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Professional Investors as Naturalistic Decision Makers: Evidence and Market Implications

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This paper is the first to examine investment decision-making from a naturalistic decision perspective. Naturalistic decision procedures tend to be used by experts making decisions in complex, ill-structured, and indeterminate situations. Survey results indicate that investment professionals, like other naturalistic decision-makers, rely heavily on mental imagery, reasoning by analogy, and decision procedures that become more intuitive as complexity increases. Also, they are "satisficers," not optimizers. In other words, their primary aim is to make an acceptable choice; finding the best choice is not necessary. Clinical training is recommended to improve the performance of investment professionals. In particular, investment professionals may benefit from training similar to that given to medical professionals wherein emphasis is placed to extensive repetitive exposure to "real world" decisions complete with plenty of immediate and unambiguous feedback.

Recent empirical studies have shown evidence of chaos and complexity in financial markets (Peters, 1996; Holland and Arthur, 1997; Atchison, 1996; Gilmore, 1996 and Kohers and Pondey, 1997). Also, studies of investor decision processes have identified the influence of evolutionary adaptation (Olsen, 2000, 2001a; Shefrin, 2000). These discoveries imply that classically based decision methods may be of limited value for investment purposes.

However, a new approach to decision-making has begun to develop, known as naturalistic decision theory (Klein, 1993; Zsambok, 1997, Huber and Wider, 1997). It focuses on how people recognize and respond to indeterminate decision situations. In a naturalistic decision situation, an expert with extensive domain-specific knowledge and experience faces a complex and ill-structured decision task and analyzes it in a non-mechanical and holistic fashion, making use of situationally specific cues and patterns. The key to realizing a good decision outcome primarily lies in correctly "sizing up" or "framing" the situation, not in the mechanical application of "context-free" optimization rules, procedures, or formulas. Also, in contrast to most classically based procedures, a good decision outcome is viewed from a dynamic perspective, where increased emphasis is placed on how a current decision fits into a longer-term plan leading to a desired future state.

Naturalistic decision experts rely upon schemata or mental models, which allow them to recall detailed knowledge from memory and generalize and simulate possible outcomes in the presence of incomplete and ambiguous information. They also develop "scripts" of prototypical situations that conserve working memory and shorten decision reaction times under stress and time deadlines. To date, naturalistic decision techniques have been applied successfully in such situations as military field command, firefighting, and business strategic planning.

Until now, naturalistic decision theory has not been formally studied relative to investment decision-making. The purpose of this paper is to demonstrate how some investment tasks such as security analysis, portfolio construction, and even personal financial planning may benefit from it. Survey evidence is also presented that suggests that many professional investors already behave as naturalistic decision-makers. Finally, methods for improving the performance of investment experts are discussed, as well as a few market-wide implications.

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Limitations of Classical Decision Theory

Classical decision theory contains a set of consistency-enforcing axioms describing the choice event in an ideal environment. Here, preferences are known and full information is available. Classical decision theory follows from the assumptions underlying the application of the scientific method. Specifically, the universe

is considered to be deterministic and to function in accordance with a knowable set of natural laws that are independent of time and space. Subjective expected utility theory is the classical decision model fundamental to most work in economics and finance.

It follows from the scientific method that, in principle at least, decision models can be constructed so that accurate predictions and desired outcomes can be achieved. Unfortunately, researchers in the physical sciences have confirmed what philosophers and mathematicians have long postulated. Accurate prediction can be impossible to achieve even if the universe is deterministic. In particular, where formal chaos and/or complexity exist, solutions can be indeterminate and classically based decision models will fail to deliver the desired results (Barrow, 1998; Mouck, 1998).

Evolutionary psychologists have demonstrated that, because the mind is evolutionary in origin, the human ability to perceive and respond to the environment is circumscribed by the process of biological adaptation. In particular, because the goal of environmental adaptation is survival, wherein neither optimization nor consistent behavior is necessary or even desirable, human minds do not contain the "software" that may be needed to produce classically optimal behavior in financial environments (Gaulin, 2001; Kenrick and Sadalla, 1998). The relationships between classical decision theory, indeterminacy, and psychological evolution are more fully discussed in Olsen [2001b].

Besides the conceptual restrictions underlying classical decision theory, it has been suggested that, in an investment setting, its power might not be necessary. First, most investors do not appear to be interested in optimal solutions. They appear quite satisfied with acceptable solutions. Second, in the real world, where change necessitates constant surveillance and reaction, the negative effects of inconsistent (non-rational) behavior associated with less rigorous techniques may be overwhelmed by the positive effects from the superior flexibility of these techniques. Third, from an efficiency perspective, the greater cognitive effort and higher costs associated with classically based techniques may enhance the attractiveness of less accurate, but less costly, rules of thumb.

Naturalistic Decision Attributes

Table 1 presents a list of the principal naturalistic decision attributes. All are simultaneously present in naturalistic tasks in varying degrees.

Ill-structured complex tasks are characterized by the lack of an obvious best procedure to use to solve the problem. It then becomes necessary to make a judgment as to the best way to proceed. In addition, these tasks do not allow the identification of a unique standard or process against which the quality of the decision choice can be compared.

Table 1. *Prominent Naturalistic Decision Attributes*

1. The problem is ill-structured and complex.
2. Information is incomplete, ambiguous, and changing.
3. Goals are ill-defined, shifting, and competing.
4. Stress is high due to time requirements and/or high stakes.
5. Decisions may involve multiple participants.

Fundamental security analysis, which requires identifying an "intrinsic value" for a security, is a classic ill-structured complex task. So is portfolio selection. A brief survey of the investment literature will illustrate the wide range of opinions and justifications offered for selecting alternative formulas, data sets, and valuation paradigms. For example, should we set values based on cash flow discounting, or P/E ratios? Should we construct portfolios using a mean–variance optimizer, or some other asset allocation technique? Is risk a function of beta, or possible loss? As Charles Ellis [1993], the "Dean of Portfolio Management," succinctly summed up:

> Portfolio management is neither art nor science. It is instead a very special problem in engineering, of determining the most reliable and efficient way of reaching a specified goal, given a set of policy constraints, and working within a remarkably uncertain, probabilistic, always changing world of partial information and misinformation, all filtered through the inexact prism of human interpretation (p. 51).

The second principal naturalistic decision attribute is that information is incomplete, ambiguous, and changing. The frame of reference here for investment management is that future outcomes and relationships are most important, not historical ones. Therefore, superior performance relies on accurate forecasting, a problematic process under the best of circumstances.

For example, even with generally accepted accounting practices, it is difficult to ferret out firm-specific economic events related to accounting number changes. When one contemplates that future financial outcomes are also influenced by events and forces that cannot be put in quantitative or manipulable terms, forecasting becomes even more difficult. Finally, to realize that positive feedback induces non-linearity in economic relationships is to recognize that the accurate identification of cause and effect is highly unlikely.

But naturalistic decision tasks are also difficult because of ill-defined shifting and competing goals. It is well known that decision-makers often form their goals "on the fly." But even when they form them in advance, they cannot accurately predict how they will feel about the goal once it is achieved. This situation poses a major problem for the financial planner or port-

folio manager who must try to satisfy clients by estimating how their goals will change over time and estimate how security markets will change. Even simpler tasks, such as putting together a portfolio that offers an acceptable mix of dividends plus capital appreciation, can be extremely difficult.

Stress, the fourth naturalistic decision attribute, is clearly present in many investment tasks. Stock traders, security analysts, portfolio managers, and financial planners all face the stress of limited time, high stakes, and personal responsibility.

Lastly, naturalistic decisions are characterized by the requirement that the decision-maker work with and be subject to constraints of decision-making "partners." In the investment decision task, the investment professional must not only understand the objective of the client, but also comply with codified securities statutes, formal and informal codes of conduct, and norms of behavior imposed by institutions and professional associations.

Naturalistic Decision Behavior of Professional Investors

As noted, naturalistic decision-making is concerned with the behavior of persons who are considered experts in a particular domain. These experts have extensive training, knowledge, and experience that provide them with superior situation assessment skills. Consistent with this expertise requirement, this study investigates the decision behavior of a random sample of 256 chartered financial analysts (CFAs), who listed their occupation as security analyst, strategist, or portfolio manager. 90% of these CFAs had six or more years of work experience, with 51% having fifteen or more years of experience. CFA certificate holders appear to fit the "expert" profile, since possession of this professional designation requires extensive formal education as well as significant work experience.

Although naturalistic decision theorists have developed a number of alternative models, the three primary decision behaviors are as follows:

Situational and alternative assessments rely heavily on mental imagery and simulation. Problem recognition is based on pattern matching, and cognitive processes emphasize analogical reasoning, the use of knowledge structures (schema), and the construction of scenarios using "storytelling" and mental modeling. Thus, naturalistic decision makers appear to make use of the Representativeness heuristic as first described by Kahneman and Tversky [1972].

Decision processes are context-dependent. Most importantly, well-structured and simple decisions are heavily based on analysis-inducing quantitative rules and procedures, while ill-structured and complex decisions rely more heavily on intuition-inducing procedures focused on qualitative information.

A satisfactory rather than an optimal decision solution is sought. That is, a given aspiration level is set, and once an alternative that meets that level is found, it is adopted. Thus, naturalistic decision-makers exhibit "satisficing" behavior (Simon, 1955).

The CFAs' responses to Question 1 in Table 2 tend to support the hypothesis of heavy use of mental imagery. The vast majority, 91%, say that the ability to construct a coherent and complete "story" is important when making an investment decision.

This response is consistent with results reported by Hofstedt [1972], Bouwman and Frishkoff [1981, 1995], Jacoby and Kuss [1985], Mear and Firth [1987], Coggin [1988], Anderson [1988], Hershey and Walsh [1990], Gregan-Paxton and Cote [2000], and Kida and Smith [1998] that investment professionals rely on mental templates, checklists, scripts, and analogies to categorize information and frame the situation, mentally "trying out" alternatives.

The responses to Questions 2–4 in Table 2 support the hypothesis that investment professionals' decision processes are context-dependent. Specifically, the responses indicate a movement away from analytical procedures toward more intuitive procedures as the decision situation becomes more complex. Again, the results are consistent with earlier findings by Slovic [1969], Slovic and Bauman [1972], Ebert and Kruse [1978], and Mear and Firth [1990] that when faced

Table 2. *Investment Behavior Responses*

Question 1. The ability to construct a coherent and complete "story" with the facts of a situation is the most important task when making a decision or recommendation.	Agree 93%	Disagree 7%
Question 2. As a forecasting/recommendation task becomes more complex and difficult, I tend to rely more on judgment and less on formal, quantitative analysis.	Agree 64%	Disagree 36%
Question 3. Quantitative valuation models are less useful in analyzing securities of new or more volatile companies.	Agree 89%	Disagree 11%
Question 4. When a high level of outcome accuracy is difficult or costly to achieve, I tend to use procedures that are less costly even though they are less accurate.	Agree 80%	Disagree 20%
Question 5. I make decisions manageable by ignoring unlikely outcomes.	Agree 62%	Disagree 38%
Question 6. I make decisions manageable by ignoring outcome states that are not grossly different from others.	Agree 82%	Disagree 18%
Question 7. I make decisions manageable by associating outcomes with a probability range instead of a point estimate.	Agree 75%	Disagree 25%
Question 8. As I become more uncertain about my ability to predict outcomes, I give greater weight to negative information about alternatives.	Agree 86%	Disagree 14%

with more complex decisions, investment professionals tend to use simple models employing surprisingly few decision attributes.

The responses to Question 4 indicate that investment professionals are willing to "trade off" decision method cost against accuracy. This is consistent with the theory and evidence of adaptive decision-making (Payne and Bettman, 1993).

Respondent answers to Questions 5–8 in Table 2 and their multi-attribute decision procedure responses in Table 3 suggest the use of "satisficing" behavior. Specifically, responses to Questions 5–7 indicate that financial professionals edit data by ignoring some possible outcomes and collapsing others into more inclusive categories. This behavior is not consistent with maximization. More importantly, Table 3 shows that most respondents (69%) rely on some form of an elimination by aspects procedure (B and D) when making decisions in a multi-attribute environment. Only 18% use a weighting by importance procedure (C), which is consistent with optimization.

The use of an elimination by aspects procedure, where alternatives are selected by prioritizing attributes and screening the most important attributes first, has also been noted by Clarkson [1962] in his study of investment trust officers. In 1972, Tversky developed and empirically tested a general descriptive model of the Elimination By Aspects procedure. This procedure is essentially a heuristic used by decision makers in complex situations. Its use appears to be partially responsible for intransitivity in some choice situations.

Responses to Question 8 confirm findings of many other studies showing that when uncertainty is present, negative information is given greater weight in the decision process (Yates, 1992).

Table 3. *Decision Procedures Used in a Multi-Attribute Decision Task Environment*

As a decision-maker, you might find it necessary to make recommendations among competing multi-attribute assets. Which of the following procedures best represents the procedure you would use most often?

Procedure A: I keep a tally of the "pros" and "cons" of each investment and recommend the one that has the greatest net number of "pros."
Proportion using: 10%

Procedure B: I first determine the most important performance attribute and compare all assets relative to some minimum cut-off level. All assets that pass are next screened on the next most important attribute, etc.
Proportion using: 29%

Procedure C: I first weight all performance attributes by importance. Then I recommend the asset with the greatest "weighted" attribute score.
Proportion using: 18%

Procedure D: I use Procedure B to narrow down prospects, and then a procedure like C.
Proportion using: 40%

Procedure E: None of the above.
Proportion using: 3%

Risk

The decision environment of the naturalistic decision-maker precludes the ability to estimate the distribution of decision outcomes with much precision. Thus, evolutionary theory suggests that naturalistic decision-makers will focus most on avoiding losses (ensuring survival), and not rely on techniques that assume detailed knowledge about outcome-generating processes. Consistent with these hypotheses, Tables 4 and 5 indicate that professional investment managers give the greatest weight to avoiding negative outcomes, and that they do not place the primary weight on technical measures of risk such as standard deviation and beta which assume accurate knowledge of future return distributions.

The data for Table 4 come from a question that asked respondents to rate the investment importance of a preselected set of risk attributes on a Likert-type scale from 1 (extremely important) to 5 (not important at all) (Olsen, 2000). Note that respondents viewed risk as more a function of "coming up short" than of return variability.

The data for Table 5 come from an exercise where respondents ranked actual stocks on their perceived level of risk on a Likert scale of 1 to 20 (Olsen, 2000). No company names were given, but participants were provided with historical standard deviations of return,

Table 4. *Importance of Risk-Related Attributes* (*N* = 169)

Attribute	Mean Score
Chance of incurring a large loss	2.0
Chance of earning less than the target (aspiration level)	2.8
Variability in return as measured by standard deviation, beta, etc.	3.5
Chance of obtaining a very large gain	4.7

Note: All scores significantly different at the 1% level.

Table 5. *Relationships Between Risk Attributes and Perceived Risk (N = 4,200)*

Risk Attribute	Partial Correlation Coefficient
Safety rating	0.32
Beta	0.24
Standard deviation	0.05

Note: Multicollinearity is not a major problem in the interpretation of this exhibit because all correlations between the risk attributes were low and stepwise regression did not reveal significant instability in the coefficients. Also, a test with an artificially constructed set of stocks where, by design, the values of risk variables were orthogonal, gave virtually the same results.

betas, and ValueLine safety ranks, which are commonly used as measures of downside loss potential.

Consistent with the results of a similar study of professional investors by Farelly and Reichenstein [1984], risk was most highly related to downside potential and least related to the standard deviation of return. Further questioning of the respondents revealed that the significance of beta as a risk attribute was not related to its statistical heritage but more to its usefulness for gauging the risk of firm loss, in a qualitative sense, relative to other firms.

When a second set of respondents performed this exercise with the companies identified, industry groups and even some company names became important as additional independent risk attributes. This result supports previous observations that professional investors rely heavily on "stories," scripts, and analogies when cognizing information, just as other naturalistic decision-makers do.

Market Implications

Our evidence so far is consistent with investment professionals making decisions in a naturalistic manner. This suggests the following implications for stock price behavior.

Stock prices are likely to be more volatile than implied by classically based decision models. Miller [1977] and Schwartz [1988] showed that less demand elasticity leads to more price volatility. Naturalistic decision behavior should decrease demand elasticity by creating greater differences in opinion about a stock's intrinsic value. Thus, stocks whose values are subject to greater uncertainty (such as newer, smaller firms) should exhibit the greatest volatility, ceteris paribus. Olsen [2001a] provides a review of studies confirming this link between volatility and valuation ambiguity.

Stock price volatility may spread among stocks as a result of contagion related to the use of the representative heuristic. Representativeness refers to a tendency to categorize and make judgments by relying on more superficial surface similarities. As we noted, naturalistic decision-makers use patterns and analogical reasoning extensively to structure decisions and evaluate alternatives. Thus, it is likely that overgeneralization will occur at times. Solt [1989] provides evidence of this by showing that good companies are often mistaken for good investments. Gregan-Paxton and Cote [2000] demonstrate the existence of analogical reasoning by investors within industry groupings. Finally, studies by Jarrell and Peltzman [1985], Madura and Bartunek [1994], and Blose and Bornkings [1996] reveal that the effects of company-specific events can "spill over" onto other firms in the same industry.

The use of naturalistic decision processes may cause stock prices to appear to respond to information events in an inconsistent fashion. For example, an earnings announcement may cause little change in price, but a notice of a new product might be associated with a large price movement. Such behavior has been noted by Haugen [1999] and Bekaoui and Cousineau [1977], among others. The key to understanding this anomalous behavior lies in how easily investors can integrate the new information with what they think they know about the firm. In general, decision-makers tend to pay more attention to information that appears more concrete, that is easier to integrate, and that appears more trustworthy. Thus, it is not surprising that more abstract accounting-based information is given less weight than product announcements or dividend changes.

Naturalistic decision-makers often use decision methods that are context-specific. In other words, their decision methods became more intuitive and less cognitively costly as the decision task became more complex. Thus, it is likely that investment professionals will sometimes see more "efficacy" in making an investment decision by "following the crowd." Empirical studies by Shiller and Pound [1989], Nofsinger and Sias [1998], and Ippolito [1999] tended to confirm this.

Educational Implications

There are two principal implications of naturalistic decision-making for the performance and training of investment professionals.

First, the use of naturalistic decision procedures by investment managers appears to have created the same level and pattern of expert performance seen in other complex ill-structured decision domains (Rehm, 1990; Ericsson, 1994). That is, superior performance is rarely outstanding, because it is difficult to sustain.

Second, decision quality will be most improved by a greater emphasis on "clinical training" of investment professionals, much in the manner of medical professionals. Current professional investment training begins with textbook studies, followed by on-the-job experience. This approach may not be appropriate.

Although decision-related techniques can be learned in a relatively context-free classroom environment, there is extensive evidence that this type of learning does not transfer well to less deterministic real-world situations. Learned tools and techniques tend to be more efficient when their acquisition is undertaken in a realistic setting.

Also, naturalistic decision-making is more about situation appraisal and problem structuring than about the event of making a decision. Thus, it requires extensive exposure to and careful instruction in the intricacies and idiosyncrasies of *specific* decision situations. In this regard, the use of simulations and scenario analysis and the provision of clear and immediate feedback are essential. On-the-job training does not provide the

intensity, repetition, or unambiguous feedback necessary to solve complex, ill-structured tasks.

Finally, it is probably not wise to try to develop automatic procedures and rules to replace the investment expert. As in medicine, expert systems can be valuable in rapidly sorting and integrating a mass of data and helping the decision-maker make forecasts and avoid bias. However, automated procedures lack the nuanced judgment that only an experienced expert can provide (Fogler, 1994; Smithson, 1997; Goodwin and Wright, 1994; and Goodwin and Filders, 1997).

Although, in hindsight, naturalistic decision-makers will not always make the correct choice, in a non-deterministic environment there may not be a better alternative. Classical decision models, which assume a predictable deterministic environment, a goal of optimality, and axiomatic rationality, imply decision behaviors that are not within the capability or even the requirement of investors.

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