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Advances in Financial Decision Making: In Search of a New Paradigm

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Abstract

This paper will employ a model comprised of five components (Rules of Thumb/Heuristics, Rational Being/Theory, Cognitive Psychology/Behavioral Finance, Neuroscience, and the Unconscious Mind) for conducting a qualitative meta-analysis of the current state of financial decision making behavior. Early financial decision making was not supported by any formal theory until Irving Fisher's Theory of Interest in 1907. While the field of management was making strides early in the 20th century, finance remained primarily an experiential field dominated by rules of thumb until the late 1940s. The development of expected utility theory ushered in the golden age of theoretical finance as academics borrowed concepts from economics and the physical sciences to support Modern Portfolio Theory, the Capital Asset Pricing Model, Option Pricing Theory, and so forth. The failure of theory to explain why individuals do not behave as theory predicts they should has stimulated interest in developing progressively better paradigms. From the early 1970s, this search has focused on contributions from cognitive psychology and neuroscience in making significant strides in understanding financial decision making behavior and why observed behavior deviates from theory. The resulting time series analysis will clarify the overlaps and the ascendency and decline of the relative influence of each paradigm over time. A major goal is to better understand how we arrived at our current state of knowledge and to provide an assessment of the sources of future contributions and strategies likely to be major contributors to our growing knowledge of financial decision making in the future.

Introduction

What is "special" about the study of financial decision making, say in comparison to decision making related to recreational or career choices? Finances or decisions about money serve as an overall proxy for many of the so-called hygienic needs in the Maslow and Hertzberg Motivation-Hygiene Theory. In this generally accepted theory, human needs may be represented by a hierarchy as shown below:

FIGURE 1
MASLOW-HERTZBERG MOTIVATION-HYGIENE HEIRARCHY OF NEEDS

Source: http://tutor2u.net/business/gcse/people_motivation_theories.htm

In this theory, human needs identified as hygienic/basic need to be satisfied before higher level needs, such as self-esteem, job satisfaction, and human fulfillment. These hygienic needs appear lower on the pyramid display in figure 1 and include such needs as physiological and safety/security needs. We learn and become conditioned to the association of having access to money with the satisfaction of these basic needs. Thus, decisions associated to acquiring money are an important to our capability of satisfying basic needs and providing a pathway to self-actualization, or achieving our ultimate human goals. This generally applies widely across cultures and differentiates financial decisions from most other types of decision making.

Financial decision making by individuals in the past few years has provided a new awareness (and humility) regarding the quality of the accumulated knowledge supporting those decisions. Actions by Congress providing incentives for individuals in the real estate market to make ill-advised home purchases, home owners using their homes as ATMs to increase near term consumption, the failure of Americans to save sensibly for retirement, poor investment performance by individual investors, and poor decision making by corporate managements that destroy huge amounts of wealth beg the question: Why do we get such consistently poor results and how can we improve financial decision making in the future for the benefit of stakeholders?

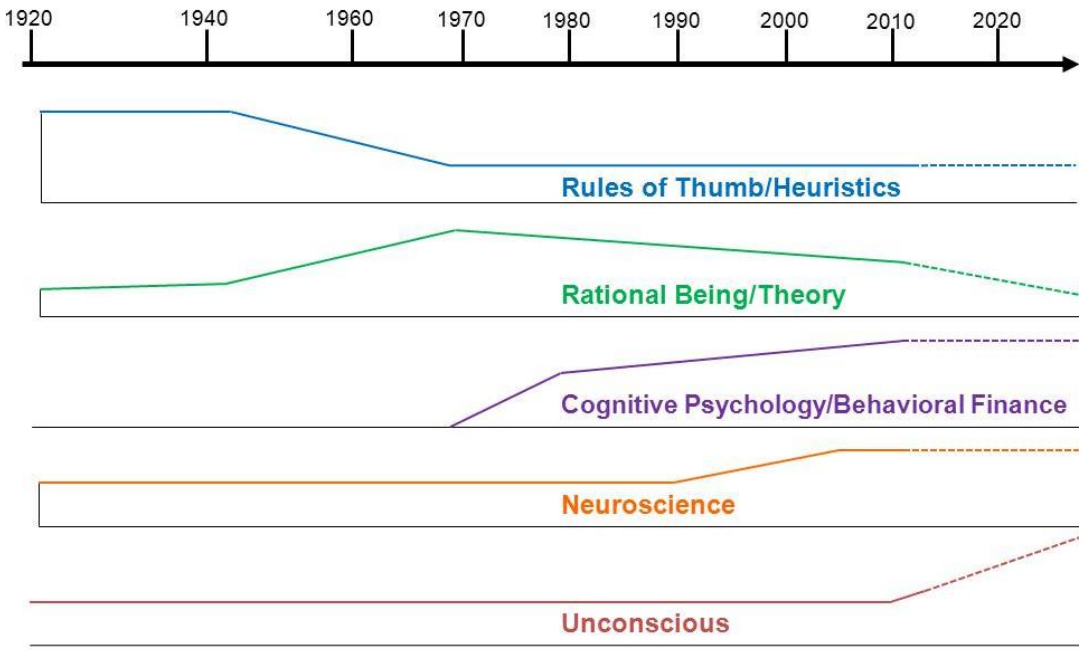
To respond to this important question, developing a historical context describing and analyzing how financial decision making has evolved over time is an important starting point. This context, when combined with an assessment of where we are in understanding financial decision making, can lead us to a deeper understanding of how to use what we know more effectively and what sort of a research program is needed to fill the gap going forward. In this

paper a model comprised of five components (Rules of Thumb/Heuristics, Rational Being/Theory, Cognitive Psychology/Behavioral Finance, Neuroscience, and the Unconscious Mind) will be employed for conducting a qualitative meta-analysis of the current state of financial decision making behavior.

In the last 100+ years varying amounts of research has been conducted to improve financial decision making. In general, it appears that, as the then-current most-favored paradigm becomes increasingly encumbered with anomalies and unfavorable critiques, a new paradigm rises by being able to explain some of the weaknesses of the "old" paradigm and new areas of research are opened up. The old paradigm declines and the new paradigm becomes increasingly adopted and applied to real world observations. At the point of maximum enthusiasm, a reductionist tendency leads us to feel that finally we may have some important solutions and henceforth financial decision making will be significantly improved. The cycle continues as this currently favored paradigm reaches its maximum influence and begins to decline due to identified failures to account for observed behaviors, while a new paradigm takes its place as the one now favored to move us forward. The model employed in this paper will attempt to show how the various paradigms for financial decision making have risen to prominence for a period, and then declined in relevance due to these forces.

The overall model is shown below:

FIGURE 2
KNOWLEDGE ACCUNULATION – FINANCIAL DECISION MAKING



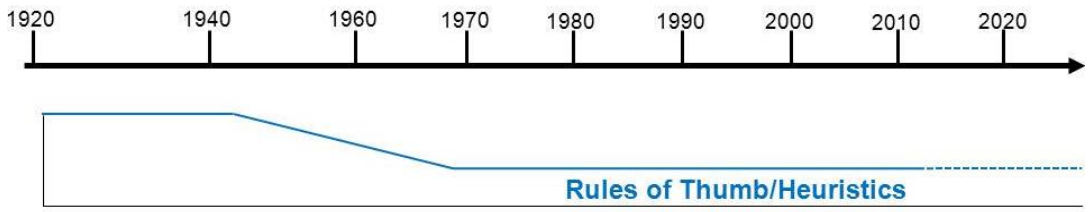
Each component (Rules of Thumb/Heuristics, Rational Being/Theory, Cognitive Psychology/Behavioral Finance, Neuroscience, and the Unconscious) of this model will be described, analyzed, and assessed as its contribution to the body of knowledge with respect to financial decision making. The height of each curve in figure 2 represents its relative influence

as a paradigm at the designated points in time. The examination and analysis will be on both a time series (how a specific component/paradigm has evolved over time) and cross sectional (how paradigms contribute to the body of knowledge at points in time) basis. This qualitative meta-analysis approach is meant to provide an integrated view of contributing paradigms over time with the goal of providing more transparency to a very complex process (how financial decisions are made). With better awareness of what we know and what we don't know, it is hoped we can move forward in our research to develop better financial decision making practices in the future.

Rules of Thumb/Heuristics Paradigm

If we go back to the time before the development of financial theory, financial decision making was heavily influenced by rules of thumb or heuristics, as depicted in Figure 3.

FIGURE 3
RULES OF THUMB/HEURISTICS PARADIGM LIFE CYCLE



Rules of thumb/heuristics are simply mental shortcuts. Gigerenzer and Wolfgang (2011) provide a definition of heuristics for the purposes of this paper: "A heuristic is a strategy that ignores part of the information, with the goal of making decisions more quickly, frugally, and/or accurately than more complex methods," (p. 454). Thus, heuristics do not attempt to find the optimal solution, but one that is best, given the context and constraints faced by the decision maker. The case against heuristics is that, because heuristics are using mental shortcuts, that they are inferior to more comprehensive approaches. In support of the power of heuristics, Gigerenzer (2008, p. 21) lists the criticisms and responses to the use of heuristics, selected items are displayed in Table 1.

TABLE 1
HEURISTICS CRITICISMS AND RESPONSES

Criticism	Response
Heuristics produce second-best results: optimization is always better	In many situations, optimization is impossible (e.g., computationally intractable) or less accurate because of estimation errors (i.e., less robust)
Our minds rely on heuristics only because of our cognitive limitations	Characteristics of specific environment (e.g., computational intractability) and of the mind make relying on heuristics the best choice
People rely on heuristics only in routine decisions of little importance	People rely on heuristics for decisions of both low and high importance (see the investment and organ donation examples)

People with higher cognitive capacities employ complex weighting and integration of information; those with lesser capacities use simple heuristics (related to criticism 1)	This statement is not supported by experimental evidence. Cognitive capacities seem to be linked to the adaptive selection of heuristics and seem less linked to the execution of a heuristic (see also the Markowitz example later in this paper).

Certainly, heuristics are not the best approach in every case, but when applied appropriately, they represent the best one can do in specific situations given the tradeoff between time available to make a decision, uncertainty, and the cost of getting better information. If we have a situation where there is little uncertainty, adequate information and sufficient time to process data, we may be able to do better than employing a heuristic that uses a mental shortcut. However, as uncertainty increases, the time to make a decision becomes constrained, and the quality of information to support analysis declines, a heuristic may perform better than a more complex, data-driven approach. The nature of this set of tradeoffs was formalized by Simon (1957) with the term "bounded rationality." Bounded rationality refers to the fact that the ability of a decision maker to take as much time as needed to make an optimal decision is constrained by the quantity and quality of information available, and the time available to make the required decision. The overall constraint is the cognitive limitations associated with one's mind in the pursuit of an optimal rather than satisficing (best decision, given the circumstances) decision.

Going back to before the 1950s, finance was considered a proto-science (Jovanovic, 2008), a discipline without a robust theoretical framework. As a proto-science, decision making is driven by experience, available data, and simple analytical procedures developed to organize and process data for the decision maker to consider. In situations where there is good quality data and a validated analytical process, basic statistics and business condition indicators were used effectively to judge the condition of a firm or an investment candidate. An example is the DuPont Model developed by Alfred Sloan in the 1920s for analyzing an entity's profitability as a function of asset turnover and profit margin as a means to direct management's attention to those areas in the firm that require better oversight and management. The basic model is as follows:

$$\text{ROE} = \left[\frac{\text{NOPAT}}{\text{Sales}} * \frac{\text{Sales}}{\text{Assets}}\right] * \left[1 - \frac{\text{Net interest expense after tax}}{\text{Net debt}}\right] * \frac{\text{Net debt}}{\text{Equity}}$$

Where:
ROE = the return on equity
NOPAT = Net Operating Profit

In words, the return on equity is equal to the operating profit margin * the number of times assets are turned over (in relation to sales) * leverage factor (how return can be leveraged by using borrowed money, the last two expressions). These factors all interact in the relationships shown to demonstrate how profitability is derived. While very useful in focusing the financial manager's attention to the important financial metrics that comprise the firm's profitability, the formula does not represent a financial theory.

In another example, if we consider a situation where one needs to select between three capital investments, where there is a high degree of uncertainty and we have no theory describing how data associated with the investments can be processed to rank the investments, shortcuts based on experience may be the best approach. A popular heuristic going back to the 1800s for making the capital investment decision is the payback criterion. One makes the investment based on how quickly the investment is recovered by the future cash flows. If the criterion is to invest only when the investment can be recovered in three years, then any investment with a payback period beyond three years is foregone. If there are multiple investment opportunities available to achieve a goal, then one should select the investment that pays back the soonest, as long it meets the minimum payback period requirement. This heuristic has stood the test of time in terms of its perceived utility and is still used as one method to select capital investments. Another heuristic for deciding how to allocate $X to multiple approved independent investment opportunities is to use the 1/N heuristic. For example, if there are three investments, then allocate 1/3 of the available funding to each. We see this heuristic employed frequently when individuals allocate their 401K retirement funds to various investment options.

A financial heuristic that has been persistent over time is full cost pricing, where economic theory maintains that, in a competitive economy, profitability is maximized when the price is set to marginal cost. Etzioni (1987) found that, contrary to theory, executives consistently employ full-cost pricing as a means to deal with the uncertainties in the estimates of demand functions, avoid charging too high a price and driving away customers or too low a price in an oligopolistic market, and to avoid the burdens of setting the prices for thousands of items using marginal costs for firm with many products. A rival methodology for setting prices, activity based costing, that is more consistent with economic theory has been increasingly adopted by organizations, but is still less popular than full cost pricing.

Perhaps the most well-known heuristic is the Pareto principle, referred to as the 80/20 principle, or focus on the vital few rather than the trivial many (Juran, 1954). The basis for the principle was Pareto's research (1906) pointing out that in Italy approximately 80% of the country's income was earned by 20% of the population. The terms Pareto principle and "vital few and trivial many" were popularized by Juran (1954) based on his work in the 1940s applying the findings of Pareto to many areas of management (including finance). For example, capital investment programs appear to obey this principle, with a small percentage of projects accounting for a major portion of the problems, such as cost overruns and schedule slippages. Thus, a manager should focus on the 20% of the projects accounting for 80% of the associated problems.

Recent research has identified a number of additional heuristics used in general and financial decision making, such as the following (Gigerenzer & Wolfgang, 2011): summarized in Table 3.

TABLE 2
HEURISTICS AND FINANCIAL EXAMPLES

Recognition Heuristic: If one of two alternatives is recognized and the other is not, then infer that the recognized alternative has the higher value with respect to the criterion. This is used effectively in modern advertising, where an ad is repeated many times to trigger consumer selection of a non-branded product/service based simply on recognition. A number of experiments have been conducted where the mere mention of a phrase prior

to decision effectively biases selection of a specific alternative. A financial application is the frequent repeating of high margin financial services in advertising to materially increase the probability of consumers choosing these specific services.
Fluency heuristic: If both alternatives are recognized but one is recognized faster, then this alternative is assumed to have higher value based on the criterion. An example would be Broadway shows playing in a specific time frame in New York, select the one that comes to mind first. In finance, an example is, if a proposed investment reminds one of a past successful investment, then invest in this one.
Take-the-first heuristic: Choose the first alternative that comes to mind. (Hepler, 2008) showed experienced basketball players video sequences from a professional game and asked what they would have done, pass the ball to the player at the left or take their shot. Generally, the first option that came to mind was shown to be better than later options, as were the options that players chose when they had more time to inspect the situation. If your initial gut feeling is to get out of a losing investment, this is usually the best choice. Normally, as discussed with the cognitive psychology paradigm, losing investments cause emotional reactions that lead one to hold on to them too long.
One-Clever-Cue Heuristics: Many animals (and homosapiens) use relatively simple cues to make an important decision. The example offered by Petrie and Halliday (1994) is when a pea hen chooses a mate, she investigates only three or four of the peacocks displaying in a lek and chooses the one with the largest number of eyespots. A financial decision making example is the criterion location, location, and location given heavy weight in deciding which home to buy.
Take-the-Best: In the take-the-best heuristic, we have a model where people will decide which of two options to select based upon simple binary cues based on memory. The sequence of actions is to search for valid cues, stop when you reach the first cue that discriminates between the options, and then select the option with the highest value based on the cue. As an example, Czerlinski et al. (1999) relates a discovery where the take-the-best heuristic can predict more accurately than more sophisticated linear and nonlinear multiple regression models. Similarly, keeping it simple in financial decisions by focusing on the main variables has been shown to yield the best results in most cases.
Fast & Frugal Trees: These are basically checklists rather than complex statistical techniques. An example is the way checklists have been found to be better than regression analysis to determine if emergency room patients for heart conditions should be sent to intensive care. Another example is the setting up of filters to narrow down investment options based upon desirability criteria (e.g., earnings per share, market to book value ratio, earnings growth, and leverage).
Default Heuristic/Status Quo: If there is a default, do nothing about it. John and Goldstein (2003) compare the rates of potential organ donors in a sampling of countries. In countries where the policy is to automatically include individuals in the donor program with the ability to opt out, most choose to remain in the program. In countries where individuals have to choose to be a donor, the rates of enrollment are much lower. An example in financial decision making is the automatic enrollment of new employees into the option to allocate sufficient employee pay to their 401K to maximize the matching feature in the employer plan. Research has shown that many more employees will accept the match (with the ability to opt out) and save more for retirement than in plans where the employee has to specifically choose the maximum match option (opt in).

Tit-for-tat (Axelrod, 1984): Cooperate first, and then imitate your partner's last behavior or extract revenge for what is considered a betrayal of trust. An example is the Trust Game related by McCabe et al. (2001), where two agents participate in a one-shot trust game. When the game is modified (after the exchanges) and the "investor" is given the opportunity to extract revenge for a betrayal of trust, many take the opportunity to punish the offending party, even though the result is that both parties are worse off. Trust is critical in financial transactions of all sorts. The pervasive feelings of betrayal by the public in the 2008 financial crises has materially adversely affected trust in many financial areas (especially the withdrawal of a large number of individuals from investing in equities) and contributed to significantly lower levels of economic activity.
Imitate the majority (Boyd & Richerson, 2005): Look at what a majority of people in your peer group are doing, and imitate their behavior. Herding (also discussed in the cognitive psychology section) is well known as an important factor in causing financial extremes, such as the forming of bubbles or sinking into an economic depression. Anthropologists have suggested that this heuristic has an evolutionary origin; that it served as a cost effective survivability strategy (avoiding danger/predators or gaining timely access to food).
Imitate the successful (Boyd & Richerson, 2005): Look for the most successful person and imitate his or her behavior. Similar to herding, it has been suggested that imitating the successful was identified early as a cost effective strategy for survival by our ancient ancestors and has been passed down in our DNA (more on that in the discussion of the unconscious). An example of this heuristic, benchmarking, is a valued quality improvement strategy for modern business (or for an individual making a financial decision) and involves identifying best practices and reengineering processes to improve efficiency and effectiveness.

The work of Graham (1949) and Graham and Dodd (1934) highlight another set of heuristics particularly relevant to investment analysis and trading. They spent many years investing and trading on Wall Street and Graham spent nearly 30 years as a professor at Columbia University. His heuristics are meant to deal with the complexity that goes into making investment decisions and to neutralize the tendency for human emotions to oftentimes get in the way of making intelligent decisions. He developed rules, such as the use of simple formulas to eliminate the illusion of control and deal with the bounded rationality issues inherent in investment decision making. The ten Graham and Dodd rules for deciding whether to invest are displayed in Table 2.

TABLE 3
GRAHAM & DODD INVESTMENT RULES

1. An earnings-to-price yield of twice the triple-A bond yield. The earnings yield is the reciprocal of the price earnings ratio.
2. A price/earnings ratio down to four-tenths of the highest average P/E ratio the stock reached in the most recent five years. (Average P/E ratio is the average stock price for a year divided by the earnings for that year.)
3. A dividend yield of two-thirds of the triple-A bond yield.

4. A stock price down to two-thirds of tangible book value per share.
5. A stock price down to two-thirds of net current asset value — current assets less total debt.
6. Total debt less than tangible book value.
7. Current ratio (current assets divided by current liabilities) of two or more.
8. Total debt equal or less than twice the net quick liquidation value as defined in No. 5.
9. Earnings growth over the most recent ten years of seven percent compounded—a doubling of earnings in a ten-year period.
10. Stability of growth in earnings—defined as no more than two declines of five percent or more in year-end earnings over the most recent ten years.

These simple rules, or investment heuristics, are still employed as effective criteria for consistently making good investments. More complicated methodologies have been proposed, but the heuristics have been shown to compete very well with the best of these alternatives for identifying good investments.

The work of Graham and Dodd applied primarily to investors, where there was sufficient time to evaluate and consider the pros and cons associated with prospective choices. Another side of investing is trading, where there is an even greater reliance on heuristics to guide buying and selling behavior with the intention of holding assets for shorter periods of time. An example is the list of "rules"/heuristics expressed by Jesse Livermore and virtually memorized by every professional trader as behavioral guidelines for trading securities, as displayed in Table 3.

TABLE 4
JESSE LIVERMORE TRADING RULES/HEURISTICS

1. Buy rising stocks and sell falling stocks.
2. Do not trade every day of every year. Trade only when the market is clearly bullish or bearish. Trade in the direction of the general market. If it's rising you should be long, if it's falling you should be short.
3. Co-ordinate your trading activity with pivot points (at major support or resistance levels).
4. Only enter a trade after the action of the market confirms your opinion and then enter promptly.
5. Continue with trades that show you a profit, end trades that show a loss.
6. End trades when it is clear that the trend you are profiting from is over.
7. In any sector, trade the leading stock - the one showing the strongest trend.
8. Never average losses by, for example, buying more of a stock that has fallen.
9. Never meet a margin call - get out of the trade.
10. Go long when stocks reach a new high. Sell short when they reach a new low.

Source: http://www.jesse-livermore.com/trading-rules.html

There are many heuristics (only a sampling has been discussed here) developed for different decision making situations. In some cases, they are efficient and effective and have stood the test of time. In other instances, they have been relied upon due to poor judgments

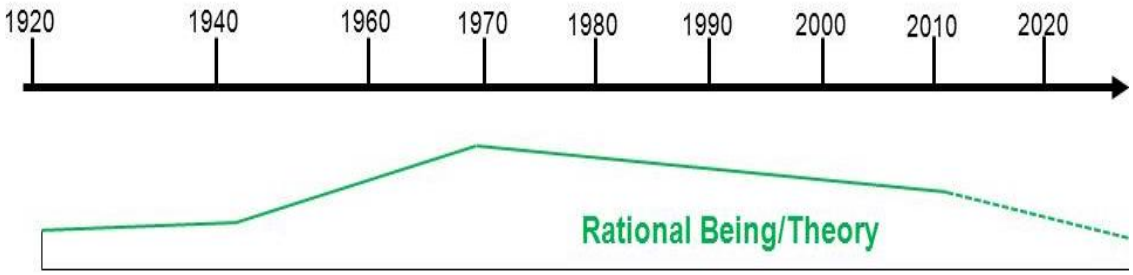
driven by emotions or misjudging the nature of the tradeoff between urgency, uncertainty, and the availability of additional decision making tools.

Heuristics are alive and well in both modern general management and financial decision making as shown in some of the examples. What we know about heuristics and how they are employed have changed markedly, primarily due to the advance in knowledge about decision making behavior. The effective use of heuristics depends on a combination of factors: the experience of the decision maker, awareness of the strengths and weaknesses of the heuristic, and the decision making context. For example, if time constraints are not an issue and there is sufficient time to gather additional information and apply decision making tools, then the justification for use of a heuristic is weak. Alternatively, if there is a high degree of uncertainty, a large amount of ambiguous information available, and an urgency to make a decision, then informed use of a heuristic may be the best approach. A danger for modern decision makers is the availability of too much information, where the cognitive limitations associated with bounded rationality and a time constraint can lead to either "analysis-paralysis" or the reliance on the improper use of quantitative analysis that is overly complex and less transparent. The use of heuristics and the timing of their use are closely related to the concept of intuition and the effects of emotions, which will be discussed in the neuroscience and unconscious sections of the paper.

Rational Being/Theory Paradigm

The period from the 1940s through the 1960s saw the development of most modern finance theory, in the areas of asset, portfolio, and contingent claims pricing; along with capital structure and dividend policy theory.

FIGURE 4
RATIONAL BEING THEORY PARADIGM



Development of this body of theory was based on the use of sophisticated techniques such as quadratic programming and concepts from classical economics. This was a significant departure from pre 1940s when observed behaviors in the market served as the basis of investment and trading principles.

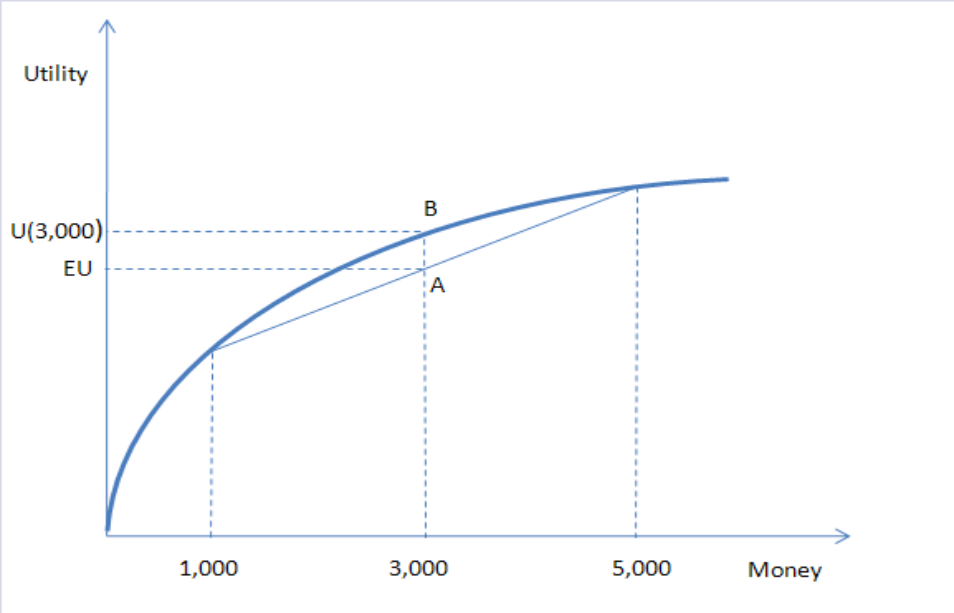
This golden age of theoretical finance was ushered in with the theory of expected utility (Von Neumann & Morgenstern, 1944) with their assumptions of the rational decision maker, which included:

1. **Completeness**: People can rank order all choices/alternatives (revealed preferences)

2. **Transitivity**: If alternative B is preferred to alternative A, and alternative C is preferred to alternative B, the alternative C is preferred to A.
3. **Continuity**: When an individual prefers A to B and B to C, then there should be a feasible combination of A and C in which the individual is then indifferent between this combination and the lottery B.

Expected utility theory postulates that individuals act rationally and in accordance with the three assumptions laid out by Von Neumann and Morgenstern. Given these conditions, an expected utility curve, reflecting how individuals make choices takes the following form:

FIGURE 5
EXPECTED UTILITY THEORY



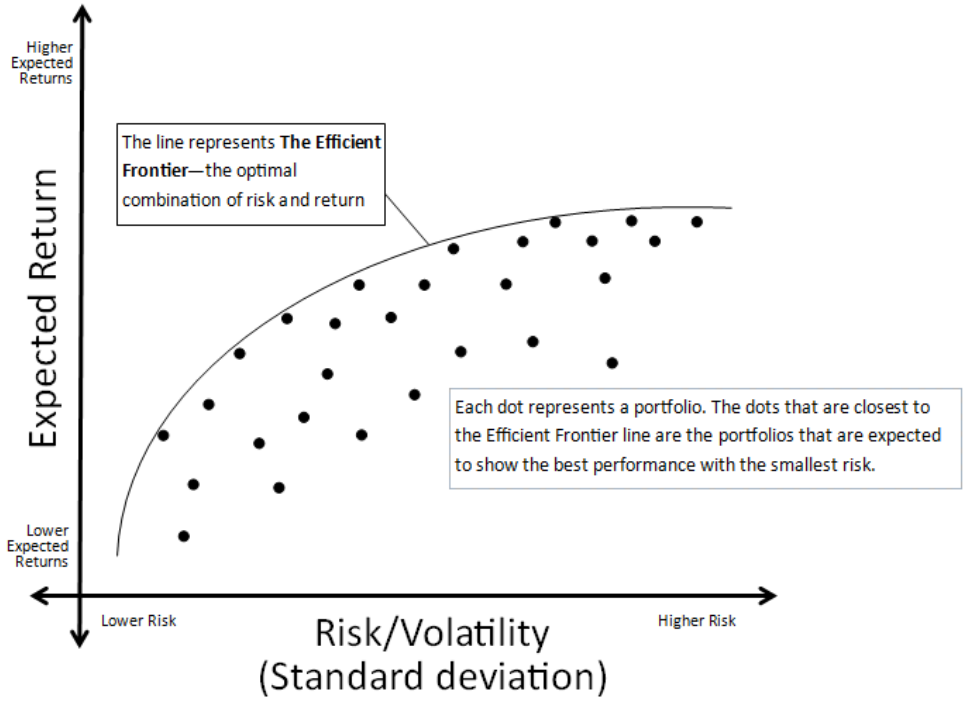
Note that the preferences for a (rational) risk adverse individual would be traced out as a concave curve and be represented by:

Risk Averse Decision Maker: U(EP=3000) > U(P) or U(3000) > U (.50*1000 + .50*50000)

Here, the utility of the expected prospect/gamble [U(EP=3000)] is greater than the utility of the gamble [U(P)]. The point on the curve where expected utility (EU) intersects the curve is the point where the individual is indifferent between that amount for certain and a gamble that pays either $1,000 or $5,000, each with a probability of .50. Note that this amount is less than the expected value of $3,000 because the individual is risk averse.

This framework for individual decision making served as a basis for modern portfolio theory developed by Markowitz (1952, 1959). Markowitz showed that, with the expected utility assumptions and the assumption that investors were mean-variance utility of wealth maximizers (they minimize risk for a specific target return, or they maximize return for a specific risk target).

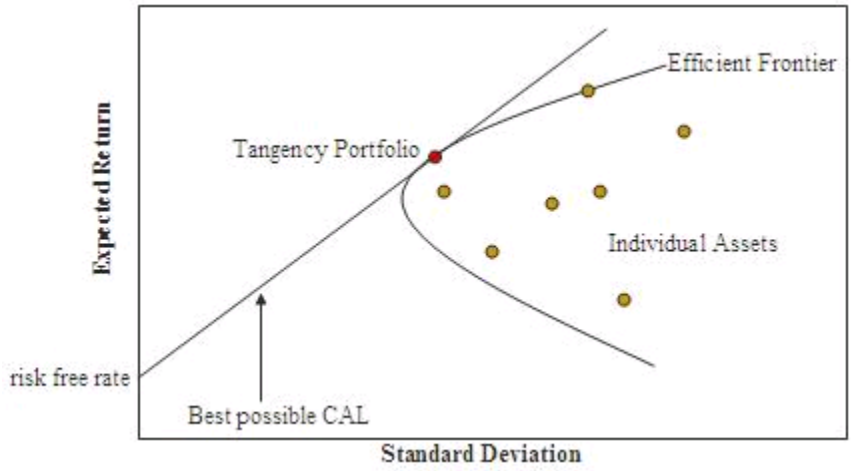
FIGURE 6
MARKOWITZ EFFICIENT FRONTIER



Source: http://www.smart401k.com/Content/Education/

Markowitz's innovation was to apply a specific utility function (mean-variance, wealth maximization) to a plotting of the expected return and variance of all investments available and employ quadratic programming to identify the efficient frontier (the curve where the sum of the squared deviations are minimized) of the investment set. A point on this frontier represents the best an investor can do, given their risk preferences (either minimizing the level of risk for a specific target return or maximizing the return for a target risk level). The mathematical solution provides the weight of each asset to include in the portfolio to satisfy the risk-return specifications. While diversification was an intuitive concept in investing, Markowtiz's work provided a theoretical basis for this critical principle (diversification is considered the only "free lunch" in the theory of finance) and demonstrated a methodology of how to scientifically implement it. Tobin (1958) later added a risk free asset, which allows the investor to reach a higher level of utility by investing in a combination of the risk free asset and a portfolio on the efficient frontier, as shown in figure 7.

FIGURE 7
EFFICIENT FRONTIER WITH A RISK-FREE ASSET



Source: http://en.wikipedia.org/wiki/Modern_portfolio_theory

Modigliani and Miller (1958) continued to develop the theory of finance with their theory of capital structure. Under the conditions (quasi efficient markets) of no taxes, no transactions costs, and individuals and corporations borrowing at the same rate, and no bankruptcy costs, they were able to show that the financial policies of degree of leverage and dividend policy had no effect on the value of the firm. This was possible because investors, under these assumptions, could manufacture their own preferred level of leverage by borrowing or lending; i.e., corporate leverage didn't have any particular value to investors so that would not affect their demand for shares in nether firm. Similarly, their presentation demonstrated that investors can create their own dividends by selling an appropriate amount of shares (Miller & Modigliani, 1961). Later, Modigliani & Miller (1963) amended their theory to show that the fact that interest is tax deductible would add some value to a firm under certain conditions.

Fama (1965) made a major contribution to the theory of finance through the formalization of the Efficient Market Hypothesis (EMH), that market prices incorporate all information and follow a random walk. According to the EMH one cannot consistently beat the market, providing further support for broad diversification as an investment principle. Around this same time, Sharpe (1964) introduced the Capital Asset Pricing Model (CAPM). The CAPM provided a methodology to price any asset on the basis of the market portfolio, its variability in returns in relation to the market portfolio and the risk free asset. Both the EMH and the CAPM adopt the assumptions associated with portfolio theory and added additional ones, such as all individuals have similar beliefs with respect to expected asset returns and risk and that these beliefs are consistent with rational expectations (i.e., estimates are unbiased). The final major contribution to theory that will be mentioned is the Black and Scholes Model (Black & Scholes, 1973) for pricing options on assets. Originally applied to common stocks, the model has been extended to cover all types of financial and non-financial options. It should be noted that the EMH does not require that individual investors be rational, only that their expectations, when averaged, are unbiased (rational expectations).

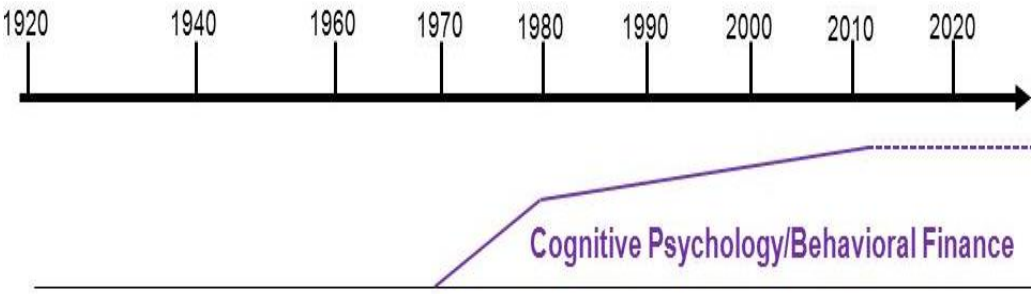
The relationship between heuristics (plus analytical techniques such as the DuPont Model) and the rise of financial theory can be credited with the evolution of finance from a

proto-science to a discipline with an underlying theoretical framework. It brought a structure to financial decision making that lessened the reliance on the use of heuristics. As a result, academics flocked to the new discipline, extending additions to theory and identifying applications. Heuristics still occupied an important role in real world decision making, especially with the work of Simon (1957) formalizing a decision making model with the concept of bounded rationality. One of these best-known instances of the persistence of certain heuristics is that of Harry Markowitz, the founder of modern portfolio theory, in his 1990 speech accepting the 1990 Nobel Prize in Economics. While his theory implies that all investors should determine the weight of assets by choosing a portfolio on the efficient frontier, he indicated that he simply used the 1/N rule to allocate his funds in his retirement account.

Cognitive Psychology/Behavioral Finance Paradigm

Financial theory was met by great enthusiasm and continued to build momentum through the 1960s; however, it did have its critics. Numerous exceptions to theory, especially to the EMH and the CAPM, were identified by researchers and practitioners. Given the strong assumptions required to support the theories, criticisms can be expected, but the volume and degree of deviations from how individuals are "supposed" to make financial decisions and how asset prices are "supposed" to act grew to a crescendo by 1970. The search was on for a new paradigm as the failures of theory to adequately answer growing challenges to its validity continued to mount.

FIGURE 8
COGNITIVE PSYCHOLOGY/BEHAVIORAL FINANCE PARADIGM LIFE CYCLE



An article appearing in a 1972 *Journal of Finance* paper (Slovic, 1972) began with the quote from Smith (1968):

> You are-face it-a bunch of emotions, prejudices, and twitches, and this is all very well as long as you know it. Successful speculators do not necessarily have a complete portrait of themselves, warts and all, in their own minds, but they do have the ability to stop abruptly when their own intuition and what is happening Out There are suddenly out of kilter……If you don't know who you are, this is an expensive place to find out, (p. 779).

The main point being made by Slovic is that the development of financial theory (describing how people should make financial decisions) made no provision for human emotions, which are important drivers in how people actually behave. This paper reinforced the challenges posed by the identified anomalies to theory as described in the previous section of the paper. In cognitive psychology experiments were being performed to explain some of the deviations from theory.

The incorporation of the findings of cognitive psychology into the body of financial knowledge has given rise to a branch of finance known as behavioral finance. Although the contributions to financial decision making by cognitive psychology responded to a number of the criticisms leveled at the normative behavior prescribed by financial theory, it has also proven to be very contentious within the academic community. In general, critics concede that individuals can be irrational at times, but maintain that, in the aggregate, such errors will cancel out and the market will be efficient due to arbitraging (otherwise known as "the law of one price"). Those academics and practitioners favoring behavioral finance maintain that there is a systematic deviation from theory in decision making behavior and argue that this can lead to violations to the Efficient Markets Hypothesis, as well as serious errors at the level of the individual decision maker.

In experiments, researchers Daniel Kahneman and Amos Tversky (1972) were observing how people behave when offered various choices/gambles. They identified situations where people systematically behaved inconsistently with rational models from economic/financial theory. This resonated with a number of academics and practitioners and stimulated the development of Prospect Theory (Tversky & Kahneman, 1973, 1974, 1981; Kahneman & Tversky, 1979; Kahneman, Slovic, & Tversky, 1982). These behavioral inconsistencies can be sorted into three categories, as shown in tables 5, 6, and 7.

TABLE 5
BIASES – POTENTIAL DECISION ERROR

Biases: The predispositions to commit specific types of errors.
1. Excessive Optimism - Occurs when people overestimate how frequently they will experience favorable outcomes, and underestimate how frequently they will experience unfavorable outcomes. Examples: Once an investment is made, there is a tendency to imagine all the favorable scenarios where the investment will reap excellent returns and ignore, at least temporarily, the scenarios where there are losses. This, in combination with the confirmation bias, develops into an over-optimistic expectation. Meinert (1991) concludes that a major reason for accumulating excessive debt may be attributed to an individual's or organization's excessive optimism about future cash flows. When cash flows do not meet expectations, the burden of a large amount of debt leads to financial distress and possibly bankruptcy.
2. Overconfidence - Occurs when people make mistakes more frequently than they believe and view themselves as better than average. Types of overconfidence are the better than average effect and the over-precision effect.

Examples of better than average effect: There have been a large number of experiments showing that people in general believe themselves better than average as drivers, in attractiveness, intelligence, and skill level. Barber and Odean (1999) found that investors who traded more had lower returns than those who traded less and attributed this behavior to overconfidence. They found in a later paper (2001) that men tend to be more overconfident than women. The trading activities of people with discount brokerage accounts was analyzed and it was demonstrated that men traded more than women investors and on average had lower returns. This suggests that men are more overconfident than women. In the over-precision effect, individuals make errors in estimating their level of confidence that an estimate lies within a designated confidence interval. For example, Alpert and Raiffa (1982) found that when people give a 98% confidence interval, it contains only 60% of the cases as the true value.

3. Confirmation - Occurs when people attach too much importance to information that supports their views relative to information that runs counter to their views.

Examples: In investing, the confirmation bias suggests that an investor would be more likely to look for information that supports his or her original idea about an investment rather than seek out information that contradicts it. As a result, this bias can often result in faulty decision making because one-sided information tends to skew an investor's frame of reference, leaving them with an incomplete picture of the situation. The slow pace of analysts updating their forecasts in response to new information can be attributed to a combination of confirmation and conservatism biases.

4. Illusion of Control - Occurs when people overestimate the extent to which they can control outcomes.

Examples: Investors tend to under-diversify when they have control of their own investment decisions; for example, investing too high a percentage in one's own company's stock (e.g., Enron). History demonstrates that broad diversification in retirement accounts, accompanied by employee opt-out options instead of opt in options for 401K/403B retirement accounts, yields better investment results on average and motivates individuals to save more for retirement (Ackert & Deaves, 2010).

5. Hindsight Bias - When subjects, after learning the eventual outcome, give a much higher estimate for the predictability of that outcome than subjects who predict the outcome without advance knowledge.

Example: After the bursting of the tech bubble, there were many financial "experts" in the media claiming to know technology stocks were in a bubble and ready to crash. Likewise, the subprime market meltdown of 2008 and the recent oil spill in the gulf motivated many, especially politicians, to level extreme criticisms at primary "players" and provide after-the-fact advice and solutions. The pairing of hindsight bias with regret is especially common with individual investors. So-called trends on

losing investments are easier to see after than before-the-fact. The feeling that losses could have been prevented by recognizing what appears to have been an obvious trend earlier feeds regret and the hindsight bias and may mistakenly give one the false sense they are wiser now.
6. Conservatism - This bias shows an attachment to past analyses, practices, beliefs, and commitments even when they start to prove erroneous, counterproductive, even unsustainable. Examples: Once a position has been stated most people find it very hard to move away from that view even when they are presented with new data. When movement does occur it is only very slow which creates under-reaction to events (incrementalism). The manner in which large organizations develop their budgets is an example of this bias. Basu (1997) shows that that investors are too slow/conservative to update their market expectations in response good news about a firm. This means that investors are inclined to initially underreact to this good news, resulting in upward drift of the share price over time, all other things being equal. Interestingly, conservatism is not evident in the reaction to bad news, which appears to be reflected immediately in the share price.

TABLE 6
HEURISTICS – POTENTIAL DECISION ERROR

Heuristics: These are information processing shortcuts (rules of thumb) that mainly result from one's experiences in a field of work. As discussed earlier in this paper, the use of heuristics, when properly aligned to the situation, can be the best approach. However, when the decision context is misjudged based on the situation (uncertainty, information availability, urgency) and emotions, such simplifying shortcuts are subject to serious errors
2. Availability - When people rely on information that is readily available and intuitive relative to information that is less salient and more abstract. Examples: A Corporate CEO goes to a conference where the new buzz word is Corporate Performance Management and returns to their company directing major investments in associated software and consulting without systematically evaluating and planning. One may evaluate the probability that a given business venture will fail by imagining various difficulties it could encounter (Kahneman & Tversky, 1974). Something that is repeated often increases its probability of being subject to the availability heuristic, a strategy employed in designing ads for marketing products and services (Kahneman & Tversky, 1974).
1. Representativeness - When people try to determine the probability that a data set A was generated by a model B, or that an object A belongs to class B, they often use the

representativeness heuristic. This means they evaluate the probability by the degree to which A reflects the essential characteristics of B.

Example: Linda, the bank teller example (Kahneman & Tversky, 1974):

Linda is outspoken and very bright, majoring in philosophy and very concerned with issues of discrimination and social justice as a student. She also participated in anti-nuclear demonstrations.

Question posed to subjects: is the probability that Linda is a bank teller greater or less than Linda being a bank teller and active in the feminist movement?

Many respondents incorrectly choose the latter choice as being more likely based on the similarity between Linda and characteristics of those sympathetic with the feminist movement; thereby ignoring the fact that this sample group is a subset of the population of bank tellers.

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3. Anchoring – When people form an estimate by beginning with an initial number and adjusting to reflect new information or circumstances. However, they tend to make insufficient adjustments relative to that number, thereby leading to anchoring bias.

Examples: Using this year's budget as the baseline/start point of next year's budget (giving some, but insufficient weight to changed conditions). A classical experiment in anchoring is to gather a group into a room and spin a wheel with numbers from 1 to 100. Then, subjects were asked whether the percentage of U.N. membership accounted for by African countries was higher or lower than the number on the wheel. Afterward, the subjects were asked to give an actual estimate.

Tversky & Kahneman (1974) found that the seemingly random anchoring value of the number on which the wheel landed had a pronounced effect on the answer that the subjects gave. Participants are then asked to write down their estimate of the number of African nations that are member of the UN. Results consistently show that the guesses across a large number of groups are highly correlated with the number appearing on the wheel. For example, when the wheel landed on 10, the average estimate given by the

subjects was 25%, whereas when the wheel landed on 60, the average estimate was 45%. They are affected by the number from the wheel, even though they know that number was random and has nothing to do with the question being asked.
4. Affect – When people base their decisions primarily on intuition, instinct, and gut feeling. Examples: Affect/intuition plays a role in preference by many for the payback criterion, even with its disadvantages (ignoring cash flows after the payback period, not discounting cash flows). Many "pet" projects approved based on intuition/affect (no cash flow forecasts & discounting), because they "feel right." (Shefrin, 2007). In an experiment, Winkielman, et. al (1997) flashed one of three images at experimental subjects: a smiling face, a frowning face, or a neutral geometric shape. The subjects were then shown a Chinese character and requested to respond on their degree of preference. Subjects preferred the characters paired with smiling faces, even though the smiling face was shown only for 1⁄250 of a second, even though they did not consciously recall seeing it.

Typical of many of the behavioral findings from cognitive psychology, a decision making approach may have multiple characteristics that support classification in more than one scheme (say, a bias by one researcher versus as a heuristic by another). Thus, no common classification scheme has been universally adopted in the literature. Researchers look at these behaviors (biases and heuristics) with different perspectives and classify them as biases, or heuristics without a common standardization. On the one hand, this lack of a standard has contributed to fragmentation and some confusion and has made the convergence to a common theory/paradigm less likely. However, this variability in classifications indicates that many of the observed behaviors may have a common source.

TABLE 7
FRAMING EFFECTS – POTENTIAL DECISION ERROR

Framing Effects: Framing effects in decision situations arise when different imagery and descriptions of the same problem highlight different aspects of the outcomes. 1. Glass Half Empty/Half Full – Preference for an option depends upon whether choices are couched in terms of probabilities of success or failure. Examples: In a large number of experiments with doctors and patients, the choice of patients to undertake the procedure is significantly affected by whether the doctor explains the procedure in terms of chance of success or failure (McNiel et. al, 1982). Similarly, financial services marketers understand that expressing the percentage of times when an investment exceeds a specific target is more likely to induce an individual to invest than describing the percentages of instances when the investment fails to meet a specified return.

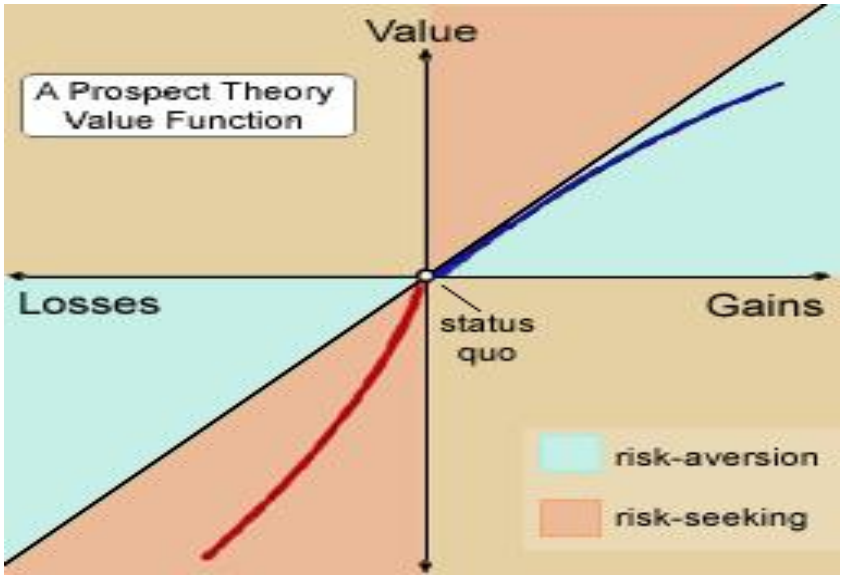
2. Aversion to a Sure Loss – When subjected to a loss from a starting endowment, there is a tendency to hold the investment/project until break even, irrespective of whether the outlook is positive or negative for future performance. This is also known as the "disposition effect" as described by Shefrin & Statman (1985).

Examples: Individual investors tend to sell winners too early and hang on to losers too long- a phenomenon mainly attributed to "loss aversion" behavior as stated above. Losses cause more severe pains (almost twice as much) than the pleasure resulting from a gain of the same magnitude. A corporate version of this is where managers are reluctant to terminate losing projects (or management initiatives), thereby committing the sunk cost fallacy. This tendency to be risk averse when a prospect is in the domain of gains and risk seeking in the domain of losses was discovered by Kahneman & Tversky (1979) and demonstrated with what they call a value function (see figure 9 below).

3. Mental Accounting - The mental account associated with the decision to accept a gamble includes money won or lost in that gamble and excludes other assets or the outcome of previous gambles. People adopt mental accounts because this mode of framing because it simplifies evaluation and reduces cognitive strain.

Examples: Many people have a household budget for food, and a household budget for entertaining. At home, where the food budget is present, they will not eat lobster or shrimp because they are much more expensive than a fish casserole. But in a restaurant, they will order lobster and shrimp even though the cost is much higher than a simple fish dinner. If they instead ate lobster and shrimp at home, and the simple fish in a restaurant, they could save money. But because they are thinking separately about restaurant meals and food at home, they choose to limit their food at home (Ritter, 2003). In financial decision making individuals tend to keep investments in separate accounts; this will induce more errors through the aversion to a sure loss tendency for losing investments and the premature taking of gains on winners. A better approach is to look at the overall return of the portfolio first, then apply rules for buying or selling individual investments within the portfolio.

FIGURE 9
UTILITY VALUE FUNCTION



Source: Kahneman & Tversky (1979)

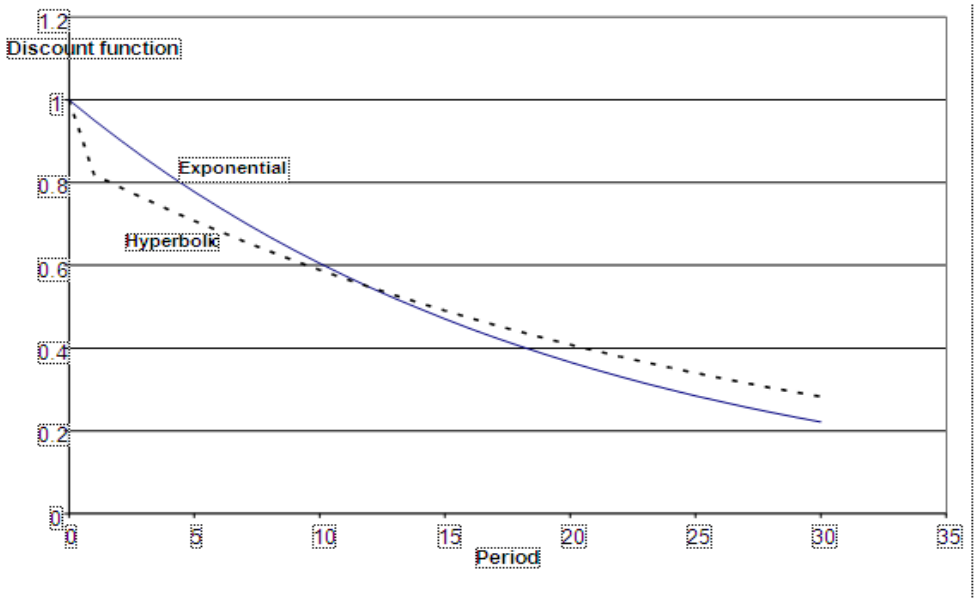
Behaving according to a value function (see figure 9), one's utility function is convex in the domain of losses (aversion to taking sure losses) and concave in the domain of gains (tendency to take small gains); whereas the traditional expected utility function demonstrating risk aversion everywhere is convex through all values of expected wealth. This framing effect is due to behavior being dependent upon the gain/loss from a beginning wealth position, rather than being based only on the expected final wealth position.

Research conducted to explain the formation and bursting of bubbles provides strong support for the position that humans are motivated to follow the path that the herd is on in circumstances where emotions run high or where there are perceived risks/costs with deviating from the path being taken by most. Markets have been observed to reach extremes at times due to the herding behavior by sizable groups of individuals. For example, the 1929 and 2000 stock market crashes after huge rises cannot be explained by the EMH. Parker & Prechter (2007) analyze a number of these bubbles and crashes and conclude that cycles of optimism and pessimism feed on each other, resulting in extreme levels of optimism and eventual reverses in asset prices. When the optimism has run its course and asset prices decline, it appears virtually everyone resets their expectations becoming pessimistic and asset prices crash as extreme price declines are realized. Olsen (1996) observes a different form of herding in analysts' projections of future prospects for firms. They tend to follow the crowd as a means of protecting themselves from being wrong and damages to their reputation (if they are wrong, then so were the majority).

In the theory of finance, comparing alternative choices requires discounting expected future benefits back to the present at the required rate of return (or the return required to delay consumption to a future date) so that choices are made on a common basis (Samuelson, 1937). For example, savers may require a return on their money in a savings account of 3% annually as a requirement to save for future consumption and not spend now. A key finding from cognitive psychology is that humans deviate from theory, which dictates that the rate of time preference or discount rate is constant, by employing hyperbolic discounting in deciding whether to take

rewards sooner rather than later. People tend to overweight the preference for immediate consumption. Frederick et al. (2002) cite a large number of studies implying that most people apply short termism or hyperbolic discounting in choices between taking a reward now or waiting for a larger reward. For example, in experiments, if one were offered $100 right now or $110 a week from now, which would they choose? Most subjects chose to take $100 now. It didn't seem worth it to wait for a week for only $10 more. On the other hand, if one were offered $100 a year from now or $110 a year and one week from now, most will wait the extra week and take the $110. These are equivalent choices in economic/finance theory, but people usually reverse their preferences and choose to wait an extra week for an extra $10 if the reward is delayed for a year. The further an event lies in the future, the less people care about it and the less it is affected by hyperbolic discounting. This is reflected in the figure below:

FIGURE 10
HYPERBOLIC VS. TRADITIONAL/EXPONENTIAL DISCOUNT FUNCTION



Source: Ackert & Deaves (2010)

This propensity people have for short term rewards largely accounts for saving less and consuming more in the short term and is one of the more serious problems faced in retirement planning. In corporate finance, such short termism accounts for overweighting self-interest and corporate cash flow consumption in the near term and not making sufficient capital available for longer term investments. Unfortunately, incentives in executive compensation plans have tended to reinforce short termism or hyperbolic discounting, instead of better aligning incentives and behavior with the welfare of shareholders, customers, and society in general.

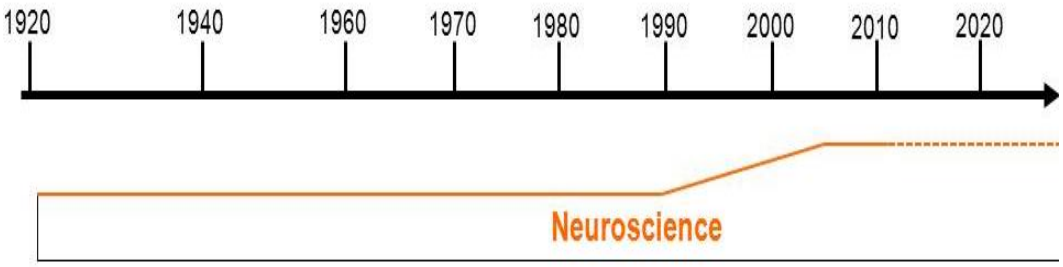
As the graphic at the beginning of this section shows, the initial publications by Slovic, Kahneman, & Tversky attracted a great deal of interest and evolved into the related field of study, behavioral finance. A diverse group of individuals from academia, psychology, corporate finance, investing, and financial advising have provided contributions and become stakeholders in the research and application of this new knowledge. This has been both positive and negative. The multiple perspectives have served an integrating function in helping to better understand

complex human behavior. On the downside, the lack of a standard taxonomy in financial decision/behavioral errors has detracted from overall coherence. More importantly, there is no comprehensive theory or paradigm to explain and predict human behaviors on a consistent basis (many "errors" are only obvious in retrospect). In addition, new knowledge development has followed the standard growth curve, initial strong advances, growth, and finally maturity. The focus in the now mature stage is in identifying new areas where this knowledge can be applied, such as executive compensation and incentive contracts, planning and investing for retirement, gender differences in financial decision making, and avoiding serious mistakes in corporate capital investments.

Neuroscience Paradigm

Neuroscience has helped to clarify and provide a physiological basis for the hypotheses and findings published for the past three decades.

FIGURE 11
NEUROSCIENCE PARADIGM LIFE CYCLE



Neuroscience has had a substantive impact on the study of financial decision making behavior since the mid-1980s with the use of electrical signals in Transcranial Magnetic Stimulation (TMS) and Transcranial Direct Current Stimulation (tDCS) (Charron et al. 2008). Using these techniques, the experimenter is able to stimulate specific areas of the brain and then observe behavior in financial decision making tasks. The primary advantage of TMS and tDCS is the ability to control the location and duration of the stimulus applied to the brain. Both techniques use electrical current applied to a subject's cortex that disrupts the functioning of and communication between neurons. By correlating the location of the disruption to behavior, researchers form an assessment of that region's role in decision making.

Positron Emission Tomography (PET) using a radioactive tracer injected into the bloodstream has been in use to study brain function since the 1950s (Charron et al. 2008). Using PET, the researcher injects a radioactive tracer in the bloodstream of a subject prior to the beginning of an experiment and the subject is placed into a cyclotron. The objective is to measure the concentration of this marker in the brain. When a brain area is active, more blood is required to carry oxygen to the area where the active cells are located. The injected tracer emits a positron that collides with its anti-particle, an electron, leading to a pair of photons of high energy that fly away in opposite directions and are detected by the PET scanner (Charron et al.,

2008). An example of its use was by Zald, et al. (2004) to study brain reactions for revenge in the trust game.

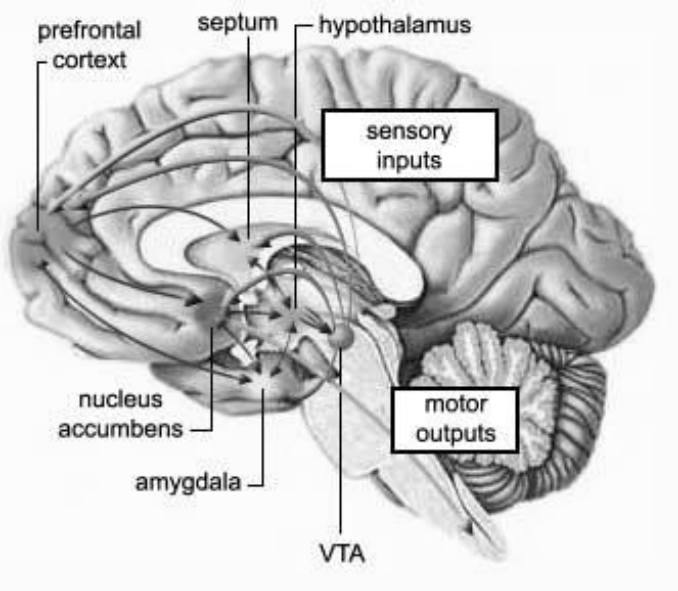
An important disadvantage of the TMS, tDCS and PET approaches is that they are invasive and, therefore, they potentially corrupt observed behaviors related to financial decision making tasks in experimental situations. In addition, they do not show the detail in brain reactions that functional magnetic resonance imaging (fMRI) does. The fMRI is a noninvasive way to study the brain's reactions to various situations within financial decision making experiments. This is superior to both the TMS and PET approaches, which are invasive and do not show the detail in brain reactions that the fMRI does.

FIGURE 12
FUNCTIONAL MAGNETIC RESONANCE IMAGING

Source: Peterson (2007b)

A functional MRI scanner applies a strong magnetic field to the subject and records the variations of the magnetic field caused by an increase in blood flowing to the brain. The change in this signal between an area that is active compared to the same area when it is not active is what is recorded in the brain images (Charron et al., 2008). It is important to note that these recorded changes in the brain are indirect indications of how the brain reacts to various financial decision making scenarios in experiments. Therein lays the basis for an ongoing controversy about the degree of confidence we can attribute to conclusions from fMRI imaging.

FIGURE 13
BRAIN REWARD AND LOSS AVOIDANCE CIRCUITS



Source: http://thisisyourbrainon.wordpress.com/

While technically not correct, depicting the brain as made up of three major regions is a convenient means for explaining functions and relationships. The base of the brain, known as the midbrain, is the most ancient component and is located on top of the brain stem. It is part of the central nervous system and involved with hearing, motor control, vision, and body temperature regulation and is estimated be around 250 million years old (equivalent to lizards and snakes). As life on the plant evolved, the limbic system developed. Located above the midbrain, it is the center of emotions, and is estimated to be as old as 170 million years (equivalent to dogs). As a higher level component of brain physiology, emotions are necessary to initiate action. The third part of the brain, in its developed state what makes us human, is the prefrontal lobe/cortex of the cerebrum lying around and on top of the limbic system. It is estimated to be about 40 million years old, though modern human behaviors, such as tool making, are not evident until around 80,000 years ago.

With the fMRI researchers can observe what happens in the brain as the emotions are signaling that action is needed. It uses radio waves and a strong magnetic field to make images of the brain that show brain activity. The neural activity causes changes in the need for oxygen, which causes changes in blood flow. Differences in the magnetic properties arising from hemoglobin in the blood when it is oxygenated compared to when it is depleted of oxygen result in magnetic fluctuations that are recorded by the fMRI.

As indicated earlier, the limbic system is the center of human emotion; it initiates positive and negative emotions and communicates these to the prefrontal lobe of the cerebrum. In the limbic system, the amygdala is a key component of the loss circuit; it sets off the alarm for action in the face of threats and danger. In an emergency these strong impulses can generate an automatic response. For example, when faced with an imminent danger, the amygdala may impel the body to take actions we are not consciously aware of. Early in human evolution,

having an amygdala to quickly initiate action to avoid danger was necessary to survival. In our evolved state as humans, the amygdala still exerts strong forces on behavior. Experiments show that the amygdala is also stimulated when individuals make a risk-free choice (Peterson, 2007a).

The prefrontal lobe of the cerebrum is the executive manager that interprets these impulses from the limbic system and makes conscious decisions on how to act. For example, when someone anticipates a loss or feels fear, the loss circuit in the limbic system lights up on the fMRI; when a gain (or pleasure) is anticipated, the reward circuit in the limbic system lights up (Bozarth, 1994). These emotions are communicated to the frontal lobes where the emotions are interpreted and an evaluation process is conducted and the decision is made.

The nucleus accumbens (NAcc) in the limbic system is the counter to the Amygdala; it transmits excitement, anticipation, and pleasant sensations to the prefrontal lobe (Kuhnen & Knutson, 2005). Dopamine, a neurotransmitter, plays a key role in stimulating the NAcc by generating an intense feeling of excitement or anticipation; thereby turning motivations into decisions and decisions into action. In a study by Knutson et al. (2001) they found that NAcc activation represents gain prediction, while anterior amygdala/insula activation represents loss prediction (Paulus et al., 2003). The nucleus accumbens also experiences increased blood flow when an individual is making a risky choice (Peterson, 2007a). fMRI experiments have shown how the nucleus accumbens reacts to dopamine in differing situations involving anticipated gains:

1. Unanticipated gain - Strong reaction and feeling of pleasure in the gain circuit transmitted to the prefrontal cortex
2. Gain equal to anticipated gain – Small or no reaction in the gain circuit
3. Gain less than anticipated – Activity in the loss circuit of the limbic system, particularly the anterior insula

These findings provide some supporting explanation for evidence of momentum in stock prices and the forming and bursting of bubbles. During the forming of a bubble, the primary dynamic consists of a series of gains that exceed expectations, generating excitement and a continued rise in the asset price. As gains become more expected, the dopamine release is less and the activity in the loss circuit declines, signifying the top of the bubble. The bubble bursts when dopamine no longer has an effect on the gain circuit/nucleus accumbens and fear takes over as the loss circuit becomes active and a great mass of individuals seek to exit the asset at once.

The results indicate that anticipatory neural activation contributes to rational choice and may also promote irrational choice. Thus, financial decision-making requires recruiting distinct anticipatory mechanisms for taking or avoiding risks, while remembering that excessive activation of one mechanism or the other may lead to mistakes. Overall, these findings suggest that risk-seeking choices (such as gambling at a casino) and risk-averse choices (such as buying insurance) may be driven by two distinct neural mechanisms involving the nucleus accumbens (NAcc) and the amygdala.

Observed voluntary behaviors, such as financial decision making, are the result of the interactions of the limbic system (demanding action) with the frontal lobes (evaluating and deciding) of the cerebrum. Observed outcomes in the form of financial decision making represent how the limbic system is working with the prefrontal lobes.

When the balance in a decision making context favors emotions, an individual is more prone to making mistakes. Biases, poor performing heuristics, and being subject to framing

effect errors are more likely in these circumstances. This is a major step forward in developing approaches for improving financial decision making. By educating individuals in the role of emotions and the importance of balancing the influences of the critical parts of the brain, we can get closer to our goal of using our accumulated knowledge to improve financial decision making across the board. Jason Zweig (2007) spent a year with neuroscientists, participating in experiments and interpreting the information contained in many images from fMRI experiments. His conclusion is that a person first needs to recognize how naturally impulsive they are, what biases and heuristics do they tend to employ, etc. As a result of his financial decision making experience in the field and time spent with neuroscientists, Zweig (2007) offers a series of suggestions to help build emotional intelligence and avoid bad decisions.

1. Take a Time Out – Don't buy or sell a major investment on the spur of the moment. This will moderate the tendency to rely on heuristics or succumb to biases based on mood (chemical reactions in the reflexive part of the brain).
2. Step Outside Yourself – Imagine you are advising someone else, this sense of accountability helps avoid poor decisions based on analysis paralysis.
3. Look Back – Recall Similar situations/economic environments and how you felt in their midst and compare these states to their resolution. A historical perspective helps moderate the emotional reactions driven by the reflexive brain.
4. Write Yourself a Policy – The best way to prevent yourself from being knocked off track by your emotions is to spell out your investing policies and procedures in advance. This policy states what you, as an individual or an organization, are seeking to accomplish with your money and how you will get there. Then you must live with its contract with yourself.
5. Get Reframed – Instead of thinking of investment in terms of chance of success, invert and consider the chance of failure/loss in value (i.e., 90% chance of success to 10% chance of failure). Can you afford that and are there ways to mitigate/soften failure? When contemplating an investment, reframe as a chance of % gain or loss in total wealth rather than the gain or loss in the investment itself.
6. Try to Prove Yourself Wrong – You are at your greatest risk when you are sure you are right. In that state, you tend to overstay the poor decisions, which can result in huge losses and a crippling sense of regret. Give the devil's advocate view a full hearing.
7. Get it Off Your Mind – When you feel overwhelmed by a risk - to break your anxiety, go for a walk, workout in the gym, and call your friends.
8. Use Your Words – While the amygdala is conjuring up images catastrophe, use words to activate the prefrontal cortex and other areas of your reflective brain
9. Get Away from the Herd – More often than not, herd action results in overpricing or underpricing of investments. Conscious awareness of this predisposition can help avoid losses and reveal opportunities for gains.
10. Get a Grip on Your Greed – In anticipating the possibility of a significant gain/reward, realize that your brain circuitry is wired (through the nucleus accumbens) to stimulate feelings of well-being/excitement that need to be moderated/held in check so one can avoid serious investing mistakes (e.g., following the herd).
11. Respect Inherent Randomness – Our brains are programmed to identify/recognize patterns in random data. If something happens as few times as twice in a row, the caudate nucleus will stimulate us to take action only to see a reversal in the next event in the sequence (see *Fooled by Randomness* by Nassem Taleb (2004))

12. Have a Plan – Recognize how much your behavior is governed by intuition and automatic behavior. This activity (making predictions) is centered in the more emotional, reflexive parts of the brain and is highly prone to errors. Having sound practices in place before decisions helps avoid whipsawing by the whims of the moment.
13. Make Decisions with the Long View in Mind (Aversion to a Sure Loss) – View decision tasks broadly, rather than narrowly, remembering that over the course of a lifetime, risks are faced repeatedly. Because of the law of averages, accepting an actuarially unfair risk as a policy is likely to produce inferior results over the long term. (e.g., Merck Vioxx decision).
14. Reset Reference Points (Aversion to a Sure Loss) – Reframe by resetting reference points in order to accept losses and treat sunk costs as sunk. Try using stock phrases such as "that's water under the bridge" and "don't cry over spilled milk" as helpful reminders.

This list of recommendations is reinforced by Peterson (2007a), where he provides good debiasing advice:

"Experience (gained through honest appraisals and rapid feedback) and emotional intelligence (specifically self-awareness) are the remedies that excellent investors use to fortify the intuitive process."

An argument can be made that this is really nothing new, that it represents common sense the average person can pick up as a result of life experiences. It may be true that a subset of managers, investors, traders, and individuals making personal financial decisions have developed decision making approaches at times consistent with the findings and recommendations from cognitive psychology and neuroscience; however, it is also true that a large segment of the population does not have this level of awareness and knowledge. Otherwise, we wouldn't see the pervasiveness of poor financial decision making evident from the historical record.

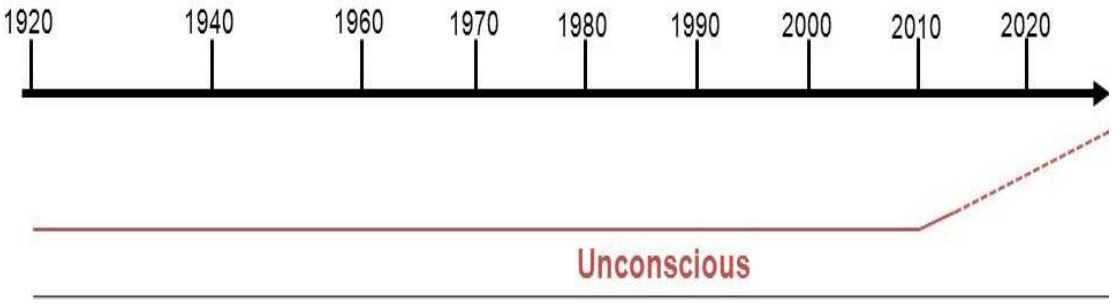
These Zweig "rules" are largely meant to help control the effect of emotions so that the different parts of the brain can work together in making the best decisions. Emotions are critical in altering humans that there is a situation that requires action in the form of a decision, but we want our decision to reflect the best that we can do instead of reacting with too much emotional content and making serious mistakes. Zeelenberg, et al. (2008) point out that there is no clear consensus on what emotions are. They propose that emotions are the initiators of action, similar to the affect heuristic of Slovic, et al. (2002), though they go beyond describing emotions as confined to positive or negative, pleasant or unpleasant (Soloman & Stone, 2002). For example, emotional states may be classified as regret, fear, excitement, pleasure, envy, angry, pride, love, shame, guilt, etc. Pfister and Bohm (2008) expand on the diversity of emotions as having three functions:

1. Speed - Emotions push us toward making a timely decision.
2. Relevance/Focus - Emotions help us focus on what is most important in the context of a decision making situation.
3. Commitment/Moral Sentiment - Emotions have physical effects on our body to reflect trust, guilt, love, etc.

The Unconscious Paradigm

The conclusion from neuroscience and cognitive psychology research is that 80-90% of our behavior has its origins in the unconscious (Eagleman, 2011). This represents the next frontier in gaining knowledge of how decision making behavior is formulated.

FIGURE 14
THE UNCONSCOUS PARADIGM LIFE CYCLE



In an important recent paper by Mercier & Sperber (2011), they argue that what researchers have labeled as biases and heuristics may be more accurately captured as a general unconscious confirmation bias. Overconfidence, excessive optimism, hindsight bias, availability, representativeness, etc. in this context all have an unconscious anthropological origin. Being outside the sphere of consciousness as their source accounts for their systematic occurrence, even when the subject is aware of the bias and reflect it in behavior anyway. Their theory has obvious tie-ins with neuroscience and cognitive psychology research, providing support for a more comprehensive approach for describing financial decision making. They rely on psychological research that shows people consistently fail in arguing logically (Evans, 2002), consistently exhibit biased reasoning (Kahneman, et al., 1982), and make serious mistakes in estimating probabilities (Kahneman & Tversky, 1972; Tversky & Kahneman, 1983). Their conclusion is that there is something innate in humans at the unconscious level that serves as the source of this behavior. This general confirmation bias is portrayed as an evolutionary efficient human adaption for communicating effectively in a group environment. This is consistent with anthropological conclusions about human brain development, that early humans were primarily motivated to develop survival strategies and having a confirmation bias provided an effective framework for successfully communicating with their group. Gaining access to resources and avoiding danger were high priorities and being able to argue from a baseline goal was critical to being a successful member of the group. As the human race evolved and survival became less of a concern, other goals became important. However, the reasoning supporting these goals (e.g., objectivity, seeking the truth, persuading) is anchored by this internalized/unconscious confirmation bias.

Cheng (2010) describes the unconscious as "Unconscious thought is thought without attention, or with attention directed elsewhere," (p. 94). In the transcendental model he proposes, conscious thought is affected by a capacity constraint, whereas the unconscious has no such constraint. With no capacity constraint, improved judgment and decision making are possible through better organization of information in memory, implying that creativity is largely a product of the unconscious due to its greater capacity and the many unconscious programs at

work. When very creative people are asked how they rationally achieved a great discovery, a typical response it that it just came to them without conscious thought. Cheng concludes his analysis by proposing a transcendent model for financial decision making, where the total cognitive capacity of an individual consists of a conscious and an unconscious component. It is an interactive model where each component has its own coefficient signifying the relative importance of the conscious and unconscious in this interactive relationship. Given the differences between individual cognitive capacities, each person would have its own unique values to solve the model. Finding ways to test this model is one of the challenges for future researchers.

In *Incognito: The Secret Lives of the Brain*, Eagleman (2011) comments on the status of neuroscience and what it can currently tell us about brain function in driving human behavior in response to expected losses and gains in decision making. As discussed earlier, fMRI brain imaging has been very helpful in showing how changes in the brain correlate to expected gain or loss before decisions are made; however, observations are indirect and, therefore, interpretations are not unambiguous. While the images for two subjects in similar experimental settings may be very similar, the behavior of the subjects may be quite different. Given any specific brain image, observed decision making behavior may occur along a broad spectrum from one subject making a snap decision ruled by emotion and a reliance on heuristics, while another subject may be stuck in an analysis-paralysis mode as the total focus is on relying exclusively on the prefrontal lobes to come to a decision. This doesn't mean that brain imaging is useless; but it does demonstrate that behavior is mediated by a number of variables that cannot be sorted out by relying too heavily on the current status of fMRI imaging. In addition, recent research from brain imaging shows that the brain is very active before there is conscious awareness. As an extreme example, in an emergency situation the brain may react and stimulate danger avoidance action without any awareness, except after the fact. In addition to such automatic action, unconscious behavior can arise from internalized experience and knowledge that one is not consciously aware of (long term storage), repressed memories, internalized cultural behaviorisms, and inherited instincts, along with the unconscious software running the many programs controlling our body systems.

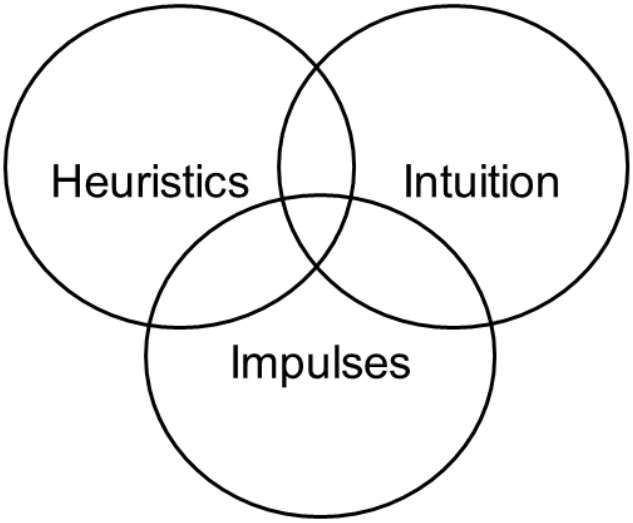
Increasing our understanding of the interaction of affect/emotion with intuition and the use of heuristics is critical to developing an improved financial decision making paradigm. Despite a good deal of research along these lines, there is still much we do not know about their relationships. There is also some ambiguity about the nature of both affect/emotion and intuition. For example, a branch of intuition research differentiates so-called system 1 from system 2 (Kahneman, 2002, 2012). System 1 represents intuition and is composed of reactions that are heuristic, automatic/fast, associative, effortless, and difficult to control. System 2 processes are rational, cognitive, and more deliberately controlled. If we relate this taxonomy to neuroscience, system 2 is centered in the prefrontal cortex, the conscious, analytical, decision making part of the brain. System 1 lies outside our conscious awareness in the unconscious.

An alternative description of intuition is the concept of fringe consciousness (Norman & Price, 2008). In this framework, intuition lies on a continuous spectrum from totally conscious to totally unconscious. In fringe consciousness, intuitive feelings provide an interface connection between the conscious to the unconscious. Norman (2010) also reviews the research attempting to define more clearly the domain of the conscious versus the unconscious. Her conclusion is that experiments demonstrate that there are graduations to consciousness, which supports the idea of fringe consciousness. To clarify the true nature of intuition, we must learn

much more about the unconscious and the path to this knowledge most likely will be revealed by further advances in neuroscience and cognitive psychology.

Sorting out the differences and relationships amongst heuristics, intuition, and impulses/emotion will be facilitated by new knowledge about the unconscious. There appears to be a substantial amount of overlap between these human responses, as well as a unique component of each as shown in figure 15.

FIGURE 15
HEURISTICS, INTUITION, IMPULSES



However, the current state of research has been unable to clearly identify and describe the overlaps and unique features associated with heuristics, intuition, and impulses, since a significant source of each resides in the unconscious. Impulses, by definition are heavily ladened with emotion, based on recalling experience, the release of neurochemicals in the brain, or from inherited mechanisms from the distant human past. Behavior based on impulses can either be optimal or sub optimal, based on the context of the situation and the role that cognitive functions are able to play. When there is a life threatening emergency the amygdala may initiate danger avoidance actions at the unconscious level where the individual is completely unaware, at least until after the fact. In other contexts, the impulse may arise from the unconscious but be interpreted by the cognitive system along with other information in driving decision making behavior. A less developed "emotional intelligence" may move the individual to make a poor decision simply based on the feelings being experienced in the body. Heuristics may be affected by impulses in some instances by moving the individual take needed action based on properly assessing the uncertainty of the environment and urgency needed to act in a timely manner. In other situations, impulses may let the lazy system 2 off the hook and open the individual to poor decisions based on biases, poor heuristics, and framing effects. Achieving greater clarity of how heuristics, intuition, and impulses interact should be a major goal of future research into the unconscious.

Certain hormones and neurotransmitters (oxytocin, dopamine, and serotonin) have demonstrated in experiments the capability to importantly affect decision making behavior, at

both the conscious and unconscious levels. In their work with oxytocin, Vercoe & Zak (2010) have established a causal relationship between the levels of oxytocin and feelings of trust/trustworthiness in research subjects. They identified what they call a HOME (Human Oxytocin Mediated Empathy) circuit in the brain that is activated by the release of oxytocin. The Home circuit increases feelings of trust/empathy and mediates the release of dopamine in the midbrain and serotonin in the serotonergic neurons to down-regulate distress. In addition, they found that low to moderate amounts of distress increase the release of oxytocin and the feeling of empathy, with the likelihood of prosocial response. In one of their experiments, viewing a 100 second video of a father interacting with son with brain cancer triggered 150% increase in oxytocin (empathy) and release of the stress hormone cortisol (stress). On the other hand, elevated distress extinguishes the desire to help and motivates desire to escape.

Conclusion

Advances in financial decision making are evident when we examine the accumulation of knowledge over the past 100 years. We have gone through various phases of learning more about how people should and do make financial decisions. The transitions from one phase of knowledge development to another have not been seamless or totally dominant in terms of a single paradigm. Over 100 years ago, when simple analytics and heuristics dominated, there were small influences from theory, psychology, and brain science. Through time the then-current dominant paradigm has attracted criticisms for not being able to correct deficiencies in financial decision making. What was once a minor contributor, say financial theory, then attracts attention, as a new paradigm that appears to improve decision making. There may be an "ah-ha" moment, such as expected utility theory by Von Neuman and Morgenstern or Prospect Theory by Kahneman & Tversky that provides the spark attracting attention and researchers to a new emerging paradigm. Each goes through the cycle of intense interest with a flurry of research, maturity and applications, and finally decline as a new source of knowledge emerges. This new source may be an "old" source simply biding its time as a minor contributor until there is a perceived major breakthrough and the Ah-ha moment. For example, the emerging paradigm, study of the unconscious, goes all the way back to Freud. Systematic exploration of the unconscious was not ready to make a major contribution until the modern work in cognitive psychology and neuroscience have laid the groundwork for stimulating new research approaches in this important area.

With all this knowledge and experience, one might conclude that financial decision making is now more science than an art. When we look at the record of the recent past however, we see pervasively poor corporate financial decision making and individual investment retirement planning on a systematic basis. In spite of what we have learned over the past century, we have become more aware than ever of what we do not know, or at least how to effectively apply what we do know. Research and experimentation in cognitive psychology and neuroscience over the past three decades points to unlocking the secrets of unconscious as the next important frontier in future advances in financial decision making knowledge. In addition, organizations should take the initiative to provide debiasing training to its managers (financial and general management) as a means to improve the "emotional intelligence" of its members and reduce the risk of systematic errors in decision making.

Knowing more about the unconscious component of our decision making behavior has the potential for materially improving financial decisions and avoiding serious mistakes in

saving, investing and managing wealth. It is clear that this new paradigm will be highly multidisciplinary, where integration, synthesis, and the linking of emerging knowledge across many relevant fields will be required. Eagleman (2011) suggests that neuroscience will play a major role, as the imaging and experimental tools become more sophisticated and more interdisciplinary approaches are employed to develop a more complete picture of human decision making. Peterson (2007b) has argued that bio feedback, can improve decision making, especially in a trading or crisis environment, by increasing individual awareness of emotions being experienced and their relationship to unfolding events. Shull (2012) has had a good deal of success in coaching traders by helping them interpret and process emotions using Freudian psychoanalytic techniques to tap the unconscious and her knowledge of leading edge knowledge about brain functioning. The medical field can also provide important contributions. Peterson (2007b) and Vercoe & Zak (2010) offer the possibilities of further medical experiments with brain chemicals (e.g., oxytocin, vasopressin, dopamine, and serotonin). The use of meditation, as implied by Cheng (2010), in a transcendental model is something that deserves exploration. Finally, the fields of Freudian psychology, archeology/anthropology, sociology, and philosophy are demonstrating the potential to make important contributions to our knowledge of financial decision making and how to improve financial outcomes for individuals and organizations. Integration of these different perspectives is important if we are to make significant advances in understanding and improving financial decision making.

As the unconscious is explored and improved models of causality are developed, important ethical issues will have to be addressed. This is particularly the case in the study of the effects of brain chemicals in the form of hormones and neurotransmitters. While most people react positively to an application of oxytocin (nasal spray) with greater feelings of empathy and trustworthiness, there is approximately 5 percent of the subjects studies where an application of oxytocin has no response. There are several ethical issues here. Is it ethical to employ applications of oxytocin widely to promote a more moral society? What would the unintended consequences be? Would the temptation for governments and other groups to secretly administer oxytocin to groups to motivate specific behaviors be too great to resist? What would the unintended consequences be? And, what about the 5 percent who have no reaction to oxytocin, would this just make the majority more susceptible to manipulation and exploitation? Similar arguments can be made to caution researchers about the use of their findings into how the brain functions, both in a conscious and unconscious sense.

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