Modeling of Policyholder Behavior for Life Insurance and Annuity Products

A Survey and Literature Review

pwc

SOA
SOCIETY OF ACTUARIES

LIMRA

Modeling of Policyholder Behavior for Life Insurance and Annuity Products

A survey and literature review

Research Team: Jason Campbell (PwC)

Michael Chan, FSA (PwC)

Kate Li, FSA, MAAA (PwC)

Louis Lombardi, FSA, MAAA (PwC)

Lucian Lombardi, ASA, MAAA (LIMRA)

Marianne Purushotham, FSA, MAAA (LIMRA)

Anand Rao, PhD (PwC)

Acknowledgements

SOA Staff

Jan Schuh, SOA

Ronora Stryker, ASA, MAAA (SOA)

POG (Project Oversight Group)

Kathryn Cantor, FSA, MAAA (Chair)

Michael DuBois, FSA, MAAA

Timothy Gaule, FSA, MAAA

Marshall Lin, FSA, MAAA

David Ruiz, FSA, FIA, MAAA

William Sayre, FSA, MAAA

David Wang, FSA, FIA, MAAA

Lisa Winters, FSA, MAAA

The opinions expressed and conclusions reached by the authors are their own and do not represent any official position or opinion of the Society of Actuaries or its members. The Society of Actuaries makes no representations or warranty to the accuracy of the information.

Contents

Tables

Figures

Research Overview

With the pace of product innovation the life insurance and annuity industry has seen over the past two decades and the corresponding increase in the complexity of financial products, the list of actuarial assumptions that can materially impact product profitability has grown and includes a group of assumptions that are collectively referred to as "policyholder behavior assumptions" (or "customer behavior assumptions"). In an actuarial context, the term policyholder behavior refers to any assumption for which experience is directly driven by the decisions policyholders make regarding the exercise of benefits and guarantees within their contracts.

Given the recent increased focus on these assumptions, this report first seeks to inventory what information is required from an experience analysis process, including the range of possible data sources and methods of experience data collection, analysis, and modeling available to actuaries.

To that end, using a combination of survey and interview techniques, this work provides an overview of the current state of the life insurance and annuity industry with respect to: (1) available policyholder behavior experience data sources, (2) credibility of current experience data, (3) assumption structure and modeling, including modeling tools, validation processes, and governance, and (4) current challenges in the area of policyholder behavior modeling.

In addition to identifying current practices within the life insurance industry, a unique aspect of this research is that it examines developments in other industries and disciplines that could benefit actuarial practice with respect to the understanding of policyholder behavior. In particular, behavioral economics was identified as a promising area for advancing industry knowledge, as it combines the study of psychology and economics to study an individual's actual decision making behavior, of which insurance policyholder behavior is a subset of the much broader range of behaviors studied.

Finally, based on a lengthy literature review process, this report includes a discussion of current practice with regard to the modeling of potential buyer behavior to support the development of more effective life insurance and retirement product marketing and education campaigns.

In order to allow companies to review the quantitative survey results in more detail, a visualization tool is provided with the report to allow the user to view a summary of the responses to all survey questions.

This research suggests that the analysis and modeling of policyholder behavior assumptions might be improved by combining traditional actuarial techniques with advances made in behavioral economics, predictive analytics, big data, and technology. A full treatment of this topic is beyond the scope of this report, but a specific application of one of these techniques is detailed in the Society of Actuaries' report *Behavioral Simulations: Using Agent-Based Modeling to Understand Policyholder Behaviors.*[1]

Summary of Research Findings

1. The life insurance industry lags the property and casualty insurance industry in using advanced analytical techniques to understand its customers — both potential future customers and existing policyholders.

2. Data quality and credibility are primary impediments to implementing greater dynamism in assumption setting and modeling for policyholder behavior.

3. Policyholder behavior data sources are nearly universally limited to insurer experience data, whether internal, industry, or reinsurer sourced.

4. In developing assumptions, nearly all companies consider the policyholder's level of financial efficiency.

5. The industry has seen significant movement in recent years toward a formal assumption-setting process across a broad range of insurer functions, in some cases including those outside traditional actuarial areas.

6. In order to model policyholder behavior successfully, it is important that the policyholder not be viewed just as a model point ("male aged 40 preferred non-smoker"), or even as an individual fulfilling their role as the owner of a contract, but as a member of society and part of a household. This allows for a better understanding of the drivers of policyholder needs and decisions.

7. Actuaries have been able to use traditional actuarial techniques to gain a very good quantitative understanding of policyholder behavior, but their qualitative understanding of that behavior is often only secondhand. Current developments in the areas of psychology, big data and computer technology offer an opportunity for actuaries to extend their knowledge of policyholder behavior.

   a. In the application of traditional actuarial techniques, data is often highly aggregated, making it difficult to separate the impact of the different decision-making environments that prevailed when specific data was collected. It is like trying to drive a car forward by looking into the rearview mirror.

   b. Most policyholders do not make decisions by solely calculating the "in-the-moneyness" of embedded options in their insurance contract. Rather, they have to consider real-life household needs and their decisions are impacted by cognitive biases.

8. For companies exploring the area of consumer purchase behavior, the survey results showed that developments in this area are often occurring outside the traditional actuarial functions. Several companies indicated that their organization had developed a new functional area to serve the increasing corporate need for data analysis and predictive modeling in the actuarial, marketing, underwriting, claims, and administrative areas.

Introduction

Policyholder behavior is a complex issue that affects the life insurance industry in almost every aspect, from product design and pricing to marketing and distribution to financial reporting and enterprise risk management (ERM). It is not a new issue but the actuarial profession is still in the early stages of understanding policyholder behavior and its wide-ranging implications.

The purpose of this report is to inform actuaries and other interested parties about current actuarial practice around the development and use of policyholder behavior assumptions including the use of dynamic modeling approaches. As part of this work, the research team focused on two areas:

1. Survey and evaluation of current practices in the industry; and

2. Review of current thinking on modeling human behaviors outside of the life insurance industry.

To that end, an important aspect of this research is the identification of leading practices in the life insurance industry and in other industries that:

1. Might have applications to life insurers; and

2. Have real potential to enhance current life actuarial practice.

Although the content of this report focuses on the term "policyholder behavior," this research seeks to broaden the industry viewpoint by studying how other industries understand their customers' behavior. In this spirit, the terms *policyholder behavior* and *customer behavior* are used interchangeably throughout this report.

Research methodology

The research was conducted in three stages:

- *Quantitative survey.* An extensive survey was sent electronically to more than 100 life and annuity companies requesting information about their assumption development and modeling practices with respect to policyholder and potential buyer behavior.

- *Qualitative interviews.* Fifteen qualitative interviews were conducted with a combination of life insurers, property and casualty insurers, and companies outside of the insurance industry to understand their practices, challenges, and perspectives on customer behavior modeling.

- *Literature review.* More than 100 related articles, papers, and books were reviewed. Sources included academic, actuarial, and industry literature around policyholder behavior. More generally, the literature review focused on decision making and behavioral patterns around personal financial matters through a behavioral economics perspective.

The quantitative survey gathered industry-level information regarding the development and application of policyholder behavior assumptions for individual life and annuity products. The qualitative interviews complemented the surveys, as researchers were able to speak directly with the individuals responsible for understanding policyholder/customer behavior to gain an in-depth perspective on their experiences and the insights gleaned from them. The literature review helped to inform the survey development, and supplemented our primary research data with a more comprehensive perspective of academic and industry inquiry into policyholder behavior.

Behavioral economics

The literature review process indicated that recently there has been increased interest in behavioral economics across the life insurance industry as well as across other disciplines. The Society of Actuaries, for example, has formed a new behavioral finance subgroup under its health section, and has also sponsored two extensive research reports by Alan Mills — *Complexity Science* and *Simulating Health Behavior* — both of which introduce behavioral economics and discuss how it can be applied to health actuarial work. Employee benefits actuaries have also begun looking into behavioral economics to gain insight into increasing employee engagement and motivation, including how health and wealth behaviors are influenced, intentionally or unintentionally. The Society of Actuaries 2012 Enterprise Risk Management Symposium featured papers on the application of behavioral economics to enterprise risk management. The United Kingdom and Singapore actuarial societies have sponsored presentations and training on behavioral economics as well.

As a result, the latter half of the report focuses on developments in behavioral economics as it applies to individuals making personal financial decisions.

Behavioral economics can be viewed as the marriage of classical economic theory and psychology, studying the effects of emotional, social, and cognitive factors on individual and institutional economic decisions, and their wider consequences. Research in this field has spawned a significant shift in the understanding of consumer behavior. Prior to this work, in most cases, it was assumed that individuals make perfectly rational decisions or take actions as if they were perfectly rational.

Today, instead, human decision-making shortcuts are being identified, and the surprisingly strong effects of various psychological biases are being studied. Behavioral economics is still a developing field and a coherent framework and terminology has yet to emerge. In this paper, we make use of a behavioral economics framework created by PwC — PwC's Behavioral Economics Analysis Framework — and discuss how the application of such a tool may help to increase understanding of life insurance and annuity policyholder behaviors. This is clearly not the only behavioral economics framework available, but we find it useful in organizing and presenting the large amount of behavioral economics research conducted in recent years. An overview of this framework is provided in the Appendix of this report.

The latter half of this report discusses how different behavioral economics heuristics can be related to policyholder behaviors, and gives examples of behavioral economics experiments to help illustrate how (surprisingly) powerful some of the psychological biases can be. The report also discusses how behavioral de-biasing methods could be used to help policyholders avoid the potential psychological biases associated with exercising the options in insurance products. We also discuss the potential methods of addressing the many challenges of traditional actuarial modeling for policyholder behaviors. One such approach — agent-based modeling — naturally incorporates behavioral economics in the modeling process and focuses on the decisions made by individuals to understand aggregate policyholder behaviors as an emergent property, rather than a simple assumption.

Policyholder Behavior Defined

What is policyholder behavior?

In an actuarial context, the term "policyholder behavior" refers to the decisions that policyholders (individuals, groups, or organizations) make in the selection and utilization of benefits and guarantees embedded in life insurance and annuity products. Policyholder behaviors have a direct impact on the financial performance of the insurance company, and thus are important to all stakeholders.

Outside the actuarial context, other industries have also been working to gain a deepened understanding of customer behaviors by incorporating techniques from the fields of psychology, sociology, and social anthropology, providing models that can potentially be leveraged by the insurance industry. These modeling techniques take a more holistic view of policyholder behavior, through the lens of a given policyholder being a member of society and of a household, with life events and psychological biases impacting his or her decision making.

Why has the term "policyholder behavior" only entered the vocabulary relatively recently?

Policyholder behavior has always been an important aspect of actuarial analysis, however the term has received increased attention in recent years. As an illustration, a recent paper from the University of St. Gallen surveying actuarial literature on the topic of lapses for life insurance found that 49 of 56 papers reviewed were published after the year 2000.[2]

There are several factors that have led to the increased attention on policyholder behavior:

- The development of products that give increased flexibility to policyholders regarding how they want to use their product,
- The increased availability of insurance products with investment components over which policyholders have control,
- The increased volatility in financial markets,
- Increasingly sophisticated financial reporting and regulatory solvency standards,
- Social and technological advances that have greatly influenced people's behaviors and allowed information to spread more quickly,
- The coming of age of Behavioral Economics and the continued quest to understand human behavior.

In the past, life insurance and annuity products were simpler, and the primary policyholder decisions were whether to continue paying premiums, to convert, or to surrender the contract. The introduction of more flexible products with a variety of investment choices and other options (such as universal life and variable universal life, and the associated no-lapse or minimum interest guarantees) expanded the freedom given to policyholders.

With the accelerated innovation of product design and market competition with other financial institutions (such as banks), more insurance and annuity products were marketed as investment and retirement vehicles with equity market participation and guarantees provided through various mechanisms (such as variable and equity-indexed annuities with guaranteed living withdrawal benefits). These products offer a variety of policyholder

options whose value is significantly impacted by how and when the policyholders choose to use their policy, and constituted one of the natural drivers of moving to "dynamic" policyholder behavior assumptions and modeling.

Many of these products were initially designed when financial markets — as well as financial reporting and capital determination requirements — were more stable. In that setting, using historical averages to set actuarial assumptions for projections and risk management was much more reasonable.[3] Recent market volatility (Figure 1), however, has led to real-world stress testing of the embedded equity and interest guarantees written by insurance companies, exposing the unhedged and unhedgable risks in their risk management programs.

In particular, there has been increased recognition that policyholder behaviors are not necessarily stable while at the same time they

Figure 1 —
Market Volatility Indicator (VIX index)

represent an unhedgable and often non-diversifiable risk. The effectiveness of many of the industry's sophisticated dynamic hedging programs came to rely heavily on actuarial experience assumptions correctly predicting behaviors through both normal and stressed scenarios, as well as through familiar and unfamiliar economic environments. That policyholder behaviors are considered unhedgeable does not obviate the need to understand and manage that risk. Otherwise, we are just developing sophisticated hedging programs around unreliable hedging targets.

As former U.S. Secretary of Defense Robert McNamara said, "*We have to find a way of making the important measurable, instead of making the measurable important*." There has been a worldwide push in the development of accounting and regulatory standards to improve information available to evaluate the financial status of insurance contracts. This is another key driver of the need for actuaries to better quantify and understand policyholder behavior.
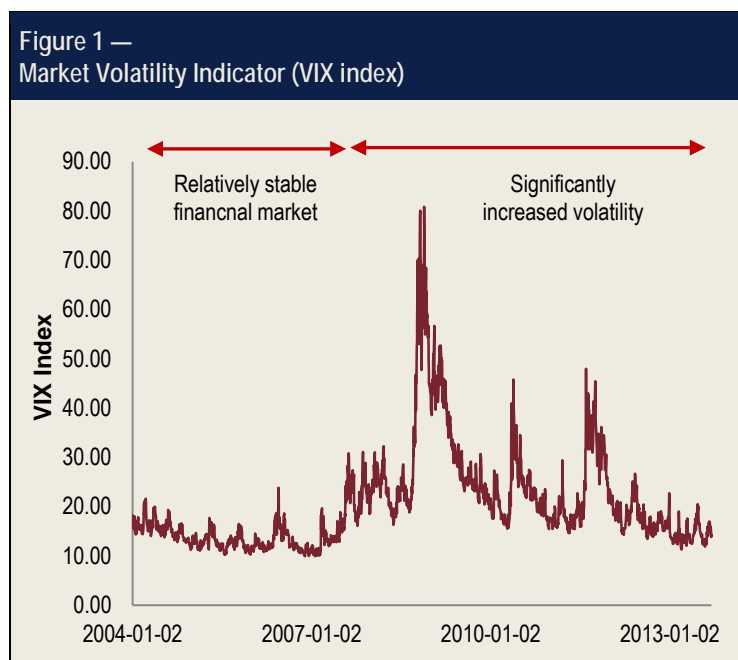
The introduction of fair value accounting, principles-based reserving and more demanding regulatory capital requirements such as Solvency II and ORSA have increased the need to regularly monitor and update policyholder behavior assumptions, and to identify and quantify the risk factors (both market and behavioral) around insurance products.

Society and financial markets are also becoming increasingly connected. Social networks and advanced technology dramatically promote the spread of information and even people's perceptions of products. In 2005, the aggregate of video, e-mails, Web transactions, and business-to-business analytics was 30 billion gigabytes. By the end of 2013, that total is estimated to have increased some 20 times, with even larger growth projected for the years ahead.[4] In the actuarial field, this is evident through a much faster spreading of knowledge: Consider the increasing number of Society of Actuaries virtual sessions and webcasts conducted versus five years ago, or the spread of products — such as variable annuities moving from the United States to Europe and Asia, a new wave of pension risk transfers, and mortality modeling techniques spreading from Europe to the United States. News and understanding about products with unusually rich features (e.g., variable annuities offering general account allocations with high minimum interest guarantees while not applying a cap on allocations), or loopholes in the product design (e.g., guaranteed minimum death benefits with dollar-for-dollar withdrawals) are now discovered and spread more quickly amongst consumers and policyholders.

These drivers have combined to provide policyholders with a greatly expanded range of options and, more importantly, enabled them to act on those options. The critical aspect of this fast-evolving area is the *dynamic nature* of policyholder behavior — and the actuarial profession has taken notice.

Dynamic assumptions are assumed to change across some characteristics, which may be via the policy itself (e.g., a variable annuity embedded option's in-the-moneyness) or due to the external environment (e.g., the gap between a company's crediting rate and external interest rates). A 2011 Society of Actuaries survey on variable annuity policyholder behavior[5] found that more than 80 percent of respondents used dynamic lapse assumptions for contracts with living benefit riders, and over 30 percent used dynamic utilization assumptions. Similarly, the 2012 Society of Actuaries survey on universal life secondary guarantee (ULSG) found that 40 percent of the companies surveyed varied assumptions dynamically for universal life policies with a secondary guarantee.[6]

While actuaries have recognized the dynamic nature of some assumptions, this has led to a host of difficult questions that have generated much of the discussion and attention around policyholder behavior assumptions. Many of these questions and challenges have exposed the crude nature and limited insight provided by traditional actuarial assumption-setting methodologies in providing an understanding of policyholder behavior. This report will explore some of these challenges as well as potential solutions.

Why is understanding policyholder behavior important?

Almost all aspects of insurance company operations are affected by policyholder behaviors, especially product design, pricing, reserving/capital decisions, asset and liability cash flows, and enterprise risk management.

During the product design phase, a company needs to consider policyholder behavior from several perspectives:

- What types of policyholder activities would the company like to encourage or discourage?
- What risks does the company want to take on or avoid?
- How can the company ensure that a balanced risk pool is created and doesn't collapse?

These are classic actuarial problems that have existed since the outset of insurance as a system: Antiselection and moral hazard issues are fundamental to insurance, yet examples abound of poorly designed products that did not adequately consider policyholder behaviors. For example, when long-term care insurance was first introduced, many insurance companies assumed lapse rates would be similar to their whole life insurance policies. In fact, actual lapses turned out to be much lower than assumed lapses in some cases, and contributed to the failures of some long-term care insurers.[7] Many companies failed to anticipate how policyholders might react in extreme economic environments — often putting too great a reliance on historical averages (e.g. market returns, historical benefit utilization). One example in the long-term care market is policyholders began using their long-term care coverage to move into assisted-living facilities as an alternative to paying rent during the economic downturn.

Policyholder behaviors need to be incorporated into product pricing decisions as well. Significant financial impacts occur if there is a material gap between policyholder behavior assumptions and actual experience. Overpriced products are unattractive to consumers and impede increases in market share and revenue. On the other hand, underpriced products can lead to large financial loss, as seen by the variable annuity market during the last financial crisis. Loopholes in the products are clearly undesirable and can lead to policyholders using the product in ways that are different from the original design and intentions, to the detriment of the risk pool and insurer. For example, some early generations of variable annuity contracts with a guaranteed minimum death benefit (GMDB) offered a dollar-for-dollar reduction in the benefit base for partial withdrawals. These were exploited by policyholders with contracts that were underwater, allowing them to withdraw most of the funds but keep a valuable death benefit at little additional cost.

For variable annuity products, policyholder behavior is one of the key assumptions in the pricing of living benefits riders. The timing and amount of withdrawals and policy surrenders have a significant impact on the cost of providing the living benefit rider. Most, if not all, variable annuity products are priced assuming a less than optimal use of the living benefit rider (with the implication that policyholders are not perfectly rational or financially efficient). The fact that most variable annuities are sold with one or more living benefits means that policyholder behavior assumptions are one of the key 'levers' to competitively pricing the product, and it is a challenge for organizations to be disciplined when there is little experience data to determine the validity of the assumptions.

Policyholder behaviors have direct impact on reserving and capital as well. Policyholder activities and decisions including premium amount and timing, investment elections, and fund transfers, affect future policyholder benefits and ongoing insurance financial options, including asset returns and expenses. Through these dynamics, policyholder behaviors not only impact the level of reserves and required capital that an insurance company needs to hold, but also the volatility of those reserves and capital.

Policyholder behavior also significantly impacts the asset and liability cash flows of the insurance company which poses significant asset-liability management challenges. Policyholder behavior risks are typically considered non-diversifiable and non-hedgeable. Taking universal life contracts as an example, when interest rates are very low the minimum crediting rate guarantees on the product become attractive and policyholders are motivated to hold onto the contract longer. This leads to an increase of the liability duration at a time when reinvestment rates are depressed. Conversely, when interest rates are high, the insurance company may find it difficult to increase crediting interest rates to match external investment returns offered by other products. In this case, policyholders may seek to leave in greater numbers to chase higher yields elsewhere, causing an asset and liability mismatch and placing a potential liquidity strain on the insurance company.

Lastly, the uncertainty of policyholder behaviors presents risks that the insurance company needs to manage proactively through its enterprise risk management program. The 2012 Society of Actuaries survey on policyholder behavior in the tail[8] stated that "Most companies considered the lapsation assumption and the investment return assumption to be critical risks." Furthermore, tail events such as a massive lapse among policyholders (a "bank run" on the insurer) could challenge an insurer's liquidity and force the selling of assets to meet redemptions. An effective enterprise risk management program should cover the whole spectrum of insurance operations, from product design/pricing and in-force management to implementation of hedging programs and contingency plans for extreme events.

In summary, policyholder behavior assumptions are critically important to the insurance industry. Ultimately, insurance is non-tangible product representing a contract between two parties. One impact on product performance is non-elective behavior (e.g., mortality), where the law of large numbers typically applies and traditional statistical methods work very well. Other impacts of product performance are elective behaviors (e.g., lapses), which are much more complicated — indeed policyholder behaviors can be described as a complex adaptive system.[9] Here the dynamic interactions of policyholders with their environment (e.g. economic, other investment and retirement products offered, and agent and social interactions) results in relationships that are not simple aggregations of underlying stable processes. This makes the modeling of these relationships particularly challenging using traditional actuarial methods.

Today's world is one where antiselection, irrational behaviors, social effects, feedback loops, and interactions between many parties and their environment all converge to create a very complicated decision making environment. Historically, this system was too complex to model all relationships and therefore actuaries relied on many simplifications. In many ways, this is similar to traditional economics, which relied on the notions of perfect markets, homogeneous agents, and long-run equilibrium assumptions to make models manageable. While this traditional economics framework worked well enough, there are clear areas of deficiency that parallel the current thinking in actuarial assumption setting for policyholder behavior.

What are the challenges of understanding policyholder behavior?

While the importance of understanding the impact of policyholder behaviors is well understood by the industry, the challenges in trying to take the modeling one step further are often formidable. Actuaries often conclude that they simply cannot hope to know more about the policyholder behavior experience and that their current assumptions are "reasonable" given all the constraints on knowledge and resources. Some actuaries still need to spend a lot of time preparing numbers and do not have enough time for analysis and explanation. Very often actuaries are still more focused on "fitting a curve" to past experience, with less emphasis on the "why" and "so what?" aspects. The challenge remains in efficiently capturing and interpreting the vast amounts of data while effectively linking the findings back to company operations to help inform strategic decision making.

For actuaries who are responsible for calibrating and validating models, the issues with modeling and understanding policyholder behaviors will be familiar. However the question remains of how comfortable they are that the models provide a realistic assessment of the risk exposure.

From both the policyholder and insurance company's perspective, information asymmetry exists. There is policyholder information that is unknown to the insurer, making it difficult for the insurance company to anticipate or understand some policyholder activities or decisions. Conversely, insurance products can have complicated mechanisms and options that may require significant efforts from the policyholder to gain a proper understanding. Due to the effort or complication required, policyholders may simply ignore some of the finer details.

The information asymmetry also introduces a "curse of knowledge" for actuaries setting policyholder behavior assumptions: It is difficult to "un-know" something about a product. This, along with the assumption-setting process being a relatively "back-office" job, can produce a significant gap between policyholder and actuarial views of the product.

There are also many data challenges when collecting information on policyholder behaviors, such as lack of credible data or lack of causal linkages around the data. Data is also aggregated (and lost) through the initial underwriting/administration of the policy process — because, (1) these systems were not built with an eye towards understanding policyholder behavior, and (2) data is not readily available to the actuary in the required format. Even with good data available and the ability to effectively handle large volumes of data, there is still a high level of expertise required to analyze and interpret the data before it can be converted to business applications such as modeling or strategic decision making.

Fundamentally, human behavior is not straightforward and understandable — the brain is still very much a black box, and it's not clear when (or even whether) advances in the field of neuroscience will allow us to detect when a person changes his or her mind. There have been empirical surveys around the types of behaviors that policyholders demonstrate, as well as studies researching correlations of observed behavior to other variables (e.g., income level or economic indicators), but research on the ways "why" and "how" decisions are made has thus far been limited.

That being said, the recent emergence of a host of information and analytical models is greatly enhancing the capability to better understand consumer behavior, including the:

- Increased acceptance of behavioral economics, and as a result, more research in this area
- Increased amount of data that is now available to study consumer or policyholder behavior — the Big Data reason
- Increased computing power to simulate millions or billions of consumer interactions
- New analytical techniques that enable the building of dynamic models of behavior — such as using agent-based modeling or Bayesian inference

To better understand the current state of policyholder behavior modeling, we contacted both insurance and non-insurance companies and conducted both a quantitative survey and interviews with personnel with policyholder behavior responsibilities. The following chapter presents the survey portion of our research.

Survey of Dynamic Policyholder Behavior Assumptions

Executive summary

With the pace of product innovation that the life and annuity industry has seen over the past two decades, and the correspondingly increased complexity of financial products, the list of actuarial assumptions that can materially impact product profitability has grown, and includes a group of assumptions that are collectively referred to as "policyholder behavior assumptions." The term policyholder behavior refers to any experience assumption for which results are directly driven by the decisions policyholders make regarding the exercise of benefits and guarantees within their contracts.

For life insurance products, this includes:

- Shock lapse and related anti-selective mortality on level premium term plans
- Conversion elections
- Loan utilization
- Dividend elections
- Premium persistency, funding patterns, and withdrawals for flexible premium plans
- Index elections and transfers between indices for indexed products
- Fund elections, fund transfers, and fixed account transfers for variable products
- Traditional lapse and surrender for all life products

For annuity products, this includes:

- Additional premium deposits
- Annuitization rates
- Renewal rates
- Withdrawals
- Living benefit elections and utilization on variable and indexed products with these guarantees
- Index elections and transfers between indices for indexed products
- Fund elections, fund transfers, and fixed account transfers for variable products
- Full surrender rates

Given the lack of industry data currently available for many policyholder behavior assumptions, and the relatively recent focus in these areas, it seems prudent to step back and carefully consider what information is required from an experience analysis process, as well as the broad range of possible data sources and methods of experience data collection, analysis, and modeling.

To that end, this portion of the research seeks to measure the current state of the life insurance and annuity industry with respect to: (1) available experience data sources, (2) credibility of current experience data, (3) assumption structure and modeling, including modeling tools, validation processes, and governance, and (4) current challenges in the area of policyholder behavior modeling. The research also seeks to identify and discuss best practices in these areas, both from within and outside the insurance industry.

Survey design

With this view in mind, the survey design included both qualitative and quantitative components. The qualitative component involved a series 15 one-hour-long phone interviews, bringing in a cross section of individuals, functions, and company types. Eight interviews were conducted with life and annuity writers, three with large property casualty writers, and four with companies outside the insurance industry, including a bank, an industrial goods seller, and a consumer staples company. These interviews allowed for a deeper level of information gathering on current life and annuity writer practices regarding policyholder behavior assumptions, as well as a view of consumer behavior modeling considerations from companies outside the insurance arena.

The quantitative component of the research involved an electronic survey fielded to more than 100 life and annuity writers, covering a broad range of questions regarding current company practices. Electronic survey respondents included 8 large companies, 12 medium-size companies, and 20 small companies. This breakdown is based on the following definition, developed for purposes of this study:

- Large company = total life premium and annuity assets under management greater than $50 billion in 2012

- Medium company = total life premium and annuity assets under management between $9 billion and $50 billion in 2012

- Small company = total life premium and annuity assets under management less than $9 billion in 2012

Companies were asked to distinguish responses to policyholder behavior assumption questions among the following:

- *Life product types:* term, whole life, indexed universal life, accumulation universal life, secondary guarantee universal life, and variable life

- *Annuity product types:* market-value-adjusted annuities, other book value fixed annuities, equity indexed annuities, and variable annuities

Survey results

From the combination of in-depth interviews with companies both inside and outside the insurance industry, as well as the information collected from electronic surveys, we identified the following key findings:

- The life insurance and annuity industry is behind the property and casualty insurance industry and other industries in using advanced analytical techniques in the area of consumer behavior.

- In order to move toward a better understanding of policyholder behavior, it is important that insurers begin to view the policyholder not just as a model point ("male aged 40 preferred non-smoker"), but as a member of the society and part of a household.

- Actuaries have been able to use traditional actuarial techniques to gain a very good quantitative understanding of policyholder behavior, but their qualitative understanding of that behavior is often only secondhand.

- The industry has seen significant movement in recent years toward a formal assumption-setting process across a broad range of insurer functions, sometimes including those outside the traditional actuarial areas.

- Data quality and credibility are primary sources of impediment to implementing greater dynamism in assumption setting and modeling.

- Data sources are nearly universally limited to insurer experience data whether internal, industry, or reinsurer sourced.

- In developing behavior assumptions, nearly all companies consider the policyholder's level of financial efficiency.

- Many companies are currently re-examining their entire actuarial assumption-setting and modeling process in order to ensure these processes are appropriate for the environment in which they currently operate.

The survey results should be considered in two pieces: (1) as a yardstick measurement of where the life and annuity industry currently stands with respect to current practices for actuarial functions involved in assumption setting for policyholder behavior, and (2) as a view toward where the industry needs to move to get to a better understanding of policyholders (both current and potential future customers) from a broader organizational perspective. Note that all results included in this report represent both qualitative and quantitative responses.

Definitions

One of the most difficult issues to address in a study of this type is defining a common language to allow for consistent interpretation and response to questions, making the results useful across companies. The following provides a set of survey terms and definitions for purposes of the quantitative (electronic survey) and qualitative data collection.

1. *Policyholder behavior.* The term policyholder behavior refers to a broad group of assumptions that are defined by the fact that the decisions policyholders make regarding the exercise of benefits and guarantees within their contracts directly drive their experience.

2. *Static assumption structure.* This is an assumption structure whereby the value of the assumption *does not* change over the course of a model projection period, regardless of changes in external factors. For example, a lapse assumption for level premium term might vary by issue age and policy year, but we still consider this a static assumption as the value does not change with interest rates, equity returns, demographic factors, or other *external* environmental factors in the projections.

3. *Dynamic assumption structure.* This is an assumption structure whereby the value of the assumption *does* change over the course of a model projection period as external factors change — for example, surrender rates that vary with the relationship between a defined competitor rate (which changes with the interest environment) and a defined company credited rate.

4. *Election assumptions versus utilization assumptions.* By election assumptions, we are generally referring to decisions made by the policyholder at issue that may or may not be included in a pricing model. Examples of election assumptions would include such items as election of guaranteed living benefits riders on variable annuity and indexed annuity products.

By utilization assumptions, we are generally referring to decisions made by the policyholder about how to utilize those optional riders or guarantees elected at issue. An example of a utilization assumption would be the expected timing and amount of withdrawals on a guaranteed withdrawal benefit after the waiting period ends.

Data sources for policyholder behavior assumptions

One of the primary challenges with determining reasonable assumptions regarding policyholder behavior for life and annuity products is the lack of experience data, either at the industry level or at the individual company level. As such, this was one of the areas of focus in both the qualitative and quantitative survey work. The researchers asked companies to identify all sources of experience data for the assumption-setting process, including their own data, reinsurer data, publicly available industry data, and purchased data.

Life insurance

For life insurance products, most companies are setting policyholder behavior assumptions by relying on their own experience data combined with varying degrees of external input.

For example, less actuarial judgment is required for assumptions for which industry data is available. An example of this is shock lapse and shock mortality experience for level premium term products where companies are taking advantage of both Society of Actuaries and reinsurer sources, with consideration for their own product designs.

At the other end of the spectrum, companies are faced with limited quantitative data on possible shifts in mortality experience (improvement or deterioration) based on the level of actual lapses and surrenders compared to anticipated levels, making it difficult to gain an understanding of such shifts and factor them into current views. Figure 2 indicates participating company responses to the question of data sources used to study policyholder behavior for each specific assumption listed.

Figure 2 —
Life Insurance Products: Data Sources Used to Study Policyholder Behavior
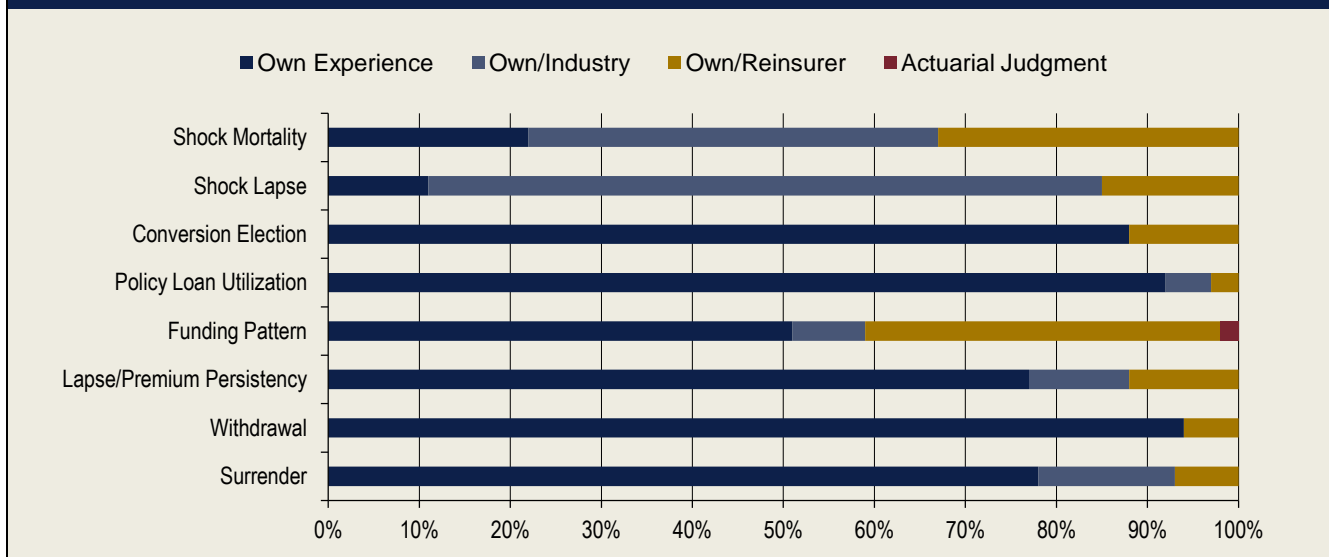
From in-depth interviews, we found that the use of companies' own data in some cases includes the use of experience on more mature blocks where a similar product or product feature was included in the past. In addition, a small number of companies indicate they also have looked to outside data sources, including customer behavior for other financial products such as mortgage repayments or certificate of deposit withdrawals to help with understanding expected withdrawal activity and level on variable and indexed annuities.

Annuities

For annuity products, there is a similar reliance on individual company experience for assumptions where data is more credible, either from current products or similar products sold in the past. This includes items such as additional premium deposits, renewals on market-value-adjusted annuities, index elections and transfer activity on equity-indexed annuities, fund elections and transfer activity on variable annuities, and fixed account transfers.

At the same time, some annuity writers are relying more on outside data sources, including industry data (*Society of Actuaries/LIMRA Variable Annuity Guaranteed Living Benefit Utilization Study*), reinsurer data, and purchased data for assumptions such as surrender, withdrawal, and annuitization for policies with guaranteed living benefit riders elected.

Figure 3 shows participating company responses to data sourcing questions for annuity policyholder behavior assumptions, including both internal and external sources.

Figure 3 —
Annuity Products: Data Sources Used to Study Policyholder Behavior
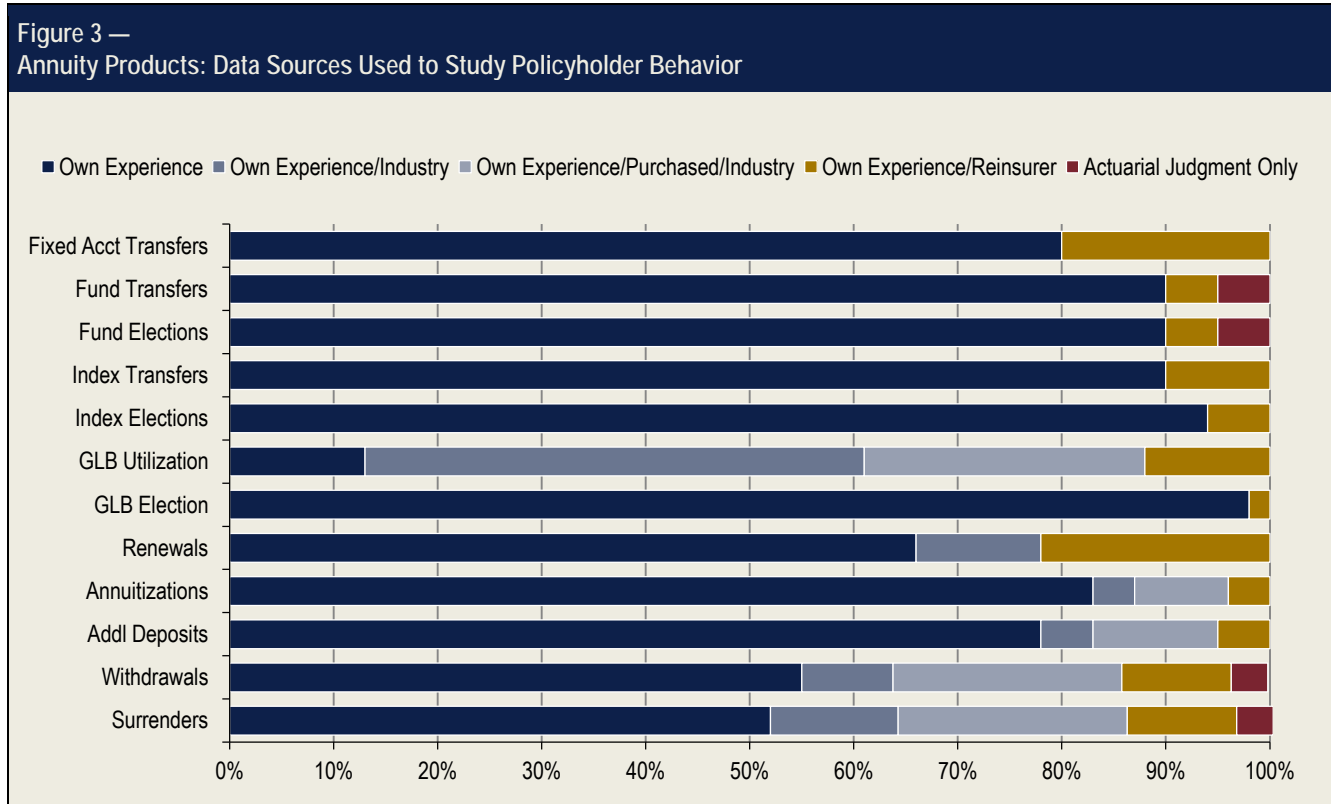
Credibility of data sources for policyholder behavior assumptions

Credibility and sourcing of data go hand in hand, so as follow-up to the questions regarding data sources for setting life insurance and annuity policyholder behavior assumptions, the survey instrument also asked respondents to indicate their current view regarding the credibility of the primary data source used for the various assumptions.

Figure 4 shows the responses by assumption for life insurance products. Note that companies view sources of data for surrenders, lapses/premium persistency, loan utilization, and dividend elections as having the greatest degree of credibility, while data sources for mortality shifts when lapses are higher or lower than expectations, shock mortality and lapse, and index elections/transfers are viewed as having the lowest credibility.

Figure 5 indicates responses regarding credibility of primary data sources for annuity products. Note that, overall, companies view primary data sources for annuities as more credible than data sources for life insurance. Like life insurance, the highest degree of credibility is attributed to data supporting surrender assumptions. For annuities, the lower levels of credibility are attributed to data sources supporting assumptions regarding guaranteed living benefit utilization and index transfers.

Figure 4 —
Life Insurance Products: Credibility of Data Sources Used to Study Policyholder Behavior
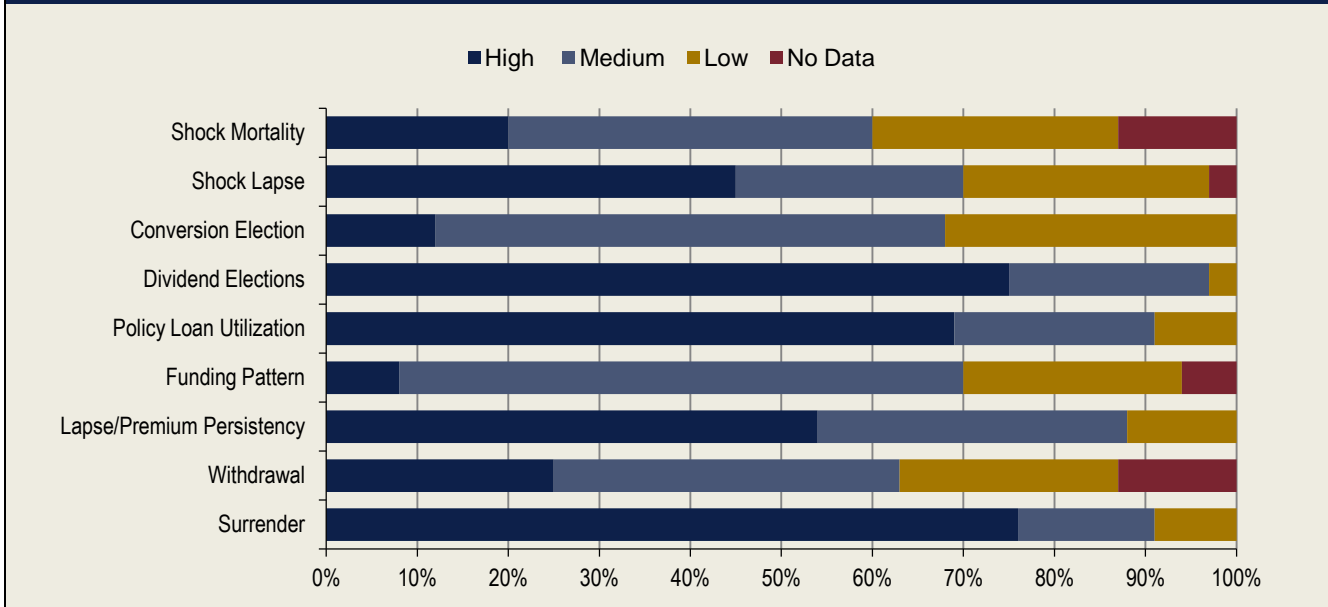
Figure 5 —
Annuity Products: Credibility of Data Sources Used to Study Policyholder Behavior

| **22**
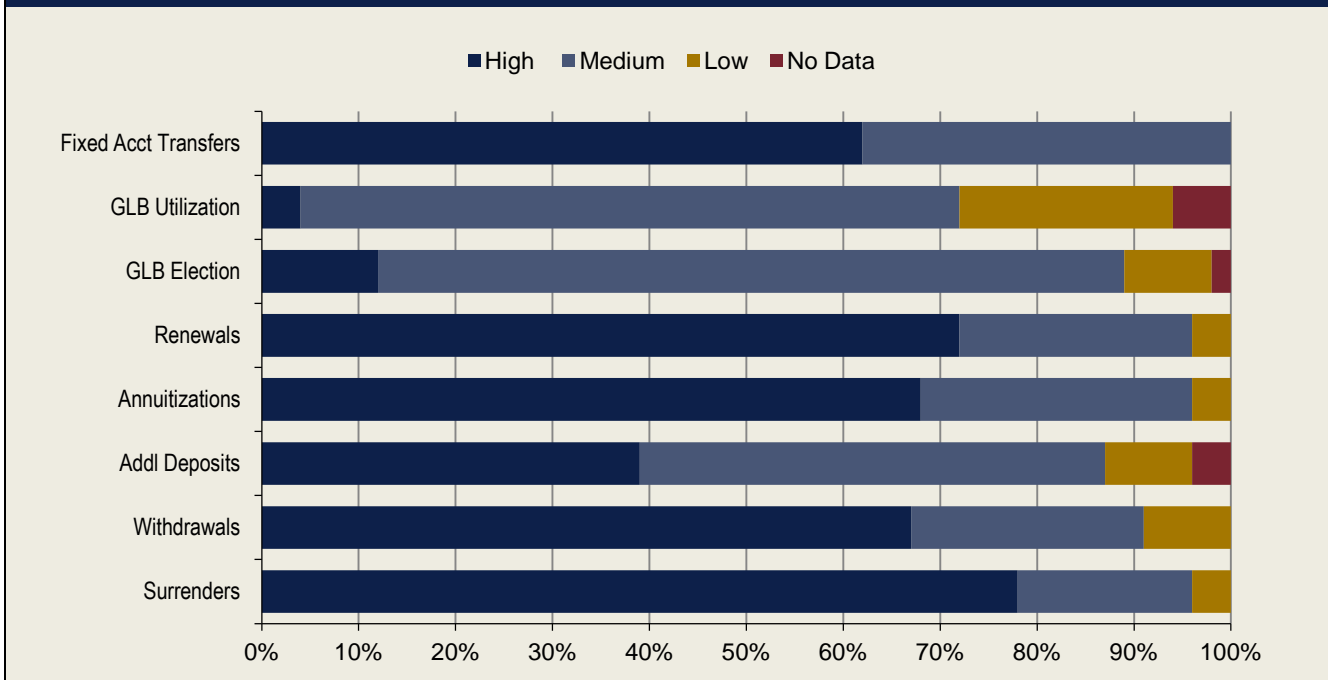
Policyholder behavior assumption structures (static and dynamic)

Participating companies were asked to identify the assumption structure by individual assumption and product type as well as the external factors identified as drivers of experience results. Response choices included static assumption, dynamic assumption, or both static and dynamic depending upon the function (e.g., pricing, cash flow testing, valuation, enterprise risk management).

In general, for those companies that responded that a particular assumption was modeled with a static structure for some actuarial modeling functions and with a dynamic structure for other functions, the most common distinctions cited were:

- For actuarial exercises such as pricing, valuation, and forecasting, the assumption was modeled with a static structure.

- For exercises such as asset/liability management and risk management, the assumption was more often modeled with a dynamic structure.

It is important to note that the goal of discussions around assumption structure is not to move all assumptions to a dynamic structure over time. Instead, companies should carefully consider the structure of each assumption in light of both its materiality to financial results and the materiality of the impact of external factors on the assumption. In many cases, companies will appropriately decide that either an assumption is not significantly material to financial results to warrant a more complex structure or that the assumption does not appear to vary with external forces.

Life insurance

For life insurance product types, universal life products currently have the greatest number of assumptions modeled with a dynamic structure. Table 1 shows, for each life insurance product type, the percentage of responding companies that are currently modeling the specified assumptions using a dynamic structure.

Note that accumulation universal life and secondary guarantee universal life are currently the life product types that rely most heavily on dynamic assumption structures. For accumulation universal life and secondary guarantee universal life products, 50 percent of responding companies have a dynamic structure for full surrenders. For accumulation universal life, this comes as a result of the importance of the credited rate to the performance of these policies. In this respect, accumulation universal life is most similar to fixed deferred annuities, where surrenders have been modeled dynamically for decades. For secondary guarantee universal life, the dynamic structure is instead based on the in-the-moneyness of the policy relative to the guarantee. For secondary guarantee universal life products with long-term or lifetime no-lapse guarantees, 42 percent of participating companies also model premium persistency/lapse assumptions with a dynamic structure that considers the in-the-moneyness of the no-lapse guarantee as the primary external factor driving the dynamic structure.

Table 1 — Life Insurance Products: Percentage of Respondents Modeling the Assumption with a Dynamic Structure					
	Percent Term	Percent Whole Life	ULSG	Accum UL	Indexed UL
Shock Mortality	0				
Shock Lapse	0				
Conversion Elections	0				
Surrenders		20%	50%	50%	27%
Lapse/Premium Persistency		15	42	38	13
Dividend Elections		0			
Policy Loan Utilization		23	13	18	17
Antiselective Mortality on High Lapse		20	33	33	0
Improvement in Mortality on Low Lapse		0	33	33	0
Funding Pattern			18	15	25
Withdrawals			29	20	20
Index Elections					0
Transfers Between Indices					0

Note also that a material percentage of companies are modeling policy loan utilization using a dynamic structure, with whole life most commonly using external factors to define the modeled assumption. All universal life product types also show a healthy percentage of companies beginning to use dynamic assumption structures for loan utilization, funding pattern, and partial withdrawal activity.

A small number of companies are currently using dynamic structures in the modeling of anti-selective mortality on high lapse as well as improvements in mortality on low lapse. In-the-moneyness is the most common factor driving this dynamism for secondary guarantee universal life products, while a competitor credited rate defined by the changing interest rate environment is the most common factor driving dynamism for accumulation universal life products.

Annuities

The annuity lines have generally been ahead of the life insurance lines in the consideration and implementation of dynamic structures for policyholder behavior assumptions. This makes sense given that the impact of policy-holder behavior experience on product profitability is currently greater on the annuity side than on the life insurance side, where mortality remains a strong driver of results.

Table 2 shows the percentage of responding companies, by annuity product type, that are currently modeling the specified policyholder behavior assumptions using a dynamic structure. Across the annuity plan types, the following assumptions head the list of those currently modeled with dynamic structures: surrenders (64 percent to 100 percent), guaranteed living benefit utilization (38 percent and 54 percent for equity-indexed annuities and variable annuities, respectively), withdrawals and fund transfers for variable annuities (50 percent and 38 percent, respectively), and additional premium deposits (10 percent to 67 percent).

Table 2 — Annuity Products: Percentage of Respondents Modeling the Assumption with a Dynamic Structure				
	MVA	**Fixed Other**	**EIA**	**VA**
Surrenders	64%	80%	69%	100%
Withdrawals	7	22	0	50
Additional Deposits	25	33	67	10
Annuitizations	0	0	0	36
Renewals	0			
GLB Election			17	0
GLB Utilization			38	54
EIA Index Elections			0	
EIA Index Transfers			0	
SA Fund Elections				0
SA Fund Transfers				38
Fixed Account Transfers				50

Assumptions regarding financial efficiency of policyholders

In contrast to assumptions like mortality and morbidity, there is a much greater impact of emotional, attitudinal, and situational factors on policyholder behavior experience. Therefore, the quantitative survey also asked participants about their views regarding the financial efficiency of policyholders, both now and in the future. Different actuaries will likely define "financial efficiency" of the policyholders differently; we broadly use the term to indicate whether the policyholders are using their insurance policies in a way that maximizes the present value of benefits to the policyholder. Note that this does not require the policyholders to be using the insurance policy optimally to meet their own needs, and is purely a "benefit maximization" perspective. Financial efficiency is an important concept as the pricing and valuation of contracts are often based on some degree of financial "inefficiency" of policyholders — actuaries can price an insurance contract based on the theoretical maximum value, but the actual prices are often less as policyholders are not solely seeking to maximize their contract values and options. The degree of "inefficiency" assumed is often a driving factor for the pricing competition between companies. This consideration is more important in setting policyholder behavior assumptions, where the past is less likely to be a good predictor of the future.

For example, taking the common example of guaranteed living benefit utilization, current industry data indicates that policyholders will not act with 100 percent efficiency to take advantage of options and guarantees within their contracts. In this instance, taking the view that policyholders will act with perfect efficiency might be conservative but would effectively throw out all experience data. On the other hand, not considering financial efficiency may lead to accepting current experience data results and projecting those unadjusted results into the future.

Based on results of the quantitative and qualitative surveys, Figure 6 indicates that just over 60 percent of responding companies hold the view that policyholders operate with "neutral" financial efficiency. Another 26 percent hold the view that policyholders will act in a very efficient manner. And about 8 percent don't consider this factor at all when setting assumptions.

Participating companies were also asked about any differences in view regarding policyholders' financial efficiency in making decisions across products or assumptions. The open-ended format of this question allowed for companies to explain any differences in their own words. Figure 7 shows the distribution of these open-ended responses by category.

Approximately 50 percent of companies vary their view regarding the financial efficiency of policyholders depending on the complexity of the product. On the life side, for example, these companies would consider a secondary guarantee universal life policyholder or an indexed universal life policyholder more likely to act to maximize financial efficiency. Other responses included variations in view regarding financial efficiency by distribution channel (18 percent), price competition/commoditization level (4 percent), and credibility of experience data (4 percent).

Figure 6 —
Policyholder Assumed Level of Financial Efficiency

- None at all
- Low level, 0%
- Neutral view
- Very efficient
- Perfectly efficient, 0%
- Don't consider

3%
8%
63%
26%

Figure 7 —
Differences in View by Product or Assumption

- Simple vs Complex
- Same across all
- Don't Consider
- Distibution Channel
- Price Competition Level
- Credibility of Experience Data

52%
4%
4%
18%
11%
11%
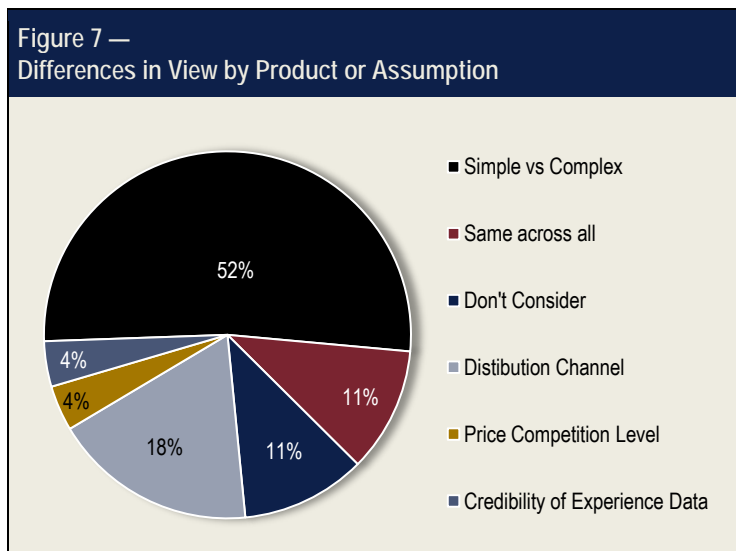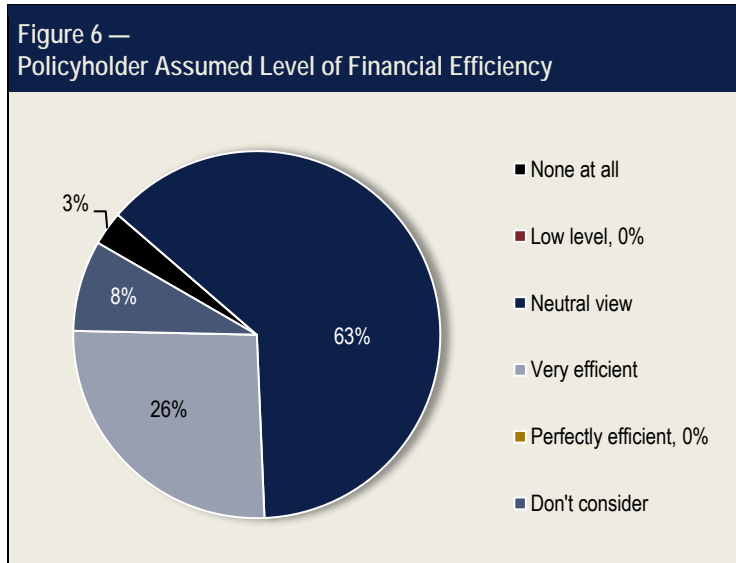
Assumption-setting and model governance practices

The survey also collected information regarding the assumption-setting and model governance practices across companies, product lines, and actuarial functions. Results indicate that in most cases, companies have either established a formal governance process or are in the process of reviewing current practices in order to establish a more formal process.

For purposes of this research, a formal governance process is one for which there exists an agreed-upon and well-communicated procedure for the full process of updating experience data, reviewing changes in experience, recommending modifications of assumptions, discussing consistency or inconsistency of assumptions across product lines and/or functional areas, and obtaining sign-off on recommended changes. This often also includes a process for validation, update, and review of actuarial models.

Figure 8 shows the current status of implementation of a formal assumption-setting and model governance structure, based on responses from participating companies. Note that from a cross-functional perspective, pricing/product development and reserving/cash-flow testing/valuation are the functional areas with the longest history of a formal assumption-setting process. More recently, companies have also begun bringing risk management and hedging into the process.

Figure 8 —
Length of Time Formal Assumption Setting Process in Place
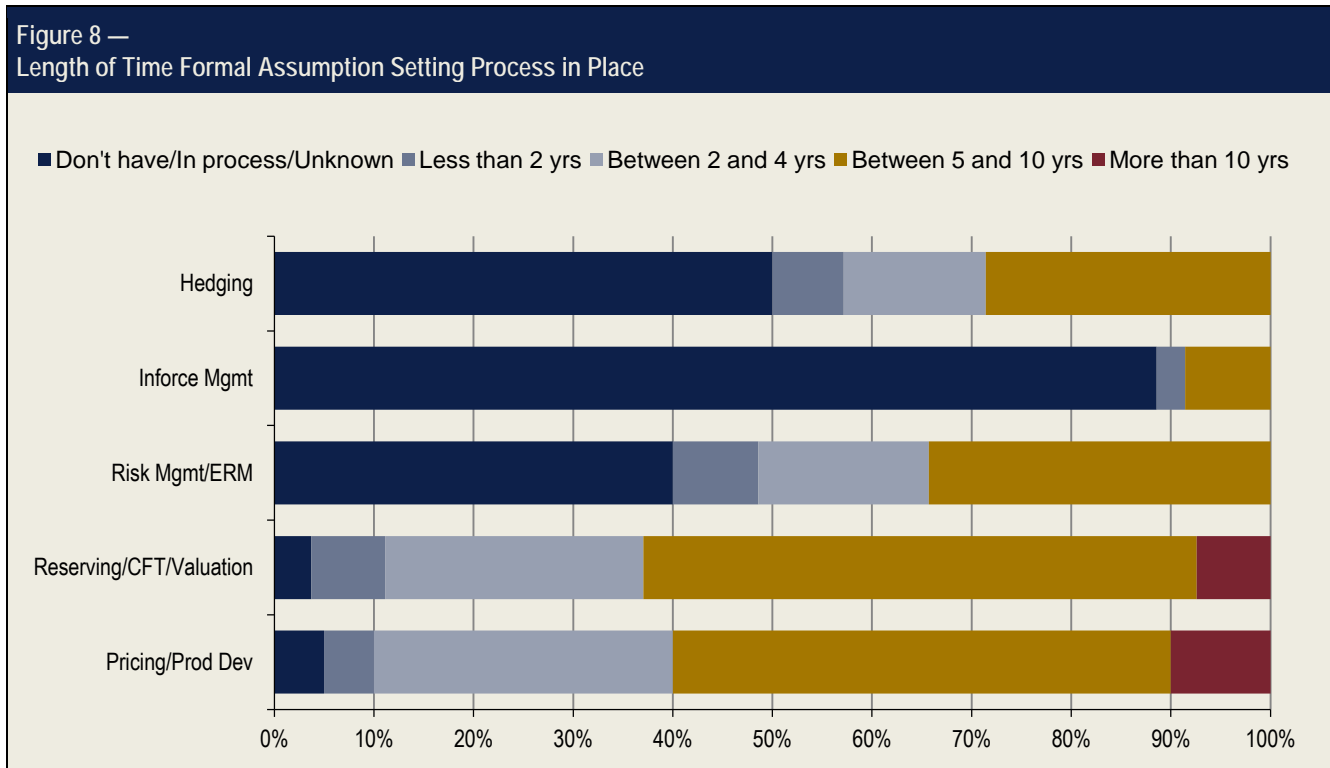
Among the survey participants, one commonly mentioned area of focus for the model governance process was standardization of model validation work, including more definition around the process and increased documentation of results.

As part of the survey work, we also asked companies about their current model validation practices, including techniques employed as part of the current validation process. This was presented as an open-ended question in order to allow companies to expand on their responses. Based on a general categorization of responses, the most common techniques for validation are (a) traditional actual to expected analysis and (b) dynamic validation (a review of the first several projection years compared to recent historical results). However, some companies are beginning to explore predictive modeling techniques to enhance understanding of the factors most strongly impacting policyholder behavior experience; therefore, they are also utilizing back-testing techniques from the predictive modeling regime to aid in the validation process. Other companies indicate they are doing more third-party review, stress testing, and scenario testing for policyholder behavior assumptions that strongly impact projection results.

In addition, companies have begun implementing some interesting new ideas as a result of reviews of the model and assumption governance process. Two companies indicated that, as part of the formal governance process, they have created a new role — model and assumption review actuary — to provide for stronger control over modeling work. One company described this position as the "Model Sheriff" concept. This individual receives copies of documentation regarding assumption and modeling changes from various functional areas and reviews these against the actual models for quality control purposes. He or she also reviews model output and reconciles differences between results across applications.

Policyholder behavior assumption setting and modeling challenges

Given that many of the items that fall into the category of policyholder behavior are relatively recent additions to the modeling and assumption-setting process, the survey instrument asked respondents to rank the challenges they have encountered in terms of degree of importance. Figure 9 shows the distribution of responses across participating companies for life and annuity products combined.

Figure 9 —
Top Challenges of Modeling Policyholder Behaviors

Data Availability	Resource Availability	Data Credibility	Model Complexity	Results Validation	Data Quality
53%	18%	15%	12%	3%	0%
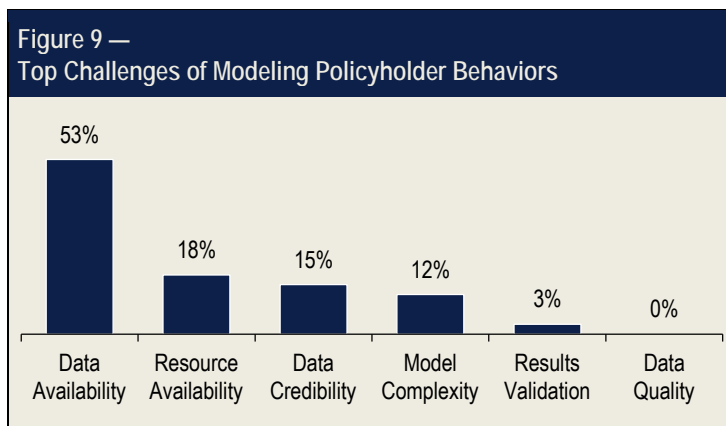
Respondents indicate that data availability/credibility issues head the list of challenges that insurers face in modeling policyholder behavior, with more than half the participating companies citing this as their number-one challenge. This is because of the pace of product development in recent years and the resulting introduction of new product designs, some with features for which very little experience data exists. In addition, even for features for which the amount of experience data is growing, insurers indicate they still have very little data that shows how experience might shift in different economic conditions and more extreme tail events.

Resources are another challenge for some respondents. Companies note that research and development work — such as is required for building out new assumption monitoring and updating processes and incorporating new and complex assumptions into the existing modeling structure — are often given lower priority in terms of assignment of actuarial resources. In addition, data organization and development efforts often require support from areas outside the actuarial functions, which poses additional challenges.

Model complexity is another commonly cited challenge for companies. Model run times have increased as insurers have moved to seriatim data that needs to be run over a large number of different economic scenarios. Also, the modeling of many policyholder behavior assumptions adds to model complexity, and in some cases existing actuarial modeling packages can be limited in their ability to incorporate these new features and assumptions. This is one of the reasons cited for increased attention to model validation.

Policyholder behavior modeling techniques

Participating companies were asked about current modeling techniques and how they are employed for different actuarial functions across both life insurance and annuity products. The survey instrument included the following techniques as possible options:

- Traditional actuarial modeling (either in-house models or purchased actuarial software)
- Predictive modeling of behavior based on policyholder attributes
- Monte Carlo simulation
- Neural nets
- Agent-based simulation

Neural nets are models that test hypotheses, learn from the results, and determine the "best" model that describes the data patterns — a process similar to our inherent learning. Neural nets incorporate both linear and non-linear variables. Typical applications include customer retention modeling, credit scoring, and forecasting. Agent-based modeling is a technique that simulates agents' (e.g., individuals' and companies') interactions with their environment and other agents in order to learn and adapt through the behavior of complex systems.

Table 3 shows the distribution of responses across the various functional areas of the company for the 40 companies that responded to the quantitative survey. Note that traditional actuarial modeling remains the most widely used modeling method. This includes both internally developed models and models that employ an outside software vendor package. A small group of companies indicate they are now employing predictive modeling methods and Monte Carlo simulation. Consumer modeling techniques such as neural nets and agent based modeling, however, are currently untapped.

Methods		
A	Traditional Modeling	D Neural Nets
B	Predictive Modeling	E Agent Based Simulation
C	Monte Carlo Simulation	F Other (Please Specify)

Table 3 —
Methods Used for the Analysis and Modeling of Policyholder Behavior

Methods	Pricing and Product Development	Reserving, CFT, Valuation	Risk Management	Underwriting	Marketing	Sales/ Distribution	Inforce Management	Hedging
A	25	29	20			3	10	5
B				2	2			
C								
D								
E								
F								
A & B	3	3	2			1	1	3
A & C	2	2	2					4
A & B & C	4	3	4				1	1
No Response	6	3	12	38	38	36	28	27
Total	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**

Changes in policyholder behavior modeling techniques

Participating companies were asked to describe how modeling approaches for policyholder behavior assumptions had changed over time. The open-ended structure of the question allowed respondents to elaborate on significant changes and the reasons they made those changes.

The most common response was that modeling has become more sophisticated, with increased credibility of experience data and an increased understanding of factors impacting the experience results. New technologies are also driving changes in the modeling approach, allowing for more sophisticated assumption structures and reduced run times. Respondents also cited the more formalized processes for model updates, along with the introduction of a predictive modeling component to assumption development, and both increases and decreases in the number of assumptions with dynamic structures.

Advancements in the understanding of customer and policyholder behavior

Respondents were first asked their opinion regarding companies within the insurance industry that are the most advanced in the understanding and utilization of information regarding customer and policyholder behavior. The following are examples of participant responses. The general view is that in the insurance arena, property/casualty writers, larger organizations, and companies that sell more investment-related products (e.g., annuities) are the most advanced at this point in time.

- "I believe that you would see that more so in the P&C field — … with the predominance of consumer interaction … ."
- "Larger organizations with more resources to allocate to these activities that have large exposure to GLWBs or GMDBs."
- "Organizations that deal primarily in annuities are the most advanced in modeling because they have to account for lapses that come as a result of changing interest rates and competitor offers."
- "I would say the ones that sell 'investment-related' products like UL, annuities, because some kind of modeling has been required for a while, so presumably the models are more advanced."
- "Large insurance companies have generally greater access to data, and more resources."

Next, respondents were asked their views about the most advanced companies outside the life insurance industry and why. Examples of responses to this question are shown below. Note that with the advancement of concepts such as Big Data and consumer experience tracking, insurers clearly understand the advantages that consumer staples and retail companies accrue by gathering and analyzing data. The question for insurers is how to best apply these techniques in an industry where a sale cannot yet be executed in ten minutes or less.

- "Retail and P&C industries are viewed as driving the broader buyer behavior modeling revolution."
- "The ability to capture large amounts of data (historical and real time)."
- "Creating opportunities for customer interactions (touch points)."
- "Interest/investment in advanced analytical methods."

However, more companies are seeing the potential advantages of better understanding and utilizing customer and policyholder behavior information, and are beginning to consider initial investments in these areas. In this regard, large multi-lines are leading the way.

Current practices and recommendations

Based on a combination of analysis and review of responses to the electronic survey and in-depth discussions with participants in the phone interview survey, the research team compiled the following list of current practices in the area of policyholder behavior assumption setting, including decisions regarding assumption structure (static versus dynamic), modeling techniques, model validation, and model governance. These practices can provide a basis for companies to benchmark their current practices against those of other companies and potentially to enhance their own approach to understanding and modeling policyholder behavior.

Data collection, analysis, and assumption setting

- Review sources of internal data and external data, the latter including industry data, reinsurer data, purchased data, government data, and data from public financial sources.

- Consider the value of collecting and analyzing data from customer service and other web-based sources of customer interaction data (on both an historical and real-time basis).

- Consider the applicability of experience on older, more mature in-force blocks whose features are similar to those of newer product offerings.

- Consider ways to better understand potential variations in policyholder behavior experience results under more extreme positive or negative scenarios.

- Apply predictive modeling and other statistical analysis techniques to identify the factors that have the greatest influence on policyholder behavior outcomes.

- Centralize all internal sources of data regarding policyholder behavior (the most advanced companies are investing in resources to combine various administration, underwriting, sales, and valuation systems in order to maximize the data available for analysis purposes).

Modeling

- Put in place assumption-setting and review practices that balance the value of modeling a particular policyholder behavior assumption with a more dynamic structure against the negative impact of added complexity to the models.

- Review current modeling tools and techniques across actuarial functions within a product line in order to identify and understand consistencies and inconsistencies in assumptions and model results.

Validation

- Establish a formal validation process that includes both high-level and more detailed analysis of model results.

- Document results of the validation process each time changes are made to the assumptions or modeling process.

- Leverage the "Model Sheriff" concept: Establish a role with responsibility for review of model updates, assumption changes, and model results across the various actuarial functions for a particular product line.

Governance process steps

- Implement a formal process for experience data updates, including identification of current and potential additional data sources.

- Implement a procedure for reviewing the results of experience data updates and formulating recommendations regarding potential assumption changes.

- Establish a platform for cross-functional discussions and agreement regarding the appropriateness of inconsistencies in assumption value/structure across pricing, product development, valuation, cash-flow testing, risk management, in-force management, and hedging areas.

- Identify individuals that will sign off on final model and assumption changes for each model update cycle.

- Establish a cross-functional data analytics repository, not just across actuarial functions but across organizational functions.

- Begin to establish a basis for experimenting with advanced statistical techniques to better understand policyholder and potential buyer behavior for a variety of purposes, including marketing, underwriting, actuarial, and customer service.

Behavioral Economics: Background

The next three chapters will provide a general overview of behavioral economics and then dive into detailed summaries of its application to purchasing life, annuity and an overall assessment of retirement products, followed by an in-depth overview of the implications of behavioral economics to policyholder behavior.

The field of behavioral economics is the application of economics and psychology to explain irrational behavior. According to Kunreuther, Pauly and McMorrow:

> *"Real world agents often do not make choices in the way that economic models of rationality suggest they should. In evaluating the results of such behavior and suggesting what strategies one should pursue, researchers still normally turn to the conventional economic models as normative benchmarks."*

Conventional economic models' are typically driven by classical economic theory, suggesting that people are rational and driven by self-interest, making decisions which maximize their own economic utility. These assumptions break down when humans do not consider decisions in unemotional, strictly rational terms. Psychology, on the other hand, offers an explanation of decision-making affected by environmental influences and helps provide an explanation as to why people's decisions differ from classical economic predictions.

Key benefits of utilizing behavioral economics when attempting to understand policyholder behavior include:

- Identifies common "shortcuts" used in consumer decision-making
- Explains external variables affecting consumer decision-making
- Explains market inefficiencies
- Offers insights into product design and marketing

Behavioral economic principles generally fall into four broad categories as shown in Table 4 and are prevalent across industries.

Table 4 — Behavioral Economics Principles			
Decision Shortcuts		**Value Assessments**	
Relative Choices	Rules of Thumb	Love of Free	Endowment Effect
Reliance on Defaults	Dominated Alternatives	Anchoring	Hyperbolic Discounting
Attribute Priming	Choice Paralysis	False Contexts	Subtraction by Addition
Mental Accounting	Framing		
Emotional Impacts		**Social Impacts**	
Risk Aversion	Self Control Facilitation	Social/Financial Domains	Conformity Effect
Risk Exclusion	Hot vs. Cold States	Cheating	Signaling
Loss Aversion	Self-Herding	Bandwagon Effect	

Decision Shortcuts: Consumer decisions are far more complex than they appear. Consumers use mental "shortcuts" to guide them to what they feel is the right decision. Understanding these shortcuts can help companies guide consumers to the "right" decision. For example, one decision shortcut is the *reliance on defaults*. People are unlikely to override set defaults and rely increasingly on defaults as decision complexity and difficulty increases. Another example is *relative choice*, where consumers value products based on comparisons to other products rather than a good's intrinsic value, and tend to avoid selection of options where no relevant comparisons are available. Increasing the complexity of a purchase decision can lead consumers to delay their purchase, often indefinitely. Other examples of decision shortcut principles include *attribute priming, mental accounting* and *framing*.

Value Assessments: Value is a relative concept. Is a television "worth" $300 or $400? Is a warranty "worth" $29.99? In assessing the "value" of a product or service consumers often use seemingly "irrational" metrics and concepts to guide their behavior. For example, with *anchoring*, valuation assessments are often made based on initial exposure to price, irrelevant comparisons, or specific attributes. In another value assessment, *hyperbolic discounting*, consumers too heavily discount the value of future spending or purchases, leading to excessive consumption in the present at the cost of far less consumption in the future. Other examples of value assessment principles include *love of free, endowment effect* and *subtraction by addition*.

|

Emotional Impacts: Emotions get the better of people. Emotional impacts can drive someone to or away from what would be considered the "rational" economic decision. Appealing to these emotional impacts can be more powerful than a price reduction in driving demand. ***Loss aversion***, a common emotional impact, describes the tendency for people to strongly prefer avoiding losses rather than acquiring gains. Studies suggest that losses are as much as twice as psychologically powerful as gains. Another important element for insurers to consider is ***hot and cold states***. With this principle, consumers in a cold (non-stimulated) state make different decisions than those in a hot (emotional or otherwise stimulated) state. Other examples of emotional impact principles include ***risk aversion, over-confidence effect, self-herding*** and ***self control facilitation***.

Social Impacts: People are social. Consumers take into account behaviors of fellow consumers and social norms to guide them to what they believe is the "right" decision. In one example, the ***signaling*** principle, one party takes some observable and costly measures to convey meaningful information about him/herself to another party in an effort to convince the other party of the value or quality of their product. Another social impact example is the ***bandwagon effect***, where people often do (or believe) things because many other people do (or believe) the same. Other examples of social impact principles include ***social/financial domains*** and ***dishonesty effect.***

Please refer to the appendix for full definitions of each principle. Now, let's get into more detail around the specific application of these behavioral economics principles to life insurance and annuity products.

Behavioral Economics: Life Insurance Purchasing Behaviors Literature Review

Decision shortcuts

Framing life insurance in a way that supersedes its negative association with death and diverts the consumer's attention away from realizing or assessing his or her own mortality is an important foundational idea for carriers to understand. People categorize their finances in ways that change how they perceive the associated money (mental accounting). Life insurance, therefore, can be considered for more than just a protection against tragedy. Agents can also contextualize and sell a policy as a disciplined, mandatory savings plan that will help the insured stick to their retirement savings goals — framing life insurance as a pillar for a comprehensive financial plan for the future.

Value assessment

Life insurance, it's said, is "sold, not bought" due to the inherent nature of the product, which carries many negative connotations and associations that most people don't want to think about day-to-day. Since people generally do not enjoy planning for death and, especially in the early life-cycle stages, are incapable of placing a value on the duration of their expected life, life insurance isn't commonly an active purchase decision.

When it comes to mortality, consumers seem to have difficulty in properly discounting their risk of dying (*hyperbolic discounting*). In *Cashing Out Life Insurance: An Analysis of the Viatical Settlements Market,*[10] Neeraj Sood found that people tend to *anchor* their mortality based on perceived current health risks that are unlikely to happen, thereby prioritizing their current state and being incapable of properly discounting their future state. Among Sood's citations was a piece of literature by Payne[11] where he found that the way a person frames his or her mortality differed dramatically from that person's expected lifetime projection. When asked the age to which they would live versus the age at which they would die, the effect measured out to a difference of ten years.

Another important aspect of life insurance, in additional to the protection aspect, is the savings and tax benefits from owning a life insurance policy. These topics are crucial to the sales of life insurance policies, but our literature review did not find much relevant literature on this topic with regard to value assessment biases. Therefore, this is an important area for future research.

To combat the inability to assess future value and having the consumer rely heavily on present value, carriers can introduce new financial calculations at the point of sale. Using tools to quantify the full dollar value over the lifetime of that customer deters the consumer from incorrectly assessing future value.

Emotional impacts

Typically, consumers are ***loss-averse*** to purchasing life insurance because a potentially large time gap exists between making the payments for protection and submitting the claim and receiving the benefit. An obvious related hurdle lies in the fact that nobody purchasing life insurance will ever make the claim themselves and see the benefit of their payments. Therefore, life insurance must be seen as an investment whereby consumers are stimulated by incentives to protect their loved ones over an extended period of time.

In *Rational and Behavioral Perspectives on the Role of Annuities in Retirement Planning,*[12] author Jeffrey R. Brown states that people tend to underestimate the likelihood and desensitize the consequences of a low-probability event that they have not yet experienced, such as death. This stems from an inherent ***overconfidence bias***, which affects many young consumers whose mortality does not play a present role in their everyday lives. Over time, people tend to become overconfident in their prior beliefs because of an availability bias. Only when events or new information is brought to light for the consumer will that consumer begin to feel the need for purchasing life insurance. Overconfidence is disproportionately an attribute of men, which partly explains why women drive many life insurance purchases.

The Brown paper touched upon the ***hot and cold states*** of emotion. Consumers in a cold (non-stimulated) state make different decisions than those in a hot (emotional or otherwise stimulated) state. Hot emotions often lead consumers to purchase life insurance, even after these emotions have cooled down over time. For example, a national tragedy involving the death of a young individual or individuals may serve as an impetus for consumers to purchase life insurance. In our literature review, we did not find any research concerning consumer and policyholder behavioral changes after large catastrophe events, rather the research focused on insurance company behaviors and whether they denied claims, withdrew from markets, etc. Understanding how catastrophic events can affect life insurance and annuity customer and policyholder behaviors appears to be another promising area for further research.

Another piece of literature dealt with the concept of diverting the negative emotional association from life insurance products and inserting positive reactions. In "Behavioral Finance and Life Insurance,"[13] Justin A. Reckers and Robert A. Simon found that emotional awareness broadens decision making beyond focusing on the financial circumstances of the consumer. For the economically rational policyholder who only considers payouts, protecting one's family in case of a premature death is the only motivation for purchasing coverage. Therefore, inserting a positive emotion into purchasing life insurance, such as protecting loved ones or drawing out the positive payout benefits, will help present the product in a much more consumer-friendly light.

Understanding the intersection between behavioral economic principles and the purchase of life insurance has a few key implications for life insurance providers. Because consumers need to be reminded that they are not immune to death and that their sense of immortality is faulty, carriers framing risk and insurance decisions and presenting coverage plans should consider stretching the time horizon over which risk is measured, and aligning certain life events into this horizon. This helps override the consumer's overconfidence and availability biases, and pushes the consumer towards a "hot" emotion by making the span of their lifetime and the associated risks more tangible. Coverage plans need to be framed in a way that allows the consumer to view the purchase of life insurance as a good investment for the family or loved ones, and that those loved ones will be better off with the insurance policy. Another implication comes in the form of associating positive emotions with life insurance. For instance, with whole life, carriers can make the consumer aware that the policy can pay for itself over time. Because consumers respond well to the idea of something not having to be paid for directly, such whole life policies could be sold as protections that will one day be "free."

Social impacts

Again, the proverb that "life insurance is sold, not bought" rings true: Life insurance is not simply an individual decision, and the path to purchasing this product delves into social norms and interplays within a potential consumer's social network, namely because the death of that individual affects that social network and every individual it comprises. In Andy Chui and Chuck Kwok's "National Culture and Life Insurance Consumption,"[14] the social lens of communities is posited to be based in both history and gender binaries. The paper works to explain the variance between different cultures and their consumption of life insurance, with the authors analyzing cultural dimensions such as individualism and the prevalence of social networks to explain some of the adoption rates of life insurance products. Their analysis focused on the differences between "masculine" societies (where performance and achievement are valorized) and "feminine" societies (which stress social networks, helping others, and tending to the quality of life) suggesting that "feminine" societies or populations tend to be more interdependent, whereas "masculine" societies tilt towards independence. For instance, North American and Western European cultures would have an independent construal, whereas Asian countries would have a more interdependent construal. This is of course only one of many different social and cultural factors at work when a person makes a decision, and the driving factors are often difficult to discern.

By applying this idea of the self through the ***social/financial domain*** principle, Chui and Kwok determined that people with independent construals of self are more likely to see life insurance as a necessity. These individuals view reliance on a social network as a sign of weakness. So instead of relying on an external social network (outside of the nuclear family), independent populations turn to the market for life insurance in order to enhance the financial security of their family. On the other hand, populations with an interdependent construal of the self would rely on their social networks to help take care of loved ones when they themselves pass away, so there is less of an incentive to purchase a life insurance policy.

The business implications of these examples revolve around gaining a holistic understanding of a target market and customer. Carriers can consider surveying potential market locations while keeping in mind these "soft" cultural dimensions among the market's economic, demographic, and institutional players. To execute well on such a holistic understanding would require running pilots in target markets with a high density of a particular demographic and analyzing the strength of their social networks. For instance, if a carrier were to target a densely populated area of Asian-American immigrants, Chui and Kwok's research would hypothesize that, given the "femininity" of Asian culture, the demand for life insurance would be low. However, the research also shows that more feminine cultures tend to purchase general insurance, which means the carrier should consider initiatives to cross-sell its life products.

Behavioral Economics: Annuities Purchasing Behaviors Literature Review

Understanding consumer behavior in light of the purchase of annuity contracts has long been particularly challenging, especially when considering its effectiveness in ensuring a relatively secure retirement versus other financial products. The annuitization of financial assets, which should be an attractive and very rational wealth management vehicle used to hedge against outliving ones assets, has, in large measure, not been a popular investment strategy. Research points to this "annuitization puzzle," where the case for annuitization is strong but nonetheless has not translated into large numbers of consumers choosing to annuitize. In 1965, Menahem Yaari wrote a seminal paper, "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer,"[15] developing annuity demand theory. With regard to the consumer life-cycle, Yaari asserted that given an unknown date of death, certain consumers should fully annuitize all of their savings. According to his defining assumptions, these consumers are, under the von Neumann–Morgenstern utility theorem, expected "utility maximizers" with intertemporally separable utility: They face no uncertainty other than time of death, and they have no bequest motives (i.e., leaving behind inheritance, arranging personal property assets, and estate planning). Yaari's simulation showed that by buying an annuity, compared to holding a bond, a consumer assures him- or herself a higher level of consumption in every year they live. These findings were advanced in Thomas Davidoff, Jeffrey Brown, and Peter Diamond's 2005 paper *Annuities and Individual Welfare,* which supported the theory of optimality of full annuitization under market completeness, while relaxing some of Yaari's "very strict assumptions."[16] The findings state that "even for preferences that stretch the bounds of plausible impatience, a large fraction of wealth is optimally placed in a constant real annuity."[17] We can look to behavioral economics to help uncover these known inconsistencies between "what is rational" and actual behavior, and help explain this perceived puzzle.

Decision shortcuts

Annuities are often a key product in the retirement planning space, this is a space where many individuals do not properly plan for retirement or participate in savings plans because they are intimidated by their options and the planning process. When weighing retirement options, there are many factors that complicate the decision — the age at which one starts saving, the expected age at retirement, life expectancy at retirement, the expected rate of return and the risk of investments, and other financial commitments (e.g., mortgage obligations) — and without a mental method for simplifying the decision, many workers are too overwhelmed by the sums of money for which they need to plan. The pressure of time, information overload, and other environmental factors can increase the perceived complexity of retirement decisions, which negatively influences decision quality. These complexity biases can even force consumers who are actively looking to improve their retirement position into a gridlock situation in which, unable to differentiate their options, they ultimately forego the opportunity to make a decision, i.e. participate in savings plans, or investing in deferred and payout annuities.

Where individuals do plan and consider their options, many other decision shortcuts affect individuals. In their paper "Behavioral Obstacles in the Annuity Market,"[18] Wei-Yin Hu and Jason Scott argue that retirees evaluate annuities from the perspective of a gamble. When deciding whether to annuitize, consumers wonder if they will live long enough to make back their initial investment. Hu and Scott explain this using the framework of ***mental***

accounting. Consumers that view the annuity decision as a gamble on their life tend to segregate the annuity into its own mental account, independent of all other retirement consumption money. "Within this mental accounting framework, gains on the annuity 'gamble' occur if the total discounted value of payouts exceeds the initial investment (i.e., the retiree lives longer than expected), whereas losses occur if payouts are less than the initial investment (the retiree dies 'early')."[19]

In *Annuitization Puzzles,* Shlomo Benartzi, Alessandro Previtero, and Richard Thaler explain that "*framing* issues can be particularly powerful in the case of annuitization because the concept is complicated and most people have not thought very much about the question before nearing retirement age."[20] The manner in which the decision is presented and the phrasing of the language can significantly affect an individual's decision making. In research[21] referenced in *Annuitization Puzzles,* the research team conducted a survey to test the attractiveness of an annuity in one of two frames, a consumption frame and an investment frame. Under the consumption frame, the annuity was described as providing $650 of monthly spending for life. The investment frame offered the annuity as a guaranteed monthly return of $650 for life. The results of the experiment, surveying adults at least 50 years old, showed the investment frame to be less appealing. Only 21 percent of subjects chose to annuitize when the decision was presented as an investment providing a monthly return, whereas 70 percent chose to annuitize with the consumption frame. The authors predicted that the consumption frame is more attractive because the investment return greatly depends on time of death.

J. Mark Iwry and John Turner address the decision between an annuity and a lump-sum distribution in their paper *Automatic Annuitization,*[22] offering three broad explanations to the annuitization puzzle. First, they explain that annuities may not inspire confidence. With little comparison shopping between annuities, and a lump-sum option, choices are more difficult to understand. A second explanation is uncertainty of life expectancy and the risk of lost annuity payments. A final reason offered for the puzzle is that "annuities may preclude important alternative uses of retirement savings."[23]

The success of certain **default decision** strategies that improve 401(k) participation for lump-sum plans is not paralleled with annuities. According to Iwry and Turner, evidence suggests that even when an annuity is the default decision, most participants opt out in favor of the lump-sum decision. The power of the default is weak in these circumstances. Referencing *Increasing Annuitization in 401(k) Plans with Automatic Trial Income,*[24] which proposes a plan of automatic trial income to increase participation, Iwry and Turner note that, "Under this approach, which seeks to use inertia to overcome misconceptions about annuities, a 401(k) plan sponsor could tell retiring participants that half (or some other specified portion) of their account balance was tentatively earmarked for annuitization. The annuitization would begin with regular monthly payments for two years, unless the retiree opted out. At the end of the two-year trial period, retirees could elect an alternative distribution option; but if they did nothing, the regular monthly payments would automatically continue for life."[25] The idea is that after a "test drive," workers would experience the advantages of the regular income stream, and may be more likely to make the permanent decision to annuitize. A complementary approach involves phased or incremental acquisition of deferred annuities during the plan's accumulation phase. Iwry and Turner's conclusion on encouraging demand for lifetime income is to frame choices that avoid all-or-nothing, now-or-never, or never-forever decisions.

|

Value assessments

Some consumers narrowly evaluate annuities in an isolated mental account, ***hyperbolically discounting*** them as unattractive investments, as they shift money from the present into the future. This is not an appealing gamble, as consumers do not want to give up what they already have *(endowment effect)*. In *Golden Eggs and Hyperbolic Discounting,*[26] David Laibson showed that as hyperbolic discounters become aware of their rate of impatience, they often implement self-commitment devices that prevent overspending. Even though annuities are savings-commitment devices, there is still little realized demand. Hu and Scott argue that annuities are not convincing savings-commitment devices because consumers do not overcome the other behavioral anomalies associated with the risks of an annuity.[27] The availability heuristic combined with the conjunction fallacy (mistakenly believing that a combination of events is more likely than either event alone) leads individuals to exaggerate the probability of dying early. Additionally, annuities compete against the popular rule-of-thumb or heuristic "don't spend from the principal." This may not always be an adequate or efficient commitment, but it is convincing from a decision perspective.

Exacerbating the issue is the fact that individuals often tend to underestimate longevity risk, which leads to inaccurate assumptions related to post-retirement planning. In fact, studies show that 43 percent of men and 38 percent of women underestimate life expectancy at retirement by five years.[28] Because people do not know precisely how long they will live, they run the risk of exhausting their assets before dying. Such risk exposure can be reduced by consuming less during retirement, but of course this simply increases the odds of a retiree dying with "too much" wealth left over.

Emotional impacts

When consumers think of annuities, they think of their own mortality and question whether to take the gamble of taking monthly income from the product versus the lump sum of cash given up to purchase said annuity. This gamble is reinforced with the negative association of a loss of control over one's finances, which runs counter to what workers have been hearing throughout their entire working lives. Consumers are ***loss-averse*** and are less willing to give up a lump sum of their hard-earned wages for a gamble on their own life expectancy.

In actual markets, very few households choose to annuitize a substantial portion of their wealth. This is the annuitization puzzle. Academic research suggests that annuity contracts should be more popular, as they simultaneously increase consumption and eliminate risk, essentially entailing a negative price. However, there is a prominent aversion to these products. A survey conducted by Allianz Life Insurance Company of North America noted that nearly 54 percent of Americans age 44 to 75 expressed distaste for the word "annuity."[29] The other side of the issue is that people are generally uneducated about the concept and benefit of an annuity product.

Another concern in retirement planning and the purchasing of annuities is that due to lack of *self-control*, people may be tempted to spend their lump sums once they are out of the pension plan. While recipients do roll over some of their lump-sum distributions into Individual Retirement Accounts (IRAs), they use a large fraction to pay debts and cover current expenses.[30] A problem with taking a lump sum from the pension, of course, is that withdrawals become subject to taxes if the recipient is younger than age 59½. Many retirees are poorly equipped to manage their investments in old age, perhaps because they never were particularly financially literate, or because they suffer diminished faculties due to poor health and/or lack of mobility with age. Importantly, it is difficult even for experts to undertake the sophisticated calculations required to simultaneously manage the investment portfolio, the drawdown rule, and the target horizon over which these decisions are made.[31] Most financial planners are not particularly well versed in these techniques either, and neither are their clients. But possibly due to overconfidence, they often expect the money to last longer and earn more than a prudent strategy (such as annuitizing) would dictate.

Social impacts

The business implications from analyzing the social impacts of behavioral economics to annuities are many. Companies should develop ways to socialize the concept of annuities in a manner that minimizes the association between profit and death. Understanding the individual holistically and stressing the importance of providing for dependents through an annuity helps put a positive light on the situation. Another hurdle is getting consumers to not only understand the annuity product but to make the active choice of signing up for one amongst standard, more prevalent, retirement products. Consumers are already wary about choosing annuities and proper framing of the annuity and presentation of the product in a transparent way may help assuage these fears.

We next turn our attention from purchasing behaviors to applying behavioral economics in understanding insurance policyholder behavior.

Behavioral Economics: Policyholder Behaviors Literature Review

This chapter presents a literature review on psychological factors that have been identified as potentially impacting policyholder behavior. We start by noting that much of the behavioral economics research and many of the experiments performed have been done in other areas (e.g., personal finance, retirement and retirement plans), and we found relatively little in the insurance policyholder behavior realm specifically.

Table 5 summarizes the policyholder behaviors associated with the major life and annuity products and the behavioral economics principles that could be applicable to each of the behaviors. This list is not exhaustive, but focuses on what we consider to be the key themes. An important message from this table is that many of the behavioral economics heuristics have a direct application to understanding policyholder behaviors, which promises this to be an interesting area for further research.

	Renew/ lapse	Premium decision	Timing of withdrawals	Amount of withdrawals	Investment decision	Annuitization
Table 5 — Policyholder Behaviors and Applicable Behavioral Economics Principle *Life and Annuity Products*						
Decision Shortcuts						
Relative choices	Compare to other products, influenced by 'irrelevant' options				Policyholders may be unduly affected by how investment options are presented	Decisions depend on what other options are presented and what it's compared against
Reliance on defaults		Inertia in premium amounts, reliance on target and illustrated premiums	Product designs may suggest a default timing endorsed by experts or social norms	Withdrawal rates shown in communications may be seen as a default amount endorsed by experts or social norms	Default investment allocations may be seen as endorsed by experts	Most annuitization decisions are opt-in, but what if it was the opposite?
Mental accounting	Funds in the product may be 'labeled' for one use or another, leading to seemingly irrational decisions		Funds from the product may be seen to meet a specific purpose and appear less fungible than they really are	Withdrawals might be driven more by spending needs than maximizing the present value of future financial benefits from a policy	There appears to be a separation between old-money versus new-money in an account and how they are handled	
Framing					Decisions may be affected by whether the account is seen as an "investment" or "savings" or "retirement" account	Part of the answer to the "annuitization puzzle" seems to be a framing problem in annuities communications

Table 5 — Policyholder Behaviors and Applicable Behavioral Economics Principle *(continued)* *Life and Annuity Products*						
	Renew/ lapse	**Premium decision**	**Timing of withdrawals**	**Amount of withdrawals**	**Investment decision**	**Annuitization**
Value Assessment						
Love of free	Policies that have become self-supporting may seem "free" and not easily given up					
Anchoring		Illustrations such as target premiums can anchor premium amount decisions		Communications on how much policy-holders can withdrawal might anchor their decisions		
Endowment effect						Already own the annuitization option, hard to give up?
Hyperbolic discounting	Procrastination may be aided by future benefits being heavily discounted	Payments create a conflict between short-term and long-term needs		Withdraw more now, not fully realizing impact on future withdrawals		
Emotional Impacts						
Risk aversion	Insurable interests and the policyholder's risk aversion levels may change, ideally products would evolve to that				Seek conservative allocations if the funds are considered a retirement vehicle	
Over-confidence			Planning fallacies may lead to unexpected withdrawal timing		Individuals over-confident in their abilities may trade more frequently or hold riskier positions	
Loss aversion	Aversion to losing a policy for nothing after paying for years				Rebalancing doesn't trigger tax effects, so normal "irrationality" of keeping losers might be even more pronounced	Fear of losing a lot if accidents happen soon after purchasing a life annuity
Self-control facilitation	Keeping a policy may be a disciplined method to save and prepare for future expenses					Annuitization can be a disciplined method to ensuring adequate income
Hot vs. cold states	Emotions can influence even seemingly cold, rational decisions.				Investment and reallocation choices might differ by emotional state	
Self-herding		People seek to justify past decisions they have made				Justifying past decisions if a annuitization rider was purchased

|

	Renew/ lapse	Premium decision	Timing of withdrawals	Amount of withdrawals	Investment decision	Annuitization
Social Impacts						
Social/financial domains						
Bandwagon effect	Mass lapse risk can be fueled by word of mouth and impressions passed from person to person				Follow the crowd in times of volatility	

Table 5 —
Policyholder Behaviors and Applicable Behavioral Economics Principle *(continued)*
Life and Annuity Products

Below we discuss some of the more interesting and insightful behavioral economics experiments performed to demonstrate the various psychological biases (typically not in the insurance area). A summary description of these experiments and their findings are shown in separate call out boxes for the interested reader.

Lapse and surrender

"Lapse" historically referred to the circumstances in which a policyholder with a traditional life insurance contract fails to pay the periodic premium, resulting in policy termination. In contrast, "surrender" is a term used by some to mean lapses on insurance products with a cash value component, where an active request to terminate the policy leads to return of the policy's cash value. Many practitioners use the two terms interchangeably, and we will make the distinction where appropriate.

We start our discussion of policyholder behaviors with lapses, as this represents one of the most important and studied policyholder behaviors. The 2012 Society of Actuaries ULSG survey on policyholder behavior in the tail stated that "Most companies considered the lapsation assumption … to be critical risks."[32] Similarly, in Europe, the recent Quantitative Impact Study (QIS5) for the new regulatory framework Solvency II identified lapse as a main risk among life underwriting risks.[33]

We first consulted actuarial academic literature for studies and theories of policyholder lapsation. We found two main hypotheses for why policyholders decide to lapse a product, both of which focus on external factors that drive lapses:

- *Interest rate hypothesis.* Lapse rates are negatively related to internal rates of return (such as high guaranteed minimum crediting rates) and positively related to external rates of return (such as market interest rates or stock returns). See for example Dar and Dodds (1989)[34] or Kuo et al. (2003).[35]

- *Emergency funds hypothesis.* Policyholders surrender their policies due to financial distress. For example, see citations for Eling and Kochanski (2012) or Fier and Liebenberg (2013).

There does not appear to be a consensus amongst the empirical findings on which of the two hypotheses are dominant. It seems likely that both have varying effects depending on the market and product types.

Relatively lacking in academic research is the internal decision process that drives a policyholder to exercise the right to surrender a policy. Understanding the internal decision processes would help provide an alternative and possibly complementary method towards forecasting policyholder behaviors. We next considered whether research in the behavioral economics area might help us further understand policyholder lapses. Part of the challenge isn't just understanding individual behaviors, but rather having the appropriate data that makes it possible to go to micro-data and being able to translate it back into our actuarial models where the outputs we are concerned with are typically at the aggregate level. In the July 2013 issue of *The North American Actuarial Journal,* Stephen G. Fier and Andre P. Liebenberg presented a paper[36] examining lapse behaviors using a microeconomic model, where they used household-level data — not aggregate data — to understand, for example, how the impacts from income shocks lead to policy lapses. Viewing lapses as being a stable 6 percent per year based on historical averages precludes further analysis into understanding why these 6 percent of policyholders lapsed – and more importantly, going forward what would happen to lapses in an environment different from that which the historical data was collected. To make advances in that direction, it seems promising to go beyond aggregate-level summaries and understand how the underlying decisions are made.

Policy lapses and surrenders are an interesting behavior as it can either be a conscious decision to surrender a policy, a forced decision driven by cash needs, or a failure (conscious or not) to pay the required premiums to keep a policy inforce. For each of these situations behavioral economics has identified different psychological factors and biases when it comes to general personal finance matters, and we will discuss the following under the four categories first introduced in the Behavioral Economics: Background chapter of this report: (i) decision shortcuts (ii) value assessments (iii) emotional impacts and (iv) social impacts. We also note that we found little behavioral economics research specific to insurance policyholder behaviors, and therefore many of the examples we show are generalizations and extrapolations from other areas of research. Nonetheless we hope that by showing such research, further interest can be stimulated within the actuarial community to explore this rich area.

Decision shortcuts

It seems clear that few policyholders have the requisite skills and time to justify performing an unbiased optimization calculation for determining whether to lapse/surrender their policy or not, in the way an academic might seek to optimize the lapse decision by, for example, solving the optimal stopping problem for an American option. Instead, policyholders and financial advisors likely rely on decision shortcuts and heuristics when making such decisions. Understanding these shortcuts can help advance our knowledge of the decision process and help guide product design and pricing for new products, while potentially helping existing policyholders to an objectively "better" decision. Behavioral economics research has identified the following decision shortcuts as being frequently applied when people make financial decisions:

- *Relative choices.* Most people make decisions by comparing products to one another, rather than performing a ground-up valuation of each option. When given a choice of whether to keep an insurance contract or lapse, a policyholder is likely looking outside to other products (insurance and quite possibly other financial products) to determine if what they own is a "good deal" or not. However, this product comparison process can introduce psychological biases that can lead to seemingly irrational choices.[37]

The key point here is that few policyholders will likely have a "fair value" sense of what their contract is worth, and it's much more likely that their valuation is based on how attractive it seems relative to other products on the policyholder's mind at the time of decision making. The alternatives considered by the policyholders, including those marketed by the insurer and other competitors, likely has a large impact on how policyholders chase better products, or how they decide which source of money to tap into when experiencing a liquidity need. Therefore the insurer needs to be careful in how the product is presented and what other products it may be compared against.

■ *Mental accounting.* People have a common tendency to create artificial budgets covering different categories of spending and saving, and this tendency can lead to seemingly irrational decisions. One observation is that some people might simultaneously be saving at a low interest rate (e.g., for a child's college fund) and borrowing at high interest rates (e.g., for a car purchase).

When considering lapse decisions, we conjecture that two types of mental accounting could apply in a policyholder's mind. One is that the funds used to pay premiums may be given special treatment depending on how they view the insurance premiums in the hierarchy of "expenses" or "savings." The other is how the cash value built up in a life insurance or annuity policy is seen: Is it for future spending or purely asset accumulation? These can be affected by how the insurance company frames its products. For example, a reinsurer which acquires the businesses of two virtually identical products may nonetheless see very different lapse experience because of the different marketing names of the products: one may have an

---

RELATIVE CHOICES

A well-known example was discussed by Dan Ariely in his book *Predictably Irrational*.

■ People were first asked which of the following two options they would prefer:

1. A one-year subscription to the web-edition of *The Economist* for $59

2. A one- year subscription to both the print and web-editions of *The Economist* for $129

Under this setup 68% of people preferred option 1.

■ A second experiment was then run with a new (redundant) option added:

1. A one-year subscription to the web-edition of *The Economist* for $59
   (same as previous)

2. A one-year subscription to the print edition of *The Economist* for $125
   (new and redundant option)

3. A one-year subscription to both the print and web editions of *The Economist* for $125
   (same as previous)

Notice that the second option is redundant and doesn't really offer individuals a new choice — yet the **number of people preferring option 1 dropped to 16%,** with the remaining 84% now "realizing" that the $125 print-and-web subscription offers better value.

"investment" theme while the other is named along a "saver" theme. The different marketing names can attract policyholders with different mindsets, and they may also further reinforce the different mental accounting performed by policyholders every time they think of the product.

While we couldn't find more concrete research on how mental accounting affects annuities or policy loans in life insurance policies, we did find research done on other financial products that can be a useful reference: Thaler[38] found that money in a current account gets spent but retirement accounts remain untouched, making the funds seem less fungible than they really are. Venti and Wise[39] found that after IRAs were introduced, contributors did not reduce their other saving, and most had not saved much before IRAs were introduced. In summary, people's budgeting and withdrawal decisions weren't made on the basis of needs only, but also perceptions and mental accounting. Influencing how people think about their insurance contract — where it is mentally accounted for — could influence their behaviors in tapping into the funds.

Value assessments

Research into behavioral economics has found that "value" is often a relative concept, and is easily influenced by emotions rather than rational calculations. For example, Payne[40] conducted an experiment that framed mortality in positive and negative terms ("live to X years" versus "die by X years") and found that peoples' assessments differed by nearly ten years between the two questions (asking "living to" questions elicited longer life expectancies). This has implications for lapse assumptions where actuaries assume policyholders exercise a degree of rational value assessment — for example, the anti-selective lapses driven by mortality considerations, or dynamic lapse assumptions driven by external interest rates or the in-the-moneyness of variable annuity guarantees, without regard to how the decisions or options are presented to policyholders.

- *Hyperbolic discounting.* Research has shown that individuals behave as if they have increasing discount rates across time horizons — i.e., as if something far out in the future is discounted at a much higher interest rate than something near. There may be a (hopefully small) portion of policyholders who are meaning to surrender a policy they no longer need, or would choose to surrender their policy if they went through a simple financial planning exercise, but have simply procrastinated in doing so. Financial planning can be a painful activity and a "cost" that may feel worth postponing, even if it generates high future benefits.

- *Love of free.* Consumers respond disproportionately well to the concept of "free," and would likely be much more motivated to continue paying premiums on a product with an accumulated cash value close to being able to support itself versus another product with the same present value of premiums but without this "free" perception.

Emotional impacts

Life insurance and annuity products often have a strong emotional component to their purchase and ownership. For life insurance products, the policyholder lives to see none of the benefits but pays all the premiums. For annuities, the policyholder is either seeking to be self-sufficient and not burden family members for their retirement income, or had struggled with losing control of the assets and potentially sacrificing bequest motives when making the purchase.

When life insurance owners were asked in a survey why they chose to keep their life insurance in effect while making other sacrifices, **93% said they did so because they believed that protecting their family and loved ones is a must.**[41]

Therefore, a significant consideration in owning and keeping a policy is non-financial. Even though most actuaries view life insurance and annuity products through a purely financial lens, we should understand that many emotional factors are at play during the policyholder's decision making process.

- *Risk aversion.* The primary reason people purchase insurance products is because they are risk-averse. Should their insurable interest need change (e.g., children grow up and become independent), risk aversion may no longer apply, and we would expect policyholders to lapse their policy unless there were other material benefits for keeping the policy. For example, with level term life insurance products, people may have selected the term period based on a combination of affordability and their anticipated insurance needs (e.g., coverage until their mortgage is paid off or until their children are expected to graduate from college). At the end of the level term period, many policyholders would have met their goals and would not need to continue the insurance coverage. Some policyholders may have become terminally ill and therefore it is in their financial interest to continue the coverage, even if their original insurable interest has changed (e.g., no more family "liabilities"). Some other policyholders may have new insurance needs (e.g., a new child born during the coverage period). How an insurer decides to raise insurance premiums at the end of the level term period impacts these subgroups of policyholders very differently, and it may be worth considering whether having a single lever (increasing premiums) is the best way to differentiate and reach the different policyholders.

- *Loss aversion.* Studies have consistently shown that people will select "winners" to sell and hold onto "losers" even though they know it is not tax optimal to do so.[42] This would suggest that policyholders may actually be more likely to hold onto a variable annuity contract that has suffered losses; however, the picture is clearly more complex than that due to (1) the fact that variable annuity contracts are often held as a retirement income vehicle and not simply as an investment, and (2) the presence of implicit "investment guarantees." Actuaries generally agree that contracts that are deep in-the-money (with a valuable guarantee) have lower lapses than contracts that are out-of-the-money, so while policyholders are holding onto a loser from an account value perspective, they are winners from the guarantee perspective. Some policyholders may want to begin taking benefits as soon as possible to make themselves feel good about their decision to purchase the product and signal to others what a wise investment they've made, especially as newer generations of variable annuity products offer more conservative guarantees.

Another potential implication of loss aversion is when long-term care insurance policies were first priced. Lacking experience, some companies used lapse experience from their whole life policies as a basis, but the lapse experience could be very different. Although in hindsight it may seem obvious, one of the drivers of the difference seems to be that policyholders were averse to terminating their long term care contracts and losing it for nothing after paying years of premiums, whereas whole life policyholders would be surrendering for a policies cash value.

■ *Self-control facilitation.* While it is obvious that the presence of surrender charges reduces lapses/surrenders, it may be less obvious that many individuals are quite willing to accept such controls. It seems that people are willing to accept less freedom in order to prod themselves into saving and preparing for the future in a disciplined manner.

Indeed, the gap between (low) actual saving rates and (high) normative response rates for retirement savings is evidence for the self-control conflict over time. Recent changes in European legislation have trended towards requiring high cash values: In Germany, for example, surrender charges were capped and guaranteed cash values raised while in Norway surrender charges were removed completely.[44] The desire to offer policyholders more options should be balanced against whether such controls are truly in the policyholders' best interests, in addition to raising average insurance costs.

> *In one survey, **60%** of Americans said it is better to keep restrictions on withdrawing savings from retirement plans, while **55%** reported feeling behind in their savings and only **6%** reported being ahead.[43]*

■ *Hot and cold states.* Studies have found that people in good moods make unrealistically optimistic judgments and decisions, while bad moods lead to unrealistically pessimistic views (Loewenstein et al. 2001): "It is probably not an overstatement to say that visceral factors [like negative emotions, (e.g., anger, fear), drive states (e.g., hunger, thirst, sexual desire), and feeling states (e.g., pain)] are more basic to daily functioning than the higher level cognitive processes that are often assumed to underlie decision-making."[45] There is also a "projection bias" in that people in "hot" states will overestimate how long those states will last.[46]

While most research focuses on how emotional states influence peoples' choices, one real-world application has measured real-world emotions and how they manifest in financial markets.

To the best of our knowledge, no similar study has been performed on society "sentiment" and insurance purchase and policyholder behaviors, so we can only speculate, for example, whether "increased anxiety" would increase or decrease lapses on insurance products, or whether access to policy loans and variable annuity withdrawals would increase or decrease. There are still large gaps in current research and understanding of policyholder behavior.

> *A groundbreaking study by Eric Gilbert and Karrie Karahalios studied how anxiety, worry, and fear from a dataset of blog posts predicted downward pressure on the S&P 500 index.[47]*

It is possible to trigger "hot" states in people that can affect their decision making — for example when purchasing airline tickets online, information may be displayed stating that there are *"only two tickets left at this price!"* When contacting policyholders about their lapse decisions or notifying them about premium charges, the insurance industry should be careful whether its communications inadvertently trigger such "hot" or "cold" states when important financial decisions are being made.

Social impacts

Life insurance and annuity product decisions are rarely made by an individual in isolation; instead, they represent significant interplays within the policyholder's social network, which may include members of their household, other family, agents, friends, etc.

- *Bandwagon effect.* This effect can be more pronounced when extreme conditions are present. Following the most recent financial crisis additional attention was paid to the mass lapse risk and potential liquidity strain that the life insurance industry would face.[48] However there are still large gaps in understanding whether these risks are driven solely by interest rates, unemployment rates, or if there is additional propagation of risks through social networks and different geographies, and the impact different advisers and insurance company communications might have.

Premium and funding levels

We next focus our discussion on premium assumptions. For traditional insurance products, stopping premiums was directly tied to lapsing the product, but for many newer (non-traditional) products, policyholders are given the flexibility of varying the size and timing of premium payments and changing the funding level of their insurance policy to impact future costs and benefits.

By allowing policyholders this flexibility, a significant uncertainty is introduced to a company's projection of its in-force block and new business generation: It's not clear how each policyholder will choose to use the policy, and whether they keep minimal funding of the policy and use it as a protection product (particularly for universal life products with secondary guarantees) or choose a high level of funding and use it as a savings product. This has implications for the future profitability of the business, as interest spreads are often an important source of profit supporting the business. Unlike traditional actuarial assumptions, the law of large numbers may not apply as well since the policyholder behaviors are often not homogenous within a risk pool. We next consider how different behavioral economics heuristics apply to the premium decision.

Decision shortcuts

Few policyholders have the requisite skills and time to justify performing an unbiased premium optimization calculation to maximize their policy value (in particular with more complex product designs). Instead, policy-holders likely use decision shortcuts to make their premium payment decisions. Understanding these shortcuts can help advance our knowledge of the decision process and help guide policyholders to an objectively "better" decision. We think the following decision shortcuts are likely candidates:

- *Reliance on defaults.* Individuals exhibit a large degree of inertia in their decision-making process and often rely on default assumptions that were set up or used in the past. For example, they may choose to make the same payment they made in the last period, or they may follow target premium illustrations shown to them by the insurance company. Perhaps for this reason, many actuaries set premium

assumptions using recent experience and assume that it continues — of course actuaries should consider whether it's appropriate to assume the same premium continuing indefinitely — another common practice is to set premium assumptions as a percentage of the target premiums illustrated for each policy.

■ *Status quo bias.* Another bias similar to inertia and procrastination is the "status quo bias," where people have a tendency to stick with their prior choices. The surprisingly powerful influence of default options is consistent with this bias.

Value assessments

We think the following value assessments are likely candidates:

■ *Anchoring.* Anchoring refers to the (surprising) tendency of numerical estimates to be influenced by suggested numbers; the effect extends to situations where completely irrelevant numbers can have an effect too.[49] When prompting policyholders to make premium payment decisions, the communications should be careful to avoid any unintended anchoring.

ANCHORING

In one experiment, Dan Ariely, George Loewenstein, and Drazen Prelec showed six products to subjects without mentioning a market price.

Subjects were asked whether they would pay a price equal to the last two digits of their Social Security numbers. Afterwards, subjects were also asked the maximum price they would pay.

The results showed that the Social Security number — completely unrelated to the products values — had a significant impact on the prices the subjects were willing to pay: subjects with above-median Social Security numbers stated values 57% to 107% higher than those with below-median social security numbers!

Although there is noise from cell to cell, the overall trend is clear (and staggering) and shows how susceptible individuals' value assessments may be to outside influences.

Average Stated Willingness to Pay (US$) for Products Across Social Security Number Quintiles* *(Last Two Digits)*						
SSN quintile	Cordless trackball	Cordless keyboard	Average wine	Rare wine	Design book	Belgian chocolate
1st	8.6	16.1	8.6	11.7	12.8	9.6
2nd	11.8	26.8	14.5	22.5	16.2	10.6
3rd	13.5	39.3	12.6	18.1	15.8	12.5
4th	21.2	34.5	15.5	24.6	19.3	13.3
5th	26.2	55.6	27.9	37.6	30.0	20.6

*Source: *The Quarterly Journal of Economics,* February 2003. Authors: Ariely, Loewenstein, and Prelec.

Marketing studies also confirm how anchoring can come into play: In one, a stack of canned tomato soup with a sign saying "limit 12 per customer" led to people buying more.[50] We do not know whether limiting additional premium payments to a stated dollar amount could have a similar unintended anchoring effect but it seems to be an interesting area of further research.

- *Hyperbolic discounting.* Insurance products face an uphill battle: Policyholders must accept periodic short-term pains (premium payments) in exchange for a relatively long-term payoff — either a death benefit far in the future or a tail event protection of retirement income. Given people's hyperbolic discounting tendencies, it's a feat that so many policyholders overcome their hyperbolic discounting tendencies to continue premium payments. One way this manifests in premium designs is that insurance companies sometimes charge higher amounts for handling higher premium payment frequencies (e.g., monthly versus annual) because, in addition to processing expenses and the time value of money differences, it's been noted that policyholders with higher premium paying frequencies (i.e., those who must make more decisions more frequently) have higher lapse rates. To get around this, the frame of reference for premiums could be understood as a saving rather than as an expense (i.e., a pain).

Emotional impacts

- *Self-herding.* Valuations of future actions and determinations of future behaviors are sometimes made on the basis of helping to justify past behaviors (even if subconsciously): Policyholders who have been paying premiums to keep a policy inforce tend to continue to do so, and confirmations from the insurance company can contribute to a self-reinforcing behavioral loop. There is also an element of self-herding when it comes to the level of premium paid for flexible premium payment. Policyholders normally would need to figure out how much they want to pay, and then may stick to that pattern.[51]

ANCHORING — FINANCIAL ESTIMATES

J. E. Russo and P. H. Schoemaker surveyed professionals on their interest rate estimates under three different anchoring systems.

- The first group received one question only:
  1. "What is your best estimate of the prime interest rate six months from now?"

- The second group had to answer a low anchoring question first:
  1. "Do you believe that six months from now the prime rate will be above or below 8%?"
  2. "What is your best estimate of the prime rate six months from now?"

- The third group received a high anchoring question:
  1. "Do you believe that six months from now the prime rate will be above or below 14%?"
  2. "What is your best estimate of the prime rate six months from now?"

The first group had an average guess of 10.9% (at the time of the study, 1983, the actual prime rate was around 11%). The second group's average was 10.5%, and the third group was 11.2%. There is clearly potential to influence even a professional's estimates.

Timing of withdrawals

This mainly applies to the timing of when policyholders may begin making partial withdrawals on variable annuity products. Typically, partial withdrawals are allowed without penalties after the policyholder attains a certain age or the policy hits a certain duration, after which different guaranteed withdrawal rates may apply. The guaranteed withdrawal rates are normally stratified by ages, with higher guaranteed rates offered if withdrawals don't begin until a higher age.[52]

The timing of when policyholders may begin their withdrawals introduces a layer of uncertainty to the valuation of the policy, since the timing and guaranteed amount of cash-flows differ greatly. In addition to timing, there is an additional layer of uncertainty around the dollar amount of withdrawals, which will be discussed as the next topic.

The following behavior bias could play a role in the decision process.

Decision shortcuts

- *Reliance on defaults.* The communications and tiering of withdrawal rates likely has a signaling effect to policyholders of when they should begin taking withdrawals. A related decision is when individuals choose to begin Social Security payments after they reach age 62. We know from Social Security studies that people respond to the framing effects of the "full-benefit age" signaled by the Social Security administration.[53] As former Congressional Budget Office Director Peter Orszag described in 2008, "[T]he *full-benefit age seems to act as a signal that leads a substantial number of people to target that age.*"[54]

  Figures 10 shows the distribution of Social Security claims by age for men and women born in the years 1937 through 1940. In the 1937 cohort, the full-benefit age was 65, and we see a corresponding spike in claims (18 percent of all claims) at exactly age 65. The full-benefit age moved out by two months per year for the 1938, 1939, and 1940 birth cohorts, and we can see that the spikes moved to follow that pattern exactly, even though they could have received actuarially fair benefits at other times.[55]

  Given how strongly individuals seem to respond to such signaling effects, it seems likely that insurers can also influence policyholders through various product design features such as setting a full-benefit age, setting additional bonuses, or setting when benefits stop accruing. These design features also form a good basis for setting assumptions, even where experience is not yet available.

- *Mental accounting.* People's perceptions toward the associated money are affected by how they often set up divisions or categorizations of their finances. When policyholders make a decision about when they would like to start withdrawing money, it is likely a decision of tradeoffs: Either begin withdrawals at the eligible age and receive the pre-set amount of money, or delay withdrawal and receive more money every month. What drives the final decision is what makes the policyholder feel like he/she is receiving a higher amount in total.

The 2009 *Retirement Income Reference Book* cites a survey of 942 retirees aged 55 to 80 with at least $200,000 in household investable assets. The survey noted that *"taxes top the list of reasons that retirees defer tapping specific investments."* However, when owned, *"annuities top the list as the first investment for regular withdrawals."*[56] This is a relatively clear case of inconsistent preferences, as annuities provide a tax-deferred status to funds and it's typically more advantageous to allow the funds to grow tax-deferred and draw on other sources of funding first, but people exhibit mental accounting and often see annuities as a first source of income spending for retirement.

Figure 10 —
Social Security Benefit Claim[57]
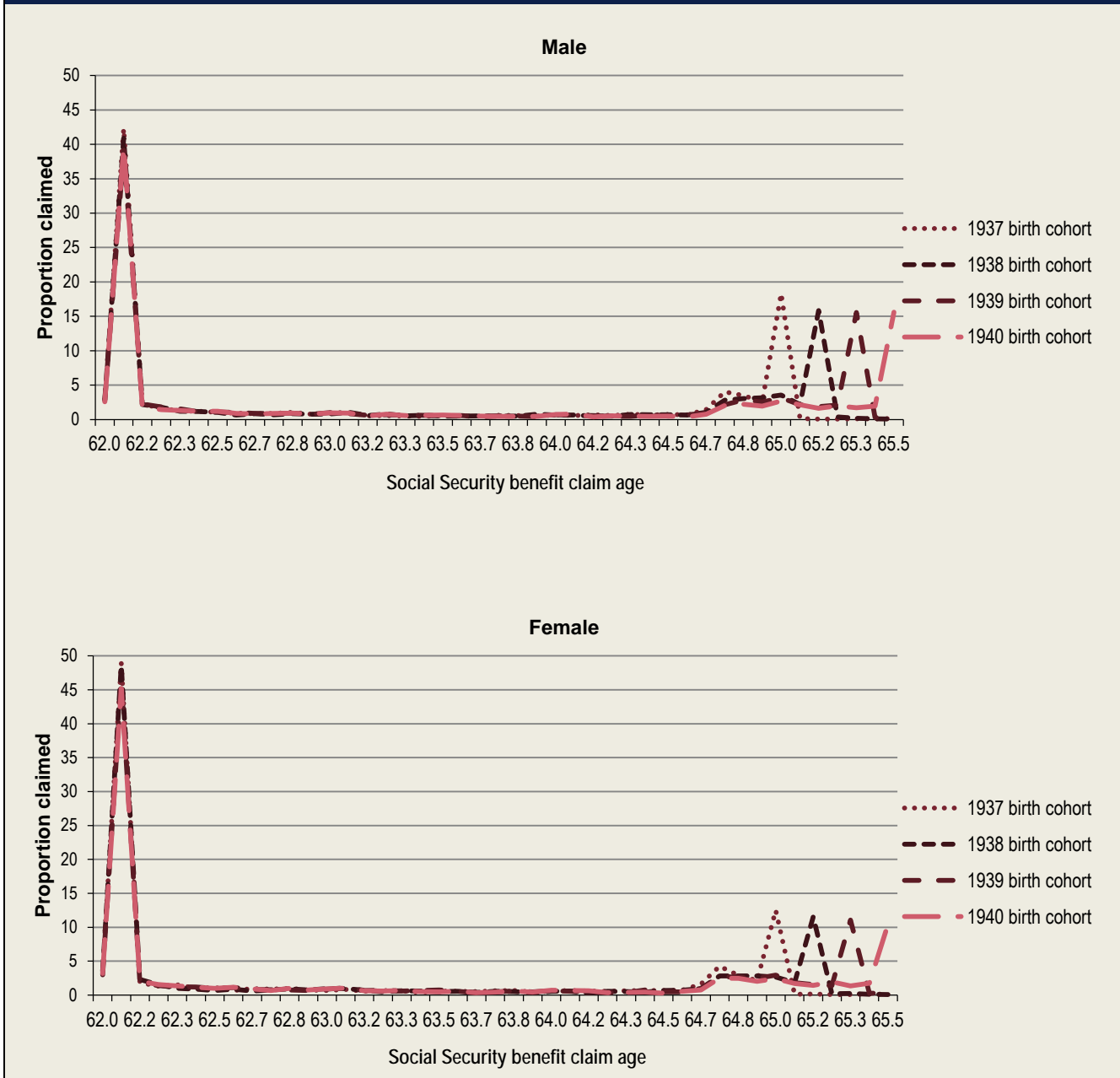
Emotional Impacts

- *Over confidence.* How difficult it is for humans to plan ahead becomes evident from the findings on "planning fallacies," which is a rich area of research.[58] This drives a gap between how policyholders may have planned to use an insurance product for retirement income versus how they end up needing to use the product. While a policyholder may have planned to start taking withdrawals from a variable annuity at age 65 to get the higher guaranteed withdrawal rate, he or she may have faced a budget shortfall and needed to begin withdrawals earlier (e.g., at 64 and not 65). That may seem "irrational" from an actuary's perspective, as the guarantee values are likely maximized by either taking withdrawals earlier (before age 64) or later (at 65).

  Conversely, policyholders may have purchased a product with the intention of beginning withdrawals upon retirement, but their estimates of when they would be able to retire could be fairly inaccurate. Research suggests that only 30 percent of US pre-retirees are fully prepared for retirement at age 65.[59] Of the remaining group, another 30 percent is likely to close the savings gap by age 65, though this hardly appears to be evidence of a long-term, life-long rational planner at the heart of the life-cycle model. Finally, 40 percent appear unlikely to achieve a reasonable standard of replacement income by age 65. According to a Gallup poll, the numbers are much more pessimistic if retirement is planned for age 61, when the average American typically retires.[60]

  One implication is that actuaries should take self-reported confidence levels on retirement savings and preparedness with an understanding that planning is inherently difficult and individuals are often prone to being overly optimistic when prompted for estimates. An individual that is confident he or she has enough savings to wait before, for instance, a deferred income annuity payment begins may discover that they need that money earlier. Newby-Clark et al. found that asking subjects for their predictions based on realistic "best guess" scenarios and asking subjects for their hoped-for "best case" scenarios gave the same results.[61] Indeed, people's "most probable" cases had everything going exactly as planned, with no unexpected delays or unforeseen catastrophes — i.e., it was the same vision as their "best case."

OVER CONFIDENCE

The power of the planning fallacy was illustrated in an experiment by Roger Buehler, Dale Griffin, and Johanna Peetz, which asked students how confident they were of finishing an academic project before a set of target dates — e.g., a student may be 50 percent sure of finishing by November 1, 75% sure of finishing by November 15, and 99% sure of finishing by December 31. Table 6 shows the gap between the reported confidence levels and actual results on finishing the work.

Confidence Levels vs. Actual Results	
Reported confidence level	**Actual result**
50%	13%
75%	19%
99%	45%

Similarly, studies have found that individuals persistently underestimate their future expenditures. For example, budget estimates for the next month are consistently underestimated even when people are asked immediately after they just finished reporting their prior period's actual spending. This observation is consistent with the finding that people fail to incorporate past experiences into their predictions.[62]

Partial withdrawal amounts

This section mainly applies to the amount of withdrawals taken by policyholders when they begin taking withdrawals on variable annuity products.

Actions taken on partial withdrawals are affected by the complexity of different product designs, for example, the impact of excess/full/partial withdrawals on the benefit base amount, and consequently the future value of their living benefit riders, is often complex and difficult for policyholders to fully grasp.

The following behavior biases could play a role in the decision process.

Decision shortcuts

- *Mental accounting.* People have a common tendency to create artificial budgets covering different categories of spending and saving, which can lead to seemingly irrational decisions. One previously noted example is the observation that some people are simultaneously saving at a low interest rate (e.g., for a child's college fund) and borrowing at high interest rates (e.g., for a car purchase). Depending on how policyholders mentally account for the funds in an insurance/annuity policy, they may choose to use it in ways that may create an illusion that money is not as fungible as it actually is, leading to withdrawal patterns that may seem less than rational.

  For example, if a variable annuity with a guaranteed minimum withdrawal benefit was set up to fund certain discretionary expenses, the withdrawals may fluctuate according to the expense needs rather than with a view of maximizing partial withdrawals to optimize any embedded option value in the policy contract. We found little research that explored how policyholders view their insurance and annuity contracts, and which potential "mental buckets" these funds and premiums have fallen into and indeed how the products may transition between "buckets."

  In general, mental accounting is important to how insurers design their products. Many insurance products are designed with the life-cycle model in mind — e.g., when policyholders may begin making partial withdrawals and the size of partial withdrawals that would be needed. But mental accounting explains why, in contradiction to the life-cycle model, current income flow is what drives budgeting decisions rather than the present value of lifetime wealth assumed in economic models. Budgeting is done on a periodic basis, with spending grouped into separate categories such as "entertainment" or "meals." If one budget has run out, a person may decide to postpone further spending in that category for the current month while continuing other expenditures that still have budget.[63]

It should be noted that mental accounting is not necessarily irrational — in fact, it can be helpful in overcoming people's short-term planning horizons and is a means for self-control by way of pre-commitment.[64] Knowing how policyholders mentally account for their policy and what needs (insurance, expenses) the policy has been matched up against may therefore provide the industry with a better view of if, when, and how much may be taken in partial withdrawals.

- *Reliance on defaults.* Systematic payout/withdrawal programs and product designs around withdrawal rates and amounts may be seen as a 'sensible' amount endorsed by experts or social norms.

Value assessments

- *Anchoring.* People are easily affected by numbers presented to them, even when the numbers aren't relevant to the decisions they need to make. These numbers have an effect of anchoring our thinking, and research has found that we tend to adjust away from these anchors less than we should. For examples of anchoring effects, see "premium and funding levels" on page 53. When policyholders are considering the amount to partially withdrawal from an account, they are likely affected by the numbers shown to them in all communications from the insurance company.

Investment decisions and fund transfers

With variable and equity-indexed products (variable annuities and universal life, equity-indexed life and annuities), policyholders have the option to invest and transfer between different funds offered through a separate account, and also to transfer money between the separate and general accounts. These policyholder decisions impact valuation, expenses and risk management from an insurer's perspective.

The role of simple heuristics used in the allocation of assets in retirement plans is fairly well studied, but we could find little research on whether these heuristics hold for insurance products or how well they could be translated over (insurance products have many differentiating factors from other investment products: for example minimum crediting rates or minimum guarantee riders).

Given the wide range of flexibility and options these products offer, policyholders can engage in diversified investment activities and decision making. Under modern portfolio theory taught in most introductory invest-ment and corporate finance courses, one should simply select a point on the efficient frontier, but clearly this is not a trivial exercise. Indeed, Harry Markowitz, Nobel prize winner and the father of modern portfolio theory, allocated his contributions "fifty-fifty between bonds and equities" in his retirement account, although he recognized that he "should have computed the historic co-variances of the asset classes and drawn an efficient frontier."[65]

Decision shortcuts

- *Relative choices.* The Markowitz example above is an example of "naïve diversification" or the "1/n" rule as termed by Thaler and Bertnatzi.[66]

Additional experiments[67] were conducted over a large number of retirement plans with consistent findings that the relative number of equity funds offered correlates with the amount invested in equities.[68] We are not aware of similar studies for variable and equity-indexed products, but it would certainly be an interesting area for an insurer to research.

Further research showed that the effects of this heuristic wears off when a large number of funds are offered, and the correlation is no longer significant when the offering grows beyond ten funds. Instead, a different type of naïve diversification seems to kick in, as individuals seem to divide assets equally amongst a small number of funds (with the median between three and four funds). Huberman and Jiang call this the "conditional 1/n rule."[69] An interesting aspect of this "conditional 1/n rule" is that its use appears to be affected by how easily the total pie of 100 percent can be divided by the number of funds chosen ("n"). Again, this would suggest a careful design of the fund offerings, as fund allocations directly impact the hedging costs and risks to the insurer.

Another interesting manifestation of the relative choices principle is that investors can be overwhelmed by the options available and seek safer options.[70]

RELATIVE CHOICES

In one study, UCLA employees were asked to allocate their retirement contributions among five investment funds. Two menu options were set up: One group of employees was presented with four equity funds and one fixed-income fund, and the other group of employees was presented with the reverse (i.e., four fixed-income funds and one equity fund). **Those offered one equity fund allocated 43% to equities, whereas those offered multiple equity funds ended up with 68% in equities.**

Another study estimated that for every ten additional funds offered in a retirement savings plan, the allocations to money market funds increased by 4% and the allocation to safe funds (money market and bond funds) was 5.4% higher. However, before designing products with a larger number of fund choices under the theory that greater choice leads policyholders to make safer investment choices, the reader should note that the same study found that average employee participation in the plan fell by 2% for every ten additional funds offered."

These experiments are an example of information overload.[71]

The number of investment options offered and the manner in which they are presented likely has a large impact on the allocations of funds and options within insurance products, and may directly impact policyholder satisfaction levels. The implications of these experiments should be carefully considered when designing new products or changing the fund offerings with inforce products.

■ *Framing.* Individuals may be influenced by whether an investment account is designated as a "retirement account" versus an "asset accumulation tool." Recent experiments suggest individuals are strongly influenced in their asset allocation decisions by the presentation of information and the election process.

An interesting example is how Thaler and Benartzi first noticed that seemingly trivial factors can have an outsized impact on asset allocations. They discovered that their finance and economics colleagues at the University of Chicago had selected at most four funds in their retirement plans, thinking it was the maximum number; however, "*a quick look at the sign-up form revealed why faculty had this (incorrect) impression: The form has only four lines for investment elections. To choose more than four funds, a second form is needed, admittedly a small cost but one that might be nearly insurmountable for the typical disorganized professor.*"[72]

They then conducted a more rigorous experiment through the Morningstar.com website, where two groups of subscribers were asked to allocate their funds amongst a list of eight different funds. One group was shown a form with four lines for selections, and the other group was shown a form with eight lines. The catch is that the group shown a form with only four lines could easily select additional funds by clicking on a highlighted link. The instructions made this explicit: "*Based solely on the above, please indicate how you*

EXPERIMENTS

The "classical" experiment illustrating information overload was conducted by Sheena Iyengar and Mark Lepper. They set up tasting booths in a supermarket showing either 6 or 24 jams (the larger selection included all 6 jams from the smaller group).

The results offered an interesting twist: **More people stopped to sample the jams when there were 24 offered (60% versus 40% of passing traffic), but only 3% made purchases, versus 30% when only 6 jams were offered.**

Another experiment displayed Godiva chocolates. One stand had 6 options while another stand had 30 options — again, with the larger group incorporating the 6 chocolates from the smaller group, meaning there were 24 additional options that should only expand people's satisfaction and should, under rational economics, offer a dominating solution set.

Similar to the jam experiment, people were more likely to purchase from the more limited set, and tellingly, they were *more* satisfied with their purchases.

---

would allocate your retirement contributions. You may choose up to four funds. (If you would like to elect more than four funds, please click here.)"[73]

The results suggest that even clicking on the link was a large obstacle, or perhaps the presentation had a signaling effect. Whatever the cause, those shown the form with only four lines had 10 percent of the subjects pick more than four funds. In contrast, 40 percent of those assigned the form with eight lines ended up picking more than four funds. Risk management and valuation actuaries should consider whether process changes to the fund election and reallocation process could significantly impact the asset allocations, with implications for hedging and valuation.

- *Mental accounting.* It appears that individuals use implicit methods for tagging and coding their balances, and this has an impact on how assets are allocated and reallocated.[74]

  Our first question is whether there is a similar effect for accumulation insurance products too. An implication would be whether product designs or programs could be offered to policyholders to "break" such a mental accounting so that even "old money" can be rebalanced and avoid concentration risks.

- *Reliance on defaults.* Given the overwhelming task of figuring out an optimal allocation, it's not surprising that many investors/policyholders rely on default allocations provided by the investment company. Defaults give the impression (often correct) that a knowledgeable party has vetted the default option as being suitable for the purpose. Defaults also carry the benefit of diminishing a sense of significant personal regret in the policyholder if the results turn out worse than average — the policyholder had simply followed the default. Situations where the policyholder deviated from the default and got poor results may introduce a greater sense of regret.

- *Procrastination.* On fund transfers between accounts, research has shown that people can experience inertia and procrastination in their decision-making process and actions. Earlier we noted a study by Ameriks and Zeldes, which found that 73 percent of TIAA-CREF participants did not make any reallocations of their funds over a 10 year period.[75] It's also been noted that banks maintain a distinction between current and savings accounts, which forces account holders to transfer funds to a savings account to earn interest. A

MENTAL ACCOUNTING

A study by Ameriks and Zeldes found that TIAA-CREF participants seemed to have a separate account for "old money" (already contributed to a retirement plan) versus "new money" (not yet contributed to plan): Over a ten-year study period, only 27% of participants reallocated their "old money" while 53% made allocation changes to their future contributions or "flows."

This tendency to mentally account for "old" versus "new" money differently, and having a lower propensity to change the "old money" allocations, could be linked to a self-herding behavior (where individuals feel a need to be consistent and justify past decisions) as well as regret avoidance (a potential to regret after reallocating the assets and seeing the old allocation perform better). For "new money," such ties and reference points have not yet been set.

fully rational account holder would transfer excess funds to the savings account diligently, but this rarely happens.[76] Another area of procrastination that has parallels to insurance products is when interest rates on existing savings accounts are lowered. Despite being informed of such changes, many customers will not move to search for higher interest rates elsewhere. It should be noted that such strategies, while they may be profitable for the company, can lead to regulatory scrutiny — as in the case of US life insurers not diligently identifying deceased policyholders and paying unclaimed death benefits.[77]

Emotional impacts

- *Risk aversion.* Individuals have a tendency to weigh losses more heavily than gains. Behaviors are greatly driven by their risk appetite, with different risk appetites leading to different fund selections, which thus generate different risks for both the policyholders and the insurance company. Policyholders that are risk-averse tend to choose less risky funds (such as bond funds) versus equity funds.

- *Loss aversion.* It's been noted that people hold onto "losers" and sell "winners" in their stock portfolio, even though the opposite strategy would be more tax efficient.[78] The thinking is that individuals avoid selling "losers" as that would make the losses "real." In aggregate, it's been observed that the trading volume for stocks declines when the price is lower rather than when prices increase.[79] However, this is clearly a case where insurance policyholders face a very different decision-making environment:

  1. The tax implications are different — e.g., reallocations within a variable annuity do not trigger taxes, which may actually strengthen the loss-aversion bias

  2. The insurance guarantees may offset the loss-aversion impulse

Studies have also found that people's loss aversion can actually be affected by different frames. Benartzi and Thaler[80] offered experiment subjects repeated gambles that were either described in words (N plays of gamble X) or in terms of the probability distribution of outcomes (after N plays). People preferred the latter, possibly because the probability of a loss is overestimated when presented in words. In an investment context, another experiment gave people either one-year returns or returns summarized over a longer time horizon. Those presented with information over longer time horizons were willing to take more risk.

A similar experiment by Gneezy and Potters[81] manipulated the frequency of feedback on outcomes and the opportunities people were given to make decisions: One set of test subjects was given feedback and decision-making power every round, while the other set moved every three rounds ("low frequency setting"). In the low frequency setting, people preferred riskier investment options and had higher earnings on average. Similarly, an experiment by Fellner and Sutter[82] varied the investment time horizon and found that longer time horizons with less frequent feedback lead to higher investments and returns.

Overall, people's loss aversion can be affected by how information and the investment decision are presented. When presented information over longer time horizons and/or given lower frequency of feedbacks, individuals tend to take more risks and on average achieve higher earnings. The decisions insurers then have to make is how often to report account value, benefit base, and other product metrics to policyholders, and what format the information presentation should take.

|

- *Overconfidence.* Some investors are characterized by overconfidence and excessive optimism. While overconfidence probably has some positive economic, psychological, and even evolutionary benefits, in the domain of investing it may also lead to behaviors that are less than optimal and certainly at odds with modern portfolio theory. Overconfidence may, for instance, help explain the high levels of trading activity in equity markets. Brad Barber and Terrance Odean report high rates of turnover, on the order of 75 percent, among households owning brokerage accounts.[83] They calculate that trading is typically hazardous to one's wealth, with active traders earning 11.4 percent over a five-year period, while the market returned 17.9 percent, and low-turnover accounts 18.5 percent. That study also reports that men trade 45 percent more than women, and that the difference is even greater for single men versus single women. We are not aware of similar research for trading activity within equity accounts of insurance products (e.g. variable universal life and variable annuities) but this would clearly be an interesting area for further research given the significant findings in other areas of investing.

  Another cause of overconfidence is from the "law of small numbers," as termed by Kahneman and Tversky.[84] This refers to people's tendencies to draw inferences that are too strong from small amounts of data. For example, a fund may have a short period of good performance, which may be overweighted against the level of management fees the fund charges. This is strengthened by another behavioral heuristic known as the "availability bias," where people draw disproportionately from salient and memorable experience. When judging risk and returns using this heuristic, people rely far more on personal experience and the experience of friends rather than on aggregate data.

- *Hot vs. cold states.* People in a non-stimulated ("cold") state make different decisions than those in an emotional or stimulated ("hot") state. While this behavior bias is applicable to basically all policyholder decisions, it tends to be more pronounced for investment decisions where the external market environment is constantly sending signals and messages that can trigger varying degrees of fear, anxiety, or optimism. Policyholders may also be stimulated in their decision making by communications from the insurer and financial advisors — for example, they may be told that they have only a one-day window to opt in or out of a new feature, or that there are only five spots left for a particular investment management program for which they are eligible.

Social impacts

- *Bandwagon effect.* People often do (or believe) things because many other people do (or believe) the same. This social effect can become very large when there are unusual changes in social, technological, or economic environments. This can also lead to apparent (poor) market timing and herding behavior.[85]

  During stock market retreats, policyholders may transfer money en masse to bond funds or partially to general accounts, leading to dramatic changes in the risk profile of the business and to asset and liability cash flows.

Annuitization

Annuity products (deferred fixed annuity, fixed-index annuities, variable annuities) typically provide an option for future annuitization at guaranteed mortality and interest rates. The considerations policyholders make when thinking about annuitization options in their contracts are very similar to those they make when considering the purchase of a payout annuity contract. The difference is that there are guaranteed annuitization options available in their existing contract, in addition to the current basis for annuitization.

The following behavior bias could play a role in a policyholder's decision to annuitize.

Decision shortcuts

- *Reliance on defaults.* Annuitization can be set as one of the default or recommended options in an annuity contract. Currently, many defaults are set to an opt-in format, where the policyholder has to make an active decision to annuitize, but it may also be possible to design products where a balance is annuitized unless policyholders opt out. This clearly requires a careful design (e.g., free-look or trial periods, effective communication), but could be a method for insurers to improve asset retention while helping policyholders achieve higher levels of secure income.

- *Framing.* People act differently based on how choices are presented. As mentioned previously, the annuitization rate has historically been lower than expected. Marketing and in-force management should educate people about the risks of outliving one's assets, and help people plan for their retirement.

  The annuitization puzzle is well studied, and research has begun advocating a benefit statement approach: For products that present benefits as an account balance (e.g., variable annuities, fixed deferred annuities, 401(k) plans), the benefits should be presented as a stream of monthly or annual lifetime payments to "help reinforce a sense of ownership of the income stream rather than of only the lump sum.... Over time, this change may help encourage account owners to become accustomed to thinking of their retirement resources as monthly income. Taking the distribution as monthly payments would seem 'natural' — that is, it would be equivalent to maintaining the status quo. The intent is to reposition their frame of reference so that consumers do not feel a 'loss' when they receive an income stream rather than a lump sum."[86]

BANDWAGON EFFECT

Thaler and Benartzi studied the mean allocation of contributions to equities from 1992 through 2002, and it appeared that individuals were "learning" that stocks only go up, leading to a steady increase in equity allocations from 58% to 84% during the 1992–2000 period, before the stock market crashed.

After the crash, the allocation to equities fell back to 54%, which is seen as the "wrong" market timing. Similar behavior was seen for asset allocations within equities, where individuals were buying into the "wrong" sectors most aggressively at the peak.

Another method considered by the Retirement Income Security Project is to take a more incremental approach to annuitizing, which could "circumvent the wealth illusion or 'sticker shock' that tends to discourage individuals from paying a 'large' amount to an insurance company in exchange for an ostensibly 'small' regular monthly payment."[87] Furthermore, the income-taking phase could also be staged so that there is a two-year "trial income" period, where a 401(k) plan sponsor could begin with regular monthly payments for two years, unless the retiree opted out. At the end of the trial period, retirees could elect an alternative distribution option, with the default option being to continue payments for life.

Emotional impacts

- *Risk aversion.* Most people feel the need and desire for fixed living benefits, and use an annuity to supplement Social Security and (declining) defined benefit pension benefits. Upon annuitization, policyholders receive regular income for a certain period of time or for their full lifetime. People make this decision to reduce the risk of outliving their assets; regular income provides both monetary protection and mental ease.

- *Loss aversion.* Loss aversion may discourage people from wanting to annuitize, if they are concerned they may only get to collect benefits for several years after they annuitize. This decision-making process is impacted by people's own projections of longevity.
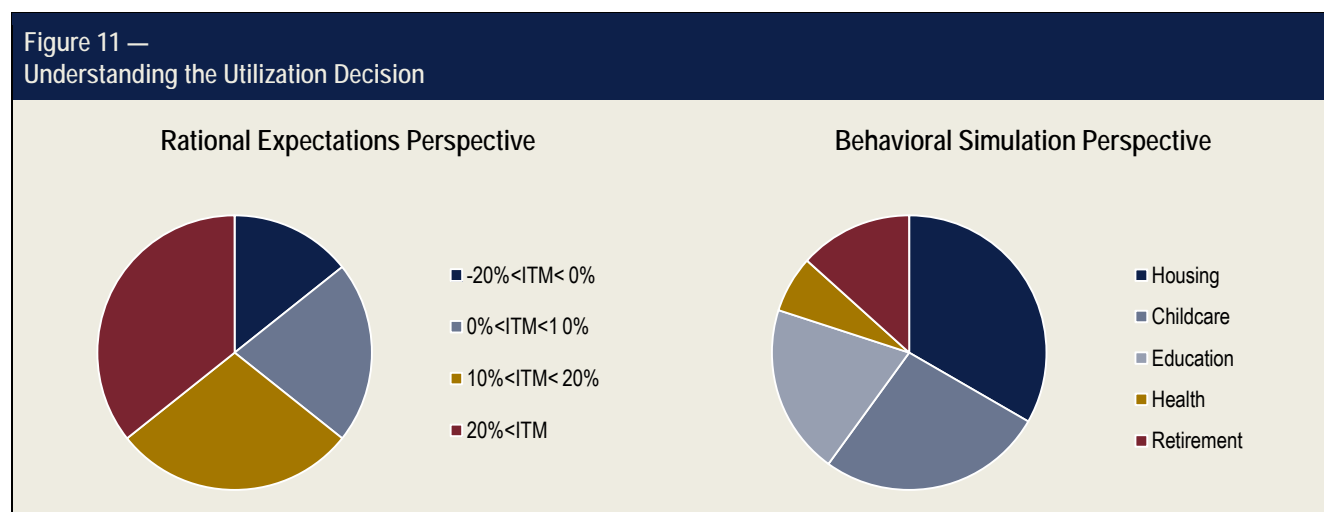
This concludes the literature review of behavioral economics and its potential applications to understanding policyholder behavior. In the next chapter, we explore the implications of the information presented, and discuss what steps can be taken to advance our understanding and modeling of policyholder behaviors.

Advancing Policyholder Behavior Modeling

The traditional actuarial approach to policyholder behavior

Actuaries have a quantitative understanding of policyholder behavior, but often only a second-hand qualitative understanding. For example, an actuary may see only a monthly report of the policy lapses that have occurred — and it may be possible to analyze the lapses along different dimensions such as age and policy duration — but there will be a gap in understanding each policyholder's household situation and the considerations that led to a policy lapse.

For example, actuaries may see a variable annuity utilization decision to be driven by different actuarial metrics, such as in-the-moneyness (ITM), but we rarely have the first-hand information of what drove the product utilization — was the money spent on housing, health issues, or retirement (Figure 11)? Where did the money go to?

Figure 11 —
Understanding the Utilization Decision

Rational Expectations Perspective

- -20%<ITM< 0%
- 0%<ITM<1 0%
- 10%<ITM< 20%
- 20%<ITM

Behavioral Simulation Perspective

- Housing
- Childcare
- Education
- Health
- Retirement

Actuaries also leverage a number of mathematical, statistical, financial and economic theories to understand policyholder behaviors, but they suffer from two major drawbacks:[88]

1. **Aggregate level modeling.** These approaches are applied at an aggregate level with little or no differentiation of policyholder behavior by different socio-demographic, attitudinal or behavioral factors. Such an aggregate level analysis fails to account for the value that different policyholders place on certain features and how they may shift under different environments, leading to unanticipated policyholder behaviors.

2. **Rational approach.** Rational approaches have assumed a classical rational expectations approach but do not account for how strongly social, cognitive and emotional factors influence consumers' financial decisions. For example, policyholders may not base their decision to lapse or surrender as much on in-the-moneyness (ITM) of an option as on loss aversion, job insecurity, or the need for liquidity.

A major drawback of aggregate level modeling is that, in the name of reducing "noise," much of the information in the data is lost.[89]

In particular, the causal factors behind lapse decisions are lost, leaving actuaries with a very heavy reliance on historical data and in hoping that the "future will look like the past." In short, we need to move beyond concluding "a random 3 percent of our policyholders will lapse this year" to understand the underlying decisions that led to it and identify which 3 percent of the population it is likely to be, and how their decisions could be influenced, so as to understand what can be done today to change behaviors and how behaviors might evolve in the future under different scenarios.

Policyholders make their decisions in a complex environment of interconnected variables, and we have a poor understanding of their decision-making processes. This limitation leaves actuaries to perform relatively simple analyses using more basic techniques due to concerns that an overly complex model, when there is limited understanding and data available, is less robust than a simple model.

More recently, insurers have used predictive analytics to develop policyholder behavior assumptions that capture more factors correlating with policyholder actions. This can be an improvement over a simple historical average static assumption or a dynamic assumption that incorporates one or two additional factors as it can sometimes identify important factors not previously considered to be relevant (for example credit scores in the property and casualty insurance field), and the statistical models are often more able to effectively draw upon the data and improve credibility. However predictive analytics also has limitations.

> *"[Predictive Analytics] is designed to rank individuals by their relative risk, but not to adjust the absolute measurement of risk when a broad shift in the economic environment is nigh. The predictive model operates on variables about the individual, such as age, education, payment history and property type. These factors don't change even as the world around the individual changes, so the predictive score for the individual doesn't change, either."[90]*

AGGREGATE LEVEL MODELING

Kenneth Train explains, "Much of the variability is eliminated by aggregation (or averaging). When this occurs, we have indeed less variability to explain and indeed statistical models will handle this in a way that produces a higher explanation of behavioral response. This is a fallacy — when there is less variability to explain, it is easier to explain and you tend to get a better fitting statistical model … You feel good, but you should not. There is a very high chance you have explained a high amount of only a small amount of the true behavioral variance in the data on individuals. What we still have left is a huge amount of unobserved variability that is central to explaining the choices made … One is not eliminating the problem, simply ignoring (or avoiding) it."

|

Predictive analytics fails to capture the rich structure of causal influences and non-quantitative factors (e.g. emotional and social factors) that influence decision making of policyholders.

In reality, many factors influence policyholder decisions. A person may let a policy lapse due to a job loss that limits his ability to afford premium payments. Or, policyholders' family circumstances may change and they no longer require the insurance coverage they purchased. There may be other external forces and influences: their insurance agent, financial planners, family and friends — or even an article they read on the internet — all can influence or shape their decision.

People also use a number of decision shortcuts and decision rules when they make decisions with only limited and uncertain information, and have psychological biases. For example, when shopping for a life insurance policy, a person may not be seriously considering making a purchase; accordingly, insurers might be smarter to view most consumers as "dormant," rather than viable targets. For example, a life event, such as marriage or the birth of a child can trigger the potential customer to consider and begin searching for a life insurance policy. His experiences and impressions of different insurance companies typically will inform the search process, and he will compare a variety of products when making a decision. At any stage along this process the consumer also may give up the search.

The current state-of-the-art leaves much to be desired. Policyholder behavior is an inherently difficult phenomenon to understand and model, but is it possible to make a more educated guess?

How do we advance our knowledge of policyholder behaviors?

In light of the challenges we discuss above, how can we improve our understanding of policyholder behavior?

Actuaries have long looked to manage policyholder behavior through product design, but their understanding is primarily intuitive. They have developed this understanding through years of business experience, established their assumptions by viewing policyholder actions in the aggregate (typically as statistical averages), and applied actuarial judgment by selecting the data sets to use and the variables to analyze. This approach is relatively efficient, and served the profession well for many years. However, as we describe above, the increased significance and complexity of policyholder behavior has led to recognition of a gap between historical experiences and how policyholders may actually behave under different socio-economic conditions.

The "weakest link" in this process is that actuaries have not had the data or tools to understand policyholder behaviors at the micro-level to capture the rich structure of causal influences and non-quantitative factors. Capturing such a structure would allow the insurance system to be recreated, and the simultaneous decisions and interactions of policyholders with their environment and the insurance companies could be simulated to forecast the outcomes of different environments and strategies. Policyholder behavior is a combination of numerous data points about policyholders who have lives and make decisions about insurance products based on their own, unique circumstances. Clearly getting to a state where an insurance company can effectively use some information requires much work and introduces other challenges, in particular:

1. How can actuaries really know each individual's circumstances and the motivations and considerations behind their decisions?

2. Even if we could learn more about households, individual motivations and decision rules, how can we translate them into practical business applications?

|

Nonetheless in our research we saw a broad development in other industries towards understanding people — customers, societies — at a much more granular level than before.

We noted a genuine excitement from experts on the possibilities arising from:

1. Large collections of data in "smarter" databases at fine levels of granularity. Such micro-data represents consumers and policyholders as individuals instead of aggregates. The development of databases which store unstructured data is particularly exciting. Some consider personal data a new asset class,[92] others compare it a new currency.[93]

2. Exponential advances in computational power, software and tools that can utilize it have made it possible to perform complex analytics faster. (e.g., high definition simulation models).

3. A much better understanding of individuals' decision making processes and behaviors, through scientific research of the brain and the enhanced legitimacy of behavioral economics as a research area.

Many of these advancements have led to clear changes in the way many other industries operate already. At one extreme end of "understanding customer behavior," Amazon filed a patent in 2013 for "anticipatory shipping," where they want to begin the delivery process for a package even before a customer orders it, by predicting the purchases using factors such as previous orders, search history and even how long a user's cursor had hovered over an item.[94]

In summary, the following approaches appear to have the most potential for offering meaningful advances in policyholder behavior modeling:

1. **Move beyond aggregates.** We have to shift our point of view. We need to switch from framing policyholder behaviors as statistical averages to recognizing that policyholders are individuals and part of a household trying to protect or accumulate assets via life and annuity products.

2. **Modeling the causal structure of individual decision making.** We need to understand that policyholders are making decisions as part of a series of cause and effect processes, which many shortcuts and biases affect.

Alex (Sandy) Pentland, a researcher at MIT (and one of the world's most powerful data scientists according to Forbes) made an important point about the shift that is already happening in other fields:

"While it may be useful to reason about the averages, social phenomena are really made up of millions of small transactions between individuals. There are patterns in those individual transactions that are not just averages, they're the things that are responsible for the flash crash and the Arab spring. You need to get down into these new patterns, these micro-patterns, because they don't just average out to the classical way of understanding society. We're entering a new era of social physics, where it's the details of all the particles—the you and me — that actually determine the outcome.[91]

Figure 12 —
Understanding the Policyholder
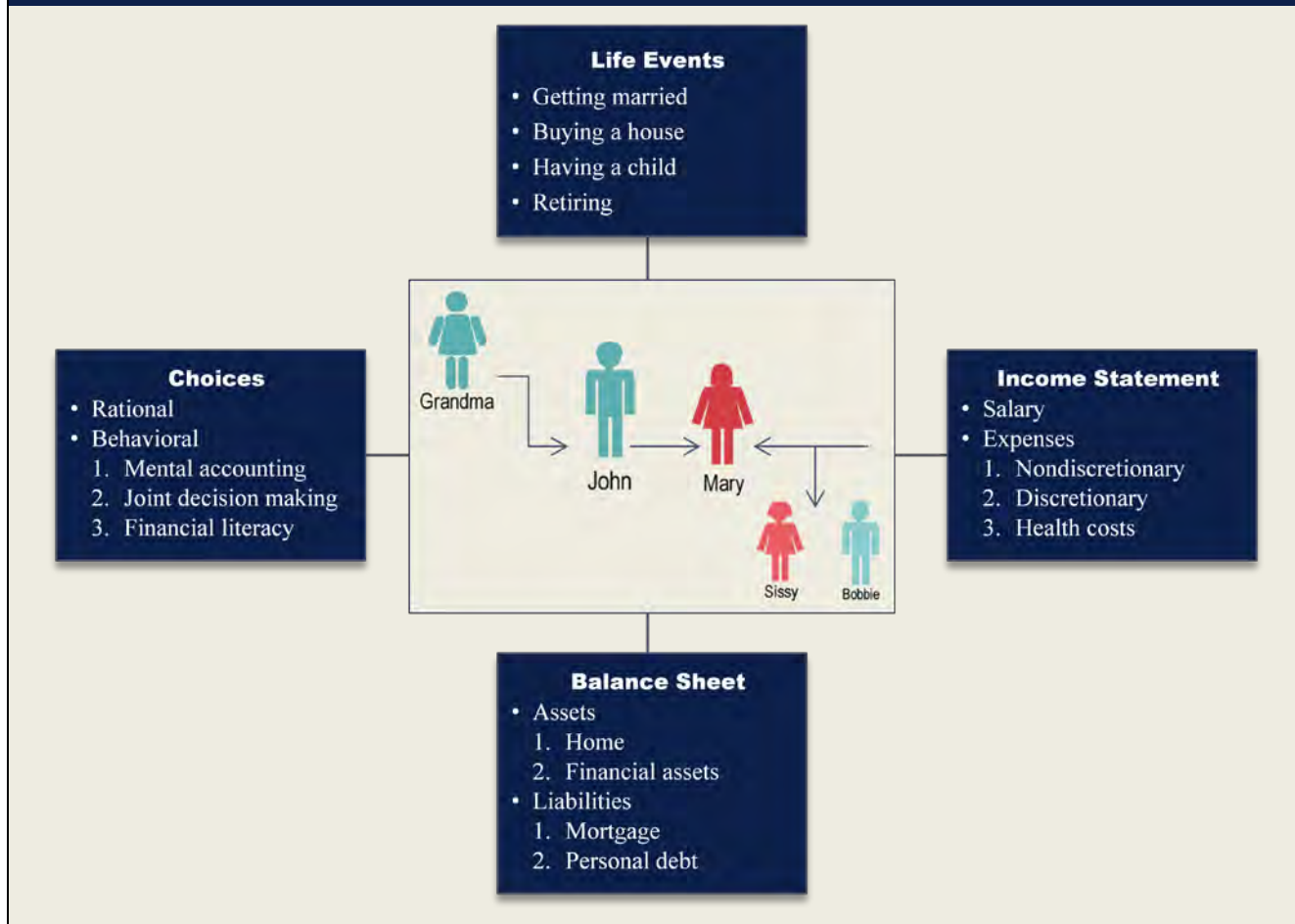
It is important that we view the policyholder not as a male age 40 nonsmoker, but as the member of society and part of a household (Figure 12).

Policyholders do not make their decisions following a random statistical distribution, their decisions are based upon life events and choices in response to their circumstances and environment. Understanding policyholder behavior should involve understanding how policyholders life, asset and advice cycles interact with the insurance products (Figure 13).

Figure 13 —
Understanding Life Events and Choices
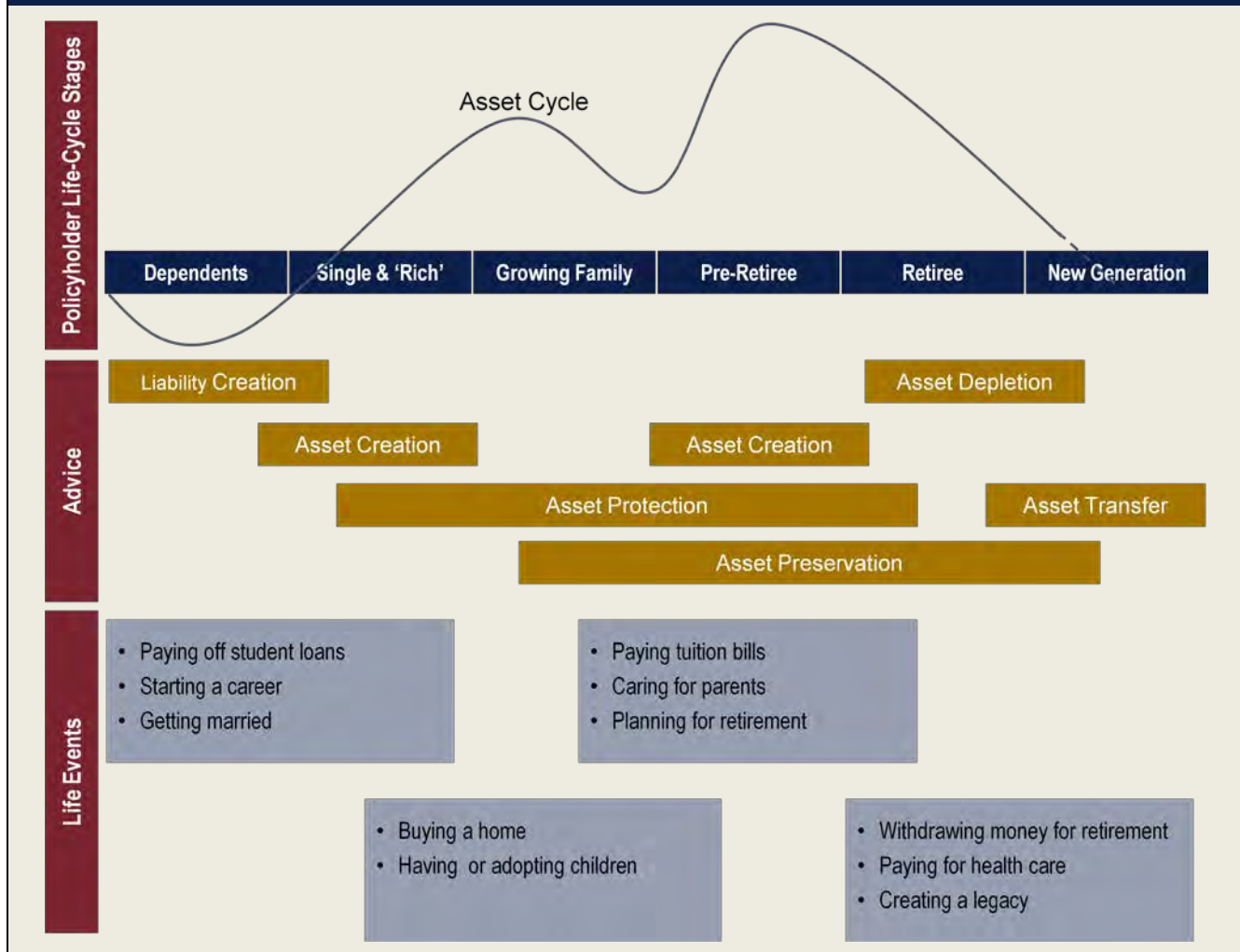
In this report we identified behavioral economics as an important step towards achieving a "true" understanding of policyholder behavior. There are many ways to use the insights gained from this process including:

1. Applying insights from behavioral economics to guide better product design;

2. Applying the insights to help "de-bias" policyholders in their decision making processes;

3. Incorporate behavioral economics principles in actuarial modeling using agent-based modeling methods.

For the remainder of this report we will continue the discussion by sharing current research on de-biasing methods. The other key applications of behavioral economics are beyond the scope of this report. Using behavioral economics in agent-based modeling methods to simulate and forecast policyholder behavior was discussed in the Society of Actuaries report *Behavioral Simulations: Using Agent-Based Modeling to Understand Policyholder Behaviors.*[95]

Turning insights into action

Now the focus turns to how some of the insights discussed previously may be applied by consumers/ policyholders and insurance companies alike to provide a greater value exchange. These insights represent different hypotheses regarding the varied biases and decision-making patterns that may be driving insurance policyholder behaviors. Many of these hypotheses are based on research related to other financial products, but not specifically related to life insurance or annuities. While recognizing this work is still in its early stages of development, the following is a brief discussion of how this information might be used.

The following are three areas where further insights can drive improvement:

1. Helping potential customers to make better decisions on choosing a suitable product

2. Helping policyholders to better use the product, either through their actions or, sometimes, inactions

3. Helping insurance companies and actuaries to turn these insights into action

From the research presented earlier in this document, many decisions are affected by psychological biases. As actuaries study policyholder behaviors, it is apparent that certain actions appear irrational, but it is less clear whether these actions were driven by a lack of financial sophistication or simply by irrationality. A research paper by the UK Financial Services Authority came to the conclusion that psychological drivers explain the irrational results they saw: "Drawing on a large and wide-ranging literature on consumer behavior, this report argues that psychological rather than informational differences may explain much of the variation in financial capability …. People's financial behavior may primarily depend on their intrinsic psychological attributes rather than information or skills or how they choose to deploy them."[96]

To guide consumer and policyholder behaviors in the life insurance and annuities space, we suggest the following path forward:

1. Provide customers and policyholders with better information and data to appreciate the need for more systematic thinking.[97] In particular, product mechanism and policyholder options should be explicit and clearly understandable.

2. Many studies have shown that more information is sometimes necessary but often not a sufficient condition to overcome biases.[98] Therefore, additional steps may need to be taken:

    — Incentives need to be properly structured

    — Incentives need to be made evident

    — The environment for decision making should account for and counteract biases (de-biasing) that may lead people to poor decisions

    — Defaults are a powerful tool that can be used to reflect expert knowledge while still allowing individual choice.

The primary challenge is how change can be effected, both with policyholders and within insurance and actuarial organizations. We next discuss this path in more detail.

Providing more information

Providing clear and explicit information helps consumers choose products that are best suited to their protection or financial needs. It is important to note the difference between simply providing more information and disclosures, versus being mindful of what information is presented and how it could potentially impact policy-holder decisions. For example, is the product marketing name suggesting a certain type of behavior? Does it suggest the policyholder be an "agile investor" or a "secure saver?" How are benefit statements constructed? Do they present information first in terms of balances accrued, or in terms of what the future income will be if the policyholder withdraws money? Earlier, we saw how framing, mental accounting, anchoring, and various biases could have significant impacts on the end results.

Over the life of the policy, key information about the product, the policyholder activities utilizing the product, and policyholder options can guide the policyholder to gain a better understanding and facilitate good decision making.

Why providing more information isn't enough

Numerous studies have shown that providing more or better information alone is not sufficient to effect change, and that it is difficult to overcome psychological biases and raise financial decision-making abilities.

The following are two key insights and questions raised by the research:

- *It is very difficult to increase knowledge.* A paper by the UK Financial Services Authority came to such a conclusion.[99] One study cited mentioned that a group of employees were given the opportunity to switch retirement plans from defined benefit to defined contribution, and the employer offered a free financial education program. The effectiveness of the program was measured through a financial literacy test based on true/false answers. Random answers would on average score 50 percent. Before the education, the average score was 54 percent; after the education, the score was 55 percent.

- *Can education overcome biases?* James Choi, David Laibson, and Brigitte Madrian[100] performed a study with MBA students at the Wharton Business School. The students were asked to choose the best index tracking fund, with a clearly dominant choice nested among all sorts of irrelevant presentation materials. Despite significant incentives to choose the correct fund, many failed to do so, even after the materials were redesigned to emphasize the cost differences, which were the differentiator. If even the most financially sophisticated individuals do not make sensible decisions when confronted with apparently simple choices, we must question whether the seeming irrationality in policyholder behaviors is driven by financial ignorance and lack of financial education, or whether it stems from psychological biases. Kahneman and Tversky tested whether general knowledge of statistics reduces or eliminates observed biases, with surprisingly negative results.[101]

  These results extend beyond MBA students — even experts often perform worse given more information. Grove and Meehl performed a meta-analysis of study data and reported that across many expert prediction activities (e.g., predicting individual health outcomes, college grades, or criminal recidivism), simple statistical methods often performed better than the experts.[102] Even worse, the performance of the experts fell further if they were allowed to interview the subjects in addition to simply reviewing written information.

Given the challenges, what can be done? Some behavioral economists have taken the view that the best response comes not from informing consumers of the problem, but from institutional design and regulation that recognizes the psychological biases at work.

This aligns closely with the following comments:

> *"What might be less obvious to the casual observer — but apparent to the many people in this room who have worked on the optimal structure of retirement and savings systems – is that information is necessary but not sufficient. Incentives must be properly structured and made evident. Defaults must reflect expert knowledge and judgment about what choices will optimize the welfare of the typical individual but still allow individual choice. And the environment for decision making must account for and counteract biases that tend to lead people astray."[103]*
> — Peter Orszag

Next, we discuss de-biasing methods used to facilitate more rational policyholder behavior.

De-biasing decisions

There are many examples in the literature of experiments designed to study biases and how traditional rationality assumptions fall apart, but there is relatively little information on how to overcome such biases. Broadly, methods to overcoming consumer biases are called "de-biasing" methods.

This discussion is prefaced by stating that even if there is a sense that policyholders are making poor decisions in some areas, it is debatable whether it is appropriate to try to intervene. The decision regarding whether to intervene is likely to be very context-specific which precludes a general discussion of its rights or wrongs.

The following is a brief description of a series of experiments and findings in current "de-biasing" research. Due to the scope of this report, the discussions and presentation of results is necessarily high-level.

One commonly mentioned de-biasing method involves asking the individuals to be more critical in their thinking, potentially by prompting them to "consider the opposite," or have other people challenge their thinking. This method helps to counteract overconfidence and the tendency to ignore evidence and viewpoints with which we intuitively disagree.[104] It was also found to be somewhat effective in overcoming the "anchoring" bias. Thomas Mussweiler, Fritz Strack, and Tim Pfeiffer designed an experiment to test just this and found that the effects of anchoring (in car value estimates) were weaker when participants were instructed to first generate anchor-inconsistent arguments.[105]

Another de-biasing method is based on the observation that people seem to be more engaged in critical thinking when they know they will be accountable at the end and will need to justify their decisions to others.[106]

Accountability has also been identified as being effective against "conjunction errors," which relates to individuals' difficulties with handling compound probabilities. Eric J. Johnson, John Hershey, Jacqueline Meszaros, and Howard Kunreuther performed a study with MBA students at the Wharton Business School where students were asked how much they would be willing to pay for terrorism insurance. One group was asked how much they would be willing to pay for terrorism insurance covering a flight from Thailand to the US (part of their studies take place in Thailand), the second group was asked how much they would be willing

to pay for terrorism coverage of the round-trip flight, and the third group was asked how much they would be willing to pay for terrorism insurance that covered the complete trip. The average willingness to pay was $17, $14, and $7 respectively — exactly the opposite trend that would be expected from a rational person.[107] The bias seems to have been introduced from the additional details making the situation more representative and therefore seeming more probable. Accountability was often found to be an effective remedy.

In this report, the planning fallacy is described as applicable to several behaviors, such as being able to plan for when and how much a withdrawal from insurance products will be needed. A potential de-biasing technique is what Buehler et al. (2002) call the "recall relevance" method. Individuals are asked to describe a plausible scenario based on their personal experience that would result in plans unfolding in a typical timeframe, rather than relying on exclusively planning-based approaches that tend to be overly optimistic and assume each step will go forward in an almost "best case scenario" outcome.

Kahneman and Tversky presented a personal case study in the planning fallacy and the "recall relevance" de-biasing technique:

> *"In 1976, one of us was involved with a project to develop a curriculum for a new subject area for high schools in Israel … Everyone was asked to write on a slip of paper the months that would be needed to finish the project … The estimates ranged from 18 to 30 months.*
>
> *One of the team members — a distinguished expert in curriculum development — was then posed a challenge by another team member: "Surely we're not the only team to have tried to develop a curriculum where none existed before. Try to recall as many projects as you can. Think of them as they were in a stage comparable to ours at present. How long did it take them at that point to reach completion?" After a long silence, the curriculum expert said, with some discomfort, ''First, I should say that not all the teams that I can think of, that were at a comparable stage, ever did complete their task. About 40% of them eventually gave up. Of the remaining, I cannot think of any that completed their task in less than seven years, nor of any that took more than ten.'' He was then asked if he had reason to believe that the present team was more skilled in curriculum development than the earlier ones had been. ''No,'' he replied, ''I cannot think of any relevant factor that distinguishes us favorably from the teams I have been thinking about. Indeed, my impression is that we are slightly below average in terms of resources and potential.*
>
> *They finally completed the initiative 8 years later, and their efforts went largely for naught — the resulting curriculum was rarely used.''[108]*

One interesting de-biasing technique that does not seem to work well with the planning fallacy is providing more financial education. It might be that attention and thinking power are limited resources, and providing more information crucially detracts from the pertinent data. John Kruschke and Mark Johansen found that cue competition occurs: More salient cues weaken the effects of less salient ones, and the presence of irrelevant cues confuses people.[109]

Bertrand et al found that factors supposedly inconsequential to the financial decision on hand can nonetheless have a large impact — indeed it was found that, "on average, any *one* psychological manipulation has the same effect as a one percentage point change in the monthly interest rate."[110] For example, providing loan applicants with the opportunity to win a prize actually discouraged loan demand, while providing less information about the variety of available loans increased take-up.[111]

While the obvious de-biasing method here would be to restrict choice rather than educate policyholders, this might not be perceived well and presents a real conflict. This situation is further complicated by a lack of visibility into what people actually want. For example, a 1991 experiment by Wilson and Schooler asked subjects to rate different jams. Without any prompting, people preferred jams that were consistent with the ratings of external experts. However, when people were asked to deliberate on why they liked or disliked the jams they tasted, the results started deviating with the experts, and perhaps more important, the people showed more regret with their choices compared to the group that was not prompted to deliberate.[112] For certain situations, accountability and careful thinking can help overcome biases, but in other situations these seem to have a detrimental effect.

In a closely related context, it was found that the overconfidence bias effect could be weakened by having a third party assess the person's position, or by exposing people to a more concrete instance rather than talking theoretically or in statistics. Weinstein, Klein found that informing people about relevant health risk factors in general and requiring them to describe their standing on these factors had no overall effect on subsequent risk judgment — they were still overconfident and claimed to be less likely than their peers to suffer harm.[113] However, if the people were exposed to lists created by others assessing their standing (rather than being self-assessed), their overconfidence bias often decreased.

A series of studies on smoking behavior found that smokers were more likely to be realistic of their risks if they knew of specific instances of people who were harmed by smoking. A series of advertisements by a life insurer showing people who knew the age to which their parents had lived and asking viewers whether they had family who lived into old age may have worked along the same lines: The risk of living to age 90 or 100 becomes much more real when people can think of specific instances rather than thinking of it being a remote probability far out in the future. Presumably, once this realization takes hold, the person would act to insure that risk.

One possible cause for overconfidence in an insurance context is that it's easy for individuals to underestimate the likelihood and consequences of unlikely events that have not yet been experienced. This is particularly true for mortality or longevity events. For some, the probability may feel so low as to be below the individual's threshold for concern and therefore constrain a searching for solutions or actions. One potential de-biasing method here is to frame the risk over a different time horizon that makes the risk more salient. For example, the probability of a long-term care event in any one year may seem remote, but the probability over a lifetime is significant.

Another manifestation of overconfidence is that people tend to give range estimates that are overly narrow — i.e., they are overly confident in their point estimate and the potential variability around the estimate. One effective de-biasing technique is to ask the individuals to estimate the ranges in separate stages: Jack Soll and Joshua Klayman asked people to answer knowledge questions (for example, the year of the first hot air balloon flight), together with a range for which they would be 80 percent confident that the answer fell within that range. The results ended up including the correct answer about 30 percent to 40 percent of the time, but rather than being an indication of poor trivia knowledge and overconfidence among people, the interesting finding is that when asked to estimate the 10th and 90th percentiles separately, the quality of the answers improved to 60 percent overall correctness.[114] Since insurance is centered on variability, these results have implications for helping potential insurance customers understand the true risks they face, and in helping policyholders assess the risks of their decisions.

Conclusions

Understanding policyholder behavior is increasingly important to insurance companies and the industry as a whole. In order to add to the body of knowledge in this area, the survey conducted as a part of this research project identified current trends in industry practice with regard to the analysis and modeling of policyholder behavior. The survey results are summarized in this report and are also available electronically. The actuarial community may find the information useful in several ways, including a review of internal assumption setting and modeling practices as well as strategic planning.

From the survey results, it is clear that understanding the drivers of various policyholder behaviors remains a challenge and the lack of credible data is a major drawback of current methods. To complicate things further, there have been significant advances in insurance product designs in recent years requiring a greater focus on the unique factors that impact policyholder behavior experience. And in many cases these factors are very different than those that tend to strongly influence non-elective assumptions such as mortality and even morbidity.

Viewing policyholders as individuals rather than averages is an important consideration as it allows actuaries to understand the individual, causal levels of decision making which aggregate to the complex phenomena of "policyholder behavior." Such an individual view has only recently become possible as a result of the continued advances in cognitive science and behavioral economics, as well as the explosion of new technology in the personal data and computing fields. From our survey interviews, it became clear that many other industries have embraced these advances and applied new techniques as a source of competitive advantage, and that the life insurance industry has tended to lag behind.

Behavioral economics may offer a means to better understand and explain both product purchasing and inforce policyholder behavior. Because policyholder behavior impacts almost every aspect of an insurance company's operation, behavioral economics can have very broad application in many different areas. This discussion focused on how behavioral economics can generate insights into the causal factors in decision making and the potential behavioral biases that policyholders may have.

The report also identified some ways that insurers can potentially influence or adapt to policyholder behaviors. Of particular note, because of its far-reaching impact on the general public, the industry should continue to promote improving consumer and policyholder financial literacy. As part of this process, an insurance company can look to develop marketing material and policyholder communications that help consumers and policyholders to understand their personal needs and the products insurers offer.

Insurers can also consider "de-biasing" approaches to help overcome policyholder behavioral biases. As an alternative to educating people out of error, a more effective approach may be to take consumer biases into account when designing a policy, using default features to objectively nudge them toward acting in their best interests.[115]

We close by noting that while both the survey and literature review portion of our research provide some direction for actuaries as they look to improve policyholder behavior modeling, there are still many gaps in the understanding of policyholder behavior and more research is needed in this area. We hope that this report will help actuaries to recognize all the amazing developments and resources now available to support the modeling of policyholder behavior.
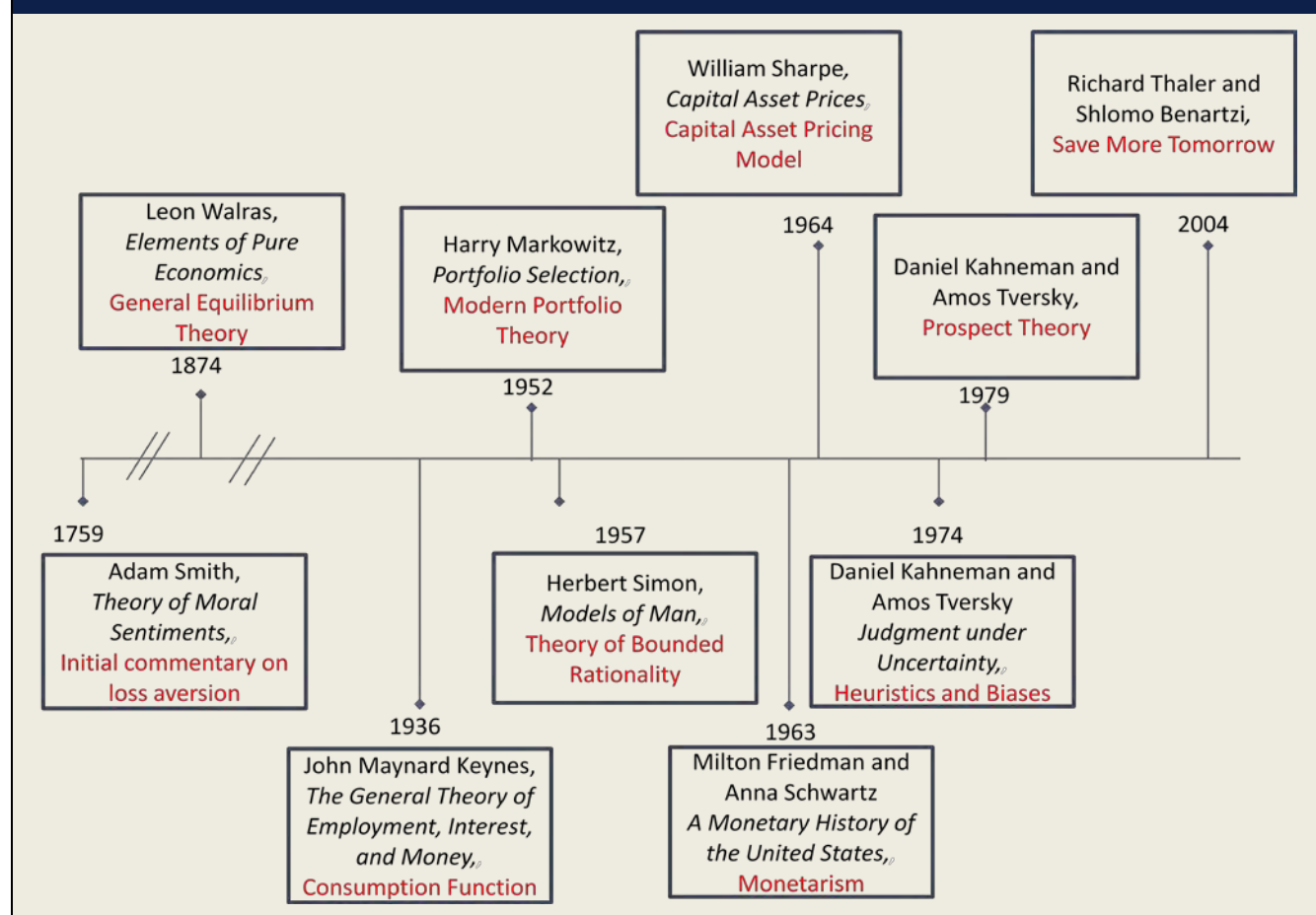
Appendices

The appendix presents a closer review of the field of behavioral economics and how it has evolved from key financial economic research that has impacted the recent thinking around understanding policyholder behaviors.

Behavioral economics — History

One of the key assumptions within the school of classical economics is that consumers will behave rationally within the constraints of the market, meaning that every rational consumer will act in ways that maximize their utility, make decisions to optimize their return, and generally avoid anything that is an obstacle to that end. However, the real decisions and actions of consumers show that this core theory is flawed; more often than not, consumers do not behave rationally. The field of behavioral economics seeks to explain this dissonance: why what actually happens differs from what should happen (Figure 14).

Figure 14 —
Behavioral and Financial Economics Timeline

William Sharpe,
Capital Asset Prices,
Capital Asset Pricing
Model

Richard Thaler and
Shlomo Benartzi,
Save More Tomorrow

Leon Walras,
*Elements of Pure
Economics,*
General Equilibrium
Theory
1874

Harry Markowitz,
Portfolio Selection,
Modern Portfolio
Theory

1964

Daniel Kahneman and
Amos Tversky,
Prospect Theory

2004

1759

1952

1979

Adam Smith,
*Theory of Moral
Sentiments,*
Initial commentary on
loss aversion

1957

Herbert Simon,
Models of Man,
Theory of Bounded
Rationality

1974

Daniel Kahneman and
Amos Tversky
*Judgment under
Uncertainty,*
Heuristics and Biases

1936

John Maynard Keynes,
*The General Theory of
Employment, Interest,
and Money,*
Consumption Function

1963

Milton Friedman and
Anna Schwartz
*A Monetary History of
the United States,*
Monetarism

Behavioral economics can be seen as a marriage of classical economic theory and psychology. In the latter half of the 20th century, notable cognitive psychologists, Daniel Kahneman and Amos Tversky used principles found in their work to explain the errors in economic models of rational behavior. Tversky and Kahneman argued that

heuristic shortcuts consistently produced decision making which differed from classical economic principle. The concept of homo economicus is at the core of classical economics. This assumes that human beings will always act in a calculated, rational, and self-interested way based on extrinsic motivations. This line of thought was challenged by the works of these two young psychologists who developed the Prospect Theory in their seminal work *Prospect Theory: An Analysis of Decision under Risk* which challenged utility theory and expected utility theory while also better explaining various economic anomalies.

The concept of behavioral economics may be in vogue today, but the interaction of psychology and economics is nothing new. In order to have an understanding of the future of behavioral economics it is imperative to understand the past. Today it is recognized that the human brain does not work purely as a stimulus response machine, but it is better understood as a (sometimes flawed) information-processing device. Three hundred years ago, Adam Smith was just as concerned about the psychology of man's passions and impartiality as he was about supply and demand. An examination of behavioral economics, past and present, will provide an understanding of what the future may hold for this fascinating line of thought.

Adam Smith: Classical economics and the age of enlightenment

Adam Smith is known as the father of modern economics for good reason. His most renowned publication, *An Inquiry into the Nature and Causes of the Wealth of Nations* coincided with the American Revolution and would be a precursor to the Industrial Revolution. His work touches on staples of economic thought such as divisions of labor and the free market. In 1759, 17 years before he published the work for which he is best known, Adam Smith published *The Theory of Moral Sentiments,* which was concerned with human morality and sympathy and the effect it had on the individual and society. This work would lay the foundation for the majority of his work in the future.

Before being known as a political economist, Adam Smith was first and foremost a philosopher. Smith's time at Glasgow University was spent studying social philosophy. His first area of expertise would be moral philosophy in which he expounded on morality and sympathy. It wasn't until after the extreme popularity of his first book *The Theory of Moral Sentiments* that Smith began to take on economic thought in his university lectures.

During the age of enlightenment, intellectual leaders presented a diverse range of skills and interests. Smith contemporaries such as Burke, Locke, and Hume were often philosophers first and practitioners second. The foundations of social sciences were much more fluid and closely related than they are now. Economics is not unique in this case. During this time we saw significant advances in economic thought such as Smith's invisible hand of the free market or Jeremy Bentham concept of utilitarianism. But it should be recognized that Adam Smith and many of his peers were not economists but philosophers at heart. Their works ranged from politics to science, from economics to the underpinnings of human nature. These concepts as a whole were not mutually exclusive, but often rooted in a recognition of human morality and motivation.

Capitalism, communism, and neoclassical economics

The connection between psychology and economics was not lost during the turn of the 19th century. Francis Edgeworth's *Theory of Mathematical Psychics* introduced utility theory and legitimate insight into human decision-making patterns. But the first half of the 19th century will most readily be remembered for Karl Marx's *The Communist Manifesto* and Fredrich Engels' *The Condition of the Working Class in*

|

England in 1844. Both papers were reactions to the boom of the industrial revolution and a critique of classical economics and capitalism which were to blame for the stratified working and living conditions of people across Europe and America. Marx argued that capitalism was an economic system that inherently exploited workers by depriving them of the fruits of their labor by paying them a wage that was less than that of the value of their labor. (Part of Marxist philosophy was based on the idea that if owners did pay wages that were equal to the value of one's labor there would be no profit to be had. Thus the difference between one's labor and one's wage is the capitalist profit, making capitalism an inherently exploitive economic system.)

Around this same time, a new school of thought began to push back Marx and his followers. The Neoclassical economic revolution once again believed humans to be informed rational beings that were purely self-interested and motivated to maximize profits or utility. During this time would come Leon Walras' *Elements of Pure Economics,* which presented a general theory of equilibrium where price should match demand and Alfred Marshall's *Principles of Economics,* which was able to better articulate the application of marginal utility, cost of production and supply and demand.

This era would ultimately prove to be a stifling period for behavioral economics. The neoclassical revolution was a time when the field of economics wanted to be seen as a natural science. The field of psychology was still in its infancy and considered too fragile to be associated with. Economists at this time made a concerted effort to distance themselves from past teachings that failed to look at human beings as homo economicus. Irving Fisher and Vilfredo Pareto both managed to produce works that fundamentally thought about how human decision making was involved in economic discourse. But the consensus in the field of economics was dominated by the Neo-classicists.

Keynes and the advances of cognitive psychology

The Neoclassical era would present many stalwarts of economic thought. John Maynard Keynes, arguably the most well-known economist of the 20th century would come to the scene of economics in a time of strife and instability. His book *The Economic Consequences of the Peace* was a critique of the Versailles conference and specifically Woodrow Wilson's inability to stand by his 14-point plan at the end of World War I. His critique argued that the conditions set forth by the Allied nations would inherently lead to another economic collapse, high inflation, and many of the same conditions that lead to the First World War.

Keynes would later be best known for his views on short run economics and aggregate demand, but throughout his works Keynes was a passive contributor to behavioral economics. Keynes was a firm believer that economics was part science (mathematical) and part art (public policy), and that the two should not be confused. He understood that it was unreasonable to fit public policy and real life into an economic model.

This era will always be best known for its Keynesian revolution, but what cannot be overlooked are the simultaneous advances in cognitive psychology. No longer was the human brain seen as a stimulus response machine. People do not generate direct responses to objective experience; rather, stimuli are mentally construed, interpreted, and understood (or misunderstood). Two world wars resulted in a need to better understand human behavior and performance. Advances in computer science led to a better conceptual understanding of the brain as an information processor that stores, manages, and retrieves information. Noam Chomsky's work in

behaviorism and Allen Newell's *Elements of a Theory of Human Problem Solving* would be the two catalysts that led to the cognitive revolution.

During this time economist Harry Markowitz developed the "Modern Portfolio Theory" that made it possible to construct an efficient frontier of optimal portfolio offerings that maximize expected returns based on a given risk. Simultaneously Milton Friedman was producing his *Essays in Positive Economics* and "Theory of the Consumption Function," and years later William Sharpe would introduce his capital asset pricing model in his "Portfolio Theory and Capital Markets." Developments in cognitive psychology continued to emerge as did new theories within economics. The environment was ripe for the field of economics to return to its marriage with psychology. But it would not be a famous economist who would pull the two fields back to common ground, but two psychologists working on judgment and decision-making.

Kahneman, Tversky, Thaler, and the reunion of lost friends

In 1977 Daniel Kahneman and Amos Tversky were two fellows at Stanford University studying judgment and decision making. At this time they began to work with a young economist, Richard Thaler, who was a visiting professor. Thaler introduced economic concepts to the two psychologists. In a unique twist of events, Kahneman and Tversky used economic models to help articulate their cognitive findings. Their paper "Judgment Under Uncertainty: Heuristics and Biases" proposed that heuristic shortcuts create probability judgments that deviate from statistical principles. It also introduced the concept of "anchoring" which proposed that implicitly suggested reference points (the "anchor") cause people to make adjustments to their estimates. Their studies found that adjustments are usually insufficient, and that the initial anchor has a significant influence over future assessments.

Their next paper "Prospect Theory: An Analysis of Decision under Risk," is considered to be the seminal work within behavioral economics. Their findings explain various divergences of economic decision making from a neoclassical approach. It develops their Prospect Theory, which proposes that human beings assess gains and losses differently. Thus, people will base decisions on perceived gains and perceived losses rather than final outcome. Classical economics would surmise that two equal opportunities would demand equal interest. This reaction is known as "loss aversion" which simply states that people are more inclined to avoid losses than they are to seek gains.

The works of Kahneman and Tversky would spark a new found interest in the field. It would reintroduce concepts like intertemporal choice which observed a preference for present over future consumption, proving that the concept of consumer "foresight" or "willpower" was defective. The concept of hyperbolic discounting would add to this discussion by explaining that agents are better described as hyperbolic discounters, whose discount function decays much more slowly at times when agents cannot be sure of their own future. This is generally regarded as being time inconsistent or irrational. Human beings show inconsistency in their decisions by making choices today that they would not have made . Developing concepts, such as "reciprocal altruism" and "inequity aversion," would come to chip away at the neoclassical concept of homo economicus and the rational human being.

In 1985, Richard Thaler would produce *"Mental Accounting and Consumer Choice."* Thaler, now considered the preeminent voice in the field, developed concepts explaining how consumers treat stocks in their portfolio as separate gambles and how people code gains and losses differently. Agents tend to be more risk taking in losses and risk averse in gains. The goal of his paper was to develop a richer theory of consumer behavior than standard economic theory.

Between Thaler's work and now, we have seen a surge of behavioral economic thought influencing many different facets of our daily lives. Franco Modigliani's Nobel Prize speech *Life Cycle, Individual Thrift, and the Wealth of Nations* described the irrationality in the lack of interest in annuities. Douglas Bernheim, Jonathan Skinner, and Steven Weinberg's collaborative paper "What Accounts for the Variation in Retirement Wealth Among U.S. Households?" confirmed that poor mental accounting and the hyperbolic discounting were an important explanation for the variations within retirement wealth.

Behavioral economists began to apply their work to the everyday functions and dysfunctions of the human population by identifying consistencies in human behavior that were inconsistent with many of the principles of neoclassic economics. In the early 2000s, Thaler would produce two papers with Shlomo Benartzi leading to another blow to neoclassical economics while helping to solidify a place for behavioral economics. His work, *Behavioral Economics,* reiterated the tendency for humans to deviate from standard economic models and his next piece, "Save More Tomorrow: Using Behavioral Economics to Increase Employee Saving," would finally provide a real world application by proposing a savings plan which allows employees to commit to increase their contribution (saving) rate in a 401(k) pension plan whenever they get a raise. A variant of the program was incorporated in the Pension Protection Act of 2006.

Today we can see the impact of behavioral economics in both the science and art of our daily lives. Private companies are using this new line of thought to better understand their customer. Economists now have a better picture of how agents truly act and government institutions are now able to construct better public policy based on the assumed imperfections of the human brain. In 2007 the Conference for Behavioral Economics focused on four basic themes:

- Policy decision rules — how should regulators decide among consumer protection policy options?
- The role of advertising and other marketing techniques in consumer decision making
- Mandated disclosures — how consumers process information and how it affects their purchase decisions
- Research into how consumers make decisions regarding phone plans and credit cards, especially in reaction to their usage own patterns

The foundation of economics was put forth with an understanding of the imperfections of human thought. It has taken more than 300 years for it to come full circle, but we should now realize that the science of economics cannot be separated from the passion and impartiality of human beings or the perfections and imperfections of how our minds truly work.

PwC's behavioral economics analysis framework

Principle	Description
Decision shortcuts	People use mental "shortcuts" to guide them to what they feel is the right decision.
Relative choices	People value products based on comparisons to other products rather than the product's intrinsic value.
	Adding complexity to the decision-making process can lead people to delay making a decision altogether.
Reliance on defaults	People are unlikely to override set defaults and rely increasingly on defaults as increasing complexity renders decision making difficult.
Attribute priming	People "primed" (i.e., strongly focused) on specific products or product attributes will tend to select those products or emphasize those product attributes in comparisons.
Mental accounting	People often set up divisions or categorizations of their own finances that change how they perceive the associated money.
Framing	People act differently based on how choices are presented.
Value assessments	"Value" is a relative concept; people often use seemingly "irrational" metrics and concepts to guide their behavior.
Love of free	"Free" triggers reactions different from logical preferences and causes people to overlook underlying math.
Anchoring	People often assess value based on their initial exposure to price or specific attributes.
Endowment effect	People value products and services they already own higher than those they do not.
Hyperbolic discounting	People discount the value of future spending too heavily, which leads to excessive consumption in the present and far less consumption in the future.
Subtraction by addition	Inclusion of features with limited applicability can deter people from choosing them.
Emotional impacts	Emotions can drive someone to or away from what would be considered a "rational" economic decision.
Risk aversion	People are willing to pay a premium to move an outcome from highly uncertain to certain.
Over confidence	Individuals believe that their exposure to risk is lower than average exposure and heavily discount the likelihood of negative events.
Loss aversion	The tendency for people to strongly prefer avoiding losses rather than acquiring gains.
Self control facilitation	Individuals recognize the need for self-control and external support and often are willing to accept the downsides of third-party control to achieve their goals.
Hot vs. cold states	Individuals in a cold (non-stimulated) state make different decisions than those in a hot (emotional or otherwise stimulated) state.
Self-herding	People make valuations of future actions and determinations of future behaviors based on past behaviors.
Social impacts	People consider others' behavior and social norms to guide them toward what they believe is the "right" decision.
Social/financial domains	People's behavior differs when they believe they are functioning in a social environment instead of a transactional payments environment.
Bandwagon effect	People often do (or believe) things because many other people do (or believe) the same.
Dishonesty effect	People are more likely to commit fraudulent actions against larger entities, and when the perceived impact is small enough to avoid triggering conscience.
Signalling	One party takes some observable or costly measures to convey information to another party.

Endnotes

[1] Louis Lombardi, Mark Paich, and Anand Rao, *Behavioral Simulations: Using Agent-Based Modeling to Understand Policyholder Behaviors*, Society of Actuaries, 2012.

[2] Marin Eling and Michael Kochanski, *Research on Lapse in Life Insurance: What Has Been Done and What Needs to Be Done?* University of St Gallen Working Papers on Risk Management and Insurance, 2012.

[3] Mary Hardy, *Investment Guarantees: Modeling and Risk Management for Equity-Linked Life Insurance,* 2003.

[4] James Glanz, "Is Big Data an Economic Big Dud?", *The New York Times,* August 18, 2013.

[5] *Policyholder Behavior in the Tail: Variable Annuity Guaranteed Benefits Survey 2011 Results,* Society of Actuaries, 2011.

[6] *Policyholder Behavior in the Tail: UL with Secondary Guarantee Survey 2012 Results,* Society of Actuaries, 2012.

[7] Howard Gleckman, "What's Killing the Long-Term Care Insurance Industry," *Forbes,* August 2012.

[8] Ibid.

[9] Alan Mills, *Complexity Science: An introduction (and invitation) for actuaries,* 2010.

[10] Neeraj Sood, *Cashing Out Life Insurance: An Analysis of the Viatical Settlements Market*, RAND Corporation, 2003.

[11] John W. Payne, Namika Sagara, Suzanne B. Shu, Kirstin C. Appelt, Eric J. Johnson, *Life Expectancy as a Constructed Belief: Evidence of a Live-to or Die-by Framing Effect*, Journal of Risk and Uncertainty, 2013.

[12] Jeffrey R. Brown, *Rational and Behavioral Perspectives on the Role of Annuities in Retirement Planning*, National Bureau of Economic Research, 2007.

[13] Justin A. Reckers and Robert A. Simon, "Behavioral Finance and Life Insurance," *Morningstar Advisor* February 2011.

[14] Andy C. W. Chui and Chuck C. Y. Kwok, "National Culture and Life Insurance Consumption," *Journal of International Business Studies,* 2008.

[15] Menahem E. Yaari, "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer," *Review of Economics Studies* (April 1965).

[16] Thomas Davidoff, Jeffrey R. Brown, and Peter A. Diamond, "Annuities and Individual Welfare," MIT 2005.

[17] Ibid.

[18] Wei-Yin Hu and Jason S. Scott, "Behavioral Obstacles in the Annuity Market," CFA Institute Financial Analysts Journal, December 2007.

[19] Ibid.

[20] Shlomo Benartzi, Alessandro Previtero, and Richard Thaler, "Annuitization Puzzles," Journal of Economic Perspectives. Fall 2011.

[21] Jeffrey R. Brown, Jeffrey R. Kling, Sendhil Mullainathan, and Marian V. Wrobel, "Why Don't People Insure Late-Life Consumption? A Framing Explanation of the Under-Annuitization Puzzle," *American Economic Review* (May 2008).

[22] J. Mark Iwry and John A. Turner, *Automatic Annuitization: New Behavioral Strategies for Expanding Lifetime Income in 401(k)s,* Brookings Institution Retirement Security Project , July 2009.

[23] Ibid.

[24] William G. Gale, J. Mark Iwry, David C. John, and Lina Walker, *Increasing Annuitization in 401(k) Plans with Automatic Trial Income,* Brookings Institution Hamilton Project, June 2008.

[25] J. Mark Iwry and John A. Turner, *Automatic Annuitization: New Behavioral Strategies for Expanding Lifetime Income in 401(k)s,* Brookings Institution Retirement Security Project, July 2009.

[26] David Laibson, "Golden Eggs and Hyperbolic Discounting," *The Quarterly Journal of Economics,"* May 1997.

[27] Wei-Yin Hu and Jason S. Scott, "Behavioral Obstacles in the Annuity Market," CFA Institute *Financial Analysts Journal,* December 2007.

[28] *2011 Risks and Process of Retirement Survey Report,* Society of Actuaries, June 2012.

[29] David M. Blanchett, "Examining the Benefits of Immediate Fixed Annuities in Today's Low-Rate Climate," *Journal of Financial Planning,* January 2013.

[30] James H. Moore, Jr. and Leslie A. Muller, "An Analysis of Lump-Sum Pension Distribution Recipients," *Monthly Labor Review,* May 2002.

[31] Olivia Mitchell and Stephen Utkus, *Lessons from Behavioral Finance for Retirement Plan Design,* Pension Research Council, The Wharton School, University of Pennsylvania, 2003.

[32] *Policyholder Behavior in the Tail: UL with Secondary Guarantee Survey 2012 Results*, Society of Actuaries, 2012.

[33] *EIOPA Report on the Fifth Quantitative Impact Study (QIS5) for Solvency II* , EIOPA , March 2011.

Endnotes continued

[34] A. Dar and C. Dodds, "Interest Rates, the Emergency Fund Hypothesis and Saving through Endowment Policies: Some Empirical Evidence for the U.K*.," Journal of Risk and Insurance* ,1989.

[35] W. Kuo, C. Tsai, and W. Chen, "An Empirical Study of the Lapse Rate: The Cointegration Approach," *Journal of Risk and Insurance*, 2003.

[36] Stephen G. Fier and Andre P. Liebenberg, "Life Insurance Lapse Behavior," The North American Actuarial Journal, July 2013.

[37] Dan Ariely, *Predictably Irrational: The Hidden Forces That Shape Our Decisions,* Harper Perennial (2010).

[38] Richard H. Thaler, "Anomalies: Saving, Fungibility, and Mental Accounts," The *Journal of Economic Perspectives,* 1990.

[39] Steven F. Venti and David A. Wise, "Have IRAs Increased U.S. Saving? Evidence from Consumer Expenditure Surveys," *The Quarterly Journal of Economics,* August 1990.

[40] John W. Payne, Namika Sagara, Suzanne B. Shu, Kirstin C. Appelt, Eric J. Johnson, "Life Expectancy as a Constructed Belief: Evidence of a Live-to or Die-by Framing Effect," *Journal of Risk and Uncertainty*, 2013.

[41] "The Value of Life in Tough Economic Times," Prudential Financial, August 2009.

[42] Terrance Odean, "Are Investors Reluctant to Realize Their Losses?" *The Journal of Finance*, October 1998.

[43] Steve Farkas and Jean Johnson, *Miles to Go: A Status Report on Americans' Plans for Retirement*, Public Agenda, 1997.

[44] Marin Eling and Michael Kochanski, *Research on Lapse in Life Insurance: What Has Been Done and What Needs to Be Done?* University of St Gallen Working Papers on Risk Management and Insurance, December 2012.

[45] George Loewenstein, "Emotions in Economic Theory and Economic Behavior," *American Economic Review*, May 2000.

[46] George Loewenstein, Ted O'Donoghue, and Matthew Rabin, "Projection Bias in Predicting Future Utility," *The Quarterly Journal of Economics,* November 2003.

[47] Eric Gilbert and Karrie Karahalios, *"*Widespread Worry and the Stock Market*," Proceedings of the International Conference on Weblogs and Social Media*, 2009.

[48] The Geneva Association, *Surrenders in the Life Insurance Industry and their Impact on Liquidity*, August 2012.

[49] Dan Ariely, George Loewenstein, and Drazen Prelec, "'Coherent Arbitrariness': Stable Demand Curves without Stable Preferences," *The Quarterly Journal of Economics,* February 2003.

[50] Brian Wansink, Robert J. Kent, and Stephen J. Hoch, "An Anchoring and Adjustment Model of Purchase Quantity Decisions," *Journal of Marketing Research,* February 1998.

[51] J. Edward Russo, Paul J.H. Schoemaker, *Decision Traps: Ten barriers to brilliant decision making and how to overcome them*, New York: Doubleday/Currency, 1989.

[52] Andrew W. Lo, "Reconciling Efficient Markets with Behavioral Finance: The Adaptive Markets Hypothesis," *The Journal of Investment Consulting*, 2005.

[53] Peter Orszag, Retirement Research Consortium, "Behavioral Economics: Lessons from Retirement Research for Health Care and Beyond,*" Retirement Research Consortium*, August 7, 2008.

[54] Ibid.

[55] Jae Song and Joyce Manchester, "Have People Delayed Claiming Retirement Benefits? Responses to Changes in Social Security Rules," *Social Security Bulletin*, February 2008.

[56] *The Retirement Income Reference Book,* LIMRA, 2009.

[57] Jae Song and Joyce Manchester, "Have People Delayed Claiming Retirement Benefits? Responses to Changes in Social Security Rules," *Social Security Bulletin*, February 2008.

[58] Roger Buehler, Dale Griffin, and Johanna Peetz, "The Planning Fallacy: Cognitive, Motivational, and Social Origins," *Advances in Experimental Social Psychology,* 2010.

[59] James Moore and Olivia S. Mitchell, "Forecasting Retirement Needs and Retirement Wealth : Projected Retirement Wealth and Saving Adequacy," *Pension Research Council, University of Pennsylvania Press*, 2000.

[60] "Gallup Economy Poll," *gallup.com,* http://www.gallup.com/poll/162560/average-retirement-age.aspx.

[61] Ian R. Newby-Clark, Michael Ross, Roger Buehler, Derek Koehler, Dale Griffin, "People Focus on Optimistic Scenarios and Disregard Pessimistic Scenarios while Predicting Task Completion Times," *Journal of Experimental Psychology: Applied*, 2000.

[62] Roger Buehler, Dale Griffin, Michael Ross, "Exploring the planning fallacy: Why people underestimate their task completion times." *Journal of Personality and Social Psychology*, 1994.

[63] Peter Kooreman, "The Labeling Effect of a Child Benefit System," *The American Economic Review Vol. 90, No. 3,* June 2000.

Endnotes continued

[64] H. M. Shefrin and Richard Thaler, *An Economic Theory of Self-Control*, National Bureau of Economic Research working papers, 1977.

[65] Chip Heath and Jack B. Soll, "Mental Budgeting and Consumer Decisions," *The Journal of Consumer Research,* June 1996.

[66] Jason Zweig, "Five Investing Lessons from America's Top Pension Fund," *Money,* January 1, 1998.

[67] Ibid.

[68] Shlomo Benartzi and Richard H. Thaler, *The Behavioral Economics of Retirement Savings Behavior*, AARP, January 2007.

[69] Gur Huberman and Wei Jiang, "Offering vs. Choice in 401(k) Plans: Equity Exposure and Number of Funds," *The Journal of Finance*, April 2006.

[70] Sheena Iyengar and Wei Jiang, *How More Choices Are Demotivating: The Impact of More Options on 401(k) Investment*, Columbia Business School, October 2003.

[71] Sheena S. Iyengar and Mark R. Lepper, "When Choice Is Demotivating: Can One Desire Too Much of a Good Thing?", Journal *of Personality and Social Psychology* , 2000.

[72] Shlomo Benartzi and Richard H. Thaler, "Heuristics and Biases in Retirement Savings Behavior," *Journal of Economic Perspectives* 2, Summer 2007.

[73] Ibid.

[74] John Ameriks and Stephen P. Zeldes, "How do Household Portfolio Shares Vary with Age?", *TIAA CREF Working Paper,* 2004.

[75] Ibid.

[76] Ted O'Donoghue and Matthew Rabin, "Procrastination in Preparing for Retirement," *Behavioral Dimensions of Retirement Economics,* 1999.

[77] New York State Insurance Department Press Release, *New York Department of Financial Services*, http://www.dfs.ny.gov/insurance/press/2011/p1107051.htm.

[78] Terrance Odean, "Are Investors Reluctant to Realize Their Losses?", *The Journal of Finance,* October 1998.

[79] H. Shefrin and M. Statman, "The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence," *Journal of Finance*, 1985.

[80] Shlomo Benartzi and Richard H. Thaler, *Risk Aversion or Myopia? Choices in Repeated Gambles and Retirement Investments, Management Science vol. 45 issue 3, 1999.*

[81] U. Gneezy and J. Potters, *An Experiment on Risk Taking and Evaluation Periods,* Quarterly Journal of Economics, May 1997.

[82] Gerlinde Fellner and Matthias Sutter, *Causes, Consequences, and Cures of Myopic Loss Aversion: An Experimental Investigation,* Jena Economic Research Papers, 2008.

[83] Brad M. Barber and Terrance Odean, "Boys will be Boys: Gender, Overconfidence, and Common Stock Investment," *The Quarterly Journal of Economics,* February 2001.

[84] Amos Tversky and Daniel Kahneman, "Belief in the Law of Small Numbers," *Psychology Bulletin,* 1971.

[85] Shlomo Benartzi and Richard H. Thaler, *The Behavioral Economics of Retirement Savings Behavior,* AARP, January 2007.

[86] William G. Gale, J. Mark Iwry, David C. John, and Lina Walker, *Increasing Annuitization in 401(k) Plans with Automatic Trial Income*, Brookings Institution Hamilton Project Discussion Paper, June 2008.

[87] J. Mark Iwry and John A. Turner, *Automatic Annuitization: New Behavioral Strategies for Expanding Lifetime Income in 401(k)s,* Brookings Institution Retirement Security Project, July 2009.

[88] Louis Lombardi, Mark Paich, and Anand Rao, *Behavioral Simulations: Using Agent-Based Modeling to Understand Policyholder Behaviors*, Society of Actuaries, October 2012.

[89] Train, Kenneth. *Discrete Choice Methods with Simulation*, Cambridge University Press, 2009.

[90] Eric Siegel, *Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie or Die*, Wiley, 2013.

[91] "Reinventing Society in the Wake of Big Data: A Conversation with Alex (Sandy) Pentland," *Edge,* August 30, 2012.

[92] *Personal Data: The emergence of a new asset class*, World Economic Forum, 2011.

[93] Meglena Kuneva, European Consumer Commissioner's Speech, March 2009.

[94] Amazon Wants to Ship Your Package Before You Buy It, *Wall Street Journal Blog*, http://blogs.wsj.com/digits/2014/01/17/amazon-wants-to-ship-your-package-before-you-buy-it/.

[95] Louis Lombardi, Mark Paich, and Anand Rao, *Behavioral Simulations: Using Agent-Based Modeling to Understand Policyholder Behaviors*, Society of Actuaries, October 2012.

Endnotes continued

[96] David de Meza, Bernd Irlenbusch, Diane Reyniers, *Financial Capability: A Behavioral Economics Perspective,* prepared for the UK Financial Services Authority, London School of Economics, 2008.

[97] Howard Kunreuther and Mark Pauly, "Understanding and Improving Insurance Decisions in the Most Misunderstood Industry," *Wharton Marketing*, July 2012.

[98] David E. Kanouse, Joel Kallich, and James P. Kahan, "Dissemination of Effectiveness and Outcomes. Research," *Health Policy,* December 1995.

[99] David de Meza, Bernd Irlenbusch, Diane Reyniers, *Financial Capability: A Behavioral Economics Perspective,* UK Financial Services Authority, London School of Economics, 2008.

[100] James J. Choi, David Laibson, and Brigitte C. Madrian, *Why Does the Law of One Price Fail? An Experiment on Index Mutual Funds*, National Bureau of Economic Research Working Papers, 2006.

[101] Daniel Kahneman, Paul Slovic and Amos Tversky, *Judgement under Uncertainty: Heuristics and Biases*, New York : Cambridge University Press, 1982.

[102] William M. Grove and Paul E. Meehl, "Comparative Efficiency of Information (Subjective, Impressionistic) and Formal (Mechanical, Algorithmic) Prediction Procedures: The Clinical-Statistical Controversy," *Psychology, Public Policy and Law*, 1996.

[103] Peter Orszag , "Behavioral Economics: Lessons from Retirement Research for Health Care and Beyond," Presentation, August 7, 2008.

[104] Jonathan Haidt, *The Happiness Hypotheses: Finding Modern Truth in Ancient Wisdom,* Basic Books (2006).

[105] Thomas Mussweiler, Fritz Strack, Tim Pfeiffer, "Overcoming the inevitable anchoring effect: Considering the opposite compensates for selective accessibility," *Personality and Social Psychology Bulletin*, November 2000.

[106] Jonathan Haidt, *The Righteous Mind: Why Good People Are Divided by Politics and Religion*, Pantheon, 2012.

[107] Eric J. Johnson, John Hershey, Jacqueline Meszaros, and Howard Kunreuther, *Framing, Probability Distortions, and Insurance Decisions,* Journal of Risk and Uncertainty, 1993.

[108] Dan Lovallo and Daniel Kahnemann, "Delusions of Success: How Optimism Undermines Executives' Decisions," *Harvard Business Review*, 2003.

[109] John K. Kruschke and Mark K. Johansen, "A Model of Probabilistic Category Learning," *Journal of Experimental Psychology: Learning, Memory, and Cognition,* September 1999.

[110] Marianne Bertrand, Dean Karlan, Sendhil Mullainathan, Eldar Shaffir, Jonathan Zinman, *What's Psychology Worth? A Field Experience in the Consumer Credit Market*, National Bureau of Economic Research Working Paper, December 2005.

[111] Ibid.

[112] T. D. Wilson and J. W. Schooler, "Thinking Too Much: Introspection Can Reduce the Quality of Preferences and Decisions," *Journal of Personality and Social Psychology*, February 1991.

[113] Neil D. Weinstein, William M. Klein "Resistance of personal risk perceptions to debiasing interventions," *Health Psychology*, 1995.

[114] Jack B. Soll and Joshua Klayman, "Overconfidence in Interval Estimates," *Journal of Experimental Psychology: Learning, Memory, and Cognition,* March 2004.

[115] David de Meza, Bernd Irlenbusch, Diane Reyniers, *Financial Capability: A Behavioral Economics Perspective,* UK Financial Services Authority, London School of Economics, 2008.

009465-0514 (46103-10-407-23005)