
► Chapter 1: Explaining Behavior ◀

GOAL OF SCIENCE is to generate explanations for various puzzling natural phenomenon.

- Generate general laws of behavior (psychology)

RESEARCH: principle method for acquiring knowledge and uncovering causes of behavior

- Systematic
- Develop explanations

OBTAIN NEW KNOWLEDGE which we might call “the truth” about the natural world. Science searches for a particular type of truth which takes us beyond simple observation towards explanation.

EXPLAINING BEHAVIOR

A. SCIENTIFIC EXPLANATIONS:

1. EMPIRICAL:
 - Based on evidence of the senses
 - Based on objective and systematic observation
2. RATIONAL:
 - Follows rules of logic and is consistent with known facts.
3. TESTABLE:
 - Verifiable through direct observation.
 - Lead to predicted outcome.
4. PARSIMONIOUS: Fewest number of assumptions.

“The simplest possible explanation is always to be preferred to more complicated alternatives.” (Ockham)

5. GENERAL: Which one accounts for more “data”
6. TENTATIVE: “Willing to entertain the possibility that the explanation is faulty.”

7. RIGOROUSLY EVALUATED:

- Evaluated for CONSISTENCY with the evidence and known principles, for parsimony, and for generality

B. COMMONSENSE EXPLANATIONS: are based on our own SENSE of what is true about the world.

- FACE VALUE
- Level of proof required
- Unverified sources of information

EXPLANATION LIKELY TO BE:

- + Incomplete
- + Inconsistent with other evidence
- + Lacking in generality

EXAMPLE:

Fire in Iroquois theater

Explanation: desire to survive

The Who Concert in 1979

C. BELIEF-BASED EXPLANATIONS: the truth of their beliefs accepted on faith.

- NO EVIDENCE REQUIRED.
- Often lacks generality

METHOD OF INQUIRY

A. Method of Authority

B. Rational Method

C. SCIENTIFIC METHOD:

- An approach for acquiring knowledge
- Empirical
- 1) **Observing a Phenomenon** (Starting point) observe a behavior of interest.
 - Systematic (example Clever Hans)
- 2) **Formulating Tentative Explanations:** Develop one or more tentative explanations that seems consistent with your observations
Hypothesis: a tentative statement that is testable
- 3) **Further Observing & Experimenting**
 - Isolate the relationship between the variables chosen for study
 - Design a study to test the relationship proposed in the hypothesis.

- 4) **Refining and Retesting Explanations:** Confirmation of a hypothesis often leads to other hypotheses that expand on the relationship.

Clever Hans:

RESEARCH PROCESS:

A. Basic Research: acquire general information on a problem.

B. Applied Research: generate information that can be applied directly to a real problem.

C. Steps of the Research Process:

1. **Developing a Research Idea and Hypothesis:** Identify issue you want to study

2. **Choosing a Research Design** (e.g. correlation study, experimental study)
 - Where to conduct study
 - How to measure behavior or interest.

3. **Obtaining Subjects**
 - humans/animals
 - Where obtain subjects
 - Treatment of subjects (ethical)

4. **Conducting Your Study**
 - Observe and measure behavior
 - Record data for latter analysis.

5. **Analyzing your results**
Descriptive & Inferential statistics

6. Reporting your results: Prepare a report if the results are reliable and important.

7. Starting the whole process over again: Typically the results will raise new questions

WHEN SCIENCE FAILS:

A. Failures caused by Faulty Inferences: Explanations rely on inference process

B. Pseudoexplanations:

C. Circular explanation:

► Chapter 2: Developing and Evaluating Theories of Behavior ◀

A. SCIENTIFIC THEORY

"A theory is a partially verified statement of a scientific relationship that cannot be directly observed."

- a) Describes a scientific relationship
- b) The described relationship cannot be observed directly
- c) The statement is partially verified

Examples of Theories:

B. ROLES OF THEORY IN SCIENCE

1. Understanding:
2. Prediction:
3. Organizing & interpreting research results:
4. Generating research:

C. CHARACTERISTICS OF A GOOD THEORY

1. Ability to account for data:

2. Explanatory relevance:

3. Testability:

4. Prediction or novel events:

5. Parsimony:

► Chapter 3: Getting & Developing Ideas for Research ◀

I. GETTING AND DEVELOPING IDEAS

A. SOURCES OF RESEARCH IDEAS

1. Unsystematic Observation: casual observation

2. Systematic Observation:
 - a) PUBLISHED RESEARCH

Incrementalism in Research:

- b) SERENDIPITOUS FINDINGS

- c) IDEAS FROM THEORY

Theory: “is a set of assumptions about the causes of a phenomenon and rules that specify how the causes act.

- 1) Guide research

- 2) Organize empirical knowledge

- 3) Helps interpret results in terms of their relevance

B. Theory

1. predictions
2. Two or more theories accounting for the same phenomena

B. DEVELOPING GOOD RESEARCH QUESTIONS

1. **EMPIRICAL QUESTION:** questions that can be answered by **OBJECTIVE** observation.

HYPOTHESIS: Tentative statement, subject to empirical test, about the expected relationship between variables

e.g., Hunger increase motivation to work for food
e.g., Therapy X reduces anxiety about public speaking

2. **Operational Definitions:**
 - + How do we determine what variable X is?
 - + How is it to be measured

Examples:

HUNGER –

ANXIETY –

2. OPERATIONAL DEFINITIONS

- Operational Definitions:**
- + How do we determine what variable X is?
 - + How is it to be measured
 - + Precise meaning of a variable

KITCHEN ANALOGY

Constructs: cake

Operational definition: recipe

Empirical Referents: ingredients, aspects of Apparatus

Quantification of Conditions of Control: cups, teaspoons, ounces, etc.
specification of apparatus conditions (e.g., 350° for 45 minutes).

Scientific Agreement: identical cakes produced in France and United States 39 years apart).

Operational Definition: recipe followed in constructing a cake; operations or specific activities we must perform to get desired physical cake.

- Recipe is an operational definition of the cake
- Recipe for a cake or operational definition for a physical construct.

PURPOSE OF OPERATIONAL DEFINITIONS:

Motive for operational definitions is to insure that anyone, anywhere who wished to follow the operations could produce and observe the same construct.

II. REVIEWING THE SCIENTIFIC LITERATURE

A. REVIEWING THE LITERATURE

1. Prevents Repeating Research

2. Design Of the Experiment

3. Current Theoretical Issues

B. SOURCES OF RESEARCH INFORMATION

a1 Primary Source: original research report

a2 Secondary Source: summarizes information from primary source

b. Scholarly Journals:

Refereed Journal: manuscripts review by 2 or 3 experts in field.

Nonrefereed Journals:

c. Books:

d. Conventions: current research

e. Personal communication:

C. PERFORMING LIBRARY RESEARCH

1. Basic Strategy:

2. Research Tools:

a) PsycINFO

b) PsycARTICLES

c) Science Citation Index

D. READING RESEARCH REPORTS

- Read the literature critically
- Source
- Consistency

ABSTRACT: summary

INTRODUCTION: (literature review)

METHOD: details - allows for replication

RESULTS: data in summary form

DISCUSSION: summarized major findings

REFERENCES: sources

► Chapter 4: Choosing a Research Design ◀

I. CAUSAL VERSUS CORRELATIONAL RELATIONSHIPS

A. Causal Relationship: changes in one variable produce changes in another variable.

B. Correlational Relationship: identify regularities in the relations between one variable and another.

II. CORRELATIONAL RESEARCH

Correlation: assesses a relationship between variables that an experimenter has no control over.

- No manipulation of an independent variable

- Measures 2 dependent variable

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A. Why use correlation research?

1) Identify potential causal relationships:

2) Ethics:

3) See variables in real-world setting:

B. Variables:

1) Predictor Variable: variable used to predict

2) Criterion Variable: value being predicted

C. Third-Variable Problem

1) Third-variable problem: An unobserved variable may influence the correlational relationship.

2) Directionality problem:

A → B

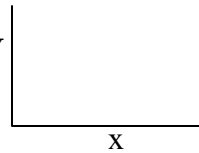
B → A

X → A + B

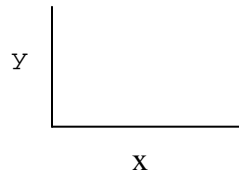
CORRELATION IS NOT CAUSATION

DIFFERENT FORMS OF CORRELATION:

a) **UNCORRELATED** (zero correlation): y
no relationship between the
variables



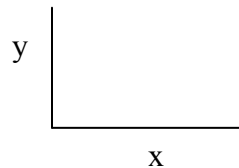
b) **POSITIVE**: x tends to
increase as y increases



c) **NEGATIVE**: y tends to
decrease as x increases



d) **NON-LINEAR**:



Varies from -1.00 to +1.00 (with 0 being no correlation).
+1.00 maximum positive correlation
-1.00 maximum negative correlation

III. EXPERIMENTAL RESEARCH

- Independent variable is manipulated
- Extraneous variables held constant
- Draw cause & effect conclusions

EXPERIMENTAL METHOD: Fundamental aim of science is the identification of the relationships between variables (enables more accurate predictions).

EXAMPLE:

Interesting observation: about memory loss after an emotional shock. How do we test it?

A. CHARACTERISTICS OF EXPERIMENTAL RESEARCH

- 1) Independent Variable:
 - Manipulated by researcher
 - Value (or level) is changed to see whether any consequent change occur in the dependent variable.
- 2) Dependent Variable:
 - Variable being PREDICTED
- 3) Controlled variable: any factor HELD CONSTANT across all treatment condition
- 4) Extraneous Variable: all other variables than are potential influences on the value of the dependent variable.
- 5) Experimental Group: Receives treatment; exposed to one level of independent variable.

- 6) Control Group: (Comparison group) No treatment provided and provides the standard or baseline performance of participants.

Hawthorne Effect:

Halo Effect:

- B. EXPERIMENTS VERSUS DEMONSTRATIONS**: Demonstrations resemble experiments but they lack a true independent variable.

IV. INTERNAL AND EXTERNAL VALIDITY

- A. Confounded Variable**: is any factor in the experiment that covaries with the independent variable across different treatment conditions.

- B. INTERNAL VALIDITY** (theoretical): Does the experiment test the hypothesis it was designed to test?
- CONFOUNDED VARIABLES are a threat to internal validity.

- C. EXTERNAL VALIDITY** (applied): WOULD WE OBTAIN THE SAME RESULTS WITH OTHER SUBJECTS?

- D. INTERNAL VS. EXTERNAL**: Strive to achieve high degree for both BUT typically steps to increase one will decrease the other.

V. RESEARCH SETTINGS

Decide on WHERE you will conduct the research

A. Laboratory Setting (any artificial setting): Allows for control over variables but lose generality.

B. Field Setting: Setting in which the behavior being studied naturally occurs.

C. Simulation

RESEARCH ERRORS:

1) Secondary Variance: confounding variables

2) Failure to use (an adequate) Control Group

► Chapter 13: Descriptive Statistics ◀

EXPLORATORY DATA ANALYSIS (EDA):

“The underlying assumption of the exploratory approach is that the more one knows about the data, the more effectively data can be used to develop, test, and refine theory.” Hartwig, F., & Dearing, B. E. (1979). *Exploratory Data Analysis* p. 9.

- Emphasis on visual displays
- Search for hidden patterns in the data.
- Help determine the types of techniques useful for a given set of data.

Inferential statistics make certain assumptions about the population. If violated, results may be misleading.

I. ORGANIZING YOUR DATA

A. Data Sheets: for survey data

B. Dummy Codes: identify categories values as numbers (e.g., 1 = female; 2 = male)

C. Grouped Versus Individual Data

1) Grouped Data:

2) Individual Data:

3) Using Grouped & Individual Data: Good strategy is to look at both group & individual data.

II. GRAPHING YOUR DATA:

A. Elements of a Graph:

- Data represented in a two-dimensional space.
- Horizontal axis: abscissa or x-axis independent variable
- Vertical axis: ordinate or y-axis dependent variable

Score on
Depression
Test (DV)



Type of Drug (IV)

B. Bar Graphs: (constructed from frequency distributions)

- Presents your data as bars
- Best used when independent variable is categorical
- Bars do not touch (discontinuous nature of Independent Variable).



C. Line Graphs:

- Useful for functional relationship
- Used to plot the changes in the relationship between two variables.



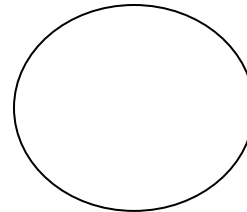
D. Scatterplots:

- Often used for correlational strategy.



E. Pie Charts:

- Useful when data are in the form of proportions or percentages.
- Represented as slices of a circular pie



F. The Importance of Graphing Data:

1) Showing Relationships Clearly:

- The relationship between the independent variable and dependent variable is often clearer.

2) Choosing Appropriate Statistics:

III. FREQUENCY DISTRIBUTION

A. Frequency Distribution:

- Sort values of scores; rank order from the highest to the lowest with frequency in a second column.

B. Displaying Distributions: Useful for extracting information about spread, center, and shape.

- 1) Histogram: (Resemble bar graphs)
 - Each bar represents a class and its FREQUENCY

- 2) Stemplot: (preserves actual values!)

Data: 1,5,9,12,12,14,16,17,19,21,21,22,22,24,26,28,30,38,41

```

4 | 1
3 | 0 8
2 | 1 1 2 2 4 6 8
1 | 2 2 4 6 7 9
0 | 1 5 9
Stem Leaf
    
```

C. Examining Your Distribution:

- Locate center of distribution
 - Note spread of scores
 - Note Overall shape
- 1) Skewed Distribution:
 - 2) Normal Distribution: symmetrical bell curve
 - 3) Outliers: may destroy validity
 - 4) Resistant Measures:

IV. DESCRIPTIVE STATISTICS: MEASURES OF CENTER AND SPREAD

MEASURES OF CENTER: single score that represents distribution (near middle)

352, 479, 493, | 510, 510, 521, | 537, 560, 572, | 617,
 637, (650 or 1560) [N=12]

	<u>650</u>	<u>1560</u>	
Mean =	536.9	612.75	
s =	77.45	295.95	
Median =	529.0	529.0	not as affected
Midspread =	95.0	95.0	not as affected
Range =	298.0	1,208.0	
Lower Hinge	499.5		
Upper Hinge	594.5		
Median depth	$(1+\text{count})/2 = (1+12)/2 = 6.5$		
Depth of Hinges	$(1+\text{median depth})/2 = (1+6)/2 = 3.5$		

Mode: most frequent score in a distribution that has been RANK ORDERED

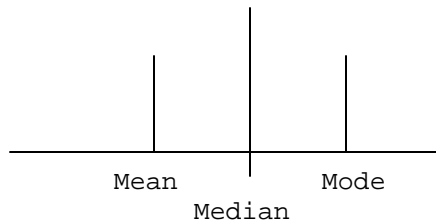
Median: Middle score of rank ordered distribution. Insensitive to the magnitude of scores above & below the median.
 Depth of median = $(1 + \text{count})/2$

Mean: Most sensitive measure of center since affected by magnitude of each score in the distribution (including outliers)

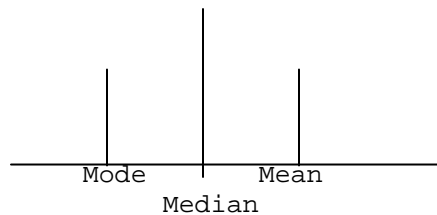
$$\bar{X} = \frac{\sum x}{N}$$

Arithmetic average of all the scores.
 Add all scores together and then divide by the total number of scores

For Negatively Skewed distribution mean underestimated the center:



For Positively Skewed distribution mean overestimates the center:



Choosing A Measure of Center:

1) Scale of measurement:

2) Shape of the distribution:

B. MEASURES OF SPREAD

Range: Easiest to calculate & least informative measure of spread

- Subtract the lowest score from the highest score.

Interquartile Range:

- Takes into account more data than range and is less sensitive to extreme scores.
 - Find the score separating the lower 25 percent Q_1
 - Find the score separating the top 25 percent Q_3
- Depth of "hinges" = $(1 + \text{median depth}) / 2$
 Depth of median = $(1 + \text{count}) / 2$
 Interquartile is $Q_3 - Q_1$

Variance: can NEVER be less than 0

$$s^2 = \frac{\sum (x - \bar{x})^2}{n-1} \quad \text{or} \quad s^2 = \frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}$$

Standard Deviation:

- Most popular measure of spread (expressed in the same unit of measurement as the original scores).

$$s = \sqrt{s^2}$$

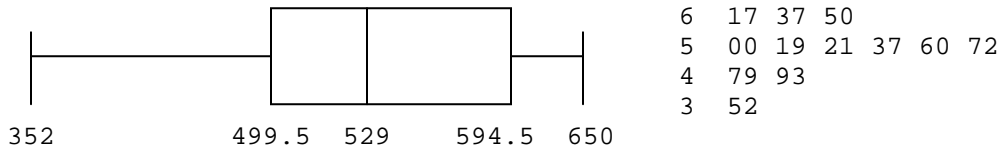
C. BOXPLOTS AND THE FIVE-NUMBER SUMMARY: Display distribution with a few numbers.

Five-number summary: minimum, first quartile, median(second quartile), third quartile, & maximum.

Can calculate:

- Range: (maximum - minimum)
- Interquartile Range: $(Q_3 - Q_1)$

Boxplots: displaying the five-number summary



V. MEASURES OF ASSOCIATION, REGRESSION, AND RELATED TOPICS

- A. Pearson product-moment correlation Coefficient** (Pearson r):
(from +1 to -1)
- Most widely used measure of correlation
- dependent measures at least interval scale.
- B. Point-Biserial Correlation:** one variable is interval or ratio, other is on a dichotomous nominal scale.
- C. Spearman Rank Order Correlation** (ρ): Used when your data are on an ordinal scale (or greater).
- D. Phi Coefficient** (F): Both variables are measured on a dichotomous scale.
- E. Linear Regression and Prediction:**
- 1) Linear Regression: you can estimate values of variables based on knowledge of the value of another.
 - 2) Bivariate Regression (two-variable): Find straight line that best fits the data plotted on a scatterplot.
 - 3) Least squares regression line: Best fitting straight line that minimizes the sum of the squared distances between each data point and the line.
 - 4) Regression Weight (b):
 - 5) Standard error of estimate: Estimate the amount of error for data and computed regression line.
- F. Coefficient of Determination:** Square of the correlation coefficient
- G. The Correlation Matrix:** Display of all possible correlations among a number of variables.
- H. Multivariate Correlational Techniques:** Look at three or more variables simultaneous
- DISTRIBUTIONS: Looking at location, spread and shape