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Odds Are Retirees Don't Care About the Odds

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Random events are those that you cannot predict with certainty and the concept of a random event is the basis for probability. But uncertainty is aversive, so people try to mitigate the discomfort of the randomness and uncertainty of retirement-income planning with predictions based on probability theory and Monte Carlo analysis.

Although ubiquitous within the financial services industry, Monte Carlo analysis is likely an ineffective tool that wastes resources and distracts most investors from the essence of the problem. It is ineffective because many people lack the numeric skills needed to accurately assess probability and because cognitive biases cause most people, including experts, to be insensitive to probabilities, neglect them completely as risk becomes more vivid or of greater magnitude, or view probability negatively.

Monte Carlo is wildly inaccurate in its predictions of how long a retiree's savings are likely to last and employs a methodology that is the opposite of what retirees want. Eliminating it from conversations should lead to safer, simpler, and more personalized retirement-income portfolios for investors and help advisors create a brand of original thinking.

WORKING MEMORY AND ATTENTION ECONOMICS

Working memory is a cognitive system with limited capacity for short-term storage and manipulation of information. Most people can only hold three to five "chunks" of information in their working memory. Exceeding that amount leads to confusion (Cowan 2010) and anything that occupies working memory reduces your ability to think (Kahneman 2011).

Attention economics treats human attention as a limited resource that is responsible for the limited capacity of working memory (Oberauer 2019). Simon (1971) noted: "In an information-rich world, the wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes. What information consumes is rather obvious: It consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention."

Mental dazzle is the tendency for a wealth of information to distract you from the essence of a problem, making it harder to solve. Assume you must transport one adult across a river and the only means to do so is a small boat belonging to two children. The boat is only big enough to hold two children or one adult. How can the adult cross the river without stranding the children from their boat? The answer is the two children cross the river. One gets out on the far bank while the other rows back. Once at the original bank, the child gets out and the adult takes the boat across the river. When he gets to the far bank, he exits the boat and that child takes it back to join the other child on the original bank.

It took groups on average a minute and a half to solve this problem. Other groups given the exact same problem but told they needed to get six adults across the river took on average twice as long to see the solution (Katz 1950). Because the boat only holds one adult, the number of adults transported is immaterial to the essence of the problem, which is how to get one adult across; then repeat that process as often as needed. As Katz noted: "the larger number has a confusing influence, reduces 'mental energy' at a critical moment, and retards the thought process. The attendant circumstances, 'six adults,' produces mental dazzle."

Creative thinkers have a flair for distinguishing what is important from what is not (Policastro and Gardner 1999). This allows them to "think globally as well as locally, distinguishing the forest from the trees and thereby recognizing which questions are important and which ones are not" (Sternberg and Lubart 1999). Albert Einstein set out to find the most comprehensive yet simplifying axioms stating, "In physics, however, I soon learned to scent out that which was able to lead to fundamentals and to turn aside from everything else, from the multitude of things that clutter up the mind and divert it from the essential" (Gardner, H. 2011).

Consider people who were fortunate enough to retire in 1980 with $1 million allocated 50/50 (all allocation references in this article should be read as stocks/fixed income). Taking a 5-percent initial withdrawal that is increased 3-percent annually allowed them to finish the twentieth year with $5.3 million, compared to $5.4 million if they earned those returns in reverse sequence. In this period, the sequence of returns was inconsequential to the outcomes because the portfolio had only one negative year in which it lost less than 1 percent. Although all returns are part of the

retirement-income problem, negative returns, especially early, are the simplifying essence. Most investors already understand losing money or market risk, so that is what advisors should talk about. The term "sequence of returns risk" is superfluous jargon that unnecessarily occupies limited working memory.

Filtering out "noise" that is likely to confuse is particularly important with retirement clients. Age-related declines in both working memory capacity and the ability to ignore irrelevant information impair learning and memory for older adults (Gazzaley et al. 2005). Older adults examine less information when making decisions (Cole and Balasubramanian 1993) and "less is more" when presenting consumers with comparative information. Results are especially pronounced for those lower in numeracy when less information was presented and/or formatted to ease cognitive burden (Peters et al. 2007). Advisors must make things simpler by understanding what to pay attention to and what to ignore, for with subtraction comes clarity of message that enhances understanding.

PSYCHOLOGY OF INSENSITIVITY TO PROBABILITY

Research around dual processing theory (Kahneman 2011), prospect theory and the certainty effect (Kahneman and Tversky 1979), risk as feelings (Lowenstein et al. 2001), the affect heuristic (Slovic et al. 2004), probability neglect (Sunstein 2001), and socioemotional selectivity theory (Carstensen 2006) show most people are insensitive to probability and neglect it completely when facing vivid risk.

Dual processing theory says we process information and risk two ways, which Kahneman (2011) labels systems 1 and 2. System 1 is an experiential system that is fast and intuitive and relies on images, narratives, and associations linked by experience to emotion and affect (a sense of goodness or badness). System 2 is an analytic system that is slow and effortful and based on normative rules such as probability and logic. The analytic process is a more recent development in our evolution but has been placed on a pedestal, portrayed as the epitome of rationality with the unrealistic assumption that we are all perfectly rational creatures following normative rules to optimize our experiences.

The reality is we lack an intuitive grasp of probability or randomness because, in an evolutionary sense, such an understanding did not positively affect lifespan for cave dwellers nor help them attract the best mate for reproducing. For our distant ancestors, the fast thinking associated with the experiential system was key to survival. That thinking did not engage with probability because ponderous thinking about the rustling in the bushes could have had a negative impact on lifespan. The result is humans did not develop an intuitive grasp of randomness (Gardner, D. 2011), our brains do not intuitively grasp probabilities (Shermer 2008), and probabilities perplex people, especially "puny" probabilities (Sunstein and Zeckhauser 2011). We do not intuitively apply statistical analysis, relying instead on "gut instinct" (Mlodinow 2009). Shermer (2008) uses the term "folk numeracy" to describe our natural tendency to misperceive and miscalculate probabilities, to think anecdotally rather than statistically.

Although probability (system 2) is not intuitive, system 1 is and can operate with little if any mediation by the analytic system. When the two conflict, the experiential system often exerts a dominating influence on behavior (Lowenstein et al. 2001; Rottenstreich and Kivetz 2006; Damasio 1994; Slovic et al. 2004, Slovic 1987; Weber 2004). This is true even when people are aware of the normative rules (Denes-Raj and Epstein 1994).

Zajonc (1980) showed system 1 can process risk without engagement of system 2 as LeDoux (1996) noted, "Emotions can flood consciousness ... because the wiring of the brain at this point in our evolutionary history is such that connections from the emotional systems to the cognitive systems are stronger than the connections from the cognitive systems to the emotional systems." Notably, the conscious processing done by system 2 is limited by working memory, whereas the intuitive system 1 has no such capacity constraints (Kahneman 2011).

The experiential system handles the majority of our decision-making without help from system 2. But analytical reasoning cannot be effective unless guided by anticipatory emotion and affect (Slovic et al. 2004) provided by system 1. The neurologist Antonio Damasio (1994) illustrated this in his work with patients with damage to the ventromedial prefrontal cortex (VMPFC) of the brain, which is the region of the prefrontal cortex (system 2) to which the amygdala (system 1) makes most of its neural connections (Lieberman 2007; Bechara et al. 1994). Damage to the VMPFC left patients' basic intelligence and capacity for logical thought intact but impaired their ability to feel affective feelings and emotions with the anticipated consequences of their actions. This lack of anticipatory emotions caused them to go bankrupt more often than normal participants in a game that earned gains or losses by drawing cards from four decks, two of which carried larger losses than the other two.

Subsequent research using the same task found in a sample of non-patients that those who showed higher affective reactions to negative events were more likely to sample from the safer decks (Peters and Slovic 1999). Notably, subjects exhibited an emotional response when reaching for a risky deck after drawing approximately ten cards, illustrating the rapid emotional response of system 1. But they did not stop drawing from those decks until after about fifty cards, and could not explain why they stopped until after eighty cards, illustrating the slower action of system 2.

In contrast to the importance of the experiential system to anticipatory emotion, psychophysical studies of anxiety illustrate the

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limited role probability plays. In these experiments, participants were told they had a given probability of receiving a painful electric shock of varying intensity within a given time period. The general finding from this research was that people's physiological responses to the impending shock correlated with their expectations about the intensity of the shock—that is, shocks of greater magnitude elicited greater arousal (Elliott 1975). The probability of receiving a shock, however, did not affect arousal (Bankart and Elliott 1974; Elliott 1975; Monat et al. 1972; Snortum and Wilding 1971) except for trials in which the stated probability was zero. The mere thought of receiving a shock causes an affective response in individuals, but the precise probability of being shocked has little impact on level of arousal.

The vividness of how a risk is described or represented mentally is one of the most impactful determinants of anticipatory emotions (Damasio 1994). The more vivid the risk the easier it is to recall, and overestimate, because the human brain tends to give priority to bad news and responds quickly to even symbolic threats (Kahneman 2011). People are willing to pay more for flight insurance for losses resulting from "terrorism" than for flight insurance from all causes, despite the fact that "all causes" obviously includes terrorism but does not explicitly call it out (Johnson et al. 1993). The word "terrorism" apparently evokes vivid images of disaster that crowd out probability judgments.

Nisbett and Ross (1980) illustrated the impact of vividness of description on anticipatory emotions by contrasting two descriptions of the same event. A description that "Jack sustained fatal injuries in an auto accident" evoked weaker emotional responses than "Jack was killed by a semi-trailer that rolled over on his car and crushed his skull." Similarly, Sunstein and Zeckhauser (2011) found that when the risk of cancer from arsenic in drinking water was described in vivid terms, there was little difference in a subject's willingness to pay to prevent it whether the risk was presented as one in 100,000 or one in 1 million. Once a risk is in people's minds, their willingness to pay to avoid it often will be relatively insensitive to probability even where probabilities may differ by a factor of twenty or more (Sunstein and Zeckhauser 2011). Participants in a study were willing to pay $7 to avoid a 1-percent chance of an electric shock but only $10 to avoid a 99-percent chance—there was little difference between willingness to pay for a 1-percent and 99-percent probability (Rottenstreich and Hsee 2001). Simply discussing a low-probability risk can generate an affective response, even if the discussion consists mostly of apparently trustworthy assurances that the likelihood of harm is infinitesimal (Sunstein 2001).

Individual differences in mental imagery are one factor that impacts vividness. Those differences may influence the degree to which more cognitive risk assessments are used in the risk-taking process (Traczyk et al. 2015). For example, gender differences in vividness might explain why women are less sensitive to probability changes than men (Fehr-Duda et al. 2004; Levy and Baron 2005). Because women report more and better imagery than men (Fehr-Duda et al. 2004) they may feel risk more vividly, causing them to be more risk averse and less sensitive to probabilities. Kahneman and Tversky (1979) showed that, for most people, losses have twice the emotional impact of gains. However, Johnson (2010) found that losses have ten times the impact of gains for retirees, so older adults' hypersensitivity to losses may cause losses to loom more vividly, leading to greater loss aversion and insensitivity to probability. As Weingart (2001) found, "If someone is predisposed to be worried, degrees of unlikeliness seem to provide no comfort."

Subjects who made the suboptimal choices commonly commented that although they knew the small bowl offered better odds, they felt they had a better chance of winning by drawing from the bowl that contained more red beans.

Even an unemotional but rich and vivid outcome reduces sensitivity to probability such that Kahneman (2011) predicts that adding irrelevant but vivid details to an outcome disrupts calculation. In one study, subjects were told they could win money by drawing a red jellybean from a small bowl containing one red and nine white beans, clearly labeled as offering a 10-percent chance, or from a larger bowl that always contained 100 beans and, depending on the trial, offered a clearly labeled 5–9-percent chance (Denes-Raj and Epstein 1994). A majority (61 percent) preferred drawing from the large bowl when it offered a 9-percent probability of winning over the small bowl, with its 10-percent chance of success. Even when the large bowl only offered a 5-percent chance of drawing a red bean, 23 percent of subjects chose it over the small bowl and its 10-percent chance. Subjects who made the suboptimal choices commonly commented that although they knew the small bowl offered better odds, they felt they had a better chance of winning by drawing from the bowl that contained more red beans.

Because the experiential system is key to making better decisions and the dominant way we evaluate risk, it is critical to the type of risk profiling financial advisors do for their clients. Traditional risk-return models assume asset allocation is a function of predicted return and volatility. However, studies that assess the perception of risk in financial decisions by comparing a traditional quantitative risk-return approach to a more experiential assessment of subjective feelings of risk find the subjective measures are far superior to predicting risk-taking (Weber 2004; Weber et al. 2005; Weber et al. 2012). This is at least partly due to the fact that perceptions of riskiness incorporate affective

reactions, which tend to have a greater impact on choice than does cognition (Weber et al. 2005; Lowenstein et al. 2001).

Prospect theory, the certainty effect (Kahneman and Tversky 1979; Tversky and Kahneman 1992), and socioemotional selectivity theory (Carstensen 2006) illustrate the dominance of the experiential system and insensitivity to probability. Prospect theory showed how people systematically violate utility theory by overweighting low probabilities and underweighting medium to high probabilities, causing them to overvalue rarer events. If an event is very likely, its alternative becomes the focus, and the emotional arousal is insensitive to the exact level of probability (Kahneman 2011). Our minds focus spontaneously on whatever is odd, different, or unusual so that the unlikely event becomes focal (Kahneman 2011). Investors whose life savings are at risk are likely to overweight the low probability of running out of money generated by Monte Carlo.

Prospect theory also shows that people overweight outcomes obtained with certainty (the certainty effect) relative to uncertain outcomes (Kahneman 2011). As the probability of an aversive event passes the zero threshold, a consequence that was previously of no concern now becomes a source of worry. Subsequent increments in probability have little additional emotional impact, creating an all-or-none characteristic to the impact of probabilities on choice where people may be sensitive to the possibility rather than the probability of negative consequences (Lowenstein et al. 2001). Li and Chapman (2009) propose that the certainty effect is a special case of a "100% effect" and suggest it may be preferred because it is cognitively easier to process 100 percent than other probabilities. Evidence that our brains process certainty faster and with less cognitive effort (Arkes 1991) suggests it is a function of our experiential systems (Dickhaut et al. 2003).

Notably, a series of experiments found older adults as effective as younger adults at selecting the better of two risky choices, but when a sure thing was one option, even if it was inferior to the risky option, they were more likely to select it (Mather et al. 2012). This tendency for older adults to weigh certainty more heavily could cause them to favor predictable investments when they need to include more growth investments in their portfolio. It also could cause the earliest possible Social Security payout to look like the sure thing to seniors.

People also are prone to overweight outcomes due to an availability heuristic, which causes them to judge an event as more likely the easier it is to imagine or recall (Kahneman 2011). Simply discussing a low-probability hazard "may increase its memorability and imaginability and hence its perceived riskiness, regardless of what the evidence indicates" (Slovic et al. 1982).

Socioemotional selectivity theory (SST) maintains that as we age we prefer, remember, and are more motivated by emotional content and positive information (positivity effect) over negative information (Carstensen 2006). Older adults prefer and remember advertisements with emotionally meaningful appeal to those with knowledge-related appeal (Fung and Carstensen 2003) and rate positive pamphlets about health care as more informative than negative pamphlets about health care (Shamaskin et al. 2010). Brain scans show that younger adults exhibit greater amygdala activity when viewing positive or negative stimuli relative to neutral stimuli, but amygdala activation in older adults increased only when viewing positive stimuli (Carstensen 2006; Charles et al. 2003). Similarly, although researchers have documented age-related declines in working memory for some types of information, they have found it to be unimpaired for emotional information, especially positive information (Mikels et al. 2005).

Given the dangers of distributing wealth with strategies that worked for accumulating, it is imperative that advisors motivate retirees to change their strategies/behavior. Positive/emotional messages are more effective for that. Researchers found advertisements that stress experiential elements of a product motivated consumers to seek out more information than those that stressed functional elements (Couwenberg et al. 2017). This is particularly true for older adults who have been found to have more favorable attitudes toward affective (versus rational) product ads (Drolet et al. 2007). Less-numerate older adults were more likely to take a cholesterol drug when given nonnumeric information about drug risks than numeric information (Peters 2010). Older adults told the positive benefits of walking walked more than ones told the negative consequences of not walking, whereas message framing had no impact on the behavior of younger adults (Notthoff and Carstensen 2014).

As noted, the experiential system relies on images, narrative, and associations linked by experience to emotion, each of which aids in motivation or memory. Four studies on time discounting and how to get people to save more for retirement illustrated the persuasive power of images. Those who interacted with age-progressed computer renderings of their future selves exhibited an increased tendency to accept later monetary rewards over immediate ones (Hershfield et al. 2011). The Significant Objects project was an anthropological experiment that demonstrated the power of narrative (Walker and Glenn 2020). The project originators bought 100 knickknacks for an average price of $1.29 each and, after attaching stories from volunteer writers, sold each for several times its original cost. Finally, the baker/Baker paradox illustrates how associations linked by experience help us recall vivid images and sensory elements: If you see a picture of a person and later see that picture again, you are more likely to remember the person's occupation than the person's name if you are told the person is a baker than if you are told the person's name is Baker. The name Baker is an abstract concept that you do not associate with anything, but you associate the occupation baker with the experiential elements of smell and taste or the vivid image of someone in a white coat with a white hat. In one study with participants asked to recall names and occupations of

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multiple faces, older adults had relatively more trouble than younger adults remembering names but recalled occupations as well as younger adults (James 2004).

LACK OF INTEREST

In addition to misperceiving probabilities, many people simply do not want numeric data about the likelihood of an event occurring (Sunstein 2001). In studies on decision-making that presented several managers with hypothetical but realistic business decisions involving risk, subjects required to search out their own information rarely asked for any data on probabilities (Huber et al. 1997). In his study of 700 managers and risk taking, Shapria (1997) observed that managers are quite insensitive to probabilities and feel more comfortable with "descriptions of particular events" such as "the worst possible outcome," with this insensitivity at least partly due to the perception of probability as "random and not controllable." We associate randomness with disorder (Mlodinow 2009). Investors are interested in your plan to control or manage risk, and feeling lucky is not a plan.

Psychologist Gerd Gigerenzer reports that decision-makers at large international companies he works with estimate that 50 percent of all decisions are gut decisions (Fox 2014). Hogarth and Kunreuther (1995) found that when people are asked about their decision processes around the purchasing of warranties, they rarely list the probability that the item needs repair. Instead, they use arguments such as peace of mind or sleeping well at night to explain their decisions. We make the most important decisions intuitively as we follow our hearts.

One reason people may lack interest in Monte Carlo analysis is because its application of one solution to multiple scenarios is the opposite of what retirees want. People are not averages, they are individuals who want personalized solutions and understand they cannot get that from a store that only sells one size. Focus groups I worked with, when asked to evaluate a single solution, questioned why there was only one and indicated they would like to have more options, reacting positively to marketing passages that referenced personal solutions.

Monte Carlo typically applies one solution to multiple scenarios and limits you to some version of the 4-percent rule. By actively managing risk and cash flow, however, advisors can create hundreds of solutions (Sandidge 2016, 2019) that allow them to offer the type of personalized approach retirees want. The paradox of choice is that, although people like to have choices, giving them too many can cause them to struggle to make decisions and older adults prefer fewer choices (Reed et al. 2008). Advisors should make investors aware of the many approaches available but quickly narrow down the selection to a couple of personalized solutions.

Additionally, Monte Carlo's focus is on the risk of spending your entire principal over the long term and investors are concerned with short-term principal erosion. In one exercise, focus groups I worked with saw a list of financial terms related to retirement income and were asked if each term gave them a positive, negative, or neutral feeling. One of only three terms that generated a preponderance of negative responses was "spending principal." Note that was the actual term, not "spending your entire principal." Nobody wants to spend their entire principal, but what many miss is that retirees do not want to spend any principal. Advisors must be able to articulate their plans to minimize principal erosion this year and each subsequent year (Sandidge 2016, 2019).

Finally, investors do not care about the thousand scenarios Monte Carlo runs; they care about the one scenario they are going to live through, and they worry that one will be the worst case. Viscusi (1997) showed that people "devote excessive attention to the worst case scenarios." When people focus on worst-case scenarios that trigger strong emotions, they fail to inquire into the probability of that scenario occurring, according to Sunstein (2001), which adds "It might not be helpful to present people with a wide range of information, containing both assuring and less assuring accounts."

When discussing worst-case scenarios, the industry tends to jump to the worst-case outcome of running out of money long-term, but advisors should talk about preparedness to reduce the magnitude of worst-case market scenarios. Investors' comfort levels are likely bounded by the worst that has happened, especially recently. Personal experience significantly impacts recognition of risk and willingness to take precautions (Weinstein 1989). As Kahneman (2011) noted, protective actions by individuals against disasters "are usually designed to be adequate to the worst disaster actually experienced" and "images of a worse disaster do not come easily to mind." Taleb (2010) likewise noted that the biggest we have seen is likely the biggest we can envision.

Advisors should articulate how their retirement-income strategies would have performed in a recent worst-case environment, emphasizing short- and long-term principal erosion. Given the potential positive impact of staggering (Sandidge 2016) or reducing (Sandidge 2019) cash flow, coupled with the fact that few people likely could watch their life savings drain to zero without making any lifestyle changes, lifestyle risk is the much more likely worst-case outcome for most people. Advisors should focus on positive discussions around preparedness and possible lifestyle changes instead of leading with "you could run out of money."

PROBABILITY AND MONTE CARLO ANALYSIS INJECT NEGATIVITY

Priming and the law of least effort (Kahneman 2011); cognitive fluency/disfluency (Alter and Oppenheimer 2009); and the tendency to associate probability with disorder, randomness, and uncontrollability (Mlodinow 2009) explain why many people view probability and Monte Carlo analysis negatively.

Priming is the ability of one stimulus to create an association to another stimulus and it will cause many people to have negative feelings toward Monte Carlo. Along with "spending principal," "Monte Carlo analysis" and "probability" were the only three terms that generated a preponderance of negative responses from a list of financial terms presented to focus groups, and not surprisingly references to "Monte Carlo analysis" in marketing passages elicited negative comments about gambling.

Many financial firms prominently display "Monte Carlo analysis" despite the reality it primes people for a negative association with gambling. Not talking about anything associated with gambling when asking someone to hand over a life savings would seem obvious, but as Kahneman (2011) noted, "we can be blind to the obvious, and we are also blind to our blindness."

The analytic system is effortful so we associate probability with effort. The law of least effort maintains that if there are multiple ways to achieve the same goal, people will gravitate to the one requiring the least amount of effort—whether physical or cognitive effort (Kahneman 2011). Similarly, cognitive fluency (ease) and disfluency (strain) show that anticipated cognitive demand causes people to associate the difficulty of processing with the difficulty of executing the behavior, which impacts willingness to engage in that behavior (Song and Schwarz 2008). Consumers who are able to process experiential product attributes fluently like those products better (Brakus et al. 2014).

Similarly, descriptive logos, which include textual or visual elements that clearly communicate the product or service provided by a brand, are processed more fluently and study participants liked descriptive logos more than non-descriptive ones. Additionally, descriptive logos make brands appear more authentic, more favorably impact consumers' evaluation of brands, more strongly increase consumers' willingness to buy from brands, and boost brands net sales more (Luffarelli et al. 2019).

Something as simple as a harder-to-read font (perceptual fluency) can affect willingness to engage in a behavior and lead to negative judgments. In one study, half of subjects received directions on how to implement an exercise routine in an easy-to-read Arial font and half saw it in a harder-to-read Brush font. The ones viewing the easy-to-read font reported a higher willingness to incorporate the exercise routine into their daily schedule and estimated it would take 8.2 minutes to complete compared to estimates of 16.1 minutes by those seeing the harder-to-read font (Song and Schwarz 2008). Subjects equated greater cognitive effort required to process the directions with greater physical effort to complete the task.

Given the preference of older adults for positive information and dislike for effort, advisors should avoid priming investors for a negative perception of retirement income. Yet I often hear, including from "experts," retirement income described as "harder," "more difficult," or "more complex" than wealth accumulation. It is a different problem, requiring different thinking, but is solvable with math of no higher level than that needed for wealth accumulation (Sandidge 2016, 2019). If you do not understand the differences, it probably is harder. More importantly, retirees are likely to choose the advisor describing retirement income as "different" rather than "harder" because it is a more positive term that will require less effort. This is consistent with focus groups who reacted negatively to marketing passages that described retirement planning as "difficult" or "complicated."

Uncertainty is aversive (Bar-Anan et al. 2009) and we have a strong need to feel in control (Gardner, D. 2011), but we associate probability with randomness, uncontrollability, and disorder (Mlodinow 2009). This can cause people to view probability negatively.

Priming, the law of least effort, cognitive fluency/disfluency, and the tendency to associate probability with randomness, uncontrollability, and disorder make probability and Monte Carlo negatives for investors. Retirees want retirement income to be easy, but system 2 is effortful. Advisors should avoid using any negative priming like calling retirement income "harder" and in particular should never use words associated with gambling in conversations with investors.

PROBABILITY CONFOUNDS NOVICE AND EXPERT

Many people lack the numeric skills needed for an accurate assessment of probabilities and even those with superior skills often struggle. Results from the National Adult Literacy Survey show almost half of the general population struggle with relatively simple numeric tasks; 16 percent of highly educated individuals incorrectly answered questions about risk magnitude such as which represents the largest risk: 1 percent, 5 percent, or 10 percent (Lipkus et al. 2001). Along with older adults, women also tend to score lower on this test. Given that less numerate decision-makers use explicit probabilities less and narrative more (Dieckmann et al. 2009) and our numeracy skills tend to decline with age, it would follow that narrative and anecdote have greater influence on the decision-making of older adults than numeric information.

Even experts struggle with the interpretation of probabilities. Slovic et al. (2000) asked experienced psychologists and psychiatrists to judge the likelihood that a mental patient would commit an act of violence within six months after discharge from the hospital. When they framed the risk as "20 out of every 100 patients similar to Mr. Jones are estimated to commit an act of violence," 41 percent refused to discharge the patient. However, when the same risk was framed in probabilistic terms as, "patients similar to Mr. Jones have a 20% chance of committing an act of violence," only 21 percent refused to discharge the patient. That the clinicians rated the risk differently depending on whether it was presented in terms of frequency or probability shows even professionals are not immune to framing biases regarding probability.

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The Monty Hall problem may be the best example of how even experts struggle with probability. Martin Gardner, who made the earliest known statement of the problem, observed that "in no other branch of mathematics is it so easy for experts to blunder as in probability" (Mlodinow 2009). It was a question to Marilyn vos Savant's "Ask Marilyn" column in *Parade Magazine* that assumed you were on a game show and chose one of three doors, with a new car behind one and a goat behind each of the other two. After the host opens one of the doors that you did not choose to reveal a goat, should you switch your original choice when given the option?

Marilyn's reply that you should always switch generated a flood of mail challenging her answer, including nearly 1,000 PhDs who thought it was obvious that with two doors remaining the contestant faced a 50/50 proposition and had as good a chance of winning by staying with the original choice. However, Marilyn was correct: When initially faced with three doors, the contestant had only a one in three chance of picking the car, so the odds were they chose a goat and should switch their pick. In one study simulating the Monty Hall problem, only 13 percent of 228 subjects chose to switch (Granberg and Brown 1995), and even with the benefit of multiple trials, subjects were reluctant to switch their choices. Notably, pigeons repeatedly exposed to the Monty Hall type of problem rapidly learn they should always switch, unlike humans, who fail spectacularly (Herbranson and Schroeder 2010).

MONTE CARLO IS LINEAR THINKING IN A NONLINEAR RETIREMENT-INCOME WORLD

Accumulating wealth is a linear process and predictable, but in the nonlinear world of retirement income, returns and standard deviation are not predictors of success and therefore are unreliable inputs for Monte Carlo analysis. Additionally, Monte Carlo takes a systematic approach to risk and cash-flow allocations, but advisors are likely to make adjustments to those allocations, and the butterfly effect means each adjustment can cause outcomes to change significantly.[1] Thus, flawed inputs and systematic approaches lead to flawed outputs that are likely to have little correlation to a real-world setting.

The two retirement-income portfolios depicted in figure 1 both begin with $1 million in the year 2000 and take 5-percent initial withdrawals with the dollar value of those withdrawals increased 3 percent annually. The line is half Treasury bills and half-long Treasuries, earned 4.8 percent annually, and assumes the investor paid a 1.5-percent annual fee. The bars are 100-percent S&P 500 Total Return Index and earned 6.1 percent annually with no fee.

Under classical portfolio theory, the higher returns and lower fees that accompany the bars predict greater wealth in the long term, but the less-volatile portfolio (6.1 standard deviation versus 17.6) with a lower return (4.8 percent versus 6.1 percent) and higher fees (1.5 percent annually versus no fee) generated more wealth ($427,933 versus $0). Because expected returns and standard deviation are not reliable predictors of retirement-income success, they are flawed inputs for Monte Carlo calculations.

Figure 1

CHAOS AND RETIREMENT INCOME

Year-by-Year Account Values, 2000–2016

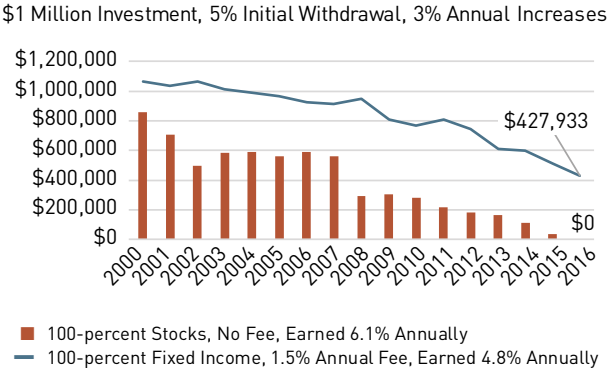
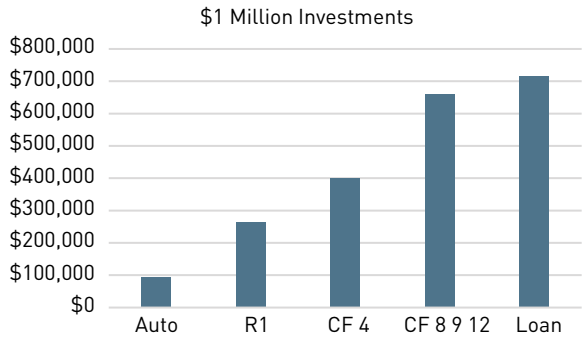


Figure 2

SYSTEMATIC VS. ACTIVE

Ending account values, 1966–1990



Compounding those flaws, Monte Carlo typically never varies the inputs that advisors control, and due to the butterfly effect of chaos theory, even seemingly insignificant changes to those inputs can change outputs dramatically. Figure 2 illustrates this by comparing ending values after twenty-five years of a systematic approach typical of Monte Carlo analysis to more active approaches. The first bar never varied the risk allocation (50/50 rebalanced annually) nor the cash-flow methodology (5-percent initial withdrawal, with that dollar amount systematically increased 3 percent annually). This systematic or autopilot approach left $94,000 of the original $1-million investment after twenty-five years.

The second bar did everything the same as the first, except it employed a 30/70 risk allocation the first year, then a 50/50 mix in all remaining years. This small adjustment to year one risk (R1) improved that year's return from –2.9 percent to –0.04 percent and doubled the ending value of the first bar.

The third bar applied the same methodology as the second except it did not increase cash flow in the fourth year (CF4),

a year in which the portfolio had a negative return. This small difference increased the ending value to $401,000. Thus, two seemingly insignificant adjustments to risk and cash-flow inputs the first and fourth years quadrupled the output (ending value) generated by the systematic approach of the first bar.

The fourth bar followed the same approach as the third except it did not increase cash flow in the eighth, ninth, or twelfth years, like the fourth year negative return years (CF 8 9 12), pushing the ending value to $660,000.

Trying to solve retirement income with strategies and assumptions that work for wealth accumulation is inefficient and potentially dangerous, but knowledge of old solutions tends to block the imagination needed to see new solutions (the Einstellung effect).

The fifth bar (Loan) did everything the same as the previous bar but also assumed you had an outside source of funds, which you took withdrawals from instead of from the portfolio in negative return years, then repaid that loan with 4-percent interest in the next positive return year. This loan strategy increased your ending value to $714,000. In figure 2, the seemingly minor adjustments of bars two to five, compared to the systematic approach of the first bar, increased the ending value from $94,000 to $714,000, illustrating the butterfly effect and the potential positive impact of actively managing risk and cash flow.

Figure 2 illustrates a handful of adjustments generating four additional outcomes, but over a thirty-year retirement, there are a countless number of combinations of inputs, with each combination creating a different path. Assuming you do an annual review over thirty years, there are potentially thirty different inputs apiece for risk and cash flow. Different advisors charge different fees. Likewise with products. Each year that you employ the loan strategy discussed in figure 2 changes outcomes, as does the fact that different loan sources have different costs of funds. Those are small adjustments, much less than financial shocks such as jobs lost or catastrophic illness. As Gleick (1987) noted, nonlinear problems are like a maze whose walls shift with each step you take, and because of the butterfly effect, each step you take in retirement can significantly change your path.

Trying to solve retirement income with strategies and assumptions that work for wealth accumulation is inefficient and potentially dangerous, but knowledge of old solutions tends to block the imagination needed to see new solutions (the Einstellung effect[2]). Systematic investment is the type of commitment device that has helped many people save for retirement, but a systematic approach to withdrawing savings is inefficient and dangerous and retirement-income calculators based on a systematic methodology are deeply flawed.

Using flawed inputs and a systematic approach creates an illusion of control and suboptimal risk analysis that leads to flawed forecasts of portfolio longevity in a practical setting. When I went on the websites of three of the largest mutual fund companies and input that I was sixty-five years old, just retired, and wanted to take a 5-percent initial withdrawal from my savings, they all suggested I withdraw less because I presume they were using Monte Carlo approaches that systematically increased cash flow. The first company suggested I take a 4.5-percent withdrawal but did not appear to be including any fees. The second explicitly included a fee and suggested I withdraw 3.5 percent and added that I would still have a 20-percent chance of running out of money. The third said if I ran into a bad market I would run out of money in twenty years. However, 1957–1981 is the worst period for stocks since 1940 as well as a period of rising interest rates, and when I applied a 50/50 portfolio, 1.5-percent annual fee, and 5-percent initial withdrawal but only increased that every other year, I finished the twenty-fifth year with 50 percent of my original principal remaining. These three companies, like many others, use Monte Carlo to predict a safe withdrawal and portfolio longevity, illustrating why I say Monte Carlo generates wildly inaccurate predictions in a practical setting.

Control is a fundamental psychological need (Gardner, D. 2011) and the discomfort of uncertainty and a desire for control lead to an unjustified overreliance on prediction (Danzig 2011). A meta-analysis of studies focused on the illusion of control found that many of them were about predicting outcomes and that the illusion is stronger when it involves predicting (Gardner, D. 2011), meaning it is an illusion of prediction as much as one of control.

A study of 107 traders from London investment banks found those who were more prone to the illusion of control scored lower on risk management and analysis (Fenton-O'Creevy et al. 2003). Participants who lack control are more likely to perceive a variety of illusory patterns, including forming illusory correlations in stock market information (Whitson and Galinsky 2008).

Because "big events don't have big patterns" (Taleb 2010), it is particularly hard to predict catastrophic events. Monte Carlo and value-at-risk probability models did not prepare investment firms or investors for the 2008 market, which was the type of market that can devastate a retirement-income portfolio. Unable to predict such worst-case markets, advisors must prepare for them then adapt.

Finally, by employing a systematic approach many retirement-income calculators recommend the same solution to everyone, and people like to have choices. By varying risk and cash flow in

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a handful of years, bars two through five create four additional solutions. Being prepared to manage risk and cash flow every year creates the multitude of solutions needed for truly personalized retirement-income plans (Sandidge 2016, 2019).

The nonlinear thinking needed for nonlinear problems is about finding multiple solutions, which is the essence of creativity and innovation and the basis for a brand that motivates and differentiates, because these are experiential attributes that consumers value (Brakus et al. 2014). Product features that engage consumers in nonlinear thinking are processed fluently, and when consumers are able to process experiential attributes fluently they like products better (Brakus et al. 2014).

Unfortunately, biases like mental dazzle block the nonlinear or creative thinking needed to see multiple solutions, and "experts" in particular may be the least capable of creative insight because they are more susceptible to cognitive biases such as the Einstellung effect, narrow framing, the tendency to make assumptions (Sandidge 2016, 2019), and seeing illusory patterns (Gardner, D. 2011). This affords advisors the opportunity to create a brand that resonates and differentiates as the rare individual who is both able and willing to think different.

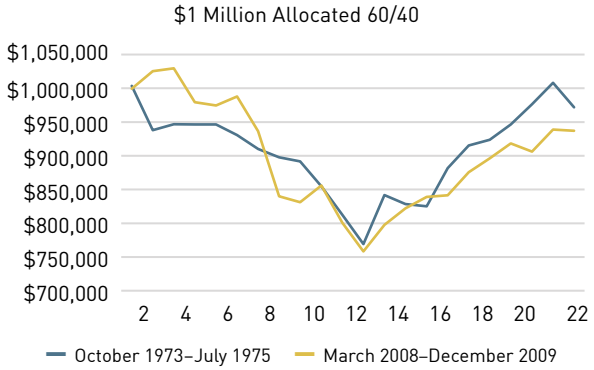
Some may quote Carveth Read (1914), that "it is better to be vaguely right than precisely wrong," to argue in support of Monte Carlo despite its limitations. Before chaos theory, science believed that approximately accurate inputs lead to approximately accurate outputs, but the butterfly effect showed that approximately accurate inputs could lead to significantly different outputs with nonlinear processes such as retirement income. People prefer data and information to uncertainty and follow the precisely wrong path because the data that accompanies it creates an illusion of knowledge, even when that data is flawed. The flawed inputs of Monte Carlo are not approximately accurate and its output is nowhere close to vaguely right, but the wealth of data it generates makes it precisely wrong.

Similarly, some may point to the quote often attributed to British statistician George Box, "All models are wrong, but some are useful," to suggest that Monte Carlo can be made useful by better explaining its limitations. However, Box also said, "Since all models are wrong the scientist cannot obtain a 'correct' one by excessive elaboration. On the contrary, following William of Occam he should seek an economical description of natural phenomena" (Box 1976). An economical description of retirement income means eliminating superfluous information, especially unnecessary jargon that carries a negative connotation.

Steve Jobs said, "You've got to start with the customer experience and work backward to the technology" (Jobs 1997). Investors want a retirement-income experience that is simple and easy and most are insensitive to probability or view it negatively. They want the choices needed for personalized solutions. They overfocus on the worst case. Finally, they want to maximize early cash flow and maintain their standard of living, while minimizing income shocks and principal erosion short- and long-term. Balancing those goals requires planning for the worst case and actively managing risk and cash flow to adapt to the environment. Working backward from those goals does not lead to Monte Carlo analysis; however, those goals are the foundational axioms of adaptive distribution theory (Sandidge 2016, 2019).

Figure 3

WORST CASE 60/40



ADAPTIVE DISTRIBUTION THEORY

Adaptive distribution theory creates a personalized cash-flow plan without complex calculations by accounting for behavioral biases, emphasizing short-term strategy, and assuming the worst then adapting as the environment you are in becomes clear. The calculations employed involve managing to an acceptable annualized rate of principal erosion.

The essence of retirement income begins by understanding that market losses hurt more financially and psychologically post-retirement, because losses early can devastate a retirement-income portfolio and cause hypersensitive retirees to panic. When presented with a low-probability high-magnitude risk, people focus on the magnitude. Advisors should use software that creates hypothetical illustrations to show how their recommended strategy would have performed for someone retiring in a market like 2008.

For example, figure 3 illustrates the twelve-month declines and ten-month recoveries for 60/40 portfolios during October 1973–July 1975 and March 2008–December 2009. Both portfolios lost almost 25 percent, which, if coupled with 4-percent withdrawals and 1-percent fees, could have led investors to see almost 30 percent of their life savings disappear in the first twelve months of retirement. That type of loss could be catastrophic to portfolio longevity and might cause retirees to panic and abandon their strategy, so even if a 60/40 allocation was appropriate for an investor when accumulating wealth, the investor should consider a less-volatile allocation in the first year of retirement.

Figure 4 shows how 20/80 portfolios minimized market losses in those same periods to approximately 7 percent, which could have limited worst-case principal erosion to 12 percent inclusive of withdrawals and fees. Although it is not the purpose of this type of illustration to predict future results, the similarity of losses in figure 3 fit the legal standard of reasonably foreseeable that it could happen again and the advisor should have taken precautions to protect against it. Such precautions should make for safer portfolios for retirees and avoid exposing advisors to unnecessary legal liability. Additionally, illustrations such as figure 4 should address retirees' concerns by showing them the advisor has a plan to manage high-magnitude risk.

After determining the appropriate risk allocation for year one, advisors should then determine the desired first year withdrawal. Much of the industry suggests retirees plan on living on 60–90 percent of pre-retirement income. However, that recommendation fails to account for a possible increase in spending early in retirement, because retirees may be more active when they expect to enjoy their best health. It also fails to capture the psychological importance of pre-retirement income as a reference point; because losses from a reference point have more emotional impact than gains, retirees are likely to be strongly motivated to maintain the status quo regarding income.

This is likely an attainable goal for many willing to forego the annual increase in cash flow typical of Monte Carlo. Sandidge (2016, 2019) showed that you maximize first year withdrawals by staggering the frequency of increases or by building in decreases later in retirement. Advisors should determine the investor's desired initial withdrawal and frequency of increase combination and create a hypothetical showing how it would have done in a worst-case short-term scenario such as figure 4 and a worst-case long-term scenario such as 1957–1981.

As discussed in Sandidge (2016, 2019), after initially taking a conservative approach to risk and cash flow, retirees may be able to become more aggressive if the environment supports it. For example, Sandidge (2016) found that a 10/90 portfolio was historically the most effective risk allocation to hedge twelve-month risk, but that allocation was the second least effective of eleven allocations for five-year downside risk, with a 30/70 allocation being optimal over five years.

Monitoring the annualized erosion rate facilitates adapting the portfolio over the long term. If an investor finishes the first year of retirement with less money than the investor retired with, it is human nature to project that erosion rate into the future (availability heuristic). If the retiree has 3-percent erosion year one and maintains that rate, the portfolio would last thirty-three years. Investors are making this calculation already, so advisors should manage to an annualized rate projecting to a number of years acceptable to the retiree.

Figure 5 shows the year-by-year annualized erosion rate for a retirement-income portfolio that increased cash flow every other year instead of annually. After overcoming a market loss in the first year, the portfolio had minimal erosion through twelve years and finished the twenty-fifth year with less than 2-percent annualized erosion and more than 50 percent of original principal remaining. At perhaps the twelve-year point when the portfolio had no erosion, if not sooner, the retiree may have chosen to take a more aggressive approach to cash-flow increases, such as increasing three out of four years. Recall 1957–1981 was a period of particularly poor returns, yet I was able to withdraw 6.5 percent (5-percent distribution and 1.5-percent fee) the first year and finish the twenty-fifth year with 50 percent of my original investment. Using a more conservative risk allocation the first year or limiting cash flow increases more would increase the ending value.

Figure 5 also illustrates the need to prepare investors for the possibility of portfolio erosion in the initial years. The portfolio was down 9.2 percent the first year, which would project to a possibly unsettling eleven years of longevity, despite the fact that

Figure 4

WORST CASE 20/80

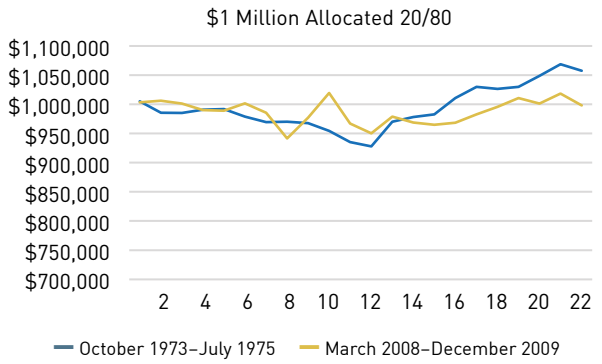
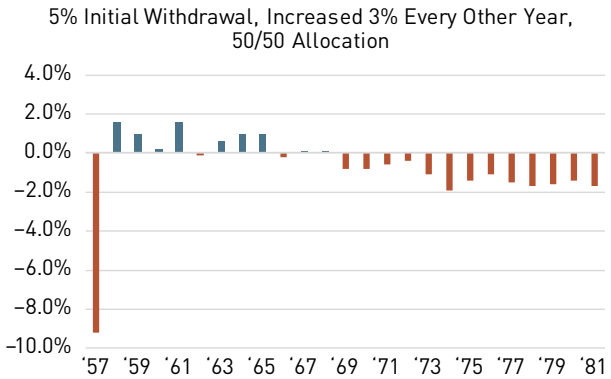


Figure 5

ANNUALIZED EROSION RATE, 1957–1981



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the market loss was only 2.7 percent. The 5-percent withdrawal and 1.5-percent fee assumptions exacerbated the market loss.

CONCLUSIONS

Monte Carlo analysis is the tool of choice for rationalists who believe we are all perfectly rational agents employing our analytic systems, following normative rules such as probability to make choices that optimize our utility. But research on dual processing theory, prospect theory, the certainty effect, risk as feelings, the affect heuristic, probability neglect, and socioemotional selectivity theory all show that the experiential system is the dominant way in which we respond to risk. We make better decisions because of the experiential system and, due to cognitive biases, lack of interest, or lack of numeric ability, people by nature are insensitive to probabilities and neglect them completely as risk becomes more vivid or emotional. The law of least effort, cognitive fluency/disfluency, priming, and the tendency to associate probability with disorder, randomness, and uncontrollability make probability and Monte Carlo analysis negatives for many people.

The Monte Carlo methodology is the opposite of what retirees want. It does not align with retiree desires for choices and personalized solutions, does not focus on the single scenario investors are prone to worry about—the worst case, does not meet investor desires to maximize initial withdrawals, and cannot accurately predict worst-case risk. Finally, by employing flawed inputs of expected return and standard deviation and by failing to account for active management, Monte Carlo analysis gives wildly inaccurate predictions of portfolio longevity in a practical setting.

Monte Carlo analysis fails to capture the risk or psychology of retirement-income management. The idea that probability correlates with the risk perception of people is as dated as the assumption of perfect rationality. As Slovic et al. (2004) noted: "One cannot assume that an intelligent person can understand the meaning of and properly act on even the simplest of numbers, not to mention more esoteric measures or statistics pertaining to risk, unless these numbers are infused with affect. Thus, the forms of information that people take for granted as meaningful, and they expend immense effort and expense toward gathering and disseminating, may be illusory." Advisors and asset managers should focus their efforts and resources on preparedness, risk magnitude, and adaptability, which are the keys to safer retirement-income portfolios, not on flawed predictions and illusions of control. They should focus on nonlinear thinking to deliver the personalized solutions investors crave and to create a personal brand around original thinking.

Reducing cognitive strain is key to delivering a message that resonates and motivates investors to change their behavior. Recipients of your message want to stay away from anything that reminds them of effort, so advisors should reduce cognitive strain by filtering out noise such as probability and Monte Carlo analysis. There is a difference between simplicity and simplistic, and creative thinkers make problem-solving easier by finding the most simplifying axioms—such as focusing on one adult crossing a river instead of six—and ignoring noise. Advisors who avoid the curse of complexity by subtracting superfluous information such as Monte Carlo analysis are easier to understand and likely to be viewed as more credible. The first step on the road to credibility when asking someone for their life savings is to never mention anything associated with gambling.

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ENDNOTES

1. The butterfly effect refers to the ability of small changes early in a process that lead to significant impact later. It gets its name from the idea that a butterfly flapping its wings in Brazil could trigger a chain of events that would culminate in the formation of a tornado in Texas. The butterfly effect applies to distribution portfolios where even small changes early in retirement can have significant long-term impact.
2. Often called a problem-solving set, Einstellung refers to a person's predisposition to solve a given problem in a specific manner even though better or more appropriate methods of solving the problem exist. The Einstellung effect is the negative effect of previous experience when solving new problems (https://en.wikipedia.org/wiki/Einstellung_effect).

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