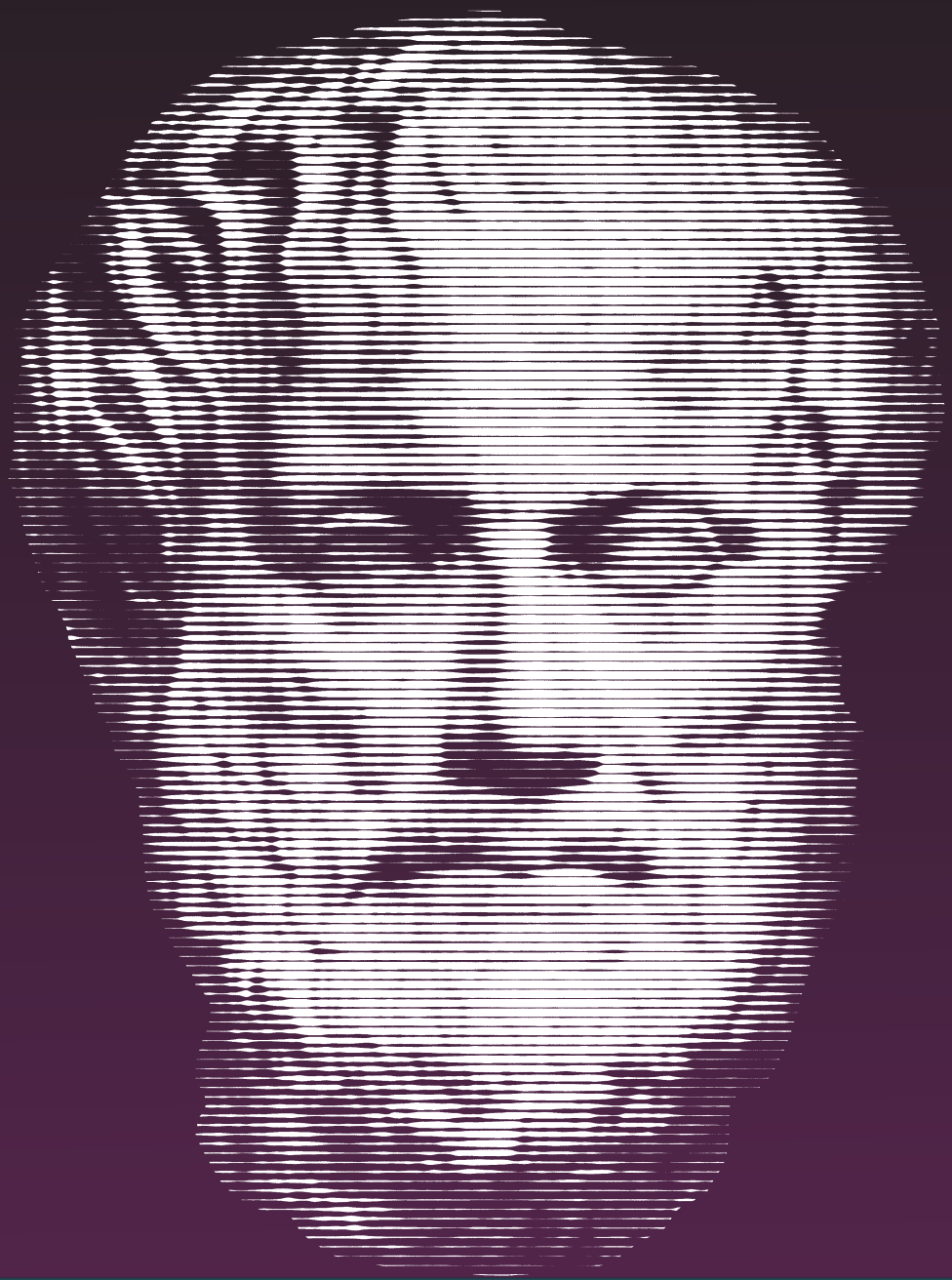
JREF

JAMES RANDI EDUCATIONAL FOUNDATION

JREF IN THE CLASSROOM MODULE 006 / v 1.0 / 07/2013

Cognition: Are You Rational?

COGNITION: ARE YOU RATIONAL?



TEACHER EDITION

IMPORTANT NOTE TO TEACHERS

The first section of this module is a quiz of sorts, comprised of examples of the kinds of tasks that have helped researchers discover common patterns in human thought processes. The tasks are designed to show students how the human brain can resort to flawed reasoning, so the majority of students will get most of the answers wrong.

One primary goal of this module is to compel students to face these human flaws and to be humbled by the knowledge that nobody is perfect. Only when people have accepted that their thought processes might mislead can they learn to compensate for those human shortcomings and adopt less subjective strategies for making decisions and solving problems.

Toward that goal, we recommend that you ask students to complete the quiz immediately after you distribute the booklet. As you progress through the lesson, students will then have the answers they gave before they were told the correct answers. This is usually a convincing demonstration that they are as human as everyone else.

In addition, you may wish to give the quiz at one class session, then collect and tally the students' answers before returning them. You can then show the distribution of answers for the class as you discuss each by adding them to a PowerPoint presentation.

about the JREF

The James Randi Educational Foundation is a not-for-profit organization founded in 1996. Its aim is to promote critical thinking by reaching out to the public and media with reliable information about paranormal and supernatural ideas.

The Foundation's goals include the following:

- Providing educational resources and grants to educators and students who are working to advance critical thinking and skepticism in their communities.
- Demonstrating to the public and the media, through educational seminars and workshops, the consequences of accepting paranormal and supernatural claims without sufficient evidence.
- Maintaining a comprehensive library of books, videos, journals, and archival resources which are available to the public online.
- Supporting local skeptical organizations by providing speakers, grants, promotional and educational resources, and training in grassroots organizing.
- Supporting and conducting scientific research into paranormal claims and publishing the findings online and in skeptic periodicals.

To raise public awareness of these issues, the Foundation offers a $1 Million prize to any person or persons who can demonstrate psychic, supernatural, or paranormal ability of any kind under mutually agreed upon scientific conditions.

SUPPORTING THE WORK OF THE JAMES RANDI EDUCATIONAL FOUNDATION

The James Randi Educational Foundation relies on the support of people like you in order to carry out its mission. Whether it is our support of grassroots skeptic outreach, our investment in resources for educators and students, our expanding digital educational offerings, or our speaking engagements, which promote skepticism with top thinkers around the world, your financial support makes our programs possible.

You may support the JREF through a charitable donation and by becoming a member at randi.org. You can ensure that your support is most effective in promoting skepticism for years to come by making a pledge of monthly support. For more information about pledges, please contact us at development@randi.org or (213) 293-3092.

* Donations are tax deductible for U.S. residents to the full extent of the law.

This module from the James Randi Educational Foundation explores some of the many errors that human beings are prone to make when evaluating information and making decisions. It discusses explanations for those errors, which are consistent with the scientific literature of the field.

The module is designed to prompt students to consider the implications of errors in thinking and to critically examine their own views of images and events in a way that promotes open-minded inquiry of current knowledge. Open-mindedness, in terms of one's ability to accept that current knowledge may be inaccurate, has been shown to be a key component of good reasoning.

GRADE LEVEL AND TIME COMMITMENT

The text in this module was written for students in Grade Nine and above. Teachers are encouraged to modify the exercises for use in lower grades.

The time required to complete this module will vary with depth of instruction and specific assignments given.

NATIONAL SCIENCE STANDARDS

Unifying Concepts and Processes

Science as Inquiry

Science in Personal and Social Perspectives

AAAS SCIENCE LITERACY BENCHMARKS

The Scientific Worldview

Scientific Inquiry

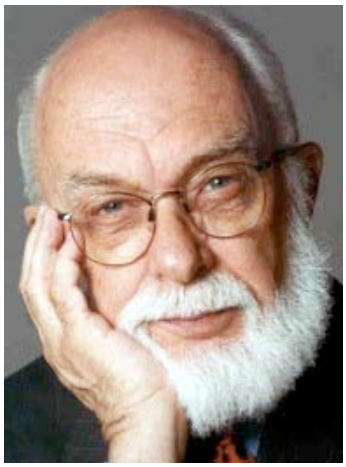
The Scientific Enterprise

ACKNOWLEDGEMENTS

This module was developed by Barbara Drescher with the assistance of James Randi, D.J. Grothe, Thomas Donnelly, and Ed Clint. Our education advisory panel is: Daniel Loxton, Michael McCrae, Chip Denman, Kylie Sturgess, Bob Blaskiewicz, and Matt Lowry.

Some of the text in this module is adapted from other JREF educational materials.

to the **reader . . .**

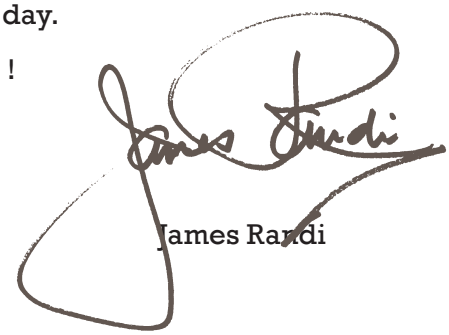


R U Rational? Most of us are convinced that we're good enough thinkers to make our way through life without much help in that direction, but some of the most of us are quite wrong in that assumption. Now, please take my advice: read the questions that are presented to you, go through this text paragraph by paragraph, think about them and answer them to the best of your ability. BUT DON'T LOOK AHEAD! If you were to do that, you'd lose some of the value of this module, which was carefully designed to teach you how to answer that question . . .

I confess, I can't play the piano. Does that mean that I'm stupid? Now, I may actually be stupid, but not because I don't play the piano. That's simply a talent that I never pursued, though I assure you that I can do some nifty card tricks . . . ! Everyone has their spectrum of abilities and interests, each person chooses what they prefer to know, but being rational is something that's available to everyone, if they work for it.

This module just might take more of your attention than you're accustomed to giving to a subject, but I assure you that the end result will be very much worth it to you. Some of the questions posed here are, I agree, pretty tough. Please stay with them, study them, and apply them to how you think about the world. If you're given—through this lesson from the JREF—even a small advantage in answering such a challenging question, we will have reached the goal we sought. The basic intention we have is to teach our students some things that are not normally handled in the educational systems that we so very much need to be equipped to face the world. My wish is that you will emerge from this experience just a little smarter, a bit better equipped to think about your surroundings, the people you meet, and what you're asked to consider in advertising, in politics, and in so many other ways, every moment of every day.

Enjoy the adventure . . . !



James Randi

are you **rational?**

Please read the following instructions very carefully. They will help you answer the questions.

The following "quiz" does not test your knowledge, your language skills, or your math abilities. For some of the questions, there are no wrong or right answers, but you will learn that people show a preference for some answers for interesting reasons. Nobody will grade you; it is primarily for your use. There are no "trick" questions. If an answer seems obvious to you, it is usually the best one to give. When the answer you would like to give is not an option (e.g., you must answer either "yes" or "no" when you would like to answer "maybe"), you must choose the answer that is closest to what you think or feel.

You will have a chance to compare your answers to the answers given by others, so it is important that you consider each question, but do not spend too much time thinking about any one of them. Try not to think about what other things you may know, but consider only the information included in each question. Pay close attention to instructions that are underlined; they are important.

1. **Which are there more of in the English language, words that begin with the letter r or words in which the 3rd letter is r?**
   a. Begin with r
   b. 3rd letter is r
   c. About the same

2. **Do you think there are more murders in the United States each year or more suicides?**
   a. There are more murders than suicides.
   b. There are more suicides than murders.
   c. The number of murders and suicides is about the same.

3. **It is Friday, and the National Weather Service Forecast says that there is a 25% chance of rain on Saturday and a 75% chance of rain on Sunday. What is the probability that it will rain this weekend? Choose the answer that is closest to yours.**
   a. Less than 25%
   b. About 25%
   c. About 50%
   d. About 75%
   e. Between 75 and 99%
   f. 100%

4. **Brad is a 38-year-old single man who enjoys driving an expensive sports car and attends a lot of dinner parties. He likes to argue and has a large ego. Which of the following is most likely?**
   - ❑ Brad has blue eyes.
   - ❑ Brad was an engineering major in college.
   - ❑ Brad is funny.
   - ❑ Brad has blue eyes and is a lawyer.
   - ❑ Brad is funny and a teacher.

5. **Cheryl is a 37-year-old woman who loves to bake. She drives a mini-van in the carpool at her children's school. Which of the following options is most likely to also be true? Choose one.**
   - ❑ Cheryl is a stay-at-home mom and her kids play soccer.
   - ❑ Cheryl is an actress.
   - ❑ Cheryl is a stay-at-home mom.
   - ❑ Cheryl takes self-defense classes.
   - ❑ Cheryl's children play soccer.
   - ❑ Cheryl is a gymnast and takes self-defense classes.
   - ❑ Cheryl is an actress and has served in the Peace Corps.
   - ❑ Cheryl is a gymnast.

6 through 9:
A syllogism is an argument that usually involves three statements: two premises which lead to one conclusion. The following is an example:

Premise: All men are mortal.

Premise: Socrates is a man.

Conclusion: Therefore, Socrates is mortal.

A valid argument is one in which the conclusion logically follows from the premises (the example above is valid). Whether the premises are true or false is not relevant; it should not be considered in your decision about the argument's validity. In addition, only the information given may be considered. Likewise, an invalid argument is one in which the conclusion does not logically follow from the premises. Whether the conclusion is true is irrelevant.

FOR EACH OF THE FOLLOWING, INDICATE WHETHER THE ARGUMENT IS VALID OR INVALID.

6. **All of the students are tired.**
   Some tired people are irritable.
   Therefore, some of the students are irritable.
   - ❑ Valid ❑ Invalid

7. **If Lisa auditions for American Idol, she will win.**
   Lisa did not win American Idol.
   Therefore, she did not audition.
   - ❑ Valid ❑ Invalid

8. **If this movie is not about horses, then I will watch it.**
   This movie is about horses.
   Therefore, I will not watch it.
   ❑ Valid ❑ Invalid

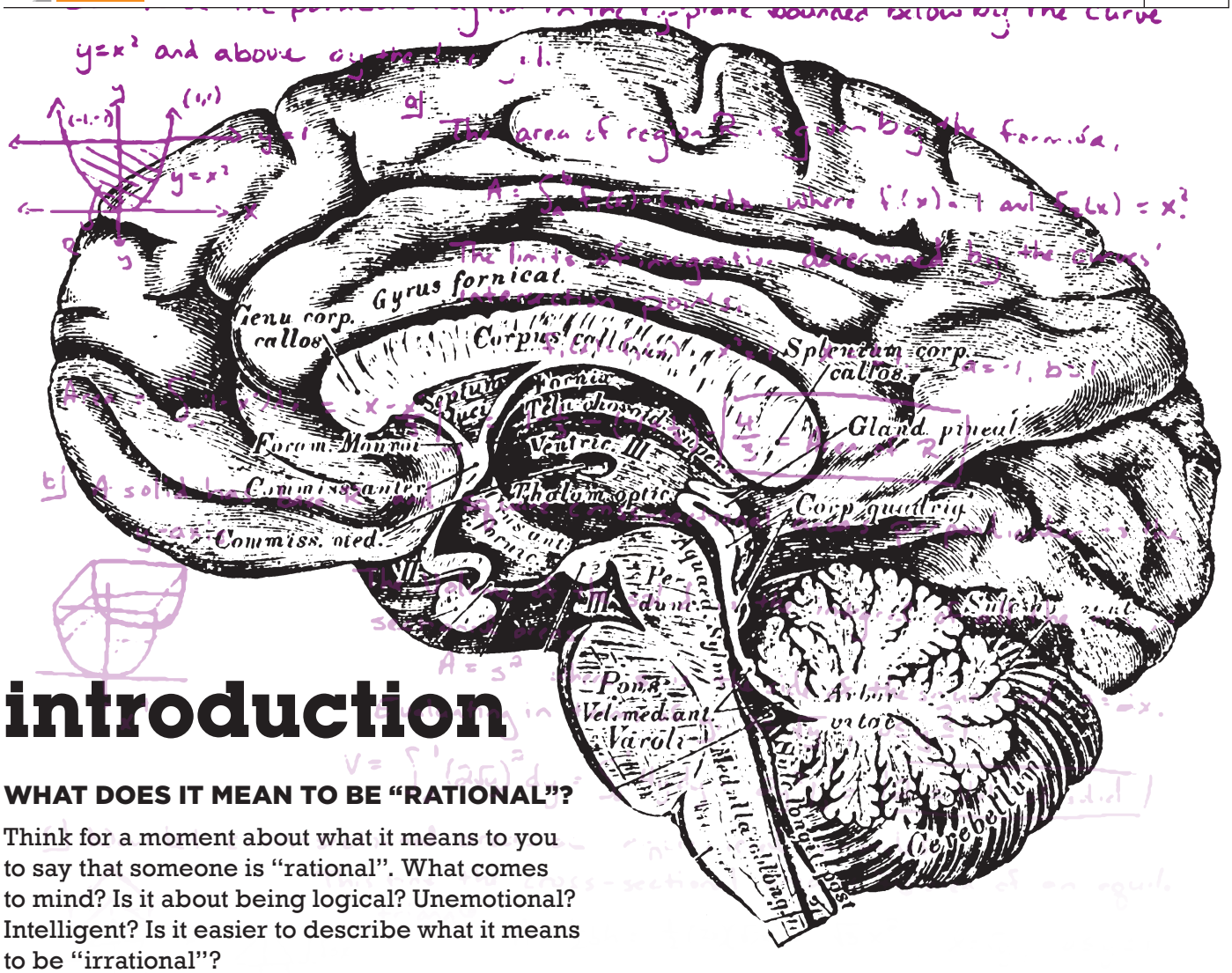
9. **All dogs have four legs.**
   Daisy is a dog.
   Therefore, Daisy has four legs.
   ❑ Valid ❑ Invalid

10. **Imagine that you are a graduate student who has just taken a tough qualifying examination (that you must retake in 2 months if you did not pass). It is the end of the semester, you feel tired and run down, and the results of the exam will not be out for 2 days. You now have the opportunity to purchase a very attractive 5-day winter break travel package to a place you would like to go (e.g., Hawaii) at an exceptionally low price. The special offer expires tomorrow. What would you do?**
    a. Buy the vacation package.
    b. Not buy the vacation package.
    c. Pay a $20 nonrefundable fee to extend the offer for 3 days.

11. **According to a comprehensive study by the U.S. Department of Transportation, a particular German car is 8 times more likely than a typical family car to kill occupants of another car in a crash. The department is considering a ban on the sale of this German car. Do you agree that the U.S. should ban the sale of this car?**
    a. Strongly agree (ban the sale of this car)
    b. Somewhat agree
    c. Somewhat disagree
    d. Strongly disagree (do not ban)

12. **How would you rate your leadership skills compared to your classmates or peers?**
    a. In the top 25% (1/4th)
    b. Above average, but not top 25%
    c. Below average, but not bottom 25%
    d. In the bottom 25%

13. **Compared to your classmates or peers, where do you think your GPA (the last overall GPA recorded) stands?**
    a. In the top 25% (1/4th)
    b. Above average, but not top 25%
    c. Below average, but not bottom 25%
    d. In the bottom 25%



introduction

WHAT DOES IT MEAN TO BE "RATIONAL"?

Think for a moment about what it means to you to say that someone is "rational". What comes to mind? Is it about being logical? Unemotional? Intelligent? Is it easier to describe what it means to be "irrational"?

It may be difficult to put into words. Psychologists have even argued about what is and is not "rational". The definition psychologists use today can be summarized as a process of good reasoning to come to the most logical conclusion, make the best choice, or take the most appropriate action.

HOW RATIONAL ARE HUMAN BEINGS?

Those who study and talk about the way people think often say that human beings are naturally irrational. This viewpoint itself is not very rational because it is the result of something called the **Availability Heuristic.**

As you will learn in this module, people use a number of rules of thumb, called **heuristics**, to draw conclusions and make decisions. These rules are based on past experience. One of these rules is that if we observe something often, it probably occurs often. When it is easy to think of an example, we think that means that it is common. So, people who study rationality tend to focus on mistakes, so they are likely to think that human beings are pretty bad at reasoning in general.

But human beings are actually capable of being rational most of the time. If we were not, we would not be able to tell when a choice or action is irrational. In recent years, scientists have learned that some people are consistently more rational than others and nobody is rational all of the time.

WHY ARE WE NOT ALWAYS RATIONAL?

If we are almost always capable of rationality, and if it leads us to the best answers, why are we not always rational? To answer this, we need to consider how we learn, make decisions, and draw conclusions.

VALUES AND GOALS

For every choice we make, there is a goal to consider. For example, when we choose what to wear each day, we consider things like the weather and where we are going that day. Let's say you have a pair of shoes that you love, but they aren't very comfortable. If it is more important to you to be comfortable that day than it is to look fabulous, you will choose a different pair of shoes.

Our goals and values play an important role in how we draw conclusions, too. Imagine, for example, that a politician has been accused of gambling with campaign funds. If you voted for the man, you are more likely to be skeptical of his guilt than if you voted for his opponent.

A preference for one outcome over another is called a bias. Biases are tendencies, not certain behaviors. For example, let's say you take your seat in English class only to find that someone has put a slice of cake on it, so your pants are now covered in cake and icing. Your best friend says that the person behind you put it there, but the person behind you says that your best friend is the culprit. Whom do you believe? There is no evidence to help you decide, yet most people in this situation will believe their friend. This tendency is a bias.

It is important to note that "bias" does not describe a certain behavior. Using our example, if your best friend is known as a prankster, you might very well believe the person behind you over that friend.

BEING RATIONAL TAKES ENERGY

Being rational sometimes requires extra work on our part. It can take more time and more energy. Often, the negative consequences of an irrational choice are not serious enough to spend the energy needed to be certain that we are making the best choice, so we take short cuts. Most of the time, we allow heuristics (rules of thumb) and biases (preferences) to help us decide.

WE LEARN FROM THE PAST

Most of what we know about the way the world works is learned through experience. Learning from experience means that we tend to expect that what happened in the past is what will happen in the future and is what is happening now. This leads us to resist information that does not fit with what we think is true.

Next, let's take a closer look at some of the heuristics and biases that are most common.

ASK...

What is the "best" choice? Is it the choice that makes you the most happy? Is it the choice that is best for your well-being? Choices are not always about us, so is it the best choice for all?

For example, imagine that someone has tied five people to a railroad track and a train is coming. The train will definitely kill the people on the track because the conductor cannot see them and does not have time to stop, anyway. You could flip a switch in front of you and divert the train to another track, but there is a worker on that track and you cannot warn him. If you flip the switch, the train will definitely hit and kill the worker. If you do nothing, the five people tied to the track will die. What is the best choice? Is it also the most rational choice? Is it the choice that you would make?

estimating **probabilities**

AVAILABILITY HEURISTIC

In 1973, psychologists Amos Tversky and Daniel Kahneman[1] asked participants a question very similar to the first in the quiz at the front of this booklet: "Which is more prevalent, words that begin with the letter k, or words in which k is the third letter?" Most chose the first, overestimating the frequency of words that start with k. This also occurred with letters such as r and n even though those letters (and k) appear much more frequently in the third position.

Tversky and Kahneman thought about how someone might answer such a question. They hypothesized that we probably try to think of examples. It is much easier to think of words that begin with these common letters than it is to think of words in which the letter is in the middle of the word, so we should not be surprised by the outcome.

This shortcut, which they called the Availability Heuristic, works well for us most of the time. The problem is that there are many reasons that it might be easy to think of examples. One of those reasons is that it is common, which is why the heuristic works. However, an event or instance that is more memorable, more emotional, reported more, or was experienced more recently than others may also be more easily brought to mind.

For example, people usually make mistakes when estimating the frequencies of causes of death. One of the questions you were asked was "Do you think there are more murders in the United States each year, or more suicides?" You may have been tempted to answer a or c because murders are reported in news media much more often than suicides. However, about twice as many people over the age of 10 commit suicide than are murdered in this country.

Emotion plays a role in this effect, too. We may be more afraid to fly than to drive because plane

ASK...

Do you think that politicians and actors are more likely to cheat on their spouses than others? Or could it be that you are more likely to hear about sex scandals and divorces among famous people? How do you think stereotypes about people are formed?

List the characteristics that you think of when you think about the following groups of people:

LAWYERS

GAMERS

PLUMBERS

SCIENTISTS

Where do you think your ideas about these groups came from? How might these stereotypes affect your judgments about people in different situations?

LAWYERS

GAMERS

PLUMBERS

SCIENTISTS

accidents are more dramatic and more reported. Murder and child abduction are some of our worst fears, so we tend to overestimate how common these things are.

REPRESENTATIVENESS HEURISTIC

There are several other mistakes that human beings make when estimating probabilities. One of these is related to confusion about how the probability of one event is related to the probability of another event. For example, what is the probability of drawing the Ace of Spades at random from a standard, 52-card deck? If you are familiar with cards, this task is simple. There is only one Ace of Spades, so the chances are 1 in 52. But the question takes a little more work to answer if it is framed a different way, such as, "If I draw one card at random, what is the probability that it will be both an ace and a spade?"

Doing the math, we must multiply the probability of drawing an ace, which is 4 in 52 (or 1 in 13) and the probability of drawing a spade, which is 1 in 4. The result is 1 in 52. In probability theory, each of these events is called a simple event. Placing "and" between them creates what we call a conjunction. The probability of the conjunction occurring is called a joint probability, (e.g., the joint probability of drawing an ace and a spade is 1 in 52).

These calculations become more complicated when the question is "What is the probability that the card will be an ace *or* a spade?" In that case, we must add the probabilities of each event, then subtract the joint probability. So the probability of drawing an ace or a spade is the following:

(1/13 + 1/4) - (1/13 x 1/4) = 17/52 – 1/52 = 16/52

Confusing? Think of it as frequencies instead. There are 13 spades (1/4 of the deck of 52) and there are 4 aces. That adds up to 17 possible cards that fit the criteria, right? Except that one of the aces is also a spade, so we have counted it twice. If we only count it once, we can see that there are 16 cards in the deck of 52 which would fit the criteria. If we actually took a deck of cards, pulled out all of the aces and spades, then counted them, we probably wouldn't make any mistakes at all.

So you can see that we are much better at this when questions are worded in ways that suggest counting instead of calculating.

For example, remember this question from the quiz: ***It is Friday, and the National Weather Service Forecast says that there is a 25% chance of rain on Saturday and a 75% chance of rain on Sunday. What is the probability that it will rain this weekend?***

The answers to these kinds of questions usually depend on where you live and how weather is reported. Some people simply average the two values and come up with 50%. Others think of each day separately and decide if it will rain or not. On Saturday the chances are less than 50%, so it probably will not rain, but on Sunday it probably will, so averaging these leads to 50% as well, right? Here's the problem: If there is a 75% chance of rain on Sunday, the probability of rain at any time over the weekend cannot be less than 75% (it is actually about 81%).

How would you answer if the question was "What is the probability that it will rain on both Saturday and Sunday?" People tend to make the same mistake, trying to average the probabilities of the two events. However, if the probability that it will rain on Saturday is 25%, then the joint probability cannot be greater than 25%, even if rain on Sunday is certain. This is called the conjunction rule.

Even when people are aware of the rules of probability, they may make mistakes because they rely too much on heuristics. It was through conjunction rule errors that Tversky and Kahneman identified the Representativeness Heuristic in 1974[2]. They presented participants with what has become known as "The Linda Problem":

Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in antinuclear demonstrations.

They were then asked to identify which from a list of alternatives is most likely. The alternatives included the following:

Linda is a bank teller.

Linda is a bank teller and is active in the feminist movement.

"Linda is active in the feminist movement" was not among the options. As you can guess, most people (85%) chose the second of these alternatives. This occurred even though it is not possible for the joint probability to be greater than the simple probability that Linda is a bank teller. The event that Linda is a bank teller is similar to the event of rain on Saturday in the first question in this section.

Tversky and Kahneman hypothesized that people used a short cut (the Representativeness Heuristic) to answer the question. The description suggested that Linda was socially liberal and likely to be an activist. In other words, the description listed characteristics we expect to see together. It was representative of a feminist, at least a feminist of the 1970s. But by using this heuristic, the participants provided an answer that violates the conjunction rule.

Several alternative explanations for the effects have been suggested, including that participants thought the first option excluded the possibility that Linda was a feminist. Another plausible explanation is that people do not know the rules of probability. However, when these hypotheses were tested by Lauharatanahirun, Drescher, and Kang[3], even those trained in probability theory and reminded of the rule made conjunction errors. The desire to give an answer that makes sense seems to override the knowledge that such an answer cannot be correct.

Consider the two similar questions on the quiz. The first is similar to the Linda Problem: ***Brad is a 38-year-old single man who enjoys driving an expensive sports car and attends a lot of dinner parties. He likes to argue and has a large ego. Which of the following is most likely?***

Among the alternatives to choose from:

Brad has blue eyes.

Brad has blue eyes and is a lawyer.

If you are like most people, you probably chose the second option because the description paints a stereotypical lawyer. However, the second option cannot be more likely than the first.

Now, consider the second question: ***Cheryl is a 37-year-old woman who loves to bake. She drives a mini-van in the carpool at her children's school. Which of the following options is most likely to also be true?***

Among the alternatives were the following:

Cheryl is a stay-at-home mom.

Cheryl's children play soccer.

Cheryl is a stay-at-home mom and her kids play soccer.

If you are like most of the participants in the study by Lauharatanahirun, Drescher, and Kang[2], your answer was the third option, which violates the conjunction rule. The other two options do not violate the conjunction rule and both offer representativeness, but the third is *more* representative. Humans love knowledge because

ASK...

How would you test the claim that eating an onion cures headaches? How would you show that the headache probably didn't go away on its own? What steps could you take to ensure that it was eating an onion, and not eating anything at all that relieved the pain? Have you heard of "the placebo effect" (the expectation that the onion will work makes the pain go away)? How would you control for that?

ASK...

How did you answer this question on the quiz: **How would you rate your leadership skills, compared to your classmates or peers?**

Compare your answers to the answers of others. By definition, half of the class is below average. Did anyone rate themselves as below average?

What about the next question: Compared to your classmates or peers, where do you think your GPA (the last overall GPA recorded) stands?"

knowledge allows us to predict and control the world around us. The third option allows us to feel that we know more about Cheryl than we actually do.

DECIDING WHAT IS TRUE

Knowledge is the single most important thing we need to survive. We need to know what we can and cannot eat as well as where to find that food. We need to know what might harm us and what might help us. We learn a lot about the world from our own personal experiences, but our senses can fool us. We also learn from what other people tell us, but how do we know that what they say is true?

For example, imagine you have a headache. Your friend says that eating onions cures headaches. They read it on the Internet, so it must be true, right? You're skeptical. How do you find out? If you are like most people, you will follow these steps:

1. Eat some onion.

2. Wait for your headache to go away.

If your headache remains several hours later, you can reasonably conclude that eating the onion did not cure your headache. It may cure some kinds of headaches and it may cure headaches in some people. It may even cure headaches if the conditions are right (e.g., if you drink enough water with it), but it certainly did not cure this headache. But what if your headache does go away? Can you conclude that eating the onion worked?

To most people, "I've seen it myself" is some of the best evidence. However, personal experience can be very misleading. The problem with this approach is that if the headache goes away, there are too many plausible explanations other than onions cure headaches. One is that a headache will often go away on its own if you wait long enough. Another is that low blood sugar was the cause of the headache and eating just about anything would have made it go away. Despite these other explanations, most people will accept that the onion was the cause because the outcome confirms what they already believe. That tendency is called the Confirmation Bias.

The Confirmation Bias is a set of behaviors that add up to favoring evidence and information that is consistent with what we already believe. It comes in many forms, but one of those forms involves how we test hypotheses.

Instead of trying to confirm the claim, you could have set up a test in which, if the headache goes away, the only thing that could have caused it was the onion. This is hard to do, but it is what people must do before they are allowed to sell a medication. It is also what scientists do to convince other scientists that their theories are correct.

JUDGING VALIDITY

To determine what is and is not true, we must usually consider the logic of the arguments people have used to try to convince us. We also must evaluate our own logic. We can practice that skill by evaluating simple arguments called syllogisms. A syllogism usually involves three statements: two premises which lead to one conclusion. For example:

Premise: All men are mortal.

Premise: Socrates is a man.

Conclusion: Therefore, Socrates is mortal.

This is called a categorical syllogism because it describes how members fit into categories. The strength of such an argument relies on two things: the strength of the premises. In the case above, we assume that the statement "All men are mortal" is true because it seems to be true, but we cannot know for certain as long as there are men still alive. We must also consider whether Socrates is a man, a dog, or a shovel.

The validity of the argument refers to the logical structure of the argument. An argument is valid if and only if the conclusion logically follows from the premises. It is extremely important to keep in mind that the validity of the argument has absolutely nothing to do with whether the premises are true.

If the premises are true and the argument is valid, then the conclusion must be true. If, however, one or more of the premises are not true, we cannot determine if the conclusion is true. Likewise, if the argument is not valid, we cannot determine if the conclusion is true. We cannot reject the conclusion, but we cannot accept it as true.

For example:

Premise: All dogs have four legs.

Premise: Daisy is a dog.

Conclusion: Therefore, Daisy has four legs.

The syllogism above is valid. We can judge its validity by drawing a diagram like the one below.

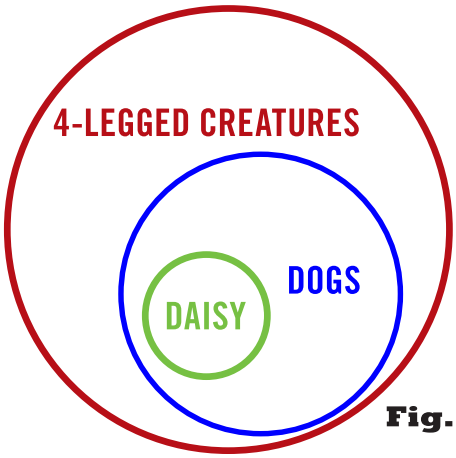


Fig. 1

The blue circle, which contains "dogs", is completely within the red circle, which defines "four-legged creatures". This illustrates the first premise. The second premise is illustrated by the green circle, representing Daisy, completely within the blue circle.

The test of validity involves determining if this diagram is consistent with the conclusion. The fact that "Daisy" is completely contained by "four-legged creatures" means that "Daisy has four legs" follows logically from the premises.

This syllogism is valid, yet many people judge it to be invalid because they know the premise that "All dogs have four legs" is not true. Some dogs have lost a limb and some are born with one or more legs missing.

You may be wondering why this is important, when knowing that a premise isn't true is enough to destroy the argument. It is important because we may not know whether a premise is true or not. It is also important because we are sometimes wrong. If we cannot judge the validity of an argument separately, we are likely to accept only those arguments in which the conclusion is consistent with our current beliefs—arguments that sound right.

For example:

Premise: All of the students are tired.

Premise: Some tired people are irritable.

Conclusion: Therefore, some of the students are irritable.

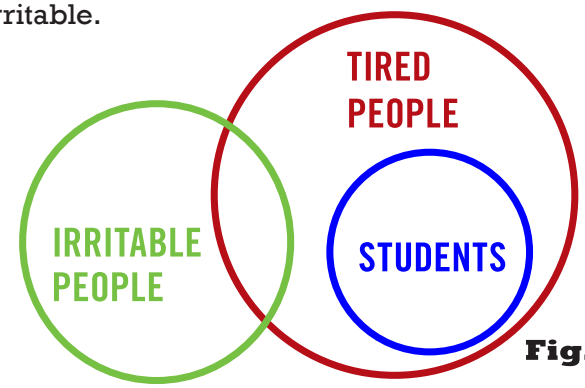


Fig. 2

This is a good example of an invalid argument that most people judge as valid. It appears valid because the premises and the conclusion are believable. The tendency to judge arguments as valid based on the content rather than the structure is called the Belief Bias[4].

The fact that the argument is invalid may be difficult to swallow, but if we draw a diagram **(Figure 2)**, we can see that it fails the test. The "students" circle is fully encompassed by "tired people", but the second premise only tells us that "tired people" and "irritable people" overlap. It does not tell us anything about whether "students" and "irritable people" share members.

Another way to see the lack of validity of this argument is to replace two of the subjects. Let's replace "students" with "dogs" and "irritable" with "cats":

Premise: All of the dogs are tired.

Premise: Some tired people are cats.

Conclusion: Therefore, some of the dogs are cats.

We have similar problems with conditional syllogisms, arguments that describe what might or will happen under specific conditions. In these cases, a major premise describes a conditional relationship (e.g., If A, then B) and a minor premise describes what has occurred. For example:

Major Premise: If Lisa auditions for American Idol, she will win.

Minor Premise: Lisa did not win American Idol.

Conclusion: Therefore, she did not audition.

This argument is similar to the one about Daisy, the dog, but you may be even more tempted to judge it as invalid. Of course, it is unreasonable to say that any specific American Idol contestant is guaranteed to win, but remember that validity does not rely on the content.

The next example is not a valid argument, but it feels like one.

Major Premise: If this movie is not about horses, then I will watch it.

Minor Premise: This movie is about horses.

Conclusion: Therefore, I will not watch it.

The conclusion does not logically follow because the major premise only tells us what will happen if the movie is not about horses.

Similarly, this next conditional syllogism is not valid.

Major Premise: If I study, I will get a good grade on the test.

Minor Premise: I got a good grade on the test

Conclusion: Therefore, I studied.

The major premise only tells us what must happen if one studies. It does not say that there is no other way to get a good grade on the test (e.g., it was an easy test).

The important thing to remember about these cases is that we must set aside our opinions about what's true in order to accurately judge whether an argument is valid. When we fail to do that, the Belief Bias can influence our judgment. We reason better when we set aside our beliefs and judge an argument on its own merit.

ASK...

Why do you think the Belief Bias is considered a form of Confirmation Bias? How might judging the logical structure of an argument using its content involve favoring what we already think is true?

making decisions

Good reasoning allows us to predict what may happen, determine risk, and decide what is or is not true. But good reasoning can also help us to make the best choices in everyday life. It can help us decide how to vote and what to buy.

JUSTIFICATION

In 1992, Tversky and Shafir[5] asked participants to answer a question very similar to this one (from the quiz in this booklet): ***Imagine that you are a graduate student who has just taken a tough qualifying examination (that you must retake in 2 months if you did not pass). It is the end of the semester, you feel tired and run down, and the results of the exam will not be out for 2 days. You now have the opportunity to purchase a very attractive 5-day winter break travel package to a place you would like to go (e.g., Hawaii) at an exceptionally low price. The special offer expires tomorrow. What would you do?***

a. Buy the vacation package.
b. Not buy the vacation package.
c. Pay a $20 nonrefundable fee to extend the offer for 3 days.

If you are like the majority of people, you chose option c, to postpone the purchase until you knew the outcome of the exam. What's interesting about this outcome is how it compares to the choices people made when the scenario was changed slightly.

Some of the participants in the study were asked what they would do if they just found out that they had passed the exam and others were asked what they would do if they had failed. In each case, when participants knew the outcome of the exam, two-thirds chose option a, to buy the vacation package. Presumably, if they'd passed, the vacation would be a deserved celebration. If they'd failed, it would be an opportunity to recharge before hitting the books again. But, if people were going to buy the vacation regardless of the outcome, why did two-thirds of the participants with the original question choose to postpone?

Apparently, most people feel the need to justify their choices. Marketers sometimes use this to their advantage by offering sales and coupons, which appear to be special deals. These are really an opportunity for the consumer to justify purchases they might otherwise not make (e.g., "I didn't really need two, but the second was half-price, so I saved money.")

MYSIDE BIAS AND OVERCONFIDENCE

Our values and preferences affect the decisions we make in ways we aren't even aware of. We favor the groups to which we belong over other groups—our family, our school, our occupation, the city, state, or country in which we live. When we are asked to decide what is true, we are more likely to believe what provides the most positive picture of us. When we are asked to judge what is fair, we judge others more harshly than we judge ourselves and our group members.

West, Toplak, and Stanovich[6] asked participants the following question, which also appeared in the quiz in this booklet: ***According to a comprehensive study by the U.S. Department of Transportation, a particular German car is 8 times more likely than a typical family car to kill occupants of another car in a crash. The department is considering a ban on the sale of this German car. Do you agree that the U.S. should ban the sale of this car?***

Nearly 75% of participants thought that the car should be banned. By itself, that is not very interesting. However, when the tables were turned and the car was American, only about 50% of the participants thought that the Germans should ban it. This tendency is called the Myside Bias, and it is also considered a form of Confirmation Bias.

A form of this bias, the Self-Serving Bias, leads us to remember things about ourselves in a more favorable light than others. For example, most people rate themselves as "above average" in a number of areas, including intelligence, reasoning ability, academic performance, athletic performance, and appearance. For example, college students tend to report higher grades in high school than their records show.

The results of this bias are far-reaching. The Actor-Observer Effect occurs when we attribute our own errors and failures to situational factors, but we think the mistakes other people make are their fault. For example, if we trip while walking on a sidewalk, we are likely to blame cracks in the sidewalk. But if we see someone else trip, we assume that he or she is clumsy.

This bias also contributes to our failure to properly assess ourselves. For example, when people learn about heuristics and biases, many recognize how others are biased, but few recognize these biases in themselves. Humans tend to overestimate their own competence in most areas.

Dunning and Kruger[7] asked participants to rate their sense of humor in comparison to others. Then participants were asked to judge the humor of a number of jokes. The findings were enlightening. Even those whose performance on the judgment task was in the bottom 25% tended to rate themselves as above average. Only those who performed the best underestimated their competence. In general, the less competent people were, the more they overestimated. Dunning and Kruger called this "ignorance of incompetence".

This can be a serious problem, especially when combined with other effects. For example, Keenberg, Drescher, and Rashtian noticed that many students who complained about poor

grades tended to use poor study methods. They found that students with poor studying habits were more likely to attribute classroom performance to things outside of their control. They also felt more entitled.

In a nutshell, students with poor study habits do not believe their bad grades are accurate. They do not think that they need to change, and they feel entitled to continue to use those bad habits. This just leads to more bad grades.

The only way out of this cycle of incompetence is to recognize that one is not as competent as one thinks. But that requires competence, so it's a bit of a catch-22. What makes this problem even more difficult to overcome is that people really, really, really hate to be wrong. We don't like to admit to ourselves that we were wrong, and we don't like to admit it others. However, this stubbornness can sometimes make a world of difference.

THE GOOD NEWS

If this module has you worried about how irrational you might be, don't fret. There is a silver lining. Because of the way our brains work, we are able to do some amazing things, including recognize when we are not thinking clearly or rationally. When we slow down and think about how these heuristics and biases might affect our thought processes, we think more clearly and rationally.

What's more, today we know more about what keeps people from thinking rationally than ever before. Sometimes, knowing that we are biased is not enough. We must also be humble. Probably the most important thing that you can do to ensure good thinking is remain open to the possibility that your current beliefs are wrong. The best critical thinkers are those who really listen to opposing views with the goal of improving their own knowledge, not just win arguments.

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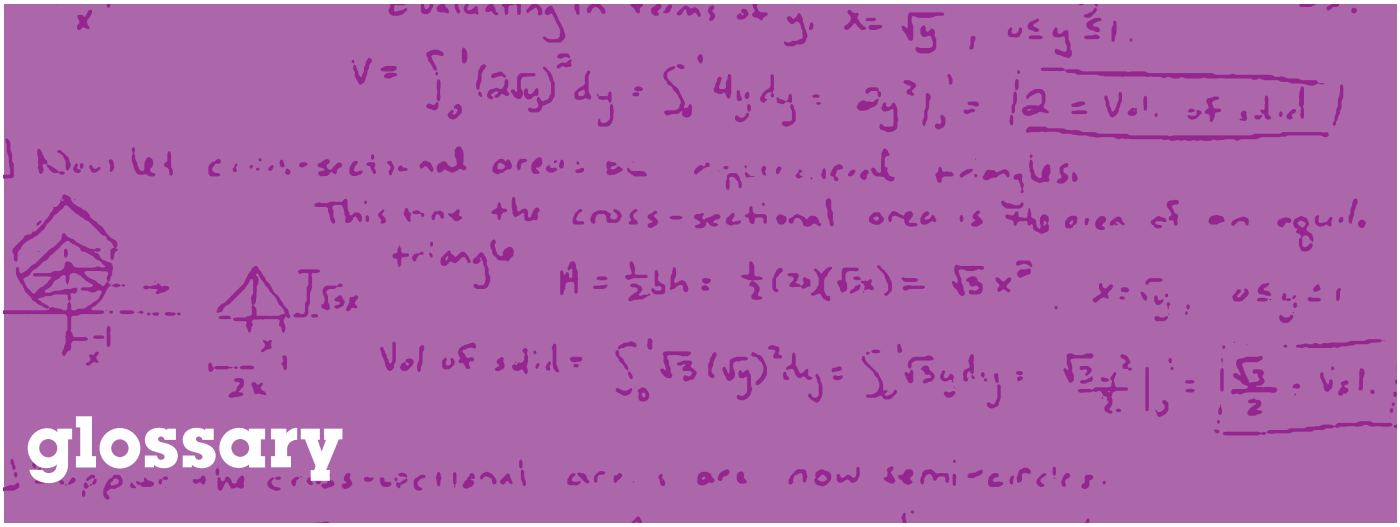

glossary

Actor-Observer Effect
The tendency to blame situations for one's own errors or failures, while attributing other people's mistakes to personal factors.

Availability Heuristic
The tendency to estimate how common something is by how easily these examples are brought to mind.

Belief Bias
The tendency to judge the validity of an argument by the believability of its conclusion or premises.
Categorical Syllogism:
A simple syllogism (argument) that describes the relationships among categories and members of categories.

Conditional Syllogism
A simple syllogism (argument) that describes what might or will happen under specific conditions.

Confirmation Bias
The tendency to favor (notice, remember, believe, give more weight to) information that confirms current beliefs.

Conjunction
The combination of two events. For example, if I flip a coin twice, the outcome of heads on the first flip and the outcome heads on the second flip is the conjunction of two simple events.

Conjunction Rule
The joint probability of two or more events cannot be greater than the probability of any simple event in the conjunction.

Heuristic
A rule of thumb (or short cut in thinking) based on experience.

Joint Probability
The probability that two or more events will occur. For example, if I flip a coin, the probability of landing on heads on the first flip is 1 in 2. The probability of landing on heads on the second flip is 1 in 2. The joint probability of landing on heads on both flips is 1 in 4.

Myside Bias
The tendency to favor choices and information related to one's self or one's current beliefs or opinions.

Representativeness Heuristic
People tend to estimate the probability that a case belongs in a category based on how much the case represents a category, ignoring other information.

Self-serving Bias
The tendency to remember, evaluate, and judge information about oneself in the best possible light.

Simple Event
A single outcome. For example, if I flip a coin twice, the probability of it landing on heads after the first flip is a simple event.

Syllogism
A simple argument, usually consisting of two premises and a conclusion.

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