Psychologists Andrew Whiten and Richard Byrne (1988) repeatedly saw one young baboon pretending to have been attacked by another as a tactic to get its mother to drive the other baboon away from its food.

Naturalistic observations are also done with humans. Here's one funny finding: We humans laugh 30 times more often in social situations than in solitary situations. (Have you noticed how seldom you laugh when alone?) And when we do laugh, 17 muscles contort our mouth and squeeze our eyes, and we emit a series of 75-millisecond vowellike sounds that are spaced about one-fifth of a second apart (Provine, 2001).

Naturalistic observation also enabled Robert Levine and Ara Norenzayan (1999) to compare the pace of life in 31 countries. By operationally defining *pace of life* as walking speed, the speed with which postal clerks completed a simple request, and the accuracy of public clocks, they concluded that life is fastest paced in Japan and Western Europe, and slower paced in economically less developed countries. People in colder climates also tend to live at a faster pace (and are more prone to die from heart disease). Naturalistic observation is often used to describe behavior. But this study, showing how pace of life is associated with culture and climate, illustrates how naturalistic observation can also be used with correlational research, our next topic.

REVIEW AND REFLECT

Description

The Case Study, the Survey, and Naturalistic Observation

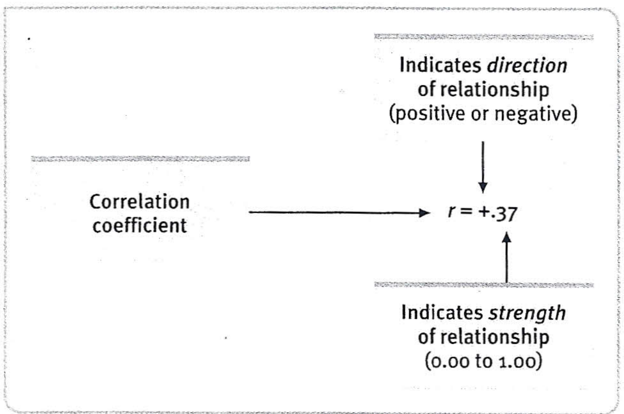
Through individual case studies, surveys among random samples of a population, and naturalistic observations, psychologists observe and describe behavior and mental processes. In generalizing from observations, remember: Representative samples are a better guide than vivid examples.

CHECK YOURSELF: What are the strengths and weaknesses of the three different methods psychologists use to describe behavior—case studies, surveys, and naturalistic observation?

ASK YOURSELF: Can you recall examples of misleading surveys you have experienced or read about? What principles for a good survey did they violate?

Answers to the Check Yourself questions can be found in the yellow appendix at the end of the book.

FIGURE 1.3
How to read a correlation coefficient



Correlation

Preview: Psychologists use numbers to describe the strength of a relationship expressed as a correlation. But they caution against illusory correlations and incorrectly inferring cause and effect.

Describing behavior is a first step toward predicting it. When surveys and naturalistic observations reveal that one trait or behavior accompanies another, we say the two *correlate.* The **correlation coefficient** is a statistical measure of relationship (**FIGURE 1.3**): It reveals how closely two things vary together and thus how well either one *predicts* the other. Knowing how much aptitude test scores *correlate* with school success tells us how well the scores *predict* school success.

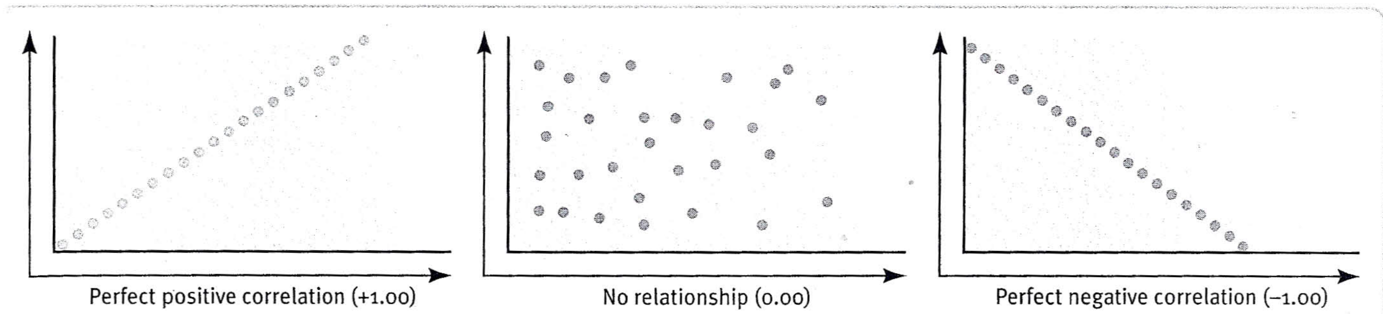


FIGURE 1.4
Scatterplots, showing patterns of correlation
Correlations can range from +1.00 (scores on one measure increase in direct proportion to scores on another) to –1.00 (scores on one measure decrease precisely as scores rise on the other).

Throughout this book we will often ask how strongly two things are related: How closely related are the personality scores of identical twins? How well do intelligence test scores predict achievement? How often does stress lead to disease?

FIGURE 1.4 illustrates perfect positive and negative correlations, which rarely occur in the "real world." These graphs are called **scatterplots**, because each point plots the value of two variables. A correlation's being negative has nothing to do with its strength or weakness; a negative correlation means two things relate inversely (one set of scores goes up as the other goes down). As toothbrushing goes up from zero, tooth decay goes down. A weak correlation, indicating little or no relationship, is one that has a coefficient near zero. A positive correlation means that one set of scores increases in direct proportion to the other set of scores' increase.

Statistics can help us see what the naked eye sometimes misses. To demonstrate this for yourself, try an imaginary project. Wondering if tall people are more or less easygoing, you collect two sets of scores: men's heights and men's temperaments. You measure the heights of 20 men, and have someone else independently assess their temperaments (from zero for extremely calm to 100 for highly reactive).

With all the relevant data (Table 1.1) right in front of you, can you tell whether there is (1) a positive correlation between height and reactive temperament, (2) very little or no correlation, or (3) a negative correlation?

Comparing the columns in Table 1.1, most people detect very little relationship between height and temperament. In fact, the correlation in this imaginary example is moderately positive, +0.63, as we can see if we display the data as a scatterplot. In **FIGURE 1.5** (page 32) the upward, oval-shaped slope of the cluster of points as one moves to the right shows that our two imaginary sets of scores (height and reactivity) tend to rise together.

If we fail to see a relationship when data are presented as systematically as in Table 1.1, how much less likely are we to notice them in everyday life? To see what is

TABLE 1.1

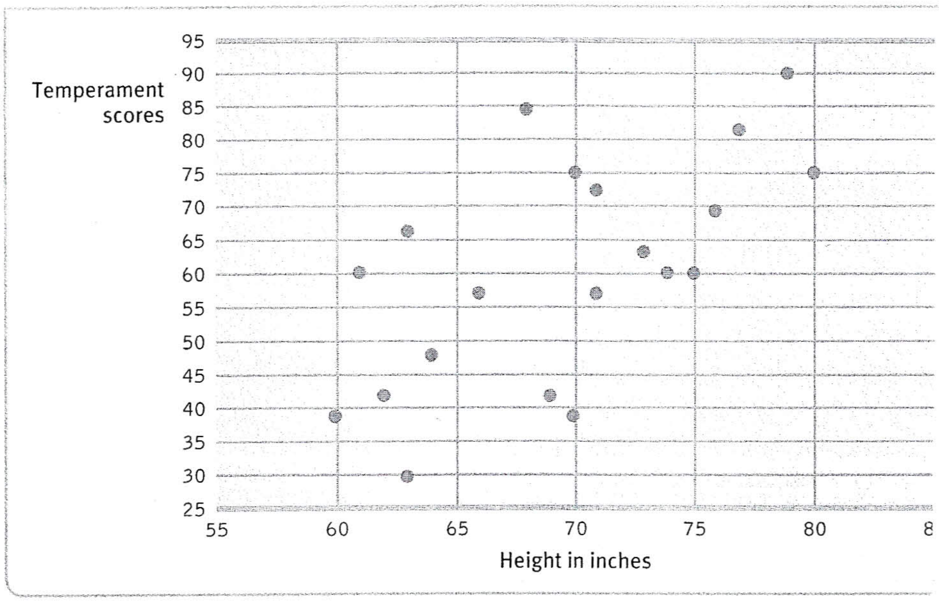
HEIGHT AND TEMPERAMENT OF 20 MEN

Subject	Height in Inches	Temperament
1	80	75
2	63	66
3	61	60
4	79	90
5	74	60
6	69	42
7	62	42
8	75	60
9	77	81
10	60	39
11	64	48
12	76	69
13	71	72
14	66	57
15	73	63
16	70	75
17	63	30
18	71	57
19	68	84
20	70	39

correlation coefficient a statistical measure of the extent to which two factors vary together, and thus of how well either factor predicts the other.

scatterplot a graphed cluster of dots, each of which represents the values of two variables. The slope of the points suggests the direction of the relationship between the two variables. The amount of scatter suggests the strength of the correlation (little scatter indicates high correlation). (Also called a *scattergram* or *scatter diagram*.)

FIGURE 1.5
Scatterplot for height and temperament
This display of data from 20 imagined people (each represented by a data point) reveals an upward slope, indicating a positive correlation. The considerable scatter of the data indicates the correlation is much lower than +1.0.

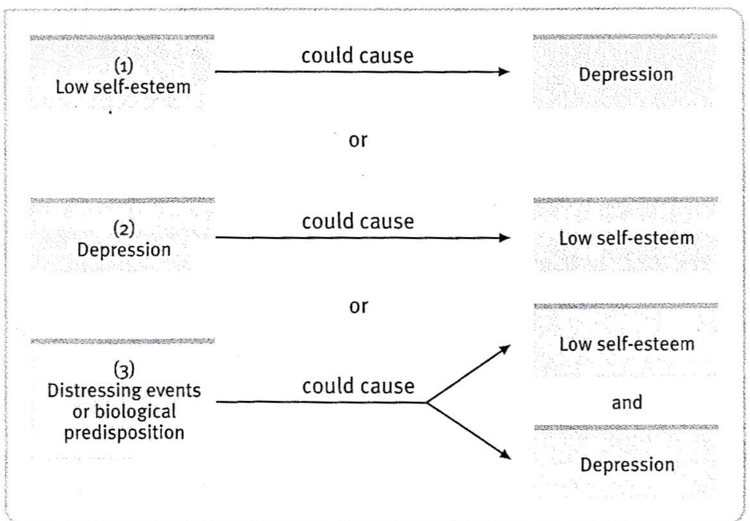


right in front of us, we sometimes need statistical illumination. We can easily see dence of gender discrimination when given statistically summarized information ab job level, seniority, performance, gender, and salary. But we often see no discriminat when the same information dribbles in, case by case (Twiss & others, 1989).

Though informative, psychology's correlations usually leave most of the va tion among individuals unpredicted. As we will see, there is a correlation betw parents' abusiveness and their children's later abusiveness when they become] ents. But this does not mean that most abused children become abusive. The corr tion simply indicates a statistical relationship: Although most abused children do grow into abusers, nonabused children are even less likely to become abusive.

The point to remember: Although the correlation coefficient tells us notl about cause and effect, it *can* help us see the world more clearly by revealing the tual extent to which two things relate.

FIGURE 1.6
Three possible cause-effect relationships
People low in self-esteem are more likely to report depression than are those high in self-esteem. One possible explanation of this negative correlation is that a bad self-image causes depressed feelings. But, as the diagram indicates, other cause-effect relationships are possible.



Correlation and Causation

We have seen that correlations, however imperfect, do help us predict and rest the illusions of our flawed intuition. Watching violence correlates with (and th fore predicts) aggression. But does that mean it *causes* gression? Does low self-esteem *cause* depression? If, b on the correlational evidence, you assume that they do, have much company. Among the most irresistible thin errors made both by laypeople and by professional psyc ogists is assuming that correlation proves causation. Bu matter how strong the relationship, it does not!

For example, what about the negative correlatior tween self-esteem and depression? Perhaps low self-est does cause depression. But as **FIGURE 1.6** suggests, we'(the same correlation of low self-esteem and depressic depression caused people to be down on themselves, something else—a third factor such as heredity or t chemistry—caused both low self-esteem and depres: Among men, length of marriage correlates positively hair loss—because both are associated with a third fa age. And people who wear hats are *more* likely to suffer skin cancer—because both are associated with fair-skinned people (who are vulnerable to skin cancer and more likely to wear protective hats).

This point is so important—so basic to thinking smarter with psychology—that it merits one more example, from a survey of 12,118 adolescents: The more teens feel loved by their parents, the less likely they are to behave in unhealthy ways—having early sex, smoking, abusing alcohol and drugs, exhibiting violence (Resnick & others, 1997). "Adults have a powerful effect on their children's behavior right through the high school years," gushed an Associated Press story on the study. But the correlation comes with no built-in cause-effect arrow. Thus, the AP could as well have said, "Well-behaved teens feel their parents' love and approval; out-of-bounds teens more often think their parents are disapproving jerks."

The point to remember: Correlation indicates the *possibility* of a cause-effect relationship, *but it does not prove causation*. Knowing that two events are correlated need not tell us anything about causation. Remember this principle and you will be wiser as you see reports of scientific studies in the news and in this book.

illusory correlation the perception of a relationship where none exists.

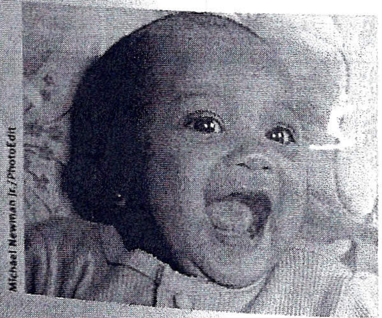
A *New York Times* writer reported a massive survey showing that "adolescents whose parents smoked were 50 percent more likely than children of nonsmokers to report having had sex." He concluded (would you agree?) that the survey indicated a causal effect—that "to reduce the chances that their children will become sexually active at an early age" parents might "quit smoking" (O'Neil, 2002).

Illusory Correlations

Correlations make visible the relationships that we might otherwise miss. They also restrain our "seeing" relationships that actually do not exist. A perceived nonexistent correlation is an **illusory correlation**. When we *believe* there is a relationship between two things, we are likely to *notice* and *recall* instances that confirm our belief (Trolier & Hamilton, 1986).

Illusory correlations help explain many a superstitious belief, such as the presumption that more babies are born when the moon is full or that infertile couples who adopt become more likely to conceive (Gilovich, 1991). Those who conceive after adopting capture our attention. We're less likely to notice those who adopt and never conceive, or those who conceive without adopting. In other words, illusory correlations occur when we over-rely on the top left cell of **FIGURE 1.7**, ignoring equally essential information in the other cells.

Such illusory thinking helps explain why for so many years people believed (and many still do) that sugar made children hyperactive, that getting cold and wet caused one to catch a cold, and that weather changes trigger arthritis pain. Physician Donald Redelmeier, working with Amos Tversky (1996; Kolata, 1996), a psychologist who specialized in "debugging human intuition," followed 18 arthritis patients for 15 months. The researchers recorded both the patients' pain reports and the daily weather—temperature, humidity, and barometric pressure. Despite patients' beliefs, the weather was uncorrelated with their discomfort, either on the same day or up to two days earlier or later. Shown columns of random numbers labeled "arthritis pain"



Michael Newman Jr./PhotoEdit

	Conceive	Do not conceive
Adopt	confirming evidence	disconfirming evidence
Do not adopt	disconfirming evidence	confirming evidence

FIGURE 1.7
Illusory correlation in everyday life Many people believe infertile couples become more likely to conceive a child after adopting a baby. This belief arises from their attention being drawn to such cases. The many couples who adopt without conceiving or conceive without adopting grab less attention. To determine whether there actually is a correlation between adoption and conception, we need data from all four cells in this figure. (From Gilovich, 1991)

and "barometric pressure," even college students saw a correlation where there was none. We are, it seems, very, very good at detecting patterns, whether they're there or not, and not so good at testing our hypotheses.

Because we are sensitive to dramatic or unusual events, we are especially likely to notice and remember the occurrence of two such events in sequence—say, a premonition of an unlikely phone call followed by the call. When the call does not follow the premonition, we are less likely to note and remember the nonevent.

Likewise, instances of positive-thinking people being cured of cancer impress those who believe that positive attitudes counter disease. But to assess whether positive thinking actually affects cancer, we need three more types of information. First, we need an estimate of how many positive thinkers were *not* cured. Then we need to know how many people with cancer were and were not cured among those not using positive thinking. Without these comparison figures, the positive examples of a few tell us nothing about the actual correlation between attitudes and disease. (Chapter 14 explores the effects of emotions on health and illness.)

The point to remember: When we notice random coincidences, we may forget that they are random and instead see them as correlated. Thus, we can easily deceive ourselves by seeing what is not there.

Perceiving Order in Random Events

Illusory correlations arise from our natural eagerness to make sense of our world—what poet Wallace Stevens called our "rage for order." Given even random data, we look for order, for meaningful patterns. And we usually find such, because *random sequences often don't look random.* Consider a random coin flip: If someone flipped a coin six times, which of the following sequences of heads (H) and tails (T) would be most likely: HHHTTT or HTTHTH or HHHHHH?

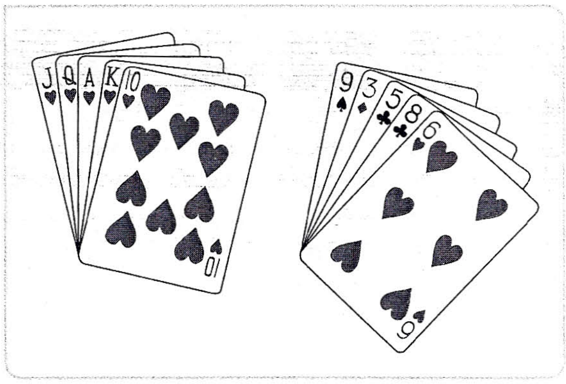


FIGURE 1.8
Two random sequences
Your chances of being dealt either of these hands is precisely the same: 1 in 2,598,960.

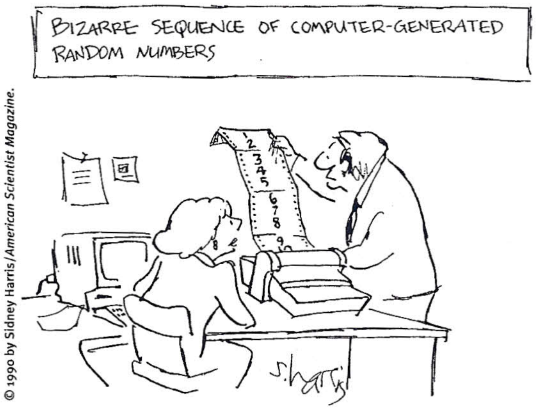
Daniel Kahneman and Amos Tversky (1972) found that most people believe HTTHTH would be the most likely random sequence. Actually, all are equally likely (or, you might say, equally unlikely) to occur. A bridge or poker hand of 10 through Ace, all of hearts, would seem extraordinary; actually, it would be no more or less likely than any other specific hand of cards (**FIGURE 1.8**).

Psychologists Thomas Holtgraves and James Skeel (1992) exposed people's perceptions of randomness in their bets placed in Indiana's Pick-3 Lottery. You can play, too: Pick any three-digit number from 0 to 999.

Did your number have a repeated digit (as in 525)? Probably not. Only 14 percent of 2.24 million number strings chosen in July 1991 had a repeated digit. Although repeated digits actually occur in 28 percent of the available numbers, such numbers *look* less random (and people prefer to bet random-looking series). In actual random sequences, seeming patterns and streaks (such as repeating digits) occur more often than people expect. Thus, shown random data, scientists and psychics alike can often "see" an interesting pattern (Guion, 1992). To demonstrate this phenomenon for myself (as you can do), I flipped a coin 51 times, with these results:

1. H	10. T	19. H	28. T	37. T	46. H
2. T	11. T	20. H	29. H	38. T	47. H
3. T	12. H	21. T	30. T	39. H	48. T
4. T	13. H	22. T	31. T	40. T	49. T
5. H	14. T	23. H	32. T	41. H	50. T
6. H	15. T	24. T	33. T	42. H	51. T
7. H	16. H	25. T	34. T	43. H	
8. T	17. T	26. T	35. T	44. H	
9. T	18. T	27. H	36. H	45. T	

Looking over the sequence, patterns jump out: Tosses 10 to 22 provided an almost perfect pattern of pairs of tails followed by pairs of heads. On tosses 30 to 38 I had a "cold hand," with only one head in eight tosses. But my fortunes immediately reversed with a "hot hand"—seven heads out of the next nine tosses.



Bizarre-looking, perhaps. But actually no more unlikely than any other number sequence.

What explains these patterns? Was I exercising some sort of paranormal control over my coin? Did I snap out of my tails funk and get in a heads groove? No such explanations are needed, for these are the sorts of streaks found in any random data. Comparing each toss to the next, 24 of the 50 comparisons yielded a changed result—just the sort of near 50-50 result we expect from coin tossing. Despite the seeming patterns in these data, the outcome of one toss gives no clue to the outcome of the next toss.

However, some happenings seem so extraordinary that we struggle to conceive an ordinary, chance-related explanation (as applies to our coin-tosses). In such cases, statisticians often are less mystified. When Evelyn Marie Adams won the New Jersey lottery *twice*, newspapers reported the odds of her feat as 1 in 17 trillion. Bizarre? Actually, 1 in 17 trillion are the odds that a given person who buys a single ticket for two New Jersey lotteries will win both times. But statisticians Stephen Samuels and George McCabe (1989) report that, given the millions of people who buy U.S. state lottery tickets, it was "practically a sure thing" that someday, somewhere, someone would hit a state jackpot twice. Indeed, say fellow statisticians Persi Diaconis and Frederick Mosteller (1989), "with a large enough sample, any outrageous thing is likely to happen." "The really unusual day would be one where nothing unusual happens," adds Diaconis (2002).

On the 2002 anniversary of 9/11, New York State's three-pick lottery numbers came up 9–1–1.

On March 11, 1998, Utah's Ernie and Lynn Carey gained three new grandchildren when three of their daughters gave birth—on the same day (*Los Angeles Times*, 1998).

We all experience events that make us feel astonished now and then. One day when my daughter bought two pairs of shoes, we later were astounded to discover that the two brand names were her first and last names. Checking out a photocopy counter from our library, I confused the clerk when giving him my six-digit department charge number—which just happened at that moment to be identical to the counter's one-in-a-million number on which the last user had finished. Ron Vachon was astounded while sitting among thousands of fans at a September 1990 baseball game in Boston. Oakland A's outfielder Rickey Henderson hit two foul balls right to him, on successive pitches. That something like that should have happened to Vachon (who dropped them both) was incredibly unlikely. That it sometime would happen to someone was not. An event that happens to but one in 1 billion people every day occurs about six times a day, 2000 times a year. (For two provocative instances of random sequences that don't look random, see Thinking Critically About Hot and Cold Streaks in Basketball and the Stock Market on page 36.)

Given enough random events, something weird will happen Evelyn Marie Adams was the beneficiary of one of those extraordinary, chance events when she won the New Jersey lottery a second time.

THINKING CRITICALLY ABOUT:

Hot and Cold Streaks in Basketball and the Stock Market

Misinterpreting random sequences is common in sports and investing. In both arenas, the statistical facts collide with commonsense intuition.

Basketball Players' "Hot Hands"

Every basketball player and every fan intuitively "knows" that players have hot and cold streaks. Players who have "hot hands" can't seem to miss. Those who have "cold" ones can't find the center of the hoop. When Thomas Gilovich, Robert Vallone, and Amos Tversky (1985) interviewed Philadelphia 76ers, the players estimated they were about 25 percent more likely to make a shot after they had just made one than after a miss. In one survey, 9 in 10 basketball fans agreed that a player "has a better chance of making a shot after having just *made* his last two or three shots than he does after having just *missed* his last two or three shots." Believing in shooting streaks, players will feed the ball to a teammate who has just made two or three shots in a row. Many coaches will bench the player who has just missed three in a row.

The only trouble is (believe it or not), it isn't true! When Gilovich and his collaborators studied detailed individual shooting records, they found that the 76ers—and the Boston Celtics, the New Jersey Nets, the New York Knicks, and Cornell University's men's and women's basketball players—were equally likely to score after a miss and after a basket. A typical 50 percent shooter averages 50 percent after just missing three shots, and 50 percent after just making three shots. It works with free throws, too. Celtics star Larry Bird made 88 percent of his free throws after making a free throw and 91 percent after missing. (Did this reduce Larry Bird to a mere puppet, manipulated by statistical laws? No, his skill was reflected in his 90 percent average.)

Why, then, do players and fans alike believe that players are more likely to score after scoring and to miss after missing? (The same phenomenon turns up in baseball, where the individual and team streaks and slumps that fascinate sportswriters are to be expected, given mere random variation [Myers, 2002].) It's because streaks do occur, more than people expect in random sequences. In any series of 20 shots by a 50 percent shooter (or any 20 flips of a coin), there is a 50-50 chance of 4 baskets (or heads) in a row, and it is quite possible that one person out of five will have a streak of 5 or 6. Players and fans notice these random streaks and so form the errant conclusion that "when you're hot, you're hot" (**Figure 1.9**).

Mutual Funds: Does Past Performance Predict Future Returns?

The same misinterpretation of random sequences occurs when investors believe that a mutual fund that has had a string of good years will likely outperform one that has had a string of bad years. Based on that assumption, investment magazines report mutual funds' performance. But, as economist Burton Malkiel (1989, 1995) documents, past performances of mutual funds do *not* predict their future performance. If on January 1 of each year since 1980 we had bought the previous year's top-performing funds, our hot funds would not have beaten the next year's market average. If we had put our money instead on the *Forbes* "Honor Roll" of funds each year for the two decades following 1975, we would have pulled in 13.5 percent (compared with the market's overall 14.9 percent annual return). Of the top 81 Canadian funds during 1994, 40 performed above average and 41 below average during 1995 (Chalmers, 1995).

When funds have streaks of several good or bad years, we may nevertheless think that past success predicts future success. "Randomness is a difficult notion for people to accept," notes Malkiel. "When events come in clusters and streaks, people look for explanations and patterns. They refuse to believe that such patterns—which frequently occur in random data—could equally well be derived from tossing a coin. So it is in the stock market as well."

The point to remember: When watching basketball, choosing stocks, or flipping coins, remember that our intuition often misleads us. Random sequences frequently don't look random. Expect streaks.

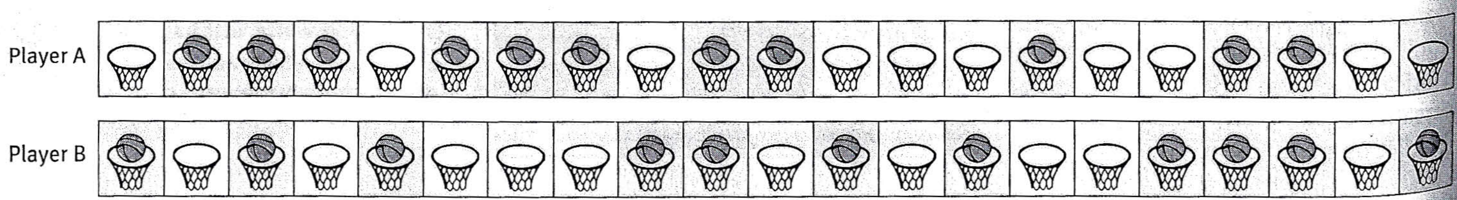


FIGURE 1.9
Who is the chance shooter?
Here are 21 consecutive shots, each scoring either a basket or a miss, by two players who each make 11. Within this sample of shots, which player's sequence looks more like what we would expect in a random sequence? (See page 39; adapted from Barry Ross, *Discover,* 1987.)

REVIEW AND REFLECT

Correlation

Correlation and Causation

The strength of the relationship between one factor and another is expressed as a number in their *correlation coefficient*. Scatterplots and the correlations they reveal help us to see relationships that the naked eye might miss. Knowing how closely two things are positively or negatively correlated tells us how much one predicts the other. But it is crucial to remember that correlation is a measure of relationship; it does not reveal cause and effect.

Illusory Correlations and Perceiving Order in Random Events

Correlations also help us to discount relationships that do not exist. Illusory correlations—random events we notice and assume are related—arise from our search for patterns.

CHECK YOURSELF: Here are some recently reported correlations, with interpretations drawn by journalists. Further research, often including experiments, has clarified cause and effect in each case. Knowing just these correlations, can you come up with other possible explanations for each of these?

a. Alcohol use is associated with violence. (One interpretation: Drinking triggers or unleashes aggressive behavior.)
b. Educated people live longer, on average, than less-educated people. (One interpretation: Education lengthens life and enhances health.)
c. Teens engaged in team sports are less likely than other teens to use drugs, smoke, have sex, carry weapons, and eat junk food less often than teens who do not engage in team sports. (One interpretation: Team sports encourage healthy living.)
d. Adolescents who frequently see smoking in movies are more likely to smoke. (One interpretation: Movie stars' behavior influences impressionable teens.)

ASK YOURSELF: Can you think of an example of correlational research that you recently heard about from a friend or on the news? Was an unwarranted conclusion drawn?

Answers to the Check Yourself questions can be found in the yellow appendix at the end of the book.

R. Sidney/The Image Works

Correlation need not mean causation Length of marriage correlates with hair loss in men. Does this mean that marriage causes men to lose their hair (or that balding men make better husbands)? In this case, as in many others, a third factor obviously explains the correlation: Golden anniversaries and baldness both accompany aging.

Experimentation

Preview: To discern cause and effect, psychologists experiment. In the typical experiment they randomly assign some people to experience a treatment of interest, while others have no such experience. Because the random assignment equalizes the groups at the outset, any later differences were probably caused by the experimental variable being tested.

Happy are they "who have been able to perceive the causes of things," remarked the Roman poet Virgil. We endlessly wonder and debate *why* we act as we do. Why do some people smoke? Have babies while they are still children? Do stupid things when drunk? Become troubled teens and open fire on their classmates? Though psychology cannot answer these questions directly, it has helped us to understand what influences drug use, sexual behaviors, thinking when drinking, and aggression.