vs. Reliability

"Reliability," on the other hand, refers to whether the darts are hitting the same spot (a *reliable* dart thrower will throw darts that hit the same spot).

Therefore, an accurate and reliable dart thrower will consistently throw the darts in the bull's eye. As may be evident, however, it is possible for the dart thrower to be reliable, but not accurate. For example, the dart thrower may throw all of the darts in the same spot (which demonstrates high reliability), but that spot may not be the bull's eye (which demonstrates low accuracy). In the context of measurement, both accuracy and reliability are equally important.

Accuracy VS Reliability

Accuracy **vs. Reliability**



The main data collection methods

The main data collection methods

- ❑ Interviews (which can be unstructured, semi-structured or structured)
- ❑ Focus groups and group interviews
- ❑ Surveys (online or physical surveys)
- ❑ Observations
- ❑ Documents and records
- ❑ Case studies

The main data collection methods

The main data collection methods

The choice of which data collection method to use depends on your overall **research aims and objectives**, as well as **practicalities (полезность)** and resource constraints.

For example, if your research is exploratory in nature, qualitative methods such as interviews and focus groups would likely be a good fit.

Conversely, if your research aims to measure specific variables or test hypotheses, large-scale surveys that produce large volumes of numerical data would likely be a better fit.

The main data analysis methods

The main data analysis methods

Data analysis methods can be grouped according to whether the research is qualitative or quantitative.

Popular data analysis methods in **qualitative research** include:

- Qualitative content analysis
- Discourse analysis
- Narrative analysis
- Grounded theory

Qualitative data analysis all begins with data coding, after which one (or more) analysis technique is applied.

The main data analysis methods

The main data analysis methods

Data analysis methods can be grouped according to whether the research is qualitative or quantitative.

Popular data analysis methods in **quantitative research** include:

Descriptive statistics (e.g. means, medians, modes)

Inferential statistics (e.g. correlation, regression, structural equation modelling)

Again, the choice of which data collection method to use depends on your overall **research aims and objectives**, as well as practicalities and resource constraints.

The main data analysis methods

The main data analysis methods

The first question you need to ask yourself is whether your research is **exploratory** or **confirmatory** in nature.

If your research aims and objectives are primarily exploratory in nature, your research will likely be qualitative and therefore you might consider qualitative data collection methods (e.g. interviews) and analysis methods (e.g. qualitative content analysis).

Conversely, if your research aims and objective are looking to measure or test something (i.e. they're confirmatory), then your research will quite likely be quantitative in nature, and you might consider quantitative data collection methods (e.g. surveys) and analyses (e.g. statistical analysis).

Designing your research and working out your methodology is a large topic, which we'll cover in other posts. For now, however, the key takeaway is that you should **always start with your research aims and objectives.** Every methodology decision will flow from that.

Analyzing the Data

Analyzing the Data

After conducting the study and gathering the data, the next step involves analyzing the data, which generally calls for the use of statistical techniques.

The type of statistical techniques used by a researcher depends on the design of the study, the type of data being gathered, and the questions being asked. Although a detailed discussion of statistics is beyond the scope of this text, it is important to be aware of the role of statistics in conducting a research study. In short, statistics help researchers minimize the likelihood of reaching an erroneous conclusion about the relationship between the variables being studied.

A key decision that researchers must make with the assistance of statistics is whether the null hypothesis should be rejected. Remember that the null hypothesis always predicts that there will be no difference between the groups. Therefore, rejecting the null hypothesis means that there *is* a difference between the groups. In general, most researchers seek to reject the null hypothesis because rejection means the phenomenon being studied (e.g., exercise, medication) had some effect.

Analyzing the Data

Analyzing the Data

It is important to note that there are only two choices with respect to the null hypothesis. Specifically, the null hypothesis can be either rejected or not rejected, but it can never be accepted. If we reject the null hypothesis, we are concluding that there is a significant difference between the groups. If, however, we do not reject the null hypothesis, then we are concluding that we were unable to detect a difference between the groups.

To be clear, it does not mean that there is no difference between the two groups. There may in actuality have been a significant difference between the two groups, but we were unable to detect that difference in our study.

Type I errors and Type II errors

Analyzing the Data

The decision of whether to reject the null hypothesis is based on the results of statistical analyses, and there are two types of errors that researchers must be careful to avoid when making this decision—Type I errors and Type II errors. A *Type I error* occurs when a researcher concludes that there is a difference between the groups being studied when, in fact, there is no difference. This is sometimes referred to as a "false positive."

Type I errors and Type II errors

Analyzing the Data

By contrast, a *Type II error* occurs when the researcher concludes that there is *not* a difference between the two groups being studied when, in fact, there is a difference. This is sometimes referred to as a "false negative."

The conclusion regarding whether there is a difference between the groups is based on the results of statistical analyses. Specifically, with a Type I error, although there is a statistically significant result, it occurred by chance (or error) and there is not actually a difference between the two groups.

With a Type II error, there is a nonsignificant statistical result when, in fact, there actually is a difference between the two groups.

Type I errors and Type II errors

Analyzing the Data

The typical convention in most fields of science allows for a 5% chance of erroneously rejecting the null hypothesis (i.e., of making a Type I error).

In other words, a researcher will conclude that there is a significant difference between the groups being studied (i.e., will reject the null hypothesis) only if the chance of being incorrect is less than 5%.

Type I errors and Type II errors

Analyzing the Data

- In our example, a researcher conducts a study to determine whether a new medication is effective in treating depression. The new medication is given to Group 1, while a placebo medication is given to Group 2. If, at the conclusion of the study, the researcher concludes that there is a significant difference in levels of depression between Groups 1 and 2 when, in fact, there is no difference, the researcher has made a Type I error. In simpler terms, the researcher has detected a difference between the groups that in actuality does not exist; the difference between the groups occurred by chance (or error).
- By contrast, if the researcher concludes that there is *no* significant difference in levels of depression between Groups 1 and 2 when, in fact, there is a difference, the researcher has made a Type II error. In simpler terms, the researcher has failed to detect a difference that actually exists between the groups.

Type I errors and Type II errors

CAU T I O N! **Type I Errors vs. Type II Errors**

Type I Error (false positive): Concluding there is a difference between the groups being studied when, in fact, there is no difference.

Type II Error (false negative): Concluding there is no difference between the groups being studied when, in fact, there is a difference.

Type I and Type II errors can be illustrated using the following table:

Type I errors and Type II errors

	Actual Results	
Researcher's Conclusion	**Difference**	**No difference**
Difference	Correct decision	Type I error
No difference	Type II error	Correct decision

Type I errors and Type II errors

More fun about it

By decreasing the probability of making a Type I error, the researcher is increasing the probability of making a Type II error. In other words, if a researcher reduces the probability of making a Type I error from 5% to 1%, there is now an increased probability that the researcher will make a Type II error by failing to detect a difference that actually exists.

The 5% level is a standard convention in most fields of research and represents a compromise between making Type I and Type II errors.

Conclusions

After analyzing the data and determining whether to reject the null hypothesis, the researcher is now in a position to draw some conclusions about the results of the study. For example, if the researcher rejected the null hypothesis, the researcher can conclude that the phenomenon being studied had an effect—a *statistically significant* effect, to be more precise. If the researcher rejects the null hypothesis in our exercise-cholesterol example, the researcher is concluding that exercise had an effect on levels of cholesterol. It is important that researchers make only those conclusions that can be supported by the data analyses. Going beyond the data is a cardinal sin that researchers must be careful to avoid. For example, if a researcher conducted a correlational study and the results indicated that the two things being studied were strongly related, the researcher could not conclude that one thing caused the other. i.e., a relationship between two things does not equal causation. *In other words, the fact that two things are related does not mean that one caused the other.*

Replication

Replication essentially means conducting the same research study a second time with another group of participants to see whether the same results are obtained. The same researcher may attempt to replicate previously obtained results, or perhaps other researchers may undertake that task.

Replication

Replication illustrates an important point about scientific research—namely, that researchers should avoid drawing broad conclusions based on the results of a single research study because it is always possible that the results of that particular study were an aberration.
In other words, it is possible that the results of the research study were obtained by chance or error and, therefore, that the results may not accurately represent the actual state of things.
However, if the results of a research study are obtained a second time (i.e., replicated), the likelihood that the original study's findings were obtained by chance or error is greatly reduced.

Correlation Does Not Equal Causation!!!

Before looking at an example of why correlation does not equal causation, let's make sure that we understand what a correlation is. A *correlation* is simply a relationship between two things. For example, size and weight are often correlated because there is a relationship between the size of something and its weight. Specifically, bigger things tend to weigh more. The results of correlational studies simply provide researchers with information regarding the relationship between two or more variables, which may serve as the basis for future studies. It is important, however, that researchers interpret this relationship cautiously.

For example, if a researcher finds that eating ice cream is correlated with (i.e., related to) higher rates of drowning, the researcher cannot conclude that eating ice cream *causes* drowning. It may be that another variable is responsible for the higher rates of drowning. For example, most ice cream is eaten in the summer and most swimming occurs in the summer. Therefore, the higher rates of drowning are not caused by eating ice cream, but rather by the increased number of people who swim during the summer.

GOALS OF SCIENTIFIC RESEARCH

The goals of scientific research, in broad terms, are to answer questions and acquire new knowledge. This is typically accomplished by conducting research that permits drawing valid inferences about the relationship between two or more variables.

Most researchers agree that the three general goals of scientific research are:

- ❑ description,
- ❑ prediction,
- ❑ and understanding/explanation.

Categories of Research

There are two broad categories of research with which researchers must be familiar.

Nomothetic vs. Idiographic

• The *nomothetic approach* uses the study of groups to identify general laws that apply to a large group of people.

The goal is often to identify the average member of the group being studied or the average performance of a group member.

• The *idiographic approach* is the study of an individual. An example of the idiographic approach is the aforementioned case study.

The choice of which research approaches to use largely depends on the types of questions being asked in the research study, and different fields of research typically rely on different categories of research to achieve their goals.

Social science research, for example, typically relies on quantitative research and the nomothetic approach. In other words, social scientists study large groups of people and rely on statistical analyses to obtain their findings.

Categories of Research

There are two broad categories of research with which researchers must be familiar.

Quantitative vs. Qualitative

- *Quantitative research* involves studies that make use of statistical analyses to obtain their findings. Key features include formal and systematic measurement and the use of statistics.
- *Qualitative research* involves studies that do not attempt to quantify their results through statistical summary or analysis. Qualitative studies typically involve interviews and observations without formal measurement.

A *case study,* which is an in-depth examination of **one person**, is a form of qualitative research.

Qualitative research is often used as **a source of hypotheses** for later testing in quantitative research.

Sample vs. Population

Two key terms that a researcher must be familiar with are "sample" and "population."

The *population* is all individuals of interest to the researcher. For example, a researcher may be interested in studying anxiety among lawyers; in this example, the population is all lawyers. For obvious reasons, researchers are typically unable to study the entire population. In this case it would be difficult, if not impossible, to study anxiety among *all* lawyers.

Therefore, researchers typically study a subset of the population, and that subset is called a *sample.*

Sample vs. Population

Because researchers may not be able to study the entire population of interest, it is important that the sample be *representative* of the population from which it was selected. For example, the sample of lawyers the researcher studies should be similar to the population of lawyers. If the population of lawyers is composed mainly of White men over the age of 35, studying a sample of lawyers composed mainly of Black women under the age of 30 would obviously be problematic because the sample is not representative of the population. Studying a representative sample permits the researcher to draw valid inferences about the population. In other words, when a researcher uses a representative sample, if something is true of the sample, it is likely also true of the population.

Descriptive research

Descriptive research is useful because it can provide important information regarding the average member of a group. Specifically, by gathering data on a large enough group of people, a researcher can describe the average member, or the average performance of a member, of the particular group being studied. Perhaps a brief example will help clarify what we mean by this. Let's say a researcher gathers Scholastic Aptitude Test (SAT) scores from the current freshman class at a prestigious university.

By using some simple statistical techniques, the researcher would be able to calculate the average SAT score for the current college freshman at the university. This information would likely be informative for high school students who are considering applying for admittance at the university.

One example of descriptive research is correlational research. In *correlational research* (as mentioned earlier), the researcher attempts to

Descriptive research

By using some simple statistical techniques, the researcher would be able to calculate the average SAT score for the current college freshman at the university. This information would likely be informative for high school students who are considering applying for admittance at the university. One example of descriptive research is correlational research. In *correlational research* (as mentioned earlier), the researcher attempts to determine whether there is a relationship—that is, a correlation—between two or more variables). For example, a researcher may wish to determine whether there is a relationship between SAT scores and grade-point averages (GPAs) among a sample of college freshmen.

Two Types of Correlation

<table>
<tr><th colspan="2">Two Types of Correlation</th></tr>
<tr><td>Positive correlation:</td><td>Negative (inverse) correlation:</td></tr>
<tr><td>A positive correlation between two variables means that both variables change in the same direction (either both increase or both decrease). For example, if GPAs increase as SAT scores increase, there is a positive correlation between SAT scores and GPAs.</td><td>A negative correlation between two variables means that as one variable increases, the other variable decreases. In other words, the variables change in opposite directions.
So, if GPAs decrease as SAT scores increase, there is a negative correlation between SAT scores and GPAs.</td></tr>
</table>

Prediction

Another broad goal of research is prediction. Prediction-based research often stems from previously conducted descriptive research. If a researcher finds that there is a relationship (i.e., correlation) between two variables, then it may be possible to predict one variable from knowledge of the other variable.

For example, if a researcher found that there is a relationship between SAT scores and GPAs, knowledge of the SAT scores alone would allow the researcher to predict the associated GPAs.

Prediction

Many important questions in both science and the so-called real world involve predicting one thing based on knowledge of something else. For example, college admissions boards may attempt to predict success in college based on the GPAs and SAT scores of the applicants. Employers may attempt to predict job success based on work samples, test scores, and candidate interviews. Psychologists may attempt to predict whether a traumatic life event leads to depression. Medical doctors may attempt to predict what levels of obesity and high blood pressure are associated with cardiovascular disease and stroke. Meteorologists may attempt to predict the amount of rain based on the temperature, barometric [ˌbɑːrəu'metrɪk((ə)l)] pressure, humidity, and weather patterns.

Prediction

There are three prerequisites for drawing an inference of causality between two events (see Shaughnessy & Zechmeister, 1997).
First, there must be a relationship (i.e., a correlation) between the two events. In other words, the events must *covary*—as one changes, the other must also change. If two events do not covary, then a researcher cannot conclude that one event caused the other event. For example, if there is no relationship between television viewing and deterioration of eyesight, then one c annot reasonably conclude that television viewing causes a deterioration of eyesight.

Prediction

Second, one event (the cause) must precede the other event (the effect). This is sometimes referred to as a *time-order relationship.* This should make intuitive sense. Obviously, if two events occur simultaneously, it cannot be concluded that one event caused the other. Similarly, if the observed effect comes before the presumed cause, it would make little sense to conclude that the cause *caused* the effect.

Third, alternative explanations for the observed relationship must be ruled out.

Prediction

DON'T FORGET

Prerequisites for Inferences of Causality:

- ✓ There must be an existing relationship between two events.
- ✓ The cause must precede the effect.
- ✓ Alternative explanations for the relationship must be ruled out.

“Methodology” versus "Research Design"

Methodology refers to the principles, procedures, and practices that govern research, whereas *research design*
refers to the plan used to examine the question of interest.

“Methodology” should be thought of as encompassing the entire process of conducting research (i.e., planning and conducting the research study, drawing conclusions, and disseminating the findings).

By contrast, “research design” refers to the many ways in which research can be conducted to answer the question being asked.

TEST YOURSELF

1. _______________ can be defined as a methodological and systematic approach to the acquisition of new knowledge.
2. The defining characteristic of scientific research is the _______________ _______________.
3. The _______________ approach relies on direct observation and experimentation in the acquisition of new knowledge.
4. Scientists define key concepts and terms in the context of their research studies by using _______________ definitions.
5. What are the three general goals of scientific research?

A. empirical;
B. description, prediction, and understanding/explaining;
C. operational;
D. science;
E. scientific method;

1	2	3	4	5

Problem Solving

Some research ideas may also stem from a researcher's motivation to solve a particular problem. In both our private and professional lives, we have probably all come across some situation or thing that has caught our attention as being in need of change or improvement. For example, a great deal of research is currently being conducted to make work environments less stressful, diets healthier, and automobiles safer. In each of these research studies, researchers are attempting to solve some specific problem, such as work-related stress, obesity, or dangerous automobiles.

Problem Solving

This type of problem-solving research is often conducted in corporate and professional settings, primarily because the results of these types of research studies typically have the added benefit of possessing practical utility.

For example, finding ways for employers to reduce the work-related stress of employees could potentially result in increased levels of employee productivity and satisfaction, which in turn could result in increased economic growth for the organization.

These types of benefits are likely to be of great interest to most corporations and businesses.

Theory

Theory

A *theory* is a conceptualization, or description, of a phenomenon that attempts to integrate all that we know about the phenomenon into a concise statement or question.

Literature Reviews

Scouring ['skau(ə)rɪŋ] the existing literature to get ideas for future research is a technique used by most researchers. It is important to note, however, that being familiar with the literature in a particular topic area also serves another purpose. Specifically, it is crucial for researchers to know what types of studies have been conducted in particular areas so they can determine whether their specific research questions have already been answered. To be clear, it is certainly a legitimate goal of research to replicate the results of other studies—but there is a difference between replicating a study for purposes of establishing the robustness or generalizability of the original findings and simply duplicating a study without having any knowledge that the same study has already been conducted. You can often save yourself a good deal of time and money by simply looking to the literature to see whether the study you are planning has already been conducted.

Three Criteria for Research Problems

Three Criteria for Research Problems

Good research problems must meet three criteria.

- First, the research problem should describe the relationship between two or more variables.
- Second, the research problem should take the form of a question.
- Third, the research problem must be capable of being tested empirically (i.e., with data derived from direct observation and experimentation).

Operational Definitions

Operational Definitions

An important point to keep in mind is that an operational definition is specific to the particular study in which it is used. Although researchers can certainly use the same operational definitions in different studies
(which facilitates replication of the study results), different studies can operationally define the same terms and concepts in different ways.
For example, in one study, a researcher may define “gifted children” as those children who are in advanced classes. In another study, however, “gifted children” may be defined as children with IQs of 130 or higher. There is no one correct definition of “gifted children,” but providing an operational definition reduces confusion by specifying what is being studied.

Variables

Variables

A *variable* is anything that can take on different values.
For example, height, weight, age, race, attitude, and IQ are variables because there are different heights, weights, ages, races, attitudes, and IQs. By contrast, if something cannot vary, or take on different values, then it is referred to as a *constant*.

Independent Variables and Dependent Variables

Independent Variables and Dependent Variables

The independent variable is called “independent” because it is independent of the outcome being measured. More specifically, the independent variable is what causes or influences the outcome.
The dependent variable is called “dependent” because it is influenced by the independent variable.
For example, in our hypothetical study examining the effects of medication on symptoms of depression, the measure of depression is the dependent variable because it is influenced by (i.e., is dependent on) the independent variable (i.e., the medication).

Definition of “Research”

Definition of “Research”
Research is generally defined as an examination of the relationship between two or more variables.
Research is an examination of the relationship between one or more independent variables and one or more dependent variables. In even more precise terms, we can define research as an examination of the effects of one or more independent variables on one or more dependent variables.

Varying Independent Variables and Measuring Dependent Variables

Varying Independent Variables and Measuring Dependent Variables

Assuming that a researcher has a well-articulated and specific hypothesis, it is a fairly straightforward task to identify the independent and dependent variables. Often, the difficult part is determining how to *vary* the independent variable and *measure* the dependent variable.

For example, let's say that a researcher is interested in examining the effects of viewing television violence on levels of prosocial behavior. In this example, we can easily identify the independent variable as viewing television violence and the dependent variable as prosocial behavior. The difficult part is finding ways to vary the independent variable (how can the researcher vary the viewing of television violence?) and measure the dependent variable (how can the researcher measure prosocial behavior?). Finding ways to vary the independent variable and measure the dependent variable often requires as much creativity as scientific know-how.

Varying Independent Variables and Measuring Dependent Variables

Categorical Variables vs. Continuous Variables

The decision of whether to use categorical or continuous variables will have an effect on the precision of the data that are obtained. When compared with categorical variables, continuous variables can be measured with a greater degree of precision.
In addition, the choice of which statistical tests will be used to analyze the data is partially dependent on whether the researcher uses categorical or continuous variables.
Certain statistical tests are appropriate for categorical variables, while other statistical tests are appropriate for continuous variables. As with many decisions in the research-planning process, the choice of which type of variable to use is partially dependent on the question that the researcher is attempting to answer.

categoric(al) [ˌkætə'gɔrɪk((ə)l)]

Categorical Variables vs. Continuous Variables

In some circumstances, researchers may decide to convert some continuous variables into categorical variables. For example, rather than using “age” as a continuous variable, a researcher may decide to make it a categorical variable by creating discrete categories of age, such as “under age 40” or “age 40 or older.” “Income,” which is often treated as a continuous variable, may instead be treated as a categorical variable by creating discrete categories of income, such as “under $25,000 per year,” “$25,000–$50,000 per year,” and “over $50,000 per year.” The benefit of using continuous variables is that they can be measured with a higher degree of precision. For example, it is more informative to record someone’s age as “47 years old” (continuous) as opposed to “age 40 or older” (categorical). The use of continuous variables gives the researcher access to more specific data.

Quantitative Variables vs. Qualitative Variables

Quantitative Variables vs. Qualitative Variables

Finally, before moving on to a different topic, it would behoove us to briefly discuss the distinction between qualitative variables and quantitative variables.

Qualitative variables are variables that vary in kind, while *quantitative variables* are those that vary in amount. This is an important yet subtle distinction that frequently arises in research studies, so let’s take a look at a few examples.

Rating something as “attractive” or “not attractive,” “helpful” or “not helpful,” or “consistent” or “not consistent” are examples of qualitative variables. In these examples, the variables are considered qualitative because they vary in kind (and not amount).

Quantitative Variables vs. Qualitative Variables

Quantitative Variables vs. Qualitative Variables

For example, the thing being rated is either “attractive” or “not attractive,” but there is no indication of the level (or amount) of attractiveness.

By contrast, reporting the number of times that something happened or the number of times that someone engaged in a particular behavior are examples of quantitative variables. These variables are considered quantitative because they provide information regarding the amount of something.

PARTICIPANTS OF EXPERIMENTAL STUDY

Key Terms

Random Selection vs. Random Assignment

Random Selection vs. Random Assignment

Random selection:

Choosing study participants from the population of interest in such a way that each member of the population has an equal probability of being selected to participate in the study.

Random assignment:

Assigning study participants to groups within the study in such a way that each participant has an equal
probability of being assigned to any of the groups within the study.

Group Equivalence

Group Equivalence

One of the most important aspects of group research is isolating the effects of the independent variable. To accomplish this, the experimental group and control group should be identical, except for the independent variable. The independent variable would be present in the experimental group, but not in the control group.

Assuming this is the only difference between the two groups, any observed differences on the dependent variable can reasonably be attributed to the effects of the independent variable.

Group Equivalence Testing

Equivalence Testing

Although using random assignment with large samples can be assumed to produce equivalent groups, it is wise to statistically examine whether the two groups are indeed equivalent.

This is accomplished by comparing the two groups on nuisance variables to see whether the two groups differ significantly.

If there are no statistically significant differences between the two groups on any of the nuisance variables, the researcher can be confident that the two groups are equivalent. In this situation, any observed effects on the dependent variables can reasonably be attributed to the independent variable (and not to any of the nuisance variables). By contrast, if the two groups are not equivalent on one or more of the nuisance variables, there are statistical steps that a researcher can take to ensure that the differences do not affect the interpretation of the study's results.

Nuisance Variable

nuisance variable

"Nuisance variable" has been used in the context of statistical surveys to refer information that is not of direct interest but which needs to be taken into account in an analysis.

Мешающая переменная - это случайная величина , которая «фундаментальна» для вероятностной модели , но сама по себе не представляет особого интереса или больше не представляет интереса.

cognizant [ˈkɒ(g)nɪz(ə)nt] adjective
- Having knowledge or awareness

Multiculturalism

Multiculturalism

When considered in its broadest sense, a researcher who has achieved *multicultural competence* is cognizant of differences among study participants related to race, ethnicity, language, sexual orientation, gender, age, disability, class status, education, and religious or spiritual orientation.

(American Psychological Association, 2003).

TEST YOURSELF

1. Researchers become familiar with the existing literature on a particular topic by conducting a ___________.
2. Researchers use ___________ to attempt to explain, predict, and explore the phenomenon of interest.
3. The ___________ hypothesis always predicts that there will be no differences between the groups being studied.
4. The ___________ is a measure of the effect (if any) of the independent variable.
5. The most effective method of assigning participants to groups within a research study is through a procedure called ___________ assignment.

Answers:

A. dependent variable;
B. hypotheses;
C. literature review;
D. null;
E. random;

1	2	3	4	5

VALIDITY

Four Types of Validity

Four Types of Validity

Four Types of Validity

- **Internal validity** refers to the ability of a research design to rule out or make implausible alternative explanations of the results, or plausible rival hypotheses.
- **External validity** refers to the generalizability of the results of a research study.
- **Construct validity** refers to the basis of the causal relationship and is concerned with the congruence between the study's results and the theoretical underpinnings guiding the research.
- **Statistical validity** refers to aspects of quantitative evaluation that affect the accuracy of the conclusions drawn from the results of a study.

Four Types of Validity

Four Types of Validity

- • **Internal validity** refers to the ability of a research design to rule out or make implausible alternative explanations of the results, or plausible rival hypotheses.

(A *plausible rival hypothesis* is an alternative interpretation of the researcher's hypothesis about the interaction of the dependent and independent variables that provides a reasonable explanation of the findings other than the researcher's original hypothesis.)

Four Types of Validity

Four Types of Validity

- • **External validity** refers to the generalizability of the results of a research study. In all forms of research design, the results and conclusions of the study are limited to the participants and conditions as defined by the contours of the research. External validity refers to the degree to which research results generalize to other conditions, participants, times, and places.

Four Types of Validity

Four Types of Validity

- • **Construct validity** refers to the basis of the causal relationship and is concerned with the congruence between the study’s results and the theoretical underpinnings guiding the research. In essence, construct validity asks the question of whether the theory supported by the findings provides the best available explanation of the results.

Four Types of Validity

Four Types of Validity

- • **Statistical validity** refers to aspects of quantitative evaluation that affect the accuracy of the conclusions drawn from the results of a study. At its simplest level, statistical validity addresses the question of whether the statistical conclusions drawn from the results of a study are reasonable.

Selection Biases

Selection Biases

Selection biases are common in quasi-experimental designs and can interact with other threats to internal validity, such as maturation, history, or instrumentation, to produce effects that might not be attributable to the independent variable.

The Rosenthal and Pygmalion Effects

The Rosenthal and Pygmalion Effects

The *Rosenthal* and *Pygmalion effects* are examples of experimenter bias.

Both of these terms refer to the documented phenomenon that researchers' expectations (rather than the experimental manipulation) can bias the outcome of study by influencing the behavior of their participants.

Strategies for Minimizing Experimenter Effects

Strategies for Minimizing Experimenter Effects

- ❑ Carefully control or standardize all experimental procedures.
- ❑ Provide training and education on the impact and control of experimenter effects to all of the researchers involved in the study.
- ❑ Minimize dual or multiple roles within the study.
- ❑ When multiple researcher roles are necessary, provide appropriate checks and balances and quality control procedures, whenever possible.

Strategies for Minimizing Experimenter Effects

Strategies for Minimizing Experimenter Effects

- Automate procedures, whenever possible.
- Conduct data collection audits and ensure accuracy of data entry.
- Consider using a statistical consultant to ensure impartiality of results and choice of appropriate statistical analyses.
- Limit the knowledge that the researcher or researchers have regarding the nature of the hypotheses being tested, the experimental manipulation, and which participants are either receiving or not receiving the experimental manipulation.

Strategies for Minimizing Experimenter Effects

Approaches for Limiting Researchers' Knowledge of Participant Assignment

- **Double-blind technique:**
The most powerful method for controlling researcher expectancy and related bias, this procedure requires that neither the participants nor the researchers know which experimental or control condition research participants are assigned to.
- **Blind technique:**
This procedure requires that only the researcher be kept "blind" or naïve regarding which treatment or control conditions the participants are in.
- **Partial-blind technique:** This procedure is similar to the blind technique, except that the researcher is kept naïve.

Participant Effects

Participant Effects

Participant effects are a source of artifact and bias stemming from a variety of factors related to the unique motives, attitudes, and behaviors that participants bring to any research study.

Participant Effects

Participant Effects by Any Other Name . . .

Participant effects are also referred to as “demand characteristics.”

Demand characteristics are the tendencies of research participants to act differently than they normally might simply because they are taking part in a study.

At their most severe, demand characteristics are changes in behavior that are based on assumptions about the underlying purpose of the study, which can introduce a significant confound [kən'faund] into the study’s findings.

Randomization

Randomization

Randomization is a control method that helps to eliminate alternative rival hypotheses that might otherwise explain the results of the study.
Randomization does not attempt to eliminate sources of artifact and bias from the study.
Instead, it attempts to control for the effects of extraneous variables by ensuring that they are equivalent across all of the experimental and control groups in the study.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

1. *Follow the scientific method.* The scientific method is what separates science from nonscience. The scientific method, with its emphasis on observable results, assists researchers in reaching valid and scientifically defensible conclusions.
2. *Keep the goals of scientific research in mind.* The goals of scientific research are to describe, predict, and understand or explain. Keeping these goals in mind will assist you in achieving the broad goals of science—that is, answering questions and acquiring new knowledge.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

3. *Choose a research topic carefully.* There are two considerations with respect to choosing a research topic. First, a research question must be answerable using available scientific methods. If a question cannot be answered, then it cannot be investigated using science. Second, it is important to make sure that the question you are asking has not already been definitively answered; this emphasizes the importance of conducting a thorough literature review.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

4. *Use operational definitions.* Operational definitions clarify exactly what is being studied in the context of a particular research study. Among other things, this reduces confusion and permits replication of the results.
5. *Articulate hypotheses that are falsifiable and predictive.* As you may recall, each hypothesis must be capable of being refuted based on the results of the study. Furthermore, a hypothesis must make a prediction, which is subsequently tested empirically by gathering and analyzing data.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

6. Choose variables based on the research question and hypotheses.

The variables selected for a particular study should stem logically from the research question and the hypotheses.

7. Use random selection whenever possible.

Use random selection when choosing a sample of research participants from the population of interest. This helps to ensure that the sample is representative of the population from which it was drawn.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

8. Use random assignment whenever possible.

Use random assignment when assigning participants to groups within a study. Random assignment is a reliable procedure for producing equivalent groups because it evenly distributes characteristics of the sample among all of the groups within the study.

This helps the researcher isolate the effects of the independent variable by ensuring that nuisance variables do not interfere with the interpretation of the study's results.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

9. Be aware of multicultural considerations.

Be cognizant of the effects that cultural differences may have on the research question and design.

For certain types of research, such as treatment-based research, it is important to determine whether the intervention being studied has similar effects on both genders and on diverse racial and ethnic groups.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

10. Eliminate sources of artifact and bias.

To the extent possible, eliminate sources of artifact and bias so that more confidence can be placed in the results of the study. The effects of most types of artifact and bias can be eliminated (or at least considerably reduced) by employing random selection when choosing research participants and random assignment when assigning those participants to groups within the study.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

11. Choose reliable and valid measurement strategies.

When selecting measurement strategies, let validity and reliability be your guides. Measurement strategies should measure what they purport to measure, and should do so in a consistent fashion.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

12. Use rigorous experimental designs.

Whenever possible, researchers should use a true experimental design. Only a true experimental design, one involving random assignment to experimental and control groups, permits researchers to draw valid causal inferences about the relationship between variables.

Because it may not always be possible or feasible to use a true experimental design, a good rule of thumb is that researchers should strive to use the most rigorous design possible in each situation.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

13. Attempt to increase the validity of a study. A well-conducted research study will have strong internal validity, external validity, construct validity, and statistical validity. This maximizes the likelihood of drawing valid inferences from the study.

14. *Use care in analyzing and interpreting the data.*

A crucial aspect of research studies is preparing the data for analysis, analyzing the data, and interpreting the data. The proper analysis of a study's data enhances the ability of researchers to draw valid inferences from the study.

CHECKLIST OF RESEARCH-RELATED CONCEPTS AND CONSIDERATIONS

15. Become familiar with commonly encountered ethical considerations.
Researchers have an obligation to avoid violating ethical standards when conducting research. This means that researchers must be familiar with, among other things, the rights of study participants.
16. *Disseminate the results of research studies.*
Science advances through the dissemination of research findings, so researchers should attempt to share the results of their research with the scientific community.

Typical Sections of an English Research Manuscript

For manuscripts that describe empirical studies, the following sections are typically included:

1. Title
2. Abstract (brief summary of the study)
3. Introduction (rationale and objectives for the study; hypotheses)
4. Method (description of research design, study sample, and research procedures)
5. Results (presentation of data, statistical analyses, and tests of hypotheses)
6. Discussion (major findings, interpretations of data, conclusions, limitations of study, and areas for future research).

IMRAD Стандартная структура научной статьи / презентации по результатам КР	
Title (Название статьи)	Указывается тема исследования, автор, аффилиация. В студенческих сборниках также научный руководитель.
Annotation (Аннотация)	Конкретизирует содержание статьи и кратко отражает структуру IMRAD
Key Words (Ключевые слова)	Указываются ключевые термины и понятия исследования
Introduction (Введение)	Проблема, актуальность, новизна, объект и предмет; цели и задачи; Аналитический обзор литературы; ключевые понятия исследования.
Methods (Методы)	Методы, материал анализа, условия эксперимента, методики и средства проведения исследования
Results (Результаты)	Анализ, интерпретация и первичное обобщение полученных в результате исследования новых данных.
Discussion (Обсуждение)	Полученные ответы, их достоверность, значение,
Conclusion (Заключение)	Обобщение полученных результатов и выводов по ним; перспективы дальнейших исследований.
References (Литература)	Библиографические данные статей оформляются по требованиям издания (e.g. ГОСТ, APA etc.). Указываются все процитированные и проанализированные источники.

FIND MORE READING AT

FIND MORE READING AT

STATISTICAL APPROACHES

Extended reading

STATISTICAL APPROACHES

Statistical Approaches for Holding Extraneous Variables Constant

- Descriptive statistics
- *T*-test
- ANOVA
- ANCOVA
- Partial correlation

STATISTICAL APPROACHES

Statistical Approaches for Holding Extraneous Variables Constant

One statistical approach for determining equivalence between groups is to use simple analyses of means and standard deviations for the variables of interest for each group in the study.

A *mean* is simply an average score,

and a *standard deviation* is a measure of variability indicating the average amount that scores vary from the mean.

We could use means and standard deviations to obtain a snapshot of group scores on a variable of interest, such as memory.

STATISTICAL APPROACHES

Statistical Approaches for Holding Extraneous Variables Constant

For some researchers,
eyeballing the results would be sufficient—in other words, if the means and standard deviations were close for both groups, we would assume that there was no confound.
For others, a statistical test (*t*-test for two groups, or analysis of variance [ANOVA] for three or more groups) to compare the means would be run to determine whether there was a statistically significant difference between the groups on the variable of interest.

STATISTICAL APPROACHES

Statistical Approaches for Holding Extraneous Variables Constant

There are two other statistical approaches that can be used to minimize the impact of or to control for the influence of extraneous variables. The first is referred to as "analysis of covariance," or ANCOVA, and it is used during the data analysis phase. This statistical technique adjusts scores so that participant scores are equalized on the measured variable of interest. In other words, this statistical technique controls for individual differences and adjusts for those differences among nonequivalent groups

STATISTICAL APPROACHES

Statistical Approaches for Holding Extraneous Variables Constant

A partial correlation is another statistical technique that can be used to control for extraneous variables. In essence, a *partial correlation* is a correlation between two variables after one or more variables have been mathematically controlled for and partialed out. For example, a partial correlation would allow us to look at the relationship between memory and symptom level while mathematically eliminating the impact of another possibly confounding variable such as intelligence or level of motivation. This assumes, of course, that appropriate data on each variable have been collected and can be included in the analyses. These statistical approaches can be used regardless of whether random selection and assignment were employed in the study.

STATISTICAL APPROACHES

Statistical Approaches for Holding Extraneous Variables Constant

Robustness of a statistical test refers to the degree to which it is resistant to violations of certain assumptions.
The robustness of certain statistical techniques does not mean they are totally immune to such violations, but merely that they are less sensitive to them.

STATISTICAL APPROACHES

T-*Test*

T-tests are used to test mean differences between two groups. In general, they require a single dichotomous independent variable (e.g., an experimental and a control group) and a single continuous dependent variable.
For example, *t*-tests can be used to test for mean differences between experimental and control groups in a randomized experiment, or to test for mean differences between two groups in a nonexperimental context (such as whether cocaine and heroin users report more criminal activity). When
a researcher wishes to compare the average (mean) performance between two groups on a continuous variable, he or she should consider the *t*-test.

STATISTICAL APPROACHES

Analysis of Variance (ANOVA)

Often characterized as an *omnibus* t-*test,* an ANOVA is also a test of mean comparisons. In fact, one of the only differences between a *t*-test and an ANOVA is that the ANOVA can compare means across more than two groups or conditions. Therefore, a *t*-test is just a special case of ANOVA. If you analyze the means of two groups by ANOVA, you get the same results as doing it with a *t*-test. Although a researcher could use a series of *t*-tests to examine the differences between more than two groups, this would not only be less efficient, but it would add experiment-wise error, thereby increasing the chances of spurious results (i.e. Type I errors) *and compromising statistical conclusion validity*.

STATISTICAL APPROACHES

Analysis of Variance (ANOVA)

Interestingly, despite its name, the ANOVA works by comparing the differences between group means rather than the differences between group variances. The name “analysis of variance” comes from the way the procedure uses variances to decide whether the means are different.

STATISTICAL APPROACHES

Analysis of Variance (ANOVA)

There are numerous different variations of the ANOVA procedure to choose from, depending on the study hypothesis and research design. For example, a *one-way ANOVA* is used to compare the means of two or more levels of a single independent variable. So, we may use an ANOVA to examine the differential effects of three types of treatment on level of depression.

Treatment for Depression		
Treatment 1	Treatment 2	Treatment 3

STATISTICAL APPROACHES

Analysis of Variance (ANOVA)

Alternatively, *multifactor ANOVAs* can be used when a study involves two or more independent variables. For example, a researcher might employ a 2 × 3 factorial design to examine the effectiveness of the different treatments (Factor 1) and high or low levels of physical exercise (Factor 2) in reducing symptoms of depression.

		Treatment for Depression		
		Treatment 1	Treatment 2	Treatment 3
Exercise	Low			
	High			

STATISTICAL APPROACHES

Analysis of Variance (ANOVA)

Because the study involves two factors (or independent variables), the researcher would conduct a two-way ANOVA. Similarly, if the study had three factors, a three-way ANOVA would be used, and so forth. A multifactor ANOVA allows a researcher to examine not only the main effects of each independent variable (the different treatments and high or low levels of exercise) on depression, but also the potential interaction of the two independent variables in combination.

		Treatment for Depression		
		Treatment 1	Treatment 2	Treatment 3
Exercise	Low			
	High			

STATISTICAL APPROACHES

Analysis of Variance (ANOVA)

Because the study involves two factors (or independent variables), the researcher would conduct a two-way ANOVA. Similarly, if the study had three factors, a three-way ANOVA would be used, and so forth. A multifactor ANOVA allows a researcher to examine not only the main effects of each independent variable (the different treatments and high or low levels of exercise) on depression, but also the potential interaction of the two independent variables in combination.

Still another variant of the ANOVA is the *multiple analysis of variance,* or *MANOVA.* The MANOVA is used when there are two or more dependent variables that are generally related in some way. Using the previous example, let's say that we were measuring the effect of the different treatments, with or without exercise, on depression measured in several different ways. Although we could conduct separate ANOVAs for each of these outcomes, the MANOVA provides a more efficient and more informative way of analyzing the data.

STATISTICAL APPROACHES

Analysis of Variance (ANOVA)

This can be corrected for either by using a statistical test that takes this error into account (e.g., multiple ANOVA, or MANOVA; see text) or by lowering the *p*-value to account for the number of comparisons being performed. The simplest and the most conservative method of controlling for experiment-wise error is the *Bonferroni correction.* Using this correction, the researcher simply divides the set *p*-value by the number of statistical comparisons being made (e.g., .05/4 = .0125). The resulting *p*-value is then the new criterion that must be obtained to reach statistical significance.

STATISTICAL APPROACHES

Chi-Square (χ2)

The inferential statistics that we have discussed so far (i.e., *t*-tests, ANOVA) are appropriate only when the dependent variables being measured are continuous (interval or ratio). In contrast, the *chi-square statistic* allows us to test hypotheses using nominal or ordinal data. It does this by testing whether one set of proportions is higher or lower than you would expect by chance. Chi-square summarizes the discrepancy between observed and expected frequencies. The smaller the overall discrepancy is between the observed and expected scores, the smaller the value of the chi-square will be. Conversely, the larger the discrepancy is between the observed and expected scores, the larger the value of the chi-square will be.

STATISTICAL APPROACHES

Chi-Square ($\chi 2$)

For example, in a study of employment skills, a researcher may randomly assign consenting individuals to an experimental or a standard skills-training intervention. The researcher might hypothesize that a higher percentage of participants who attended the experimental intervention would be employed at 1 year follow-up.

Because the outcome being measured is dichotomous (employed or not employed), the researcher could use a chi-square to test the null hypothesis that employment at the 1 year follow-up is not related to the skills training.

STATISTICAL APPROACHES

Chi-Square ($\chi 2$)

Similarly, chi-square analysis is often used to examine between-group differences on categorical variables, such as gender, marital status, or grade level. The main thing to remember is that the data must be nominal or ordinal because chi-square is a test of proportions.

Also, because it compares the tallies of categorical responses between two or more groups, the chi square statistic can be conducted only on actual numbers and not on precalculated percentages or proportions.

Multiple Comparisons and Experiment-wise Error

Multiple Comparisons and Experiment-wise Error

Most research studies perform many tests of their hypotheses. For example, a researcher testing a new educational technique may choose to examine the technique's effectiveness by measuring students' test scores, satisfaction ratings, class grades, and SAT scores. If there is a 5% chance (with a *p*-value of .05) of finding a significant result on one outcome measure, there is a 20% chance (.05 × 4) of finding a significant result when using four outcome measures. This inflated likelihood of achieving a significant result is referred to as *experiment-wise error.*

Multiple Comparisons and Experiment-wise Error

Multiple Comparisons and Experiment-wise Error

This can be corrected for either by using a statistical test that takes this error into account (e.g., multiple ANOVA, or MANOVA; see text) or by lowering the *p*-value to account for the number of comparisons being performed.
The simplest and the most conservative method of controlling for experiment-wise error is the *Bonferroni correction.* Using this correction, the researcher simply divides the set *p*-value by the number of statistical comparisons being made
(e.g., .05/4 = .0125).
The resulting *p*-value is then the new criterion that must be obtained to reach statistical significance.

Regression

Regression

Linear regression is a method of estimating or predicting a value on some dependent variable given the values of one or more independent variables. Like correlations, statistical regression examines the association or relationship between variables. Unlike with correlations, however, the primary purpose of regression is prediction. For example, insurance adjusters may be able to predict or come close to predicting a person's life span from his or her current age, body weight, medical history, history of tobacco use, marital status, and current behavioral patterns.

Regression

Regression

There are two basic types of regression analysis: simple regression and multiple regression. In *simple regression,* we attempt to predict the dependent variable with a single independent variable.

In *multiple regression*, as in the case of the insurance adjuster, we may use any number of independent variables to predict the dependent variable.

Regression

Regression

Logistic regression, unlike its linear counterpart, is unique in its ability to predict dichotomous variables, such as the presence or absence of a specific outcome, based on a specific set of independent or predictor variables.

Like correlation, logistic regression provides information about the strength and direction of the association between the variables. In addition, logistic regression coefficients can be used to estimate odds ratios for each of the independent variables in the model. These *odds ratios* can tell us how likely a dichotomous outcome is to occur given a particular set of independent variables.

Regression

Regression

A common application of logistic regression is to determine whether and to what degree a set of hypothesized risk factors might predict the onset of a certain condition. For example, a drug abuse researcher may wish to determine whether certain lifestyle and behavioral patterns place former drug abusers at risk for relapse. The researcher may hypothesize that three specific factors—living with a drug or alcohol user, psychiatric status, and employment status—will predict whether a former drug abuser will relapse within 1 month of completing drug treatment.

Regression

Regression

By measuring these variables in a sample of successful drug-treatment clients, the researcher could build a model to predict whether they will have relapsed by the 1-month follow-up assessment. The model could also be used to estimate the odds ratios for each variable. For example, the odds ratios could provide information on how much more likely unemployed individuals are to relapse than employed individuals.

LECTURE

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