

August 9, 2006

Michael J. Mauboussin



mmauboussin@lmfunds.com

## How Do You Compare? Thoughts on Comparing Well

Good thinking is a matter of making comparisons.

Bruce Pandolfini <sup>1</sup>

The facts are these: (a) value is determined by the comparison of one thing with another; (b) there is more than one kind of comparison we can make in any given instance; and (c) we may value something more highly when we make one kind of comparison than when we make a different kind of comparison.

Daniel Gilbert  
*Stumbling on Happiness* <sup>2</sup>

### Train of Thought: Economics or Psychology?

Picture a runaway train hurtling down the track, destined to kill four strangers. Now imagine you can pull a lever that will divert the train to a side track killing just one stranger. Would you pull?

Now consider a similar scene with the barreling train set to kill the four strangers. But this time you are standing on a bridge over the track next to a burley stranger. If you push the guy he will land in front of the train, ending his life but sparing the other four. Would you push?

When presented with these dilemmas most people say yes to the first and no to the second, even though the situations have the same expected outcome. Not only do people perceive these situations as dissimilar, different parts of the brain process the dilemmas. Pushing someone off the bridge has much more emotional content, literally shaping how we decide. <sup>3</sup>

These dilemmas help introduce the crucial and neglected topic of how we compare. Investing is all about comparing; indeed, it consists of little else. We compare one company to another, one industry to another, this market cycle to others, this Fed chairman to the previous one, and so on. What information we pay attention to, how we relate the past to the present, and why we prefer one choice to another often boils down to how we compare.

Though comparing comes naturally to humans, we are not as good at it as we should be. Here, the tension between standard economic models and psychology—and perhaps more broadly, the brain sciences—comes into play. Economic models tend to be clear cut, and you can readily solve for optimal solutions. For example, a purely rational person would take action in both of the runaway train scenarios because one death is better than four. Economic models are very useful because they prescribe how we should behave.

On the other hand, psychology teaches us that comparisons are not as simple as determining expected value. Many factors color our comparisons, and our minds treat disparate comparative stimuli in very different ways. So *how* you compare plays a large role in how you decide. You must carefully consider what questions to ask, how to describe situations, and the natural tendency to interpret stimuli in a way that suits you. Poor comparison processes lead to suboptimal decisions.

Ideally, we want to make quality decisions based on proper comparisons. The first step down the good-decision-making path is to understand how the mind works and the inevitable traps in the practice of comparison. Next we must develop processes that allow for skillful comparison.

Good comparisons are crucial to intelligent investing. Asset allocation, active versus passive, and portfolio construction decisions all rely heavily on comparisons. Here are some examples with a very simple comparison basis. Adding complexity makes the comparative process much more difficult and the biases more pronounced.

<u>Choice A</u>	<u>Choice B</u>	<u>One basis of comparison</u>
Consume	Save	Current versus future happiness
Stocks	Bonds	Expected risk versus reward
Active	Passive	Skill versus cost
Small cap	Large cap	Recent versus past performance
Cold fund	Hot fund	Process versus outcome
Value stock	Growth stock	Current versus future expectations

We discuss comparison on three levels. First, we outline some of the high level issues—basically how and what you should consider while comparing. Next we cover the psychological traps we tend to fall into. Finally, we offer some practical advice for investors. Needless to say, this discussion is far from complete and we will likely return to this theme.

## **Comparing—The Big Themes**

*Attributes versus circumstances.* The first obvious way to compare is based on attributes. A combination of attributes and preferences provides all you need for many simple decisions. Say you're reaching for a sweater, and the basis for comparison is your favorite color. Easy. You grab the green sweater over the blue sweater and get on with it.

However, when comparing based on possible future outcomes, the issues get thornier. Decisions about the future usually rely on some theory, or a contingent explanation of cause and effect.<sup>4</sup> Decision makers seeking to build a theory generally start by categorizing data based on attributes. (The topic of how to think about categories has kept philosophers, biologists, and linguists busy for centuries.<sup>5</sup>) Once a theory associates an attribute with a particular outcome, comparison becomes relatively straightforward: use attributes to anticipate which choice will work out best.

Here's an example from the investment world. Researchers, while testing the efficient market hypothesis, found that companies with low price/earnings ratios generate higher returns than the capital asset pricing model predicts.<sup>6</sup> This finding spawned an attribute-based theory: buy stocks with low price/earnings ratios and you will outperform the market.<sup>7</sup> Many value investors embrace this theory with zealous enthusiasm.

Management theory provides another illustration. In recent years, a number of companies created attractive business models by outsourcing parts of their supply chains. The theory suggests outsourcing leads to an improved business model. Consultants and management pundits repeated this nostrum in countless board rooms and the popular press.<sup>8</sup>

In both examples, there is a big difference between what *often* makes sense and what *always* makes sense. Early theories are challenged when researchers find anomalies that attribute-

based models can't explain. The new, improved theory often migrates from being attribute to circumstance based. The best answer to the question of whether a stock with a low price/earnings ratio is attractive, or if outsourcing is good, is, "it depends."<sup>9</sup>

A high price/earnings ratio may be attractive if the market underestimates the company's prospects for future cash flows, returns, and competitive advantage. Likewise, outsourcing is generally detrimental for a company in an industry that has yet to modularize.<sup>10</sup> So while attributes may correlate with outcomes, they are often not causal.

Evolution provides a powerful argument for circumstance-based thinking. In evolution, species fitness—the ability to survive and reproduce—is not associated with specific attributes like size, color, or strength. Rather, fitness relates much more to adaptability, which is inherently circumstantial. The parallel is clear: attribute-based approaches work until the environment changes. When making comparisons in a dynamic environment, an attribute-based approach will let you down.

What does all of this mean for comparing? First, when comparing to judge the future, be careful not to rely solely on attributes. Second, recognize the best theories are based on circumstances, and hence explain cause and effect. If the world focuses mostly on attributes—a fair description of large swaths of the investment industry today—seek to understand and compare using the prevailing circumstances.

*Process versus outcome.* Say you are deciding which of two paintings to buy. You'd quite clearly compare them based on the outcome; the artist's actions and thoughts between palette and canvas matter much less than their aesthetic appeal. You are deciding between observable outcomes that don't change. You can extend this thinking to the production of most physical objects because the process—a set of decisions and actions—links directly to the outcome.

In other realms, decisions lead to a range of possible outcomes, each with some probability. Probabilistic fields exhibit an indirect link between process and outcome. Investing is more like commissioning a painting: you can look at the painter's prior outcomes, understand the process, explain your objectives, and decide whether the artist will deliver the desired outcome. In commissioning, the process is important.

When outcomes are probabilistic, either a good or a bad process can yield a good or a bad outcome; the best you can say is a good process will assure more favorable outcomes *over time*. A simple probability game like blackjack illustrates this point. Players using basic strategy, which specifies the best way to play each hand, can reduce the house edge to about one percent. Of course, a disciplined application of basic strategy will generate good and bad outcomes in the short run. Over time, however, the strategy maximizes outcomes.<sup>11</sup>

Gamblers can also follow more haphazard strategies, with a lower probability of success, and still win. Depending on the system's probabilities, players using a poor process can and will have better results than players using a proper process over periods of time. Especially over short time horizons, luck may trump skill. Time is the friend of a good process, and the long haul always reveals the virtue of that process.

The first message is that comparing outcomes, especially short-term outcomes, in a probabilistic system is not ideal. Note there is a nearly-exclusive focus on short-term outcomes in the investment industry. This happens largely because outcomes are objective, measurable, and comparable. Such comparisons of the short term primarily capture the system's noise. Even if short-term outcomes aren't the best way to compare, two problems remain. The first is how long you should be willing to suffer through bad outcomes before reevaluating the process. The answer depends a great deal on the statistical properties of the system where the process is applied. In general, wider-distribution systems require longer appraisal periods than narrower ones.

The second problem is how to properly assess a process. Here again, there are no simple solutions. We can say a process should be statistically and economically sound, and should be based on a repeatable set of activities.

Statistically sound means the process is driven by the system's underlying probabilities and outcomes. In some systems the statistical properties are known (blackjack), in other systems the statistical properties change over time (markets), and in yet others both the probabilities and outcomes are opaque (certain forms of insurance). The process should accommodate the proper degree of uncertainty in the system.

Economically sound means the decisions maximize value over time. In blackjack, value maximization may mean minimizing the house edge. In investing, the process should identify investments with positive expected values. A positive expected value is to some degree independent of the frequency of correctness. In poker, for example, players strive to win the most money, not the most hands.<sup>12</sup>

Finally, repeatable means you can apply the process over time, adjusting for changes in the system, and still make statistically- and economically-sound decisions. How much a process has to evolve depends on how much the system changes. For stable systems like blackjack, where the rules are comparable over time, the process doesn't change. In cases where the underlying system evolves, an adaptive process is crucial.

*Intuition versus statistics.* When considering a draft prospect, should a baseball team's general manager focus on the player's statistical performance or the scout's perspective? How should a loan officer weigh an applicant's financial position versus his or her appearance and plans? In short, when comparing, are you better off using intuition or statistics?

The intuition-versus-statistics debate moved into public discourse through a pair of best-selling books, Malcolm Gladwell's *Blink* and Michael Lewis's *Moneyball*. Gladwell celebrates what he calls "thin-slicing," the "powerful" ability to quickly come to conclusions that are often "really good."<sup>13</sup> Lewis's tale, in contrast, shows how statistics triumph over intuition. When comparing players, Lewis suggests, the numbers will inform you much better than the scouts will.<sup>14</sup>

So which is better? As usual, it depends. Intuition works well in relatively simple, linear, and static systems. The key is pattern recognition. For instance, chess masters perceive clusters of pieces on the board, allowing them to better understand the relative strengths of the sides and the most advantageous moves.<sup>15</sup> Where patterns repeat reliably, intuition can be a good guide. Even when patterns aren't clear, intuition can be useful in blunt decisions—for example, fight or flight. However, only some systems fit this description, and markets are not one of them.<sup>16</sup>

Intuition and perception often fail to reveal a system's underlying properties. Our pattern-seeking and perception processes reflect our biases and extrapolate our experiences, rarely reflecting the features of a changing system accurately. This is especially true when the changes in the system are subtle.<sup>17</sup> Statistics, especially with a sufficiently large sample size, characterize the system much more effectively. Systems that change very rapidly make both intuition and statistics largely impotent as the basis for thoughtful comparison.

When comparing, humans seek patterns in even the smallest samples. We try to pick out the better baseball hitter after watching a handful of at-bats, or try to understand a company's prospects by studying the quarter's results. This extrapolation doesn't work. For example, discerning the difference between a .270 and .300 hitter in baseball is practically impossible by watching a few games: over the course of a season, assuming 600 at bats, the player with the higher batting average will yield only 18 more hits, or one-ninth of a hit per game.

What does all of this mean for how we should compare? We should start with statistics (the larger the sample the better) and then augment the statistics with intuition. This disciplined-intuition

approach will very likely lead to better decisions over time. The psychology research shows statistically-based approaches generally fare better at predicting than individuals—even experts.<sup>18</sup>

*Challenges of comparing over time.* It's hard to get away from the dimension of time when making comparisons. More often than not, we compare alternatives *today* based on our experience of the *past* to try to gain *future* happiness. Not surprisingly, our mental software sometimes gets tripped up as we look back and peer forward.

For instance, when comparing alternatives today we remember the past much better than we entertain alternatives. Psychologist Dan Gilbert notes that people are more likely to buy a vacation package marked down from \$600 to \$500 than they are to buy the identical package for \$400 if the price was \$300 the day before.<sup>19</sup> You see this in markets all the time: we tend to compare today's price—and hence a stock's attractiveness—to where it's been in the past, instead of the stock's expected return.

When comparing something today with something in the past, a couple other issues are worth bearing in mind. First, we all tend to have our own version of events, colored by our individual experience, exposure, and biases. The classic film *Rashomon* exploits this theme by showing how four witnesses to the same violent event recall it very differently.<sup>20</sup>

Further, we have a strong inclination to emphasize recent events more than distant events, even when the latter has more relevance.<sup>21</sup> The way to offset this error of idiosyncrasy is to use large sample sizes whenever possible. Again, allow statistics, which effectively aggregate a lot of experiences, to guide your choice versus relying exclusively on your take on things.

Statistics are no panacea, however, which leads to the second issue. You can only use statistics over time if the properties of the system remain stable, or stationary. The outcomes of a die roll are a good example. A large enough sample of past die-roll outcomes would provide an excellent indicator of the outcomes of a sufficiently sizable sample of future rolls. The past is prologue, and the statistics will serve you well.

Unfortunately very few systems, and virtually no complex systems, are stationary. So while comparing today's die rolls to yesterday's die rolls is instructive, comparing today's stock market to one of the past may be completely inappropriate. The nonstationarity inherent in most complex systems makes comparisons over time very difficult. As pernicious, features may be superficially comparable ("today's price/earnings multiples and interest rates are similar to those of the early 1960s") but very different in structure.<sup>22</sup>

The main problem we have when we look to the past or peer into the future is what historians call presentism, a tendency to superimpose our current state and knowledge into the past or future. For example, researchers asked people to rate their attitudes toward several prominent social issues. Nine years later, the scientists asked the subjects to rate the issues again and to indicate how they had answered before. The group's recollections of their earlier ratings resembled more their current attitudes than their original attitudes.<sup>23</sup> The same holds true as we look forward: we take our current state, tweak it, and anticipate how we'll feel in the future. But our tweaks are often insufficient.

### **Some More Reasons Comparing is Tricky**

There is a classic approach to decision making. First, figure out your goal or goals. Next, identify your array of options. Then compare them and select the best option or options, recognizing life's inevitable tradeoffs. Finally, repeat as necessary if and when your goals shift.

The real world, of course, is a lot messier than the tidy schematic suggests. This is in large part because our minds are not geared to be optimal in a textbook sense. We'll now take a tour of some of the psychological reasons we compare poorly.

Let's start with the first part of the process, figuring out a goal. We all have goals in mind, like dropping a few pounds or saving for retirement, but we're not always very good at taking steps to fulfill the goal. Details are vague when we imagine a temporally distant event, just as they are with a visually distant object. Not surprisingly, our brains treat a far-off, fuzzy event a lot differently than a near-term, defined event. If you've ever asked yourself, *why in the heck did I commit to that?* when a previously distant commitment becomes imminent, you know the feeling.

That we perceive the future and present so differently leads to behavior inconsistent with economic theory. Hyperbolic discounting, for example, demonstrates our tendency to discount equal financial propositions at different rates across time. If you offer someone a choice between \$10 today and \$11 tomorrow, most people take the \$10. In contrast, given a choice between \$10 in one year and \$11 in one year and a day, most people select the \$11.

Researchers have not only shown the discrepancy between these preferences, they have demonstrated that different parts of the brain drive the decisions. The limbic system (an older part of the brain) processes short-term impatience, while the prefrontal cortex (a newer part of the brain associated with planning) deals with long-term patience.<sup>24</sup>

Since time affects our goals and preferences, the outcome of our comparisons may be very different if our goal is temporally immediate or distant. Even if we want a slimmer waist, a slice of cheesecake now looks a lot better than abstinence, especially if our prefrontal cortex assures us the diet will begin tomorrow.

Here are some of the other issues to consider:

*Similarities versus differences.* Whether you compare based on similarities or differences can make a big difference in how you choose. For example, in the 1970s psychologist Amos Tversky asked thirty subjects which pair of countries was most similar: Sri Lanka and Nepal or East Germany and West Germany. Two-thirds of the subjects selected East and West Germany.

He then asked another group of subjects to select which pair was more different. Naturally, you'd expect similarity and dissimilarity to be complements, suggesting one-third would pick the Germany pair. But that's not what Tversky found: 70 percent of the subjects said East and West Germany were more different.<sup>25</sup> The reason, as Dan Gilbert explains it, is when we're asked about similarities we look for similarities and ignore the absence of similarities. Likewise, when looking for dissimilarities we overlook the absence of dissimilarities.<sup>26</sup>

Since you tend to find what you're looking for, *how* you compare is really important. Sometimes superficially similar things are very different, and superficially different things are actually very similar. It's crucial to be alert to what you're *not* paying attention to.

Consider the challenge biologists face in categorizing animals based on evolutionary patterns (a field formally called phylogenetic systematics). A fascinating case is cichlid fish in a pair of freshwater lakes in eastern Africa. If you study the cichlids in Lake Tanganyika you'll find fish with different specialties, including algal scrapers and scale rippers. Travel 600 miles south to Lake Malawi and you'll find fish that fulfill the same roles and look nearly identical.

The story looks to have a simple evolutionary explanation—each lake saw some specialization from a common ancestor. The problem is Lake Tanganyika formed eight million years after Lake Malawi. Genetic data reveal the species are not related and evolved from very different ancestor fish.<sup>27</sup> Even though the various fish came from different phylogenetic backgrounds, they converged on similar ecological niches. The biologists first categorized the fish based on body type; only with newer research methods could they determine the vastly different evolutionary paths.<sup>28</sup>

Conversely, superficially different subjects may behave in a similar way. Consider an example from the business world, Dell and Amazon.com. Historically, most investors compared Dell to

companies that produced personal computers, including Hewlett-Packard, IBM, and Apple. Amazon.com was compared to other retailers, like Wal-Mart, Target, and Barnes & Noble.

However, if you compare them based on business model—a low margin, high invested capital turnover strategy—Dell and Amazon.com look more like one another than they do their respective peer groups. While the industry dynamics each company deals with are undoubtedly important, the companies may well share similar value drivers and valuation characteristics.

*Absolute versus relative changes.* Expected utility theory assumes when individuals compare, they consider gains and losses in the context of their total wealth, a broad frame. In contrast, prospect theory reveals people actually consider their alternatives versus isolated components of their wealth, a narrow frame. Inconsistent with economic theory, most people compare using relative, not absolute, dollars.<sup>29</sup>

For example, if someone hears about a \$100 DVD player selling across town at half the price, most are inclined to drive to get the \$50 discount. However, if someone hears they can save \$50 on a \$30,000 car across town, most will stay put. In the first case, half off a \$100 DVD player represents a large relative discount. In the latter case, the \$50 discount is negligible versus the car's price, and hence doesn't seem worth the effort. Of course, the \$50 is the same in both instances; the difference is how we think about it.

Another crucial prospect theory finding is loss aversion, which says that given a choice between risky outcomes, we suffer about two times as much for losses as we enjoy comparable gains. Most people will turn down the opportunity to win \$100 for a correct coin toss call if they stand to lose \$50 for an incorrect call, even though the financial proposition has a positive expected value.

Awareness of our natural tendencies to think in relative terms and to treat gains and losses differently is crucial to comparing successfully. These psychological pitfalls can lead to suboptimal decisions.

*Availability and anchoring.* Psychologist Barry Schwartz tells a story of someone looking for a new automobile with a premium on reliability and safety. After consulting *Consumer Reports*, the individual decides on a Volvo. Shortly thereafter, the potential buyer meets a friend who tells horror stories about *her* new Volvo being in the shop numerous times, calling into question the vehicle's reliability. What's the chance the buyer will seek another brand?<sup>30</sup>

If you'd bet there's a good chance the buyer will switch brands, you've identified the availability heuristic at work. The availability heuristic states the more available something is to memory, the more frequently it must occur. Naturally, if an idea is fresh in our memory and we associate it with frequency, we'll automatically perceive the idea to be relevant. In Schwartz's story, one Volvo owner likely sways the buyer's opinion, even though *Consumer Reports* uses thousands of vehicles to judge reliability. As the saying goes, the plural of anecdote is not evidence.

The significance for the availability heuristic in comparing relates to, but remains somewhat distinct from, the idea of relying on statistics versus intuition. Intuition is often a gut feel, based on experience and perception. In contrast, recent or vivid events generally trigger the availability bias.

Anchoring is another powerful force that can meaningfully distort comparisons. We often anchor on a specific figure when deciding, and generally fail to adjust sufficiently. Anchoring is so deep-seated that it applies even when the subjects know they are being fed irrelevant information.

In one famous experiment, subjects were asked what percentage of African countries is in the United Nations. The researchers then spun a wheel with numbers one through one hundred. When a 10 appeared, the group guessed 25 percent; when the wheel landed on 65, it was 45 percent.<sup>31</sup> Our minds innately find and use anchors. Examples include prior stock prices, historical growth rates or valuations, and prices for goods on the shelf.

*Specialization versus generalization.* Specialization, or deep knowledge of a field, has obvious benefits in many situations. However, specialization can impede sound comparisons in two important ways.

First, it's useful to identify, and prioritize, the most relevant features when comparing. For instance, the weather forecast tells you whether to grab a light sweater or a heavy sweatshirt. Feature prioritization also works when predicting, although the features are more circumstance than attribute related.

Specialization can complicate this process. Rather than comparing using the most salient features, specialists (who know a lot of facts, after all) tend to compare based on additional features, potentially irrelevant to the decision. So if you talk to an industry expert, for example, you should expect to hear a compare-and-contrast discussion along many more dimensions than are useful or necessary to compare and decide effectively. This issue often surfaces when analysts and portfolio managers discuss investment ideas.

As a second drawback, specialization can limit our ability to detect change. Cognitive studies show that people fixated on a scene often fail to see gradual change. Of course, the accumulation of small changes is a large change. Specialists often have a difficult time putting changes into a proper context, hence penalizing their ability to compare.

*We seek facts that confirm our view.* Social psychologist Thane Pittman, in an apparent slip of the tongue, once said "I'll see it when I believe it."<sup>32</sup> As it turns out, Pittman was not off the mark. The confirmation bias impedes our ability to make intelligent comparisons, since we seek confirming information and disavow or ignore disconfirming evidence. Once we've made a decision, we're loath to change our view. This consistency allows us to stop thinking about the issue and to avoid the consequence of reasoning.

Ideally, we'd like to have an open mind when comparing alternatives. But few of us operate this way. Take political issues as an example. Prior to the 2004 election, a team of researchers put an equal number of ardent Republicans and Democrats through a brain scanner as they listened to George Bush and John Kerry contradict themselves. The scientists didn't see increased activity in brain regions associated with reasoning. However, circuits involved with conflict resolution were active, and pleasure centers lit up when the subjects heard their own candidate.

The lead researcher of the study, Drew Westen, concluded, "Essentially, it appears as if partisans twirl the cognitive kaleidoscope until they get the conclusions they want, and then they get massively reinforced for it, with the elimination of negative emotional states and activation of passive ones."<sup>33</sup>

The main point is we have a tendency to interpret ambiguous stimuli in a way that suits our prior beliefs, making comparison difficult. This is especially relevant for incremental information.

### **From Theory to Practice: Thoughts on Comparison for Investors**

When chess expert Bruce Pandolfini stressed the importance of making good comparisons he was talking about the board game, but you could say the same thing about investing. The best investors are skilled at comparison.

If you want to improve your comparing skills, a good place to start is an awareness and recognition of the many ways you can go wrong. A checklist of the issues can be a great aid to quality thinking. Here are some thoughts:

- *Describe carefully.* The research shows that *how* we describe situations plays a crucial role in how we perceive them.<sup>34</sup> So describe investment situations carefully, and make sure you consider as many perspectives as possible. Description matters.

- *Focus on business models.* Most comparable valuations in the investment industry focus on *what* the company does to make money, not *how* it makes money. What the company does tells you about the industry, how the company makes money tells you about the business model and, ultimately, the return on invested capital prospects. Intra-industry comparisons are fine, especially when the industry has homogenous business models. However, if companies approach the market differently and business models are diverse, the better comparisons may be outside the industry.
- *Consider strategies through a circumstantial lens.* Companies make a lot of strategic decisions, and you should assess the virtue of various strategies based on the prevailing or forthcoming circumstances. For instance, M&A are a major way companies try to shift their strategic position, and history shows that M&A deals destroy value, on average, for the acquiring company's shareholders. So the question becomes: under what circumstances do acquirers create value?
- *Recognize the economic backdrop.* Over time, the macro determinants of value change, including interest rates, inflation expectations, tax rates, and equity risk premia. Further, companies and industries go through a life cycle, which ultimately leads to a commodity multiple. Awareness of the economic and lifecycle backdrop can greatly improve comparisons.

We spend a lot of time comparing. In many cases the stakes are not too high. But under some conditions, including investment decisions, good comparisons are essential. It's important to recognize when you add complexity to the problem of comparison—a temporal dimension, probabilities, and vast, often-ambiguous information—people make many more mistakes. Awareness of the pitfalls and taking some steps to mitigate them can go far in making you better at comparing—and investing.

## Endnotes

- <sup>1</sup> Anna Muoio, "All The Right Moves," *Fast Company*, May 1999.
- <sup>2</sup> Daniel Gilbert, *Stumbling on Happiness* (New York: Alfred A. Knopf, 2006), 143.
- <sup>3</sup> Joshua D. Greene, R. Brian Sommerville, Leigh E. Nystrom, John M. Darley, and Jonathan D. Cohen, "An fMRI Investigation of Emotional Engagement in Moral Judgment," *Science*, 14 September, 2001, 2105-2108.
- <sup>4</sup> Paul R. Carlile and Clayton M. Christensen, "The Cycles of Theory Building in Management Research," *Harvard Business School Working Paper 05-057*, February, 2005.
- <sup>5</sup> Aristotle, *The Categories on Interpretation* (Cambridge, MA: Harvard University Press, 1938); Ludwig Wittgenstein, *Philosophical Investigations* (Cambridge, UK: Blackwell Publishing, 2001), 1:66-71; George Lakoff, *Women, Fire, and Dangerous Things* (Chicago, IL: University of Chicago Press, 1990).
- <sup>6</sup> Sanjoy Basu, "Investment Performance of Common Stocks in Relation to their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis," *Journal of Finance*, vol. 32, 1977, 663-682; Sanjoy Basu, "The Relationship Between Earnings Yield, Market Value and the Return for NYSE Common Stocks: Further Evidence," *Journal of Financial Economics*, June 1983, 129-156.
- <sup>7</sup> David Dremen, *Contrarian Investment Strategies: The Next Generation* (New York: Simon & Schuster, 1998).
- <sup>8</sup> Steven Holzer, *How Dell Does It* (New York: McGraw Hill, 2005); Mark Gottfredson, Rudy Puryear, and Stephen Phillips, "Strategic Sourcing: From Periphery to the Core," *Harvard Business Review*, February 2005, 132-139.
- <sup>9</sup> A quotation by Emerson captures this concept nicely, "The difference between men is in their principle of association. Some men classify objects by color and size and other accidents of appearance; others by intrinsic likeness, or by the relation of cause and effect. The progress of the intellect is to the clearer vision of causes, which neglects surface differences." Ralph Waldo Emerson, *Ralph Waldo Emerson: Selected Essays, Lectures and Poems* (New York: Bantam, 1990).
- <sup>10</sup> Carliss Y. Baldwin and Kim B. Clark, *Design Rules: The Power of Modularity* (Cambridge, MA: The MIT Press, 2000); Clayton M. Christensen and Michael E. Raynor, *The Innovator's Solution: Creating and Sustaining Successful Growth* (Boston, MA: Harvard Business School Press, 2003).
- <sup>11</sup> David Sklansky, *Getting the Best of It* (Las Vegas, NV: Two Plus Two Publishing, 2001), 138-167.
- <sup>12</sup> Michael J. Mauboussin, *More Than You Know: Finding Financial Wisdom in Unconventional Places* (New York: Columbia University Press, 2006), 23-28.
- <sup>13</sup> Malcolm Gladwell, *Blink: The Power of Thinking Without Thinking* (New York: Little, Brown and Company, 2005).
- <sup>14</sup> Michael Lewis, *Moneyball: The Art of Winning an Unfair Game* (New York: W.W. Norton & Company, 2003).
- <sup>15</sup> William G. Chase and Herbert A. Simon, "Perception in Chess," *Cognitive Psychology*, vol. 4, 1973, 55-81. Also, Philip E. Ross, "The Expert Mind," *Scientific American*, August 2006, 64-71.
- <sup>16</sup> Eric Bonabeau, "Don't Trust Your Gut," *Harvard Business Review*, May 2003.
- <sup>17</sup> See [http://viscog.beckman.uiuc.edu/djs\\_lab/](http://viscog.beckman.uiuc.edu/djs_lab/).
- <sup>18</sup> Philip E. Tetlock, *Expert Political Judgment: How Good is It? How Can We Know?* (Princeton, NJ: Princeton University Press, 2005). Also, Michael J. Mauboussin, "Are You an Expert?" *Mauboussin on Strategy*, October 28, 2005.
- <sup>19</sup> Gilbert, 140.
- <sup>20</sup> Daniel L. Schacter, ed. *Memory Distortion: How Minds, Brains, and Societies Reconstruct the Past* (Cambridge, MA: Harvard University Press, 1995), 1.
- <sup>21</sup> Lewis, 18.
- <sup>22</sup> Mauboussin, 135-140.
- <sup>23</sup> Schacter, 17.
- <sup>24</sup> Samuel M. McClure, David I. Laibson, George Loewenstein, and Jonathan D. Cohen, "Separate Neural Systems Value Immediate and Delayed Monetary Rewards," *Science*, vol. 306, October 15, 2004, 503-507.

- <sup>25</sup> Amos Tversky, "Features of similarity," *Psychological Review*, vol. 84, 1977, 327-352. Reprinted in Eldar Shafir, ed. *Preference, Belief, and Similarity: Selected Writings, Amos Tversky* (Cambridge, MA: MIT Press, 2004).
- <sup>26</sup> Gilbert, 100.
- <sup>27</sup> Paul W. Glimcher, *Decisions, Uncertainty, and the Brain: the Science of Neuroeconomics* (Cambridge, MA: MIT Press, 2003), 159-163.
- <sup>28</sup> Simon Conway Morris, *Life's Solution: Inevitable Humans in a Lonely Universe* (Cambridge, UK: Cambridge University Press, 2003).
- <sup>29</sup> Daniel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, vol. 47, 1979, 263-291.
- <sup>30</sup> Barry Schwartz, *The Paradox of Choice: Why Less is More* (New York: HarperCollins, 2004), 56-61.
- <sup>31</sup> "Rethinking thinking," *The Economist*, December 16, 1999.
- <sup>32</sup> Leeat Yariv, "I'll See It When I Believe It – A Simple Model of Cognitive Consistency," *Cowles Foundation Discussion Paper No. 1352*, February, 2002.
- <sup>33</sup> Michael Shermer, "The Political Brain," *Scientific American.com*, June 26, 2006.
- <sup>34</sup> Amos Tversky and Derek J. Koehler, "Support Theory: A Nonextensional Representation of Subjective Probability," *Psychological Review*, vol. 101, 1994, 547-567. Reproduced in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and Biases: The Psychology of Intuitive Judgment* (Cambridge, UK: Cambridge University Press, 2002).

## Resources

### Books

Aristotle, *The Categories on Interpretation* (Cambridge, MA: Harvard University Press, 1938).

Baldwin, Carliss Y., and Kim B. Clark, *Design Rules: The Power of Modularity* (Cambridge, MA: The MIT Press, 2000).

Christensen, Clayton M., and Michael E. Raynor, *The Innovator's Solution: Creating and Sustaining Successful Growth* (Boston, MA: Harvard Business School Press, 2003).

Conway Morris, Simon, *Life's Solution: Inevitable Humans in a Lonely Universe* (Cambridge, UK: Cambridge University Press, 2003).

Dremen, David, *Contrarian Investment Strategies: The Next Generation* (New York: Simon & Schuster, 1998).

Emerson, Ralph Waldo, *Selected Essays, Lectures and Poems* (New York: Bantam, 1990).

Gilbert, Daniel, *Stumbling on Happiness* (New York: Alfred A. Knopf, 2006).

Gilovich, Thomas, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and Biases: The Psychology of Intuitive Judgment* (Cambridge, UK: Cambridge University Press, 2002).

Gladwell, Malcolm, *Blink: The Power of Thinking Without Thinking* (New York: Little, Brown and Company, 2005).

Glimcher, Paul W., *Decisions, Uncertainty, and the Brain: the Science of Neuroeconomics* (Cambridge, MA: MIT Press, 2003).

Holzer, Steven, *How Dell Does It* (New York: McGraw Hill, 2005).

Lakoff, George, *Women, Fire, and Dangerous Things* (Chicago, IL: University of Chicago Press, 1990).

Lewis, Michael, *Moneyball: The Art of Winning an Unfair Game* (New York: W.W. Norton & Company, 2003).

Mauboussin, Michael J., *More Than You Know: Finding Financial Wisdom in Unconventional Places* (New York: Columbia University Press, 2006).

Schacter, Daniel L., ed. *Memory Distortion: How Minds, Brains, and Societies Reconstruct the Past* (Cambridge, MA: Harvard University Press, 1995).

Schwartz, Barry, *The Paradox of Choice: Why Less is More* (New York: HarperCollins, 2004).

Shafir, Eldar, ed. *Preference, Belief, and Similarity: Selected Writings, Amos Tversky* (Cambridge, MA: MIT Press, 2004).

Sklansky, David, *Getting the Best of It* (Las Vegas, NV: Two Plus Two Publishing, 2001).

Tetlock, Philip E., *Expert Political Judgment: How Good is It? How Can We Know?* (Princeton, NJ: Princeton University Press, 2005).

Wittgenstein, Ludwig, *Philosophical Investigations* (Cambridge, UK: Blackwell Publishing, 2001), 1:66-71.

**Articles and Papers**

Basu, Sanjoy, "Investment Performance of Common Stocks in Relation to their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis," *Journal of Finance*, vol. 32, 1977, 663-682.

—., "The Relationship Between Earnings Yield, Market Value and the Return for NYSE Common Stocks: Further Evidence," *Journal of Financial Economics*, June 1983, 129-156.

Bonabeau, Eric, "Don't Trust Your Gut," *Harvard Business Review*, May 2003.

Carlile, Paul R., and Clayton M. Christensen, "The Cycles of Theory Building in Management Research," *Harvard Business School Working Paper 05-057*, February, 2005.

Chase, William G., and Herbert A. Simon, "Perception in Chess," *Cognitive Psychology*, vol. 4, 1973, 55-81.

Gottfredson, Mark, Rudy Puryear, and Stephen Phillips, "Strategic Sourcing: From Periphery to the Core," *Harvard Business Review*, February 2005.

Greene, Joshua D., R. Brian Sommerville, Leigh E. Nystrom, John M. Darley, and Jonathan D. Cohen, "An fMRI Investigation of Emotional Engagement in Moral Judgment," *Science*, vol. 14, September, 2001, 2105-2108.

Kahneman, Daniel, and Amos Tversky, "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, vol. 47, 1979, 263-291.

Mauboussin, Michael J., "Are You an Expert?" *Mauboussin on Strategy*, October 28, 2005.

McClure, Samuel M., David I. Laibson, George Loewenstein, and Jonathan D. Cohen, "Separate Neural Systems Value Immediate and Delayed Monetary Rewards," *Science*, vol. 306, October 15, 2004, 503-507.

Muoio, Anna, "All The Right Moves," *Fast Company*, May 1999.

"Rethinking thinking," *The Economist*, December 16, 1999.

Ross, Philip E., "The Expert Mind," *Scientific American*, August 2006, 64-71.

Shermer, Michael, "The Political Brain," *Scientific American.com*, June 26, 2006.

Tversky, Amos, "Features of similarity," *Psychological Review*, vol. 84, 1977, 327-352.

Tversky, Amos, and Derek J. Koehler, "Support Theory: A Nonextensional Representation of Subjective Probability," *Psychological Review*, vol. 101, 1994.

Yariv, Leeat, "I'll See It When I Believe It – A Simple Model of Cognitive Consistency," *Cowles Foundation Discussion Paper No. 1352*, February, 2002.

The views expressed in this commentary reflect those of Legg Mason Capital Management (LMCM) as of the date of this commentary. These views are subject to change at any time based on market or other conditions, and LMCM disclaims any responsibility to update such views. These views may not be relied upon as investment advice and, because investment decisions for clients of LMCM are based on numerous factors, may not be relied upon as an indication of trading intent on behalf of the firm. The information provided in this commentary should not be considered a recommendation by LMCM or any of its affiliates to purchase or sell any security. To the extent specific securities are mentioned in the commentary, they have been selected by the author on an objective basis to illustrate views expressed in the commentary. If specific securities are mentioned, they do not represent all of the securities purchased, sold or recommended for clients of LMCM and it should not be assumed that investments in such securities have been or will be profitable. There is no assurance that any security mentioned in the commentary has ever been, or will in the future be, recommended to clients of LMCM. Employees of LMCM and its affiliates may own securities referenced herein.