

THE ASSOCIATIVE MACHINE

To begin your exploration of the surprising workings of System 1, look at the following words:

Bananas Vomit

A lot happened to you during the last second or two. You experienced some unpleasant images and memories. Your face twisted slightly in an expression of disgust, and you may have pushed this book imperceptibly farther away. Your heart rate increased, the hair on your arms rose a little, and your sweat glands were activated. In short, you responded to the disgusting word with an attenuated version of how you would react to the actual event. All of this was completely automatic, beyond your control.

There was no particular reason to do so, but your mind automatically assumed a temporal sequence and a causal connection between the words *bananas* and *vomit*, forming a sketchy scenario in which bananas caused the sickness. As a result, you are experiencing a temporary aversion to bananas (don't worry, it will pass). The state of your memory has changed in other ways: you are now unusually ready to recognize and respond to objects and concepts associated with "vomit," such as sick, stink, or nausea, and words associated with "bananas," such as yellow and fruit, and perhaps apple and berries.

Vomiting normally occurs in specific contexts, such as hangovers and indigestion. You would also be unusually ready to recognize words asso-

ciated with other causes of the same unfortunate outcome. Furthermore, your System 1 noticed the fact that the juxtaposition of the two words is uncommon; you probably never encountered it before. You experienced mild surprise.

This complex constellation of responses occurred quickly, automatically, and effortlessly. You did not will it and you could not stop it. It was an operation of System 1. The events that took place as a result of your seeing the words happened by a process called associative activation: ideas that have been evoked trigger many other ideas, in a spreading cascade of activity in your brain. The essential feature of this complex set of mental events is its coherence. Each element is connected, and each supports and strengthens the others. The word evokes memories, which evoke emotions, which in turn evoke facial expressions and other reactions, such as a general tensing up and an avoidance tendency. The facial expression and the avoidance motion intensify the feelings to which they are linked, and the feelings in turn reinforce compatible ideas. All this happens quickly and all at once, yielding a self-reinforcing pattern of cognitive, emotional, and physical responses that is both diverse and integrated—it has been called *associatively coherent*.

In a second or so you accomplished, automatically and unconsciously, a remarkable feat. Starting from a completely unexpected event, your System 1 made as much sense as possible of the situation—two simple words, oddly juxtaposed—by linking the words in a causal story; it evaluated the possible threat (mild to moderate) and created a context for future developments by preparing you for events that had just become more likely; it also created a context for the current event by evaluating how surprising it was. You ended up as informed about the past and as prepared for the future as you could be.

An odd feature of what happened is that your System 1 treated the mere conjunction of two words as representations of reality. Your body reacted in an attenuated replica of a reaction to the real thing, and the emotional response and physical recoil were part of the interpretation of the event. As cognitive scientists have emphasized in recent years, cognition is embodied; you think with your body, not only with your brain.

The mechanism that causes these mental events has been known for a long time: it is the association of ideas. We all understand from experience that ideas follow each other in our conscious mind in a fairly orderly way. The British philosophers of the seventeenth and eighteenth centuries searched for the rules that explain such sequences. In *An Enquiry Concerning Human Understanding*, published in 1748, the Scottish philosopher

David Hume reduced the principles of association to three: resemblance, contiguity in time and place, and causality. Our concept of association has changed radically since Hume's days, but his three principles still provide a good start.

I will adopt an expansive view of what an idea is. It can be concrete or abstract, and it can be expressed in many ways: as a verb, as a noun, as an adjective, or as a clenched fist. Psychologists think of ideas as nodes in a vast network, called associative memory, in which each idea is linked to many others. There are different types of links: causes are linked to their effects (virus → cold); things to their properties (lime → green); things to the categories to which they belong (banana → fruit). One way we have advanced beyond Hume is that we no longer think of the mind as going through a sequence of conscious ideas, one at a time. In the current view of how associative memory works, a great deal happens at once. An idea that has been activated does not merely evoke one other idea. It activates many ideas, which in turn activate others. Furthermore, only a few of the activated ideas will register in consciousness; most of the work of associative thinking is silent, hidden from our conscious selves. The notion that we have limited access to the workings of our minds is difficult to accept because, naturally, it is alien to our experience, but it is true: you know far less about yourself than you feel you do.

THE MARVELS OF PRIMING

As is common in science, the first big breakthrough in our understanding of the mechanism of association was an improvement in a method of measurement. Until a few decades ago, the only way to study associations was to ask many people questions such as, "What is the first word that comes to your mind when you hear the word DAY?" The researchers tallied the frequency of responses, such as "night," "sunny," or "long." In the 1980s, psychologists discovered that exposure to a word causes immediate and measurable changes in the ease with which many related words can be evoked. If you have recently seen or heard the word EAT, you are temporarily more likely to complete the word fragment SO_P as SOUP than as SOAP. The opposite would happen, of course, if you had just seen WASH. We call this a *priming effect* and say that the idea of EAT primes the idea of SOUP, and that WASH primes SOAP.

Priming effects take many forms. If the idea of EAT is currently on your mind (whether or not you are conscious of it), you will be quicker than

usual to recognize the word SOUP when it is spoken in a whisper or presented in a blurry font. And of course you are primed not only for the idea of soup but also for a multitude of food-related ideas, including fork, hungry, fat, diet, and cookie. If for your most recent meal you sat at a wobbly restaurant table, you will be primed for wobbly as well. Furthermore, the primed ideas have some ability to prime other ideas, although more weakly. Like ripples on a pond, activation spreads through a small part of the vast network of associated ideas. The mapping of these ripples is now one of the most exciting pursuits in psychological research.

Another major advance in our understanding of memory was the discovery that priming is not restricted to concepts and words. You cannot know this from conscious experience, of course, but you must accept the alien idea that your actions and your emotions can be primed by events of which you are not even aware. In an experiment that became an instant classic, the psychologist John Bargh and his collaborators asked students at New York University—most aged eighteen to twenty-two—to assemble four-word sentences from a set of five words (for example, "finds he it yellow instantly"). For one group of students, half the scrambled sentences contained words associated with the elderly, such as *Florida*, *forgetful*, *bald*, *gray*, or *wrinkle*. When they had completed that task, the young participants were sent out to do another experiment in an office down the hall. That short walk was what the experiment was about. The researchers unobtrusively measured the time it took people to get from one end of the corridor to the other. As Bargh had predicted, the young people who had fashioned a sentence from words with an elderly theme walked down the hallway significantly more slowly than the others.

The "Florida effect" involves two stages of priming. First, the set of words primes thoughts of old age, though the word *old* is never mentioned; second, these thoughts prime a behavior, walking slowly, which is associated with old age. All this happens without any awareness. When they were questioned afterward, none of the students reported noticing that the words had had a common theme, and they all insisted that nothing they did after the first experiment could have been influenced by the words they had encountered. The idea of old age had not come to their conscious awareness, but their actions had changed nevertheless. This remarkable priming phenomenon—the influencing of an action by the idea—is known as the ideomotor effect. Although you surely were not aware of it, reading this paragraph primed you as well. If you had needed to stand up to get a glass of water, you would have been slightly slower than usual to rise from your

chair—unless you happen to dislike the elderly, in which case research suggests that you might have been slightly faster than usual!

The ideomotor link also works in reverse. A study conducted in a German university was the mirror image of the early experiment that Bargh and his colleagues had carried out in New York. Students were asked to walk around a room for 5 minutes at a rate of 30 steps per minute, which was about one-third their normal pace. After this brief experience, the participants were much quicker to recognize words related to old age, such as *forgetful*, *old*, and *lonely*. Reciprocal priming effects tend to produce a coherent reaction: if you were primed to think of old age, you would tend to act old, and acting old would reinforce the thought of old age.

Reciprocal links are common in the associative network. For example, being amused tends to make you smile, and smiling tends to make you feel amused. Go ahead and take a pencil, and hold it between your teeth for a few seconds with the eraser pointing to your right and the point to your left. Now hold the pencil so the point is aimed straight in front of you, by pursing your lips around the eraser end. You were probably unaware that one of these actions forced your face into a frown and the other into a smile. College students were asked to rate the humor of cartoons from Gary Larson's *The Far Side* while holding a pencil in their mouth. Those who were "smiling" (without any awareness of doing so) found the cartoons funnier than did those who were "frowning." In another experiment, people whose face was shaped into a frown (by squeezing their eyebrows together) reported an enhanced emotional response to upsetting pictures—starving children, people arguing, maimed accident victims.

Simple, common gestures can also unconsciously influence our thoughts and feelings. In one demonstration, people were asked to listen to messages through new headphones. They were told that the purpose of the experiment was to test the quality of the audio equipment and were instructed to move their heads repeatedly to check for any distortions of sound. Half the participants were told to nod their head up and down while others were told to shake it side to side. The messages they heard were radio editorials. Those who nodded (a yes gesture) tended to accept the message they heard, but those who shook their head tended to reject it. Again, there was no awareness, just a habitual connection between an attitude of rejection or acceptance and its common physical expression. You can see why the common admonition to "act calm and kind regardless of how you feel" is very good advice: you are likely to be rewarded by actually feeling calm and kind.

PRIMES THAT GUIDE US

Studies of priming effects have yielded discoveries that threaten our self-image as conscious and autonomous authors of our judgments and our choices. For instance, most of us think of voting as a deliberate act that reflects our values and our assessments of policies and is not influenced by irrelevancies. Our vote should not be affected by the location of the polling station, for example, but it is. A study of voting patterns in precincts of Arizona in 2000 showed that the support for propositions to increase the funding of schools was significantly greater when the polling station was in a school than when it was in a nearby location. A separate experiment showed that exposing people to images of classrooms and school lockers also increased the tendency of participants to support a school initiative. The effect of the images was larger than the difference between parents and other voters! The study of priming has come some way from the initial demonstrations that reminding people of old age makes them walk more slowly. We now know that the effects of priming can reach into every corner of our lives.

Reminders of money produce some troubling effects. Participants in one experiment were shown a list of five words from which they were required to construct a four-word phrase that had a money theme ("high a salary desk paying" became "a high-paying salary"). Other primes were much more subtle, including the presence of an irrelevant money-related object in the background, such as a stack of Monopoly money on a table, or a computer with a screen saver of dollar bills floating in water.

Money-primed people become more independent than they would be without the associative trigger. They persevered almost twice as long in trying to solve a very difficult problem before they asked the experimenter for help, a crisp demonstration of increased self-reliance. Money-primed people are also more selfish: they were much less willing to spend time helping another student who pretended to be confused about an experimental task. When an experimenter clumsily dropped a bunch of pencils on the floor, the participants with money (unconsciously) on their mind picked up fewer pencils. In another experiment in the series, participants were told that they would shortly have a get-acquainted conversation with another person and were asked to set up two chairs while the experimenter left to retrieve that person. Participants primed by money chose to stay much farther apart than their nonprimed peers (118 vs. 80 centimeters). Money-primed undergraduates also showed a greater preference for being alone.

The general theme of these findings is that the idea of money primes

individualism: a reluctance to be involved with others, to depend on others, or to accept demands from others. The psychologist who has done this remarkable research, Kathleen Vohs, has been laudably restrained in discussing the implications of her findings, leaving the task to her readers. Her experiments are profound—her findings suggest that living in a culture that surrounds us with reminders of money may shape our behavior and our attitudes in ways that we do not know about and of which we may not be proud. Some cultures provide frequent reminders of respect, others constantly remind their members of God, and some societies prime obedience by large images of the Dear Leader. Can there be any doubt that the ubiquitous portraits of the national leader in dictatorial societies not only convey the feeling that “Big Brother Is Watching” but also lead to an actual reduction in spontaneous thought and independent action?

The evidence of priming studies suggests that reminding people of their mortality increases the appeal of authoritarian ideas, which may become reassuring in the context of the terror of death. Other experiments have confirmed Freudian insights about the role of symbols and metaphors in unconscious associations. For example, consider the ambiguous word fragments W_ _H and S_ _P. People who were recently asked to think of an action of which they are ashamed are more likely to complete those fragments as WASH and SOAP and less likely to see WISH and SOUP. Furthermore, merely thinking about stabbing a coworker in the back leaves people more inclined to buy soap, disinfectant, or detergent than batteries, juice, or candy bars. Feeling that one’s soul is stained appears to trigger a desire to cleanse one’s body, an impulse that has been dubbed the “Lady Macbeth effect.”

The cleansing is highly specific to the body parts involved in a sin. Participants in an experiment were induced to “lie” to an imaginary person, either on the phone or in e-mail. In a subsequent test of the desirability of various products, people who had lied on the phone preferred mouthwash over soap, and those who had lied in e-mail preferred soap to mouthwash.

When I describe priming studies to audiences, the reaction is often disbelief. This is not a surprise: System 2 believes that it is in charge and that it knows the reasons for its choices. Questions are probably cropping up in your mind as well: How is it possible for such trivial manipulations of the context to have such large effects? Do these experiments demonstrate that we are completely at the mercy of whatever primes the environment provides at any moment? Of course not. The effects of the primes are robust but not necessarily large. Among a hundred voters, only a few whose initial preferences were uncertain will vote differently about a school issue if their

precinct is located in a school rather than in a church—but a few percent could tip an election.

The idea you should focus on, however, is that disbelief is not an option. The results are not made up, nor are they statistical flukes. You have no choice but to accept that the major conclusions of these studies are true. More important, you must accept that they are true about *you*. If you had been exposed to a screen saver of floating dollar bills, you too would likely have picked up fewer pencils to help a clumsy stranger. You do not believe that these results apply to you because they correspond to nothing in your subjective experience. But your subjective experience consists largely of the story that your System 2 tells itself about what is going on. Priming phenomena arise in System 1, and you have no conscious access to them.

I conclude with a perfect demonstration of a priming effect, which was conducted in an office kitchen at a British university. For many years members of that office had paid for the tea or coffee to which they helped themselves during the day by dropping money into an “honesty box.” A list of suggested prices was posted. One day a banner poster was displayed just above the price list, with no warning or explanation. For a period of ten weeks a new image was presented each week, either flowers or eyes that appeared to be looking directly at the observer. No one commented on the new decorations, but the contributions to the honesty box changed significantly. The posters and the amounts that people put into the cash box (relative to the amount they consumed) are shown in figure 4. They deserve a close look.

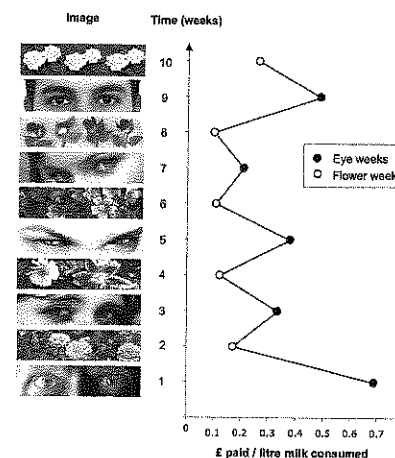


Figure 4

On the first week of the experiment (which you can see at the bottom of the figure), two wide-open eyes stare at the coffee or tea drinkers, whose average contribution was 70 pence per liter of milk. On week 2, the poster shows flowers and average contributions drop to about 15 pence. The trend continues. On average, the users of the kitchen contributed almost three times as much in “eye weeks” as they did in “flower weeks.” Evidently, a purely symbolic reminder of being watched prodded people into improved behavior. As we expect at this point, the effect occurs without any awareness. Do you now believe that you would also fall into the same pattern?

Some years ago, the psychologist Timothy Wilson wrote a book with the evocative title *Strangers to Ourselves*. You have now been introduced to that stranger in you, which may be in control of much of what you do, although you rarely have a glimpse of it. System 1 provides the impressions that often turn into your beliefs, and is the source of the impulses that often become your choices and your actions. It offers a tacit interpretation of what happens to you and around you, linking the present with the recent past and with expectations about the near future. It contains the model of the world that instantly evaluates events as normal or surprising. It is the source of your rapid and often precise intuitive judgments. And it does most of this without your conscious awareness of its activities. System 1 is also, as we will see in the following chapters, the origin of many of the systematic errors in your intuitions.

SPEAKING OF PRIMING

“The sight of all these people in uniforms does not prime creativity.”

“The world makes much less sense than you think. The coherence comes mostly from the way your mind works.”

“They were primed to find flaws, and this is exactly what they found.”

“His System 1 constructed a story, and his System 2 believed it. It happens to all of us.”

“I made myself smile and I’m actually feeling better!”

5

COGNITIVE EASE

Whenever you are conscious, and perhaps even when you are not, multiple computations are going on in your brain, which maintain and update current answers to some key questions: Is anything new going on? Is there a threat? Are things going well? Should my attention be redirected? Is more effort needed for this task? You can think of a cockpit, with a set of dials that indicate the current values of each of these essential variables. The assessments are carried out automatically by System 1, and one of their functions is to determine whether extra effort is required from System 2.

One of the dials measures *cognitive ease*, and its range is between “Easy” and “Strained.” Easy is a sign that things are going well—no threats, no major news, no need to redirect attention or mobilize effort. Strained indicates that a problem exists, which will require increased mobilization of System 2. Conversely, you experience *cognitive strain*. Cognitive strain is affected by both the current level of effort and the presence of unmet demands. The surprise is that a single dial of cognitive ease is connected to a large network of diverse inputs and outputs. Figure 5 on page 60 tells the story.

The figure suggests that a sentence that is printed in a clear font, or has been repeated, or has been primed, will be fluently processed with cognitive ease. Hearing a speaker when you are in a good mood, or even when you have a pencil stuck crosswise in your mouth to make you “smile,” also induces cognitive ease. Conversely, you experience cognitive strain when you read instructions in a poor font, or in faint colors, or worded in complicated language, or when you are in a bad mood, and even when you frown.