"The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required." – *Models of Man*, Herbert A. Simon

“Boundedly rational agents experience limits in formulating and solving complex problems and in processing (receiving, storing, retrieving, transmitting) information.” – Oliver E. Williamson citing Herbert A. Simon

“There seems to be some perverse human characteristic that likes to make easy things difficult.” -- Warren Buffett

Our rationality is limited by the information we have, the cognitive limitations of our minds and the finite amount of time we have to make a decision. Herbert A. Simon called that concept “bounded rationality.” As a consequence of these limitations, our confidence becomes unbounded. We will discuss the implications of this phenomenon and how investors can overcome it.

Simon argued that due to the complexity, dynamism and equivocality of present and future environments facing decision makers, we are not able to act in a fully rational way. This *inability to act fully rationally* results in a general state of satisficing, in which solutions that are not optimal are chosen if they meet minimum requirements.

Satisficing occurs because of the limited rationality of human mind, which is oftentimes not fully equipped to evaluate all possible consequences of decisions being made. As Simon stated, the capacity of the human mind is very small compared to the size of the problems we face. The result is that we process only a small fraction of information presented by real world problems *and do so simplistically, by employing heuristics*. When swamped by information, we select only a small portion of the total and end up with a dangerously different view of the world.

Figure 1 shows the impact of bounded rationality on complex decisions.
Cognitive limitations: Configural\(^1\) vs. linear problems

In “Judgment Under Uncertainty: Heuristics and Biases,” Amos Tversky and Daniel Kahneman showed that when dealing with uncertainty, “people rely on a limited number of heuristic principles which reduce the complex task of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors.” Tversky and Kahneman showed that when dealing with uncertainty, people make systematic errors. Importantly, these errors aren’t caused by emotions, but are a result of limitations of cognition.

In his seminal paper “The Magical Number Seven, Plus or Minus Two,” George A. Miller suggested that the number of objects an average human mind can hold in its working memory is seven plus or minus two. In a research done by Kaufman, et al., random patterns of dots were flashed on a screen for one-fifth of a second with subjects expected to report the number of dots. When the patterns contained five or six dots, subjects did not make errors. However, errors increased significantly when the number of dots increased beyond that. In fact, there was such a marked difference in performance between less than seven dots and more than seven dots that subjects were said to be subitizing\(^2\) below seven dots and estimating above seven. Figure 2 shows a typical subitizing problem. If you can identify the number of stars in the picture without counting, you are said to be subitizing.

\(^1\)Configural
\(^2\)Subitizing

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Further, research suggests that the human brain is a much more effective sequential processor of information, in that it can effectively process information in a linear fashion. However, the human mind’s capability is significantly limited at handling problems requiring configural thinking. Configural problems require a multitude of factors to be considered simultaneously with significant interaction among factors.

Given the multitude of factors that have to be dealt with when making an investment decision, it is clear that a successful investor will need to be good at configural thinking. John R. Hayes shows that when dealing with problems of configural nature, the human mind’s decision making efficiency starts deteriorating at four or more factors.

As compared to configural problems, linear problems allow for variables to be analyzed independently. Once each variable has been analyzed, the entire set of variables can be processed sequentially. Consider a linear problem involving five variables where each variable can take values of +1 or -1. After each variable has been analyzed and a score is assigned, scores of all five variables can be added together. Depending on the decision rule, the sum of individual scores can be used to make an effective decision. Interestingly, even when faced with configural problems, people process them in a linear fashion. Importantly, they do so less effectively than mathematical linear models.

**Investment decision-making**

Let’s now consider a typical investment decision making process through the lens of bounded rationality:

- A typical investment decision could depend, apart from other factors, on an analyst’s assessment of the quality of business, competency of the management, attractiveness of the price and long-term prospects of the industry. Each one of these assessments will require an analyst to weigh a multitude of factors that interact with one another. A key issue here is whether all information
that is needed to develop all possible outcomes has been gathered.

- Now, let’s assume that each of these factors is binary, meaning it can only have two possible outcomes, e.g., *high or low*. If the analyst has to consider three of these binary factors, there can be eight \((2^3)\) distinct configurations. With five factors, the number of distinct configurations increases to 32 \((2^5)\)!

The key question here is whether the analyst’s brain has the capacity to develop all possible outcomes and assess probabilities associated with each outcome. We contend that analysts who believe they can effectively perform such a feat are likely to be too confident of their abilities. The interaction of complexity of investment decisions and bounded rationality gives rise to several well documented behavioral biases some of which are discussed below.

**Overconfidence bias**

Overconfidence is a well-documented bias in which a person’s subjective confidence in his/her judgment is reliably greater than the objective accuracy of those judgments. Importantly, overconfidence bias is significantly more pronounced when dealing with difficult tasks. Not surprisingly, analysts and portfolio managers tend to significantly overestimate their prediction abilities.

John R. Nofsinger, talking about overconfidence bias in stock selection, said, “People are overconfident. Psychologists have determined that overconfidence causes people to overestimate their knowledge, underestimate risks, and exaggerate their ability to control events. Does overconfidence occur in investment decision making? Security selection is a difficult task. It is precisely this type of task at which people exhibit the greatest overconfidence.”

In a 2006 research, James Montier showed that 74% of fund managers surveyed thought themselves to be above average at their job. Of the remaining 26%, most thought they were average, but very few, if any, said they were below average!

*Figure 3*
Clamor for more information: Illusion of knowledge

When faced with uncertainty, we tend to seek more information driven by the premise that it should translate into more knowledge. However, as we discussed earlier, when faced with a barrage of information, our brains may select only a small portion of the information, process it simplistically (linearly) and arrive at decisions which are no better than when we could have made with less information. Nonetheless, more information tends to make the decision maker more confident in his/her forecasts driven by the false premise of more information being equal to more knowledge.

Clamor for more information: Illusion of control

Further, acquiring more information tends to feed the unwarranted belief in one’s ability to control outcomes. Activities that are most likely to induce the illusion of control share several characteristics: a large number of choices, great amount of information availability, familiarity with the task and high personal involvement and outcome sequence. Clearly, investment decision-making is characterized by most of these factors. Interestingly, illusion of control is magnified if the decision maker experiences success early on in the activity.

Remedying the problem of limited rationality and overconfidence
The foregoing discussion established that the human brain has a limited ability to process information, even when dealing with problems that require sequential/linear processing of information. However, when variables interact and depend on one another -- as they do in many financial market problems -- our brain’s capability is far more limited.

What makes the issue of limited rationality even worse is that when faced with configural problems, the human brain, in most cases, still resorts to linear decision-making models. Unaware of their limitations, people tend to seek more information in the belief that it will provide them with more knowledge and control over the outcomes. Beliefs that research suggests are ill-founded.

So how are we to avoid these problems? We offer two possible solutions to the problem of limited rationality:

1. Scientific way: Avoid subjective stories and conjectures. Pay attention to objective facts, preferably those that can be represented by numbers. Much of the decision-making process will be reduced to mathematical models with configural relationships dealt with in a systematic fashion.

2. The semi-scientific way: We have established that the human brain is a much better processor of linear problems than configural problems. Investors should segregate configural pieces and deal with them in a systematic way. The set of configural pieces can then be reduced to linear problem. For example, the business quality assessment may involve variable factors that interact among one another. By reducing this assessment to a systematic model, the decision maker could change the problem such that it is amenable to linear processing. The outcome of business quality assessment process could be limited to classification as a good, bad or so-so business that then lends itself to sequential processing in an investment decision-making process.

Security selection and investment decision making are complex tasks while the processing capability of our brain is limited. As investors, we will be better served by recognizing our bounded rationality and making amendments to our decision-making processes to effectively handle our brain’s limitations. Otherwise, we are likely to fall prey to behavioral pitfalls that serve to create a distorted view of reality. As Pogo famously said, “We have met the enemy and it is us.”

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1. Configural thinking requires a multiplicity of factors to be considered with significant interaction among factors.
2. Subitizing, coined in 1949 by E.L. Kaufman et. al. refers to the rapid, accurate, and confident judgments of number performed for small numbers of items. Essentially, if you can identify the number of items in a visual scene without counting, you are said to be subitizing. Read more here.

3. This file is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license. © Nevit Dilmen. The image has been resized.

4. James Montier, DrKW Macro research, February 2006

5. The theory of the illusion of control (IOC) was first defined by Ellen Langer (1975) as an expectancy of a personal success probability that exceeds the objective probability of the outcome.

6. Walt Kelly, Pogo the possum, April 22, 1970