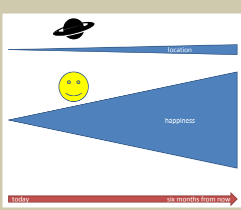
Methods

Defining psychology

- *Scientific study of behavior and mental processes*
- **Scientific:** psychologists formulate testable ideas and make objective observations to determine whether ideas are correct
- **Behavior:** directly observable actions
  - e.g., a smile
- **Mental processes:** unobservable psychological phenomena
  - e.g., the happiness that motivates a smile

Psychology compared to other sciences

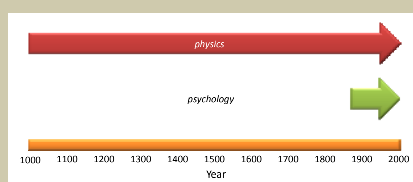
- Psychology (and other branches of the social sciences) is often called a “soft science”
  - psychological predictions tend to be less precise than predictions made in the “harder” sciences (e.g., physics)



It’s much more difficult to predict how happy someone will be 6 months from now compared to the location of a planet.

Psychology compared to other sciences

- Psychologists know less about psychology than many other scientists know about their fields of study.
  - Psychology is a relatively young field of science



Physicists have had about an 870 year head-start over psychologists!

Scientific method

- Step 1: Notice something; ask questions
  - You've got to be curious to be a good scientist. Good scientists are constantly noticing things and wondering about them.

I've noticed that when other people are around, I tend to do worse at some things (e.g., giving speeches, taking tests), but better at other things (e.g., running, working out)? Why is this? What are the underlying causes of this phenomenon? Is everyone like this or is it just me?

Scientific method

- Step 2: Propose an explanation (i.e., propose a theory)
  - A **theory** is a scientific explanation of a phenomenon. A scientific theory should contain statements that either
    1. have already been tested and verified by previous research
    2. are able to be tested for accuracy in future research
  - Hopelessly untestable statements (e.g., "A magical being that can never be observed makes this happen.") must be avoided in scientific theories.
    - Untestable ideas are oftentimes very interesting to think about, but they're impossible to verify. These sorts of ideas are better left to philosophers and theologians to ponder.

Scientific method

Why do I (and perhaps other people) do better at some things and worse at other things when other people are around?

I propose that people get physically aroused (e.g., their heart rate increases) when they are in the presence of other people.

This elevated arousal causes people to perform better at relatively easy tasks (i.e., tasks that do not require a lot of conscious thought) and worse at relatively difficult tasks (i.e., tasks that require more conscious thought).

I'll call my theory, *social performance theory* (note: theory names are not capitalized in psychology).

Scientific method

- Step 3: Test the theory
  - Conduct studies to objectively test the parts of our theory that need testing.
  - Each study will test a specific **hypothesis** or set of hypotheses that emerge from the theory.
    - Hypothesis : *factual statement that can be objectively tested*
    - Notice that theories are essentially a set of hypotheses that have either (a) already been tested or (b) still need to be tested

Valid	Hypothesis
✓	*Physically attractive men smell better (to women) than do less attractive men.*
✓	*Perfectly normal people will hurt and even kill another innocent person simply because they are told to do so as part of a psychology experiment.*
✓	*By observing activity in the brain, it is possible to predict what somebody will do several seconds before he or she is personally aware of it.*
✗	*Cats have religious beliefs.*

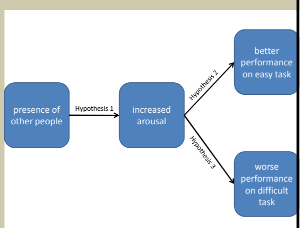
Scientific method

There at least three hypotheses that stem from social performance theory.

(1) The presence of other people causes increases in arousal.

(2) Increased arousal causes performance on easy tasks to improve.

(3) Increased arousal causes performance on difficult tasks to worsen.



Scientific attitude

- Scientists should be **humble**; willing to admit to most of their ideas are wrong.

- Science constantly evolves. Bad theories are weeded out and replaced by better theories.
  - Most scientific theories of the past have since been rejected or heavily modified because empirical data simply do not support them or because they are hopelessly untestable.
  - e.g., Freud's idea of a Todestrieb (i.e., a *death instinct*) makes little sense in a modern context.
    - It's hard to imagine how an instinct to die would not have been weeded out by natural selection a long time ago.
  - Similarly, many of today's prominent psychological theories will seem equally absurd to future psychologists.

Scientific attitude

- Scientists should be **skeptical** of new ideas.
  - Remember, most ideas are wrong; if this were not the case, then we would have figured out everything a long time ago.
  - Being skeptical does not mean to flatly reject new ideas or stubbornly resist them. On the contrary, you should embrace new ideas—just do so with a healthy level of skepticism.
  - Don't blindly accept new ideas. Instead, demand to see evidence that supports them. ["Show me the evidence!"]

  - This is especially true of extraordinary ideas (i.e., ideas that are far removed from mainstream scientific consensus).
    - Carl Sagan: "Extraordinary claims require extraordinary evidence."
    - Insist that extraordinary claims be supported by the strongest of evidence (i.e., evidence that clearly and objectively supports the claim).

Scientific attitude

- Scientists should never have **faith** in their ideas.
  - Faith: *belief in something regardless of what the objective evidence suggests*

- Faithfully held ideas can never be invalidated by evidence; thus, faith is separate from science.

- As a general rule, scientists should avoid studying anything with which they faithfully believe.
  - Scientists should instead try to be as dispassionate as possible about their ideas.
  - The perfect scientist does not care a bit whether his or her ideas are right or wrong

Goal of psychological science

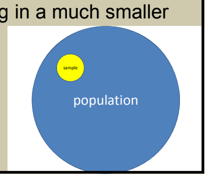
- Describe things
  How much time do people spend playing violent video games? How aggressive are people on average?
- Predict things
  Can I predict how aggressive someone is based on how much time he or she spends playing violent video games?
- Explain things
  Does violent video game playing cause people to be more aggressive?

Descriptive research

- Goal: to describe a population in terms of a variable.
  - **Variable**: anything that can differ in value. Age is a variable because not everyone is the same age. Gender is a variable because not everyone is a girl. Depression is a variable because not everyone is depressed.
    - A variable is the opposite of a **constant**—something that never varies—such as the number 14.
  - e.g., How common is depression amongst the elderly? How happy is the average child? Do more men or women go to college?
  - Purely descriptive research does not always include a hypothesis.

Samples

- Most populations that psychologists are interested in are very large (e.g., US population, everyone in the world)
  - Large populations are too big to work with in their entirety.
  - e.g., How common is depression in the US?
    - Population of US is 300 million. Are you going to assess depression in 300 million people?!?
- To make things more manageable, researchers describe populations by measuring something in a much smaller **sample** of the population.
- Then they estimate what the population is like based on what they observe in the sample.



Samples

- Sample: a representative portion of the population that you want to describe.
- Samples must "look like" the population. Don't measure depression in a sample of people with prescriptions for Prozac if you want to know how common depression is in the American population.
- Best way to accomplish this is to use random selection: that is, randomly pick people from the population to be in your sample.

Samples

- All things being equal, big samples are better than small samples.
  - The bigger the sample, the more accurate the population estimate will be.
    - e.g., if a sample is as big as the population then any estimate based on the sample must be a perfect reflection of the population.
- But samples do not need to be enormous for estimates to be accurate.

We can estimate presidential approval in the American voting population to within ±4% using a sample of just 600 randomly selected people!

Operational definitions

- Before we collect data, we first need to define the variable(s) in terms of how they will be measured. This is called an **operational definition**.
- Operational definition of "happiness":

Describing the sample

- **Measures of central tendency** give us an indication of what the average, middle, or most common person is like in our sample.
  - Mean (average), median (middle), mode (most frequent)

Participant	Happiness score
#1	2
#2	3
#3	5
#4	1
#5	4
#6	3
#7	5
#8	5
#9	4
#10	5

Mean = 3.7 (average score)
Median = 4 (middle score)
Mode = 5 (most common score)

Outliers

- Mean is most commonly reported measure of central tendency, but it can get thrown off by **outliers** (scores that are very different from most other scores). In these cases, the median is oftentimes a better choice.

Student	Yearly income
#1	$8,000
#2	$11,000
#3	$14,000
#4	$15,000
#5	$17,000
#6	$26,000
#7	$31,000
#8	$36,000
#9	$42,000
#10	$1,000,000
Mean	**$120,000**
Median	**$21,500**

The mean salary of this sample is MUCH higher than all but one person earns. The median provides a much more accurate description of the sample.

When modes are useful

- Sometimes a distribution of data will have two scores around which large groups of people cluster. These distributions are called **bimodal distributions**.

Participant	View on abortion
#1	1
#2	1
#3	2
#4	2
#5	2
#6	6
#7	6
#8	6
#9	7
#10	7
Mean	**4**
Median	**4**

The mean and median suggest that people don't care about abortion. But there are really two modes (2 and 6) suggesting that people have strong views one way or the other.

Describing the sample

- **Measures of variability** describe how different people are in the sample (i.e., how spread apart scores are).
- **Range** = [highest score] – [lowest score]
  - Range can be thrown off by outliers.
  - e.g., if 9 people score 70 and one person score 5, the range is 65, which suggests that there is a lot of variability in the sample when in reality there isn't.
- **Standard deviation** = see next slide

Standard deviation

1. Compute **deviations** by subtracting the mean from each participants' score.
2. Square each deviation.
3. Sum together **squared deviations**.
4. Divide **sum of squared deviations** by size of sample (**N**) minus 1.
5. Square root difference.

Participant number	Happiness score	Deviation	Squared deviation
1	70	6.5	42.25
2	70	6.5	42.25
3	70	6.5	42.25
4	70	6.5	42.25
5	70	6.5	42.25
6	70	6.5	42.25
7	70	6.5	42.25
8	70	6.5	42.25
9	70	6.5	42.25
10	5	-58.5	3422.25
	M = **63.5**		∑ squared deviations = **3802.5**

∑ squared deviations = 3802.5

N – 1 = 9

3802.5 ÷ 9 = 422.5

Square root of 422.5 = <u>20.6</u>

Standard deviation

- This shows why it's important to report a measure of variability. All of these samples have the exact same mean, but they are very different. You'd never know this if someone only reported the mean!

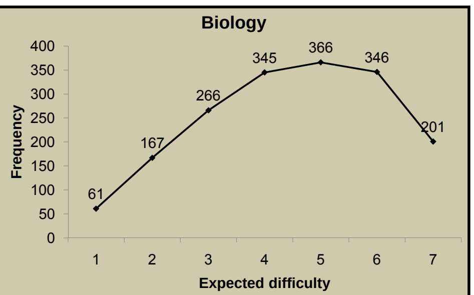
Participant	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
#1	50	41	32	23	14	5
#2	50	43	36	29	22	15
#3	50	45	40	35	30	25
#4	50	47	44	41	38	35
#5	50	49	48	47	46	45
#6	50	51	52	53	54	55
#7	50	53	56	59	62	65
#8	50	55	60	65	70	75
#9	50	57	64	71	78	85
#10	50	59	68	77	86	95
Mean	**50**	**50**	**50**	**50**	**50**	**50**
SD	**0.0**	**6.1**	**12.1**	**18.2**	**24.2**	**30.3**

Visualizing descriptive data

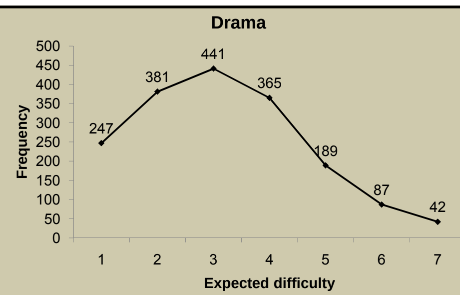
- A **frequency plot** is a common way to see what descriptive data look like.
- It shows you what the data **distribution** is like. That is, how the data is distributed across a range of scores.

Frequency plot examples

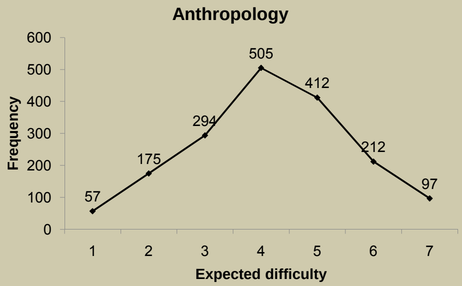
- A few years ago I asked 1,752 students in my introductory psychology classes to rate how difficult they thought classes in each of 24 academic majors (e.g., Physics, English, etc.) would be.
- Ratings could range from 1 (extremely easy) to 7 (extremely difficult).



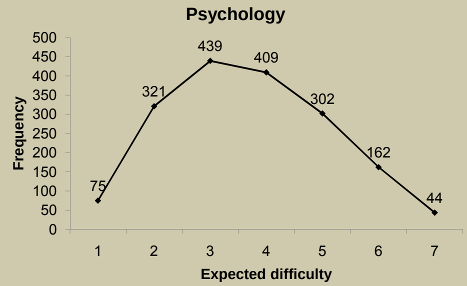
This **frequency plot** has a **negative skew** to it. The "tail" is pointing in the negative direction. Another way to think of this is that the majority of the scores are above the average (mean) score. In other words, most students think Biology is going to be difficult.



This frequency plot has a positive skew to it. The "tail" is pointing in the positive direction. Another way to think of this is that the majority of the scores are below the average (mean) score. In other words, most students think Drama is going to be easy.

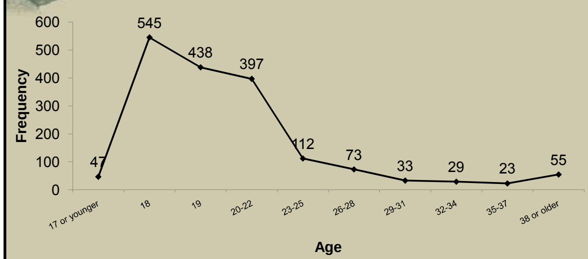


This frequency plot has a **no skew** to it. There are two similar looking "tails." Another way to think of this is that the majority of the scores are next to the average (mean) score. In other words, most students think Anthropology is going to be moderately difficult. This type of distribution is commonly referred to as a **bell curve** or **normal distribution**.



Ratings of Psychology are fairly normally distributed. Although there is a slight positive skew, suggesting that students on average think Psychology will be somewhat easy.

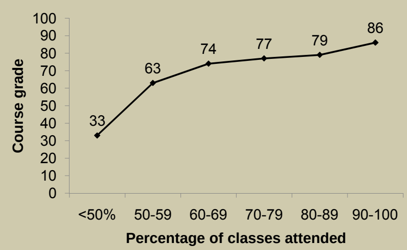
An example of highly skewed data



Most of my students are between 18 and 19, but the mean age of my students is around 21. That long "tail" of older ages pulls the mean to the right.

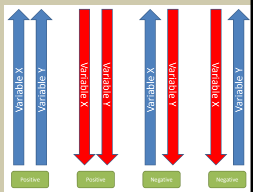
Correlational research

- Goal: to determine whether two or more variables are related (i.e., "go" together)
  - e.g., does attendance correlate with grades?



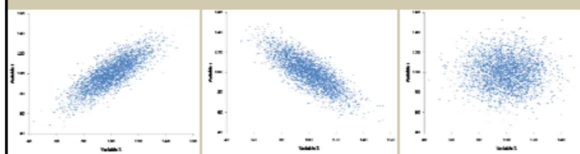
Positive and negative correlations

- Positive correlation: as one variable gets bigger another variable simultaneously gets bigger (i.e., they get bigger together); OR as one variable gets smaller another variable simultaneously gets smaller (i.e., they get smaller together)
- Negative correlation: as one variable gets bigger (or smaller) another variable goes in the opposite direction
- *Variables that are positively correlated "move" in the same direction; variables that are negatively correlated "move" in the opposite direction*



Visualizing correlated data

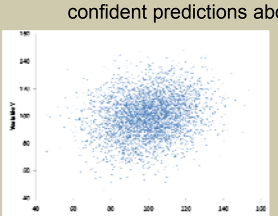
- A **scatterplot** is a common way to see a correlation between two variables.

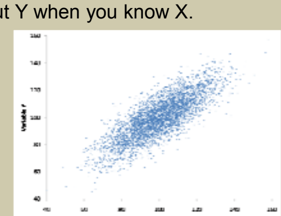


positive negative null (zero)

Correlational strength

- Correlation strength: how tightly the data cluster together on a scatter plot.
- Stronger correlations allow you to make more precise and confident predictions about Y when you know X.



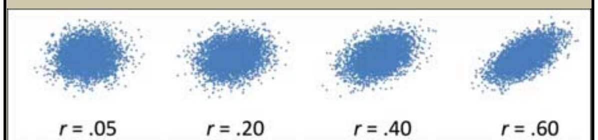


Correlation coefficient (*r*)

- Allows us to express correlation as a number
- All correlation coefficients contain two completely separate pieces of information: direction and strength
- Direction: denoted by the sign of the correlation (+ or -)
  - + = positive correlation; - = negative correlation
  - If no sign, assume it is positive
- Strength: denoted by size of number (between 0 and 1)
- Which correlation is stronger: r = -.71 or r = +.26?

Correlation coefficient (*r*)

- Four scatterplots of data ranging in strength from r = .05 (“trivial”) to r = .60 (“large”)



Note that there are no signs, which is typical of how positive correlations are reported.

- Stronger correlations allow you to make more precise predictions about Y when you know X.

Correlation and causation

- Ice cream sales are positively correlated with violent crime rates.
- What is the meaning of this correlation?
- A. Ice cream sales cause people to be more violent
- B. Being violent makes people crave ice cream
- C. Ice cream sales and violent crime rates are **spuriously** correlated
  - Spurious correlation: No direct causal link between X and Y. They are only correlated because both are being caused by some additional **third variable** (Z).
  - Z = Temperature?

Correlation and causation

- Because you cannot rule out any of the possible meanings, we have a saying when it comes to correlational research:
- CORRELATION DOES NOT PROVE CAUSATION
- Correlation is necessary to establish causation: one variable cannot cause another if it’s not even correlated with it.
- But correlation is not sufficient by itself to establish causation.

Experimental research

- Goal: to determine whether one variable causes another
  - e.g., does attendance cause students to do better in class?
  - I know though previous research that attendance correlates with grades at about, r = .65. What does this mean?
  - 1. Attendance causes students to do better in class
  - 2. Better grades cause students to attend class more (this doesn’t make sense without a time machine so we can eliminate it)
  - 3. Some other variable is causing Attendance and Grades (Z = intelligence, maturity, responsibility, fewer outside responsibilities, etc.)
- Let’s do a study that definitely tests meaning #1.

Independent variable

- All experiments will involve at least one **manipulation**.
  - Manipulation: a change made to a variable by the experimenter
- We always manipulate the **independent variable** (IV).
  - IV: the variable that we hypothesizes causes the other variable
- Best way to manipulate IV is to determine how you want it to vary and then **randomly assign** participants to each level of the variable.
- How do we want attendance to vary? 2 levels (high versus low attendance), 3 levels (high versus medium versus low), etc.

Independent variable

- Attendance: 4 levels
  - Perfect (100%)
  - Good (90%)
  - OK (80%)
  - Poor (70%)
  - How? Create 4 syllabi. Each syllabus is exactly the same except for when it comes to the class schedule. For the "good level" randomly cancel 10% of the class meetings, and so forth.
- Say we have 100 students in class (N = 100). We have to randomly assign ~25 students to each group.
  - If you think attendance is important, hope you don't get assigned to the "poor" condition by chance!

Random assignment is a wonderful thing!

- Because you randomly put participants into each of the four groups, we can be confident that participants in each groups are on average the same at the start of the experiment.

Variable	Perfect	Good	OK	Poor
IQ	112	115	111	114
Work	11.3 hrs/week	12.1	10.9	11.5
Age	20.2	19.3	19.7	20.4
Gender	71% women	66%	68%	69%
Attendance (IV)	100%	90%	80%	70%

Note: Not only does random assignment make certain that groups are equivalent in terms of these variables—it ensures that groups are equivalent on **ALL** variables, except the IV (i.e., attendance). Random assignment controls for all 3rd variables and makes the IV truly independent.

Dependent variable

- **Dependent variables** (DV) are always measured and are the variables that we hypothesized are caused by the IV.
  - In other words, changes in the DV are hypothesized to be *dependent* upon changes that we make to the IV.
- DV: Class grade (0-100% scale, calculated based on average of 5 exams given throughout semester).

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Results

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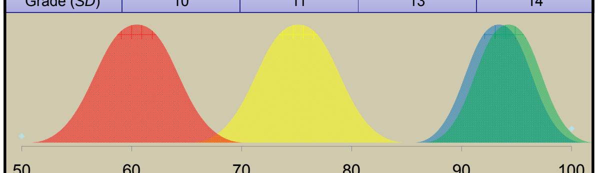
Attendance (IV)	100%	90%	80%	70%
Grade (*M*)	94	93	75	61
Grade (*SD*)	10	11	15	17

Results

Variable	Perfect	Good	OK	Poor
Grade (*M*)	94	93	75	61
Grade (*SD*)	10	11	13	14



Comparisons
Perfect vs. Good = no difference
Good/Perfect vs. OK/Poor = significant difference
OK vs. Poor = significant difference

It's OK to miss a couple classes. Beyond that and attendance starts to really hurt grades.

Confounds

- **Confound:** anything that causes confusion in terms of what the results of a study might mean
  - Causal meaning of correlational studies is confounded by lack of random assignment
  - Experimental research can also be confounded.
    - Experimenter bias: Did I teach my class differently on days when I knew students would be missing?
    - Placebo effect: Were students aware of which group they were in? Did this make students in the "perfect" condition especially confident; did it make students in the "poor" condition especially anxious?
    - Demand characteristics: Did students in "poor" condition do poorly just to make me (the experimenter) happy; did they do just the opposite just to make me angry?
  - A lot of these problems can be alleviated with a **double-blind placebo control** research design.