The worst economic crisis since the Great Depression has prompted a reassessment of how financial markets work and how people make decisions about money.

It has all the makings of a classic B movie scene. A gunman puts a pistol to the victim’s forehead, and the screen fades to black before a loud bang is heard. A forensic specialist who traces the bullet’s trajectory would see it traversing the brain’s prefrontal cortex—a central site for processing decisions. The few survivors of usually fatal injuries to this brain region should not be surprised to find their personalities dramatically altered. In one of the most cited case histories in all of neurology, Phineas Gage, a 19th-century railroad worker, had his prefrontal cortex penetrated by an iron rod; he lived to tell the tale but could no longer make sensible decisions. Cocaine addicts may actually self-inflict similar damage. The resulting dysfunction may cause even abstaining addicts to crave the drug any time, say, the thudding bass of a techno tune reminds them of when they were stoned.

Even people who do not use illicit drugs or get shot in the head have to contend with the reality that some of the decisions cooked up by the brain’s frontal lobes may lead them astray. A specific site within the prefrontal cortex, the ventromedial prefrontal cortex (VMPFC) is, in fact, among the suspects in the colossal global economic implosion that has recently rocked the globe.

The VMPFC turns out to be a central location for what economists call “money illusion.” The illusion occurs when people ignore obvious information about the distorting effects of inflation on a purchase and, in an irrational leap, decide that the thing is worth much more than it really is. Money illusion may convince prospective buyers that a house is always a great investment because of the misbegotten perception that prices inexorably rise. Robert J. Shiller, a professor of economics at Yale University, contends that the faulty logic of money illusion contributed to the housing bubble: “Since people are likely to remember the price they paid for their house from many years ago but remember few other prices from then, they have the mistaken impression that home prices have gone up more than other prices, giving a mistakenly exaggerated impression of the investment potential of houses.”

Economists have fought for decades about whether money illusion and, more generally, the influence of irrationality on economic transactions are themselves illusory. Milton Friedman, the renowned monetary theorist, postulated that consumers and employers remain undeceived and, as rational beings, take inflation into account when making purchases or paying wages. In other words, they are good judges of the real value of a good.

But the ideas of behavioral economists, who study the role of psychology in making economic decisions, are gaining increasing attention today, as scientists of many stripes struggle to understand why the world economy fell so hard and fast. And their ideas are bolstered by the brain scientists who make inside-the-skull snapshots of the VMPFC and other brain areas. Notably, an experiment reported in March in the Proceedings of the National Academy of Sciences USA by researchers at the University of Bonn in Germany and the California Institute of Technology demonstrated that some of the brain’s decision-making circuitry showed signs of money illusion on images from a brain scanner. A part of the VMPFC lit up in subjects who encountered a larger amount of money, even if the relative buying power of that sum had not changed, because prices had increased as well.
The illumination of a spot behind the forehead responsible for a misconception about money marks just one example of the increasing sophistication of a line of research that has already revealed brain centers involved with the more primal investor motivations of fear (the amygdala) and greed (the nucleus accumbens, perhaps, not surprisingly, a locus of sexual desire as well). A high-tech fusing of neuroimaging with behavioral psychology and economics has begun to provide clues to how individuals, and, aggregated on a larger scale, whole economies may run off track. Together these disciplines attempt to discover why an economic system, built with nominal safeguards against collapse, can experience near-catastrophic breakdowns. Some of this research is already being adopted as a guide to action by the Obama administration as it tries to stabilize banks and the housing sector.

The Rationality Illusion

The behavioral ideas now garnering increased attention take exception to some central ideas of modern economic theory, including the view that each buyer and seller constitute an exemplar of Homo economicus, a purely rational being motivated by self-interest. “Under all conditions, man in classical economics is an automaton capable of objective reasoning,” writes financial historian Peter Bernstein.

Another central tenet of the rationalist credo is the efficient-market hypothesis, which holds that all past and current information about a good is reflected in its price—the market reaches an equilibrium point between buyers and sellers at just the “right” price. The only thing that can upset this balance between supply and demand is an outside shock, such as unanticipated price setting by an oil cartel. In this way, the dynamics of the financial system remain in balance. Classical theory dictates that the internal dynamics of the market cannot lead to a feedback cycle in which one price increase begets another, creating a bubble and a later reversal of the cycle that fosters a crippling destabilization of the economy.

A strict interpretation of the efficient-market hypothesis would imply that the risks of a bubble bursting would be reflected in existing market prices—the price of homes and of the risky (subprime) mortgages that were packaged into what are now dubbed “toxic securities.” But if that were so and markets were so efficient, how could prices fall so precipitously? Astonishment about the failure of conventional theory was even expressed by former chair of the Federal Reserve Board Alan Greenspan. A persistent cheerleader for the notion of efficient markets, he told a congressional committee in October 2008: “Those of us who looked to the self-interest of lending institutions to protect shareholder’s equity, myself especially, are in a state of shocked disbelief.”

Animal Spirits

The behavioral economists who are trying to pinpoint the psychological factors that lead to bubbles and severe market disequilibrium are the intellectual heirs of psychologists Amos Tversky and Daniel Kahneman, who began studies in the 1970s that challenged the notion of financial actors as rational robots. Kahneman won the Nobel Prize in Economics in 2002 for this work; Tversky would have assuredly won as well if he were still alive. Their pioneering work addressed money illusion and other psychological foibles, such as our tendency to feel sadder about losing, say, $1,000 than feeling happy about gaining that same amount.

A unifying theme of behavioral economics is the often irrational psychological impulses that underlie financial bubbles and the severe downturns that follow. Shiller, a leader in the field, cites “animal spirits”—a phrase originally used by economist John Maynard Keynes—as an explanation. The business cycle, the normal ebbs and peaks of economic activity, depends on a basic sense of trust for both business and consumers to engage one another every day in routine economic dealings. The basis for trust, however, is not always built on rational assessments. Animal spirits—the gut feeling that, yes, this is the time to buy a house or that sleener stock—drive people to overconfidence and rash decision making during a boom. These feelings can quickly transmute into panic as anxiety rises and the market heads in the other direction. Emotion-driven decision making complements cognitive biases—money illusion’s failure to account for inflation, for instance—that lead to poor investment logic.

The importance of both emotion and cognitive biases in explaining the global crisis can be witnessed throughout the concatenation of events that, over the past 10 years, left the financial system teetering. Animal spirits propelled Internet stocks to indefensible heights during the dot-com boom and drove their values earthward just a few years later. They were present again when reckless lenders took advantage of low-interest rates to proffer adjustable-rate mortgages on risky, subprime borrowers. A phenomenon like money illusion prevailed: the borrowers of these mortgages failed to calculate what would happen if interest rates rose, which is exactly what happened during the middle of the decade, causing massive numbers of foreclosures and defaults. Securitized mortgages, debt from hundreds to thousands of homeowners packaged by banks into securities and then sold to others, lost most of their value. Banks witnessed their lending capital decline. Credit, the lifeblood of capitalism, vanished, bringing on a global crisis.
Rules of Thumb

Behavioral economics and the related subdiscipline of behavioral finance, which pertains more directly to investment, have also begun to illuminate in more detail how psychological quirks about money can help explain the recent crisis. Money illusion is only one example of irrational thought processes examined by economists. Heuristics, or rules of thumb that we need to react quickly in a crisis, are perhaps a legacy that lingers from our Paleolithic ancestors. Measured reasoning was not an option when facing down a wooly mammoth. When we are not staring down a wild animal, heuristics can sometimes result in cognitive biases.

Behavioral economists have identified a number of biases, some with direct relevance to bubble economics. In confirmation bias, people overweight information that confirms their viewpoint. Witness the massive run-up in housing prices as people assumed that rising home prices would be a sure bet. The herding behavior that resulted caused massive numbers of people to share this belief. Availability bias, which can prompt decisions based on the most recent information, is one reason that some newspaper editors shunned using the word “crash” in the fall of 2008 in an unsuccessful attempt to avoid a flat panic. Hindsight bias, the feeling that something was known all along, can be witnessed postcrash: investors, homeowners and economists acknowledged that the signs of a bubble were obvious, despite having actively contributed to the rise in home prices.

Neuroeconomics, a close relation of behavioral economics, trains a functional magnetic resonance imaging device or another form of brain imaging on the question of whether these idiosyncratic biases are figments of an academician’s imagination or actually operate in the human mind. Imaging has already confirmed money illusion. But investigators are exploring other questions as well: for instance, does talking about money or looking at it or merely thinking about it activate reward and regret centers inside the skull?

In March at the annual meeting of the Cognitive Neuroscience Society in San Francisco, Julie L. Hall, a graduate student of Richard Gonzalez at the University of Michigan at Ann Arbor, presented research showing that our willingness to take risks with money changes in response to even subtle emotional cues, again undercutting the myth of the steely, cold investor. In the experiment, 24 participants—12 men and 12 women—viewed photographs of happy, angry and neutral faces. After exposure to happy faces, the study’s “investors” had more activation in the nucleus accumbens, a reward center, and consistently invested in more risky stocks rather than embracing the relative safety of bonds.

“Happy faces” were a constant presence during the real estate boom earlier in this decade. The smiling vis-
be uploaded and compared with offerings from other lenders.

Along similar lines, Yale’s Shiller outlines an intricate strategy designed to avoid the excesses of bubble economics by educating against errors in “economic thinking.” Shiller suggests adopting new units of measurement akin to the *unidad de fomento* (UF) put in place by the Chilean government in 1967 and also embraced by other Latin American governments. The UF is a safeguard against money illusion, allowing a buyer or seller to know whether a price has increased in real terms or is just an inflationary mirage. It represents the price of a market basket of goods and is so commonly used that Chileans often quote prices in these units. “Chile has been the most effectively inflation-indexed country in the world,” Shiller says. “House prices, mortgages, some rentals, alimony payments, and executive incentive options are often expressed in these inflation units.”

Shiller also remains an ardent advocate of new financial technology that could serve as antibubble weapons. Regulators are now scrutinizing the sophisticated financial instruments that were supposed to protect against default on the mortgage-backed securities that fueled the housing boom. Shiller, however, argues that derivatives (a class of financial instruments that is meant to shield against risk but whose misuse for speculation contributed to the credit crisis) can help guarantee that there are enough buyers and sellers in housing markets. Derivatives are financial contracts “derived” from an underlying asset, such as a stock, a financial index or even a mortgage.

Despite the potential for abuse, Shiller perceives derivatives as prudent “hedges” against dire economic scenarios. In the housing market, homeowners and lenders might use these financial instruments to insure against falling prices, thereby providing sufficient liquidity to keep sales moving.

**Can Biology Save Us?**

Ultimately, a solution to the current crisis will have to be informed by new ways of thinking about how investors act. One particularly creative approach would correct deficiencies in existing economic theory by melding the old with the new. Andrew Lo, a professor of finance at the Massachusetts Institute of Technology and an official at a hedge fund, has devised a theory that gives equilibrium economics and the efficient-market hypothesis their due while also acknowledging that classic theory does not reflect the way markets work in all circumstances. It attempts a grand synthesis that combines evolutionary theory with both classical and behavioral economics. Lo’s approach, in other words, builds on the idea that incorporating Darwinian natural selection into simulations of economic behavior can help yield useful insights into how markets operate and provide more accurate predictions than usual of how financial actors—both individuals and institutions—will behave.

Similar ideas have occurred to economists before. Economist Thorstein Veblen proposed that economics should be an evolutionary science as early as 1898; even earlier Thomas Robert Malthus had a profound influence on Darwin himself with his musings on a “struggle for existence.”

Just as natural selection postulates that certain organisms are best able to survive in a particular ecological niche, the adaptive-market hypothesis considers different market players from banks to mutual funds as “species” that are competing for financial success. And it assumes that these players at times use the seat-of-the-pants heuristics described by behavioral economics when investing (“competing”) and that they sometimes adopt irrational strategies, such as taking bigger risks during a losing streak.

“Economists suffer from a deep psychological disorder that I call ‘physics envy,’” Lo says. “We wish that 99 percent of economic behavior could be captured by three simple laws of nature. In fact, economists have 99 laws that capture 3 percent of behavior. Economics is a uniquely human endeavor and, as such, should be understood in the broader context of competition, mutation and natural selection—in other words, evolution.”

Having an evolutionary model to consult may let investors adapt as the risk profiles of different investment strategies shift. But the most important benefit of Lo’s simulations may be an ability to detect when the economy is not in a stable equilibrium, a finding that would warn regulators and investors that a bubble is inflating or else about to explode.

An adaptive-market model can incorporate information about how prices in the market are changing—analogous to how people are adapting to a particular ecological niche. It can go on to deduce whether prices on one day are influencing prices on the next, an indication that investors are engaged in “herding,” as described by behavioral economists, a sign that a bubble may be imminent. As a result of this type of modeling, regulations could also “adapt” as markets shift and thus counter the type of “systemic” risks for which conventional risk models leave the markets unprotected. Lo has advocated the establishment of a Capital Markets Safety Board, similar to the institution that investigates airline accidents, to collect data about past and future risks that could threaten the larger financial system, which could serve as a critical foundation for adaptive-market modeling.

As brain science unravels the roots of investors’ underlying behaviors, it may well find new evidence that the conception of *Homo economicus* is fundamentally flawed. The rational investor should not care whether
she has $10 million and then loses $8 million or, alternatively, whether she has nothing and ends up with $2 million. In either case, the end result is the same.

But behavioral economics experiments routinely show that despite similar outcomes, people (and other primates) hate a loss more than they desire a gain, an evolutionary hand-me-down that encourages organisms to preserve food supplies or to weigh a situation carefully before risking encounters with predators.

One group that does not value perceived losses differently than gains are individuals with autism, a disorder characterized by problems with social interaction. When tested, autistics often demonstrate strict logic when balancing gains and losses, but this seeming rationality may itself denote abnormal behavior. “Adhering to logical, rational principles of ideal economic choice may be biologically unnatural,” says Colin F. Camerer, a professor of behavioral economics at Caltech. Better insight into human psychology gleaned by neuroscientists holds the promise of changing forever our fundamental assumptions about the way entire economies function—and our understanding of the motivations of the individual participants therein, who buy homes or stocks and who have trouble judging whether a dollar is worth as much today as it was yesterday.

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