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An examination of the effectiveness of a training programme to improve decision making in insurance risk underwriting

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AN EXAMINATION OF THE EFFECTIVENESS OF A TRAINING PROGRAMME TO IMPROVE DECISION MAKING IN INSURANCE RISK UNDERWRITING

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2019

I hereby declare that this PhD dissertation is my original work and it has been written by me in its entirety.
I have duly acknowledged all the sources of information which have been used in this dissertation.

This PhD dissertation has also not been submitted for any degree in any university previously.

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Gavin R. Maistry

12 November 2019

ABSTRACT

An Examination of the Effectiveness of a Training Programme to Improve Decision Making in Insurance Risk Underwriting

Gavin R. Maistry

This dissertation studies the effectiveness of a training programme to improve decision making in insurance risk underwriting. A key component of insurance risk underwriting decisions is qualitative judgement, in addition to quantitative analytical modelling. In the training of insurance underwriters, great strides have been made on the analytical side. However, the training of judgement, both intuitive and deliberate, has largely been ignored. The aim of this research proposal is to design and test a training programme to improve judgement in insurance underwriting.

Our research extends the *script* training concept, used extensively in medical training, to the domain of insurance underwriting for the first time. As part of the research, we interviewed underwriters of varying levels of experience. We looked to capture the *scripts* of experienced underwriters; contrast this with novices and then use these as a training tool for underwriters. We then also looked to extract the *simple rules* that underlie the intuitive judgements in insurance underwriting and use these to formally train more deliberate judgements.

The training intervention was administered to groups of professional underwriters and also groups of students. The impact of the training was measured for both accuracy and consistency improvements in underwriting decisions. Control groups were also established. We also examined the moderating impacts of experience and some components of mindfulness on the training impact. The results suggest that the combined *scripts* and *simple rules* training improves both quality and consistency of underwriting decisions (when compared to the control

group). The training design contains the key components needed to develop expertise – the *scripts* technique gives exposure to many cases; the *simple rules* then provides systematised knowledge and the underwriting process ensures objective feedback.

This study has the impact of accelerating the development of underwriting expertise and could potentially save companies billions of dollars in poor underwriting decisions. The proposed training design could potentially fundamentally change the training of underwriters to include formal training on the important aspects of intuitive and deliberate judgement. This will then also help prepare underwriters for managing risks in an increasing innovative and riskier world.

Keywords: intuitive judgement; deliberate judgement; *scripts*; *simple rules*; expertise; mindfulness.

TABLE OF CONTENTS

List of Figures iii
List of Tables iii
ACKNOWLEGDEMENT iv
DEDICATION v

1. CHAPTER 1: INTRODUCTION & RESEARCH OBJECTIVES 1
1.1. Introduction to the Insurance and Reinsurance Industries 1
1.2. Introduction to Insurance Risk Underwriting 2
1.3. The Challenge in Making Insurance Risk Underwriting Decisions 3
1.4. The Role of Judgement in Insurance Risk Underwriting Decisions 3
1.5. Research Objectives 5

2. CHAPTER 2: LITERATURE REVIEW 7
2.1. The JDM Approach and Insurance Risk Underwriting Decisions 7
2.1.1. Analytical Decision Making (ADM) and Insurance Risk Underwriting 7
2.1.2. Heuristics and Biases (HB) and Insurance Risk Underwriting 9
2.1.3. Fast and Frugal Heuristics (FFH) and Insurance Underwriting Risk 15
2.1.4. Naturalistic Decision Making (NDM) and Insurance Risk Underwriting 18
2.1.5. Conditions for Intuitive Expertise in Insurance Risk Underwriting 20
2.1.6. Combining Models and Judgement in Underwriting Insurance Risk 23
2.2. The Cognitive Psychology Approach and Insurance Risk Underwriting Decisions 25
2.2.1. *Scripts* 25
2.2.2. Rule-Based Reasoning 29
2.2.3. Deliberate Practice 30
2.3. *Simple Rules* from Strategy and Insurance Risk Underwriting 31

3. CHAPTER 3: DEVELOPMEMNT OF THE HYPOTHESES 33
3.1. Introduction to Design of the Training 33
3.2. Training Intervention (independent variable, X) 34
3.2.1. *Scripts* Component of Training 34
3.2.2. *Simple Rules* Based Component of Training 36
3.2.3. Combining *Scripts* and *Simple Rules* Based Training 37
3.3. Work Sample Tests (WST's) Used in Training 38
3.4. Measuring Underwriting Quality (dependent variable, Y) 40
3.4.1. Underwriting Accuracy (Y1) 40
3.4.2. Underwriting Consistency (Y2) 41
3.5. The Impact of Moderating Variables on Insurance Risk Underwriting Training (moderating variable, M) 43
3.5.1. The Impact of Experience on Insurance Underwriting Training 43
3.5.2. The Impact of Mindfulness on Insurance Underwriting Training 44
3.6. Summary of Hypotheses 51

4. CHAPTER 4: RESEARCH METHODOLOGY……. 52
4.1. Developing the *Scripts* for the Training ……. 52
4.2. Extracting the *Simple Rules* of Insurance Risk Underwriting for Training ……..... 55
4.3. Training and Control Participants and Samples …….....……..... 57
4.4. Combined *Scripts* and *Simple Rules* Training Method …… 59
4.5. Control Study Training Method ……...……... 60
4.6. Measures ……..…… 61
4.6.1. Dependent variables ……..……. 61
4.6.2. Moderator variables ……..……. 61
4.6.3. Control variables …… 63
4.6.4. Summary of Study Variables …….……..…….. 63

5. CHAPTER 5: DATA ANALYSIS AND RESULTS ……...…….. 64
5.1. Data ……..…… 64
5.2. Results and Analysis ……..……..... 67
5.2.1. Testing the Impact of the Training ……..... 67
5.2.2. Testing the Main Effect of Experience ……..... 70
5.2.3. Testing the Moderating Effect of Experience …… 71
5.2.4. Testing the Main Effect of Mindfulness …… 75
5.2.5. Testing the Moderating Impact of Mindfulness ……. 76
5.2.6. Testing the Moderating Impact of Control Variables …… 78
5.2.7. Results Summary ……..... 80

6. CHAPTER 6: DISCUSSION, CONCLUSIONS & EXTENSIONS ……...…..... 81
6.1. Discussion ……...……..... 81
6.2. Practical Implications ……...……..... 85
6.3. Strengths and Limitations …… 86
6.4. Extensions and Future Direction ……..... 89
6.5. Final Conclusion …….. 91

REFERENCES……. 92

APPENDIX I : INSURANCE UNDERWRITING S*CRIPTS*……..…… 100
APPENDIX II: INSURANCE UNDERWRITING *SIMPLE RULES* ……. 112
APPENDIX III: MINDFULNESS ATTENTION & AWARENESS SCALES …..….... 114
APPENDIX IV: WORK SAMPLE TESTS (WST's) ……...……. 116
APPENDIX V: TRAINING OUTLINE & COURSE INVITATION LETTER …….. 123

List of Figures

#	Description	Pg.
2.1.2.1	Relationship between Natural Disasters and Property Insurance Rates	11
2.1.2.2	Forced Choice : 4 possible outcomes	15
3.1	Schematic Representation of Conceptual Model	33
3.2.2.	Steps in the Insurance Risk Underwriting Process	37
3.5.2.	Overlaps between the Insurance Risk Underwriting Process and Mindfulness Process	48
3.6.	Schematic Representation of Variables & Hypotheses (with expected results)	51
5.2.1.	Posttest Adjusted Means by Treatment Condition	68
5.2.3.1.	Distribution of Experience	71
5.2.3.2.	Posttest Adjusted Means by Treatment Condition for various Experience Levels	72
5.2.3.3	Posttest Adjusted Means by Treatment Condition for various Status Levels	73
5.2.5.	Posttest Adjusted Means by Treatment Condition for Posttest_SMAt Levels	77
5.2.6.1.	Posttest Adjusted Means by Treatment Condition for Gender Levels	78
5.2.6.2.	Posttest Adjusted Means by Treatment Condition for various Education Levels	79
6.4.	Kirkpatrick's four levels of evaluation model	88

List of Tables

#	Description	Pg.
3.5.2.	Steps in the Mindfulness Process	45
3.6.	Hypotheses Summary	51
4.3	Summary of Training and Control Sessions	57
4.6.2.	Description of Mindfulness Measures Used	62
4.6.4.	Description of Study Measures	63
5.1.1.	Sample of Data	64
5.1.2.	Means, Standard Deviations, and Intercorrelations of Study Variables	65
5.1.3.	Distribution of Pretest Variables by Training and Control	66
5.1.4.	Distribution of Posttest Variables by Training and Control	66
5.2.1.1.	Output for Paired Samples t-test	67
5.2.1.2.	Output for ANCOVA & ANOVA	68
5.2.1.3.	Assumption Checks for ANCOVA & ANOVA	69
5.2.2.1.	Output for Simple Regression	70
5.2.2.2.	Assumption Checks for Linear Regression	70
5.2.3.1.	Experience_Level Transformation	72
5.2.3.2.	ANCOVA Output for Treatment × Experience:	72
5.2.3.3	Output for ANCOVA & ANOVA by Treatment & Status (P & S)	73
5.2.3.4.	Professionals subsample (N=109) ANCOVA & ANOVA Output for Treatment	74
5.2.3.5.	Students subsample (N=111) ANCOVA & ANOVA Output for Treatment	74
5.2.4:	Output for Simple Regression with Mindfulness Measures	75
5.2.5.	Combined sample (N=220) PROCESS Output for Treatment × Mindfulness	76
5.2.6.1.	Output for ANCOVA: Treatment × Gender Interaction	78
5.2.6.2.	Output for ANCOVA: Treatment × Education Interaction	79
5.2.7.	Hypotheses Summary and Results	81
A2.1	Simple Selection Rules for Insurable Risk	109
A2.2	Simple Risk Management Procedural Rules	110
A3	Description of Mindfulness Measures Scales	111

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DEDICATION

This work is dedicated to:

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My many work colleagues, past and present, who have helped me become a better actuary and underwriter.

"For the things we have to learn before we can do them, we learn by doing them."- Aristotle

CHAPTER 1: INTRODUCTION AND RESEARCH OBJECTIVES

1.1. Introduction to the Insurance and Reinsurance Industries

Our world is filled with uncertainty and randomness. Insurance companies or insurers are the legal entities that cover the financial consequences that emerges from the occurrence of certain of these unexpected events. Hence, insurers provide financial security to customers. Insurers offer this benefit in exchange for payment of a predetermined amount of money called the "premium". Insurance is therefore a means of reducing uncertainty. In return for buying an insurance policy for a smaller, known premium, the possibility of a larger loss is removed. By pooling premiums and insured events, the financial impact of an event that could be disastrous for one policyholder is spread among a wider group i.e. the mutualisation of risk. By this pooling of similar risks together insurance companies transform the unpredictability of the occurrence of such contingent events into more expected events, they can price and manage. This transfer of risk is of great significance for the functioning of our modern economies e.g. numerous consumers may not purchase new expensive cars or houses if they do not have the option of insuring them (Desai, 2016). The value of this certainty to society is huge.

Reinsurers are firms that insurers pass on risk to and can be viewed as B2B insurance or wholesale insurance provider. Put simply, reinsurance is insurance for insurers. The financial compensation that would be required in the event of a commercial airline plane crash, for example, could be too great for a single insurer, so reinsurance is sought to share the loss. Alternatively, a certain level of the risk from, say, an insurer's motor or life insurance business could be transferred to a reinsurer. Hence, reinsurers play a vital role in risk management of insurance companies – ensuring the financial stability of the insurance companies and ultimately giving insurance consumers financial security and peace of mind. Reinsurers can also act as consultants to the insurance companies especially in the field of underwriting various types of insurance risks where they bring their global reach and knowledge to the table.

1.2. Introduction to Insurance Risk Underwriting

An insurance or reinsurance underwriter is a professional whose job it is to understand to understand the risks to which an insurer/reinsurer is exposed to – and ultimately accept or decline the risk. The coverage the client should receive; premium and terms of the insurance contract are based on the underwriter's assessment of the level of the risk. The word "underwriter" originated from the practice of having each risk-taker write his name under the total amount of risk he was willing to accept at a specified premium (Bernstein, 1998). Underwriting includes all strategies, methods and processes to – identify, analyse, assess, control and monitor the short and long term risks an insurer/reinsurer faces or may face in the future. Their main task is to help the insurance/reinsurance company to build a portfolio of profitable insurance risks. The function of the underwriter is ultimately to protect the insurer's/reinsurer's book of business from risks that they feel will make a loss. Thus, underwriting is the key tool to reduce losses, control uncertainty and optimise decision making to improve performance of insurers/reinsurers.

The underwriting skill is gained not only through theoretical study but is also the result of years of experience dealing with similar risks and pricing and paying claims on those risks. Their underwriting work requires a combination of strong analytical skills, business knowledge and understanding of human behaviour to design and manage programs that control risk. Experienced underwriters tend to develop over time a sense for each application of risk transfer. Underwriting can be done by actuaries or other insurance professionals who are schooled in finance and risk management. The Society of Actuaries (SOA, 2010) defines an actuary as a business professional who analyses the financial consequences of risk. Most underwriters specialize in certain types of risks, for example Life and Health (L&H) risks are usually underwritten by medical doctors; Property risks by professional engineers; legal risks by lawyers; etc. Some underwriters in more senior management roles have to be more generalists and look at the fuller spectrum of risks that the insurer/reinsurer assumes.

1.3. The Challenge in Making Insurance Risk Underwriting Decisions

There is significant challenge in making underwriting decisions and the longer the insurance/reinsurance coverage period the wider the range of outcomes which is sometimes referred to as the widening "cone of uncertainty" (Tetlock, 2015) – the cone that surrounds the main prediction and gives a range of possibilities. Hence, insurance underwriting is a challenging task – requiring a significant amount of technical skills and experience. In some circles, underwriting is considered to be more art than science. It is a well-established fact within the industry that the complex forecasts and decisions that underwriters and actuaries have to make cannot be based totally on mechanical analysis of data and models of finance and risk management. Underwriters have to deal with real life uncertainty and incomplete information which cannot be captured in risk models which require well defined outcomes and associated probabilities (Knight, 1921). Hence underwriters and actuaries have to combine models with their professional expert judgement to make decisions. Also, certain aspects like customer or policyholder behaviour is very difficult to judge and impossible to incorporate fully in a mathematical model and require a thorough understanding of human behaviour.

1.4. The Role of Judgement in Insurance Risk Underwriting Decisions

The term *judgement* refers to the cognitive aspects of the decision-making process and to fully understand judgement, we must identify the component of the decision-making process that require it (Bazerman and Moore, 2009). A popular distinction in cognitive and social psychology has been between intuitive and deliberate judgements (Kruglanski and Gigerenzer, 2011). This contrast has aligned in dual-process theories of unconscious, effortless processes (assumed to foster intuitive judgements) versus conscious, effortful and ruled-based analytic rational processes (assumed to characterize deliberate judgements). Kahneman (2011) describes two modes of thinking. The first is fast, intuitive and applied so often in our daily lives that it takes over almost automatically (*System 1*). The second is slow, rational and calculating, and takes a lot of work (*System 2*) – like statistical, rational processes (Kahneman, 2001).

A better understanding of expert intuitive and deliberate judgements made in insurance underwriting decisions could help prevent underwriters making the same blunders such as an over-reliance on financial models. Blind reliance and over confidence in financial models have been argued to be a major cause of recent financial crises (Derman, 2011). Banks failed to fully appreciate that these models were attempting to model complex systems (Waldrop, 1992) like stock markets or credit markets. This modelling made simplifying assumptions and failed to account for interactions, correlation and contagion in the system. The models could not capture all the complexities of the real world environments and markets. There was a need to apply common sense and good judgement when assessing such complex financial risks to account for factors that could not be modelled. The same happens in the world of insurance underwriting where we tend to look for shelter in "models" and frequently fall prey to the "illusion of control" (Langer and Roth, 1975). We overestimate our ability to predict the future, and as a result we underestimate uncertainty that still prevails and the mechanisms to cope with this (Kahneman, 2001). Judgement, both intuitive and deliberate, is the key tool to deal with the uncertainty not captured in models yet most of the research and training still focuses on models.

Underwriters have to make time constrained decisions concerning complex insurance problems or situations. Intuition plays a key role in these decisions. Intuition is rather difficult to define but rather easy to recognize (Hogarth, 2001). The root of the term 'intuition' may be traced to the Latin *intueor* or *intueri* meaning 'to contemplate' or 'look within' (Sadler-Smith and Shefy, 2004). Kahneman and Tversky (1982) defined intuitive judgements as those that are arrived at by an informal and unstructured mode of reasoning without the use of analytical methods or deliberative calculation. Intuition should not be confused with other concepts like instinct or insights. Instincts are the inbuilt fast biological reactions with which evolution has equipped us that maximize our chances of survival in the face of a physical threat – and which can't be trained (Liebowitz, 2018). Additionally, insight is the capacity to gain an accurate and deep understanding of someone or something – deliberately (Liebowitz, 2018). Intuition is seen

as the set of hunches, impulses, gut feelings, anticipations – and judgements stemming from previous events in your life. It is viewed as the use of judgement based on experience to select pre-programmed solutions that are instantly available through pattern recognition (Hamm, 2004). There is a strong case for pattern recognition when conflicting forces on decision synthesis cause mental gridlock. More complex expert schemas developed through an accumulation of experience may be more accurate and better suited to intuitive decision making and allowing a rapid recall of effective patterns that can be used in numerous situations across an expert's domain (Hamm, 2004). However, an important aspect of discussing/defining intuition is that intuition, just as analysis, can be right or wrong (Hogarth, 2001).

1.5. Research Objectives

Cognitive psychology has pointed toward heuristics, such as *scripts* and other expert schemas as manifestations of expert intuition (Hamm, 2004). A script or a set of *scripts*, is a large set of situation patterns to recognize and rules of what to do within recognized patterns. The medical profession has made great strides in formalizing the training of how to achieve intuition and clinical wisdom in complex clinical problem solving (Hamm, 2004). By analyzing the difference between problem-solving methods of junior residents and acknowledged experts, they identify how the novices can faster and more efficiently reach the pattern recognition that characterizes the thorough process of master surgeons (Abernathy and Hamm,1994, 1995). This suggests that to promote the acquisition of intuition and expert competence, novices could be trained using *scripts*. This would teach them patterns – many patterns – along with the appropriate response in each pattern (Hamm, 2004). This technique looks a very pragmatic and practical way to develop expert intuition – but seems up to now to have been used only in the medical domain. This research examined how to extend the *script* training concept to the domain of insurance underwriting. It looked to capture the *scripts* of experience underwriters; contrasted this with novices and then used this data to develop a training invention program for training intuition and then tested the impact of this training intervention.

We also targeted in this research to uncover a better understanding deliberate judgements made in insurance underwriting through use of *simple rules*, or *heuristics.* As described above, most people use cognitive shortcuts such as *scripts* in routine situations. The problem with such tools is that they do not work well in complex, unprecedented cases – encountered frequently in underwriting decision making. Effective decision makers, go beyond the integrations represented by *scripts* and other cognitive shortcuts and develop *simple rules* that are based on the synthesis of knowledge gleaned from experience (Woiceshyn, 2009). Kruglanski, and Gigerenzer (2011) argue that intuitive and deliberative judgements can even both be based on exactly the same rules. The important question for research is what these rules are, when are they applied, and in which situations they are successful. Personal experience and lessons learnt from failures constitutes an important source of rule acquisition. An important factor in the selection of a rule is the ecological rationality of a rule for a given task (Kruglanski, and Gigerenzer, 2011).

As described above, insurance underwriters in practice have to employ expert judgement to deal with many real-life uncertainties. Hence, the underwriting profession must also appreciate and strive to gain further insights into the nature and process of expert judgement needed for insurance underwriting. Given the apparent rigor in insurance / actuarial formal training, it is interesting to note that such an important skill like expert judgement is not well understood and not covered in the training – but expected to be acquired through experience which could take many decades. A more formal understanding and training of expert judgement could greatly assist to accelerate the quality of insurance underwriting. If the acquisition of expert judgement in insurance underwriting is better understood and trainable, this could materially impact the way in which underwriters/actuaries are trained and practice. The aim of this research is also thus to look scientifically into the research question of whether training can help improve judgement and ultimately decision making in underwriting insurance risk using training techniques like *scripts* and *simple rules* applied to this field for the first time.

CHAPTER 2: LITERATURE REVIEW

2.1. The JDM Approach and Insurance Risk Underwriting Decisions

2.1.1. Analytical Decision Making (ADM) and Insurance Risk Underwriting

Underwriters, and especially actuaries, represent one of the most highly evolved practitioners of the scientific statistical and evidence-based approach. They are trained to build what can be excruciatingly complex models to use as the basis for decisions. These actuarial / statistical models rely upon a number of statistical laws for their power, such as the law of large numbers (Thoyts, 2010; Redja & McNamara, 2017) and Bayes' theorem, the use of credibility theory, etc. In the hands of actuaries specifically, studies of mortality, motor accidents, etc., have all yielded to statistical analyses permitting the individual risks to be seen as sufficiently predictable that companies are prepared to accept them for a suitable premium. Centuries of insurance business have been based upon the notion that risk events become somewhat predictable when viewed in sufficient numbers (Law of Large Numbers). The ADM would encourage chosing from among alternative actions in the classical way in terms of the mean (expected value); variance (risk) and potential scenarios under the probability distributions over possible outcomes.

Actuarial and more broadly statistical methods are ultimately a part of a rational decision making (ADM) process. In the ADM process a decision maker will identify potential solutions to a problem and then evaluate the characteristics of the outcomes under those solutions to find the optimal choice. Herbert Simon (1955) criticised rational models of decision making for ignoring situational and personal constraints such as time pressure and limited cognitive capacity. Simon's own analyses of organisational decision making led him to propose that the mind had evolved short-cut strategies that delivered reasonable solutions to real-world problems – an idea know as bounded rationality. Such mental short cuts, or heuristics, could also lead to systematic errors.

Underwriters and actuaries learn to optimise metrics like expected utility in their basic training (Bowers, 1997). Simon (1955) identified a major flaw in such ADM approaches. There is no natural limit to the analysis needed to reach the optimal conclusion. Simon suggested that ADM required "unbounded rationality" with potentially infinite data and infinite analysis. The unbounded rationality idea is easily seen in the frequent calls of underwriters and actuaries for more data and more time to complete the actuarial forecasts and analysis. Simon went on in his work to develop the idea of "satisficing" as a decision criterion instead of optimising with data analysis. "Satisficing" means concluding the decision process when a satisfactory outcome can be found from alternatives and requires judgement to select something "good enough".

Uncertainty is a defining characteristic of underwriting insurance risk. The insurance underwriter does not know all possible future outcomes with their consequences and probabilities. ADM models deal with situations of risk where outcomes and probabilities of outcomes are known – termed "risk" in economic terminology (Knight, 1921). Knight (1921) contrasts this with "uncertainty" with unknowable outcomes and probabilities. Also, according to the American Academy of Actuaries (AAA, 2014), the term risk is used in situations where the probabilities of possible outcomes are known or can be estimated with some degree of accuracy, whereas uncertainty is used in situations where such probabilities cannot be estimated – consistent with Knightian uncertainty. ADM models, like expected utility theory, cannot deal fully with real world uncertainty – and underwriters need to learn how to express and quantify the uncertainty in their predictions and decisions – and layer in expert judgement, both intuitive and deliberate, to cope with the uncertainty. Actuaries and underwriters have possibly been guilty of spending a disproportionate amount of time worrying about risk and not paying as much attention to uncertainty as we should have. *Uncertainty* is the fact that future outcomes aren't predictable just by looking at the past and are largely composed of risks that cannot be quantified or foreseen. Uncertainty is the fact that some risks are just not assessable and in fact may not even be known or knowable (e.g. Black Swan events, Taleb (2007)).

As professionals, underwriters and actuaries are heavily reliant on data and statistical techniques as a means for making underwriting decisions. However, psychologist have shown (Klein, 1998) that only very inexperienced decision makers used only an ADM approach. Underwriting judgement is very much a critical element in underwriting assumption setting, forecasting and ultimately decision making. It is therefore important to understand how this intuitive and deliberate judgement works and to what extent our judgement may be compromised by the limitations associated with being human. These insights should also allow underwriters and actuaries to better communicate their findings to other decision makers in terms they can understand, as opposed to mathematical and modelling jargon that is specific especially to the actuarial profession.

In psychology literature, "actuarial" judgement is seen as analogous to statistical judgement and has been in the middle of a heated debate on "clinical" versus "actuarial" judgement. Some seminal studies (Dawes, Faust and Meehl, 1989) claim that "actuarial" judgements are superior as they rely solely upon established relationships between data and outcomes whereas clinical judgements are made in the heads of clinicians and prone to error. This theme of a clash between models and experts relying on their judgement is developed further in Section 2.1.6. of this dissertation.

2.1.2. Heuristics and Biases (HB) and Insurance Risk Underwriting

A wide range of professions are investigating the consequences of behavioural limitations in human decision making. Given the ubiquity of intuition and judgement in the underwriting insurance risk, it is important for underwriters and actuaries to understand the potential biases inherent in human judgement and to learn methods and best practices to avoid them. Much of human judgement is based not on rational cognitive processes, but rather on heuristics – the unconscious "rules of thumb" that humans have developed over millennia to deal with our environment (Gigerenzer and Todd, 2000). And, although our ingrained and

unconscious heuristics may have served us well in dealing with the dangers and opportunities faced by our ancestors, in today's complex world, they can produce serious systematic errors, also known as biases. With a complex task like underwriting insurance risk, the limitations of human decision making are at their most vulnerable and cognitive biases are most influential. Daniel Kahneman (2011) coined the term "illusion of validity" to capture the truth that we, especially if we are "experts", often harbour an illusion that we are good at intuition/judgement and decision making, when in fact we are not.

While some work has been done to highlight the implications of heuristics and cognitive bias on insurance underwriting and actuarial work (Tredger *et al*, 2016), there is still a lack of awareness within the practicing body of underwriters and actuaries of these issues and the profession is yet to measure the extent to which they influence our day to day work. Awareness of such behavioural biases can help us understand the limitations of our forecasting and advice and the importance of how we present it. Following Tversky and Kahneman (1974), this section tackles some of the major heuristics that are employed to assess probabilities and to predict values and that are relevant to underwriting insurance risk. .

Under the *representativeness* heuristic, underwriters/actuaries tend to make judgements based on small samples that are not statistically representative. Actuaries analyse the results of analysis of past actual experience, termed experience studies, to make forecasts for future experience. If the experience is based on a small sample, the results may not have validity to be used for forecasting. Actuaries have devised the concept of "credibility theory" (Herzog, 1999) to deal with this issue and offer partial credibility validity to samples based on size. Only large samples are given full credibility for forecasting.

The *availability* heuristic causes people to think an event is more probable if it is easy to remember or if the memory is more vivid or those that trigger an emotional response (Tversky and Kahneman, 1974). Underwriters and actuaries sometimes make judgements based on data that is easily available, rather than finding appropriate data. This heuristic is especially relevant

in setting premiums in the property and casualty (P&C) industry. For example, an underwriter considering the risk of a natural disaster or catastrophe, will be more likely to demand a higher premium when such an event has occurred recently – as opposed to taking the more rational statistical average. Prices also reduce after long periods of no disasters – and this pricing cycle regularly plays out in the catastrophe insurance markets. This phenomenon is illustrated in *Figure 2.1.2.1.* below which shows how spikes in catastrophe premiums have followed actual major catastrophic events.

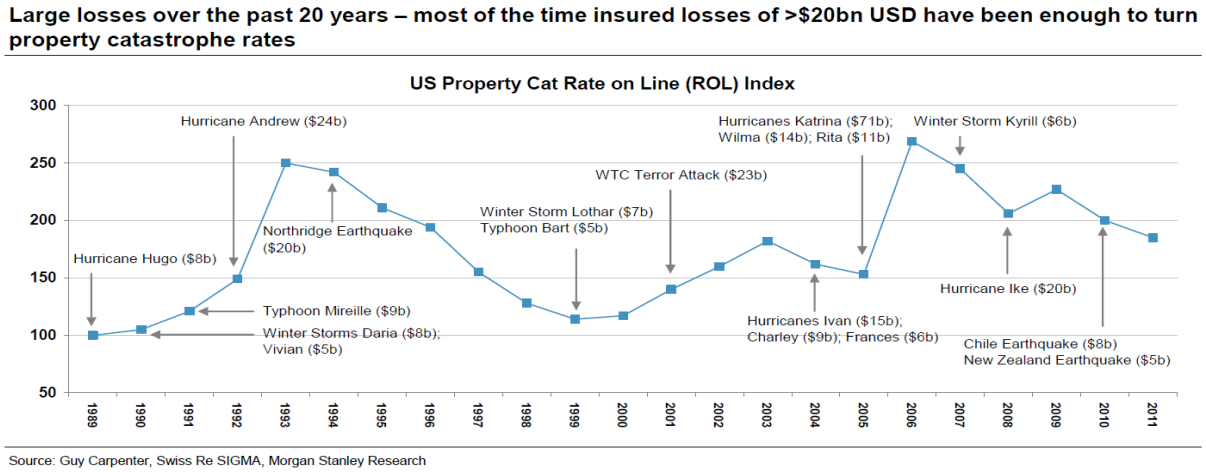

Figure 2.1.2.1. Relationship between Natural Disasters and Property Insurance Rates

The *anchoring* heuristic (Kahneman, 2011) is the tendency to be over-reliant on a starting point when making an estimate for the future. Anchoring is one of the most relevant heuristics for underwriting insurance risk. Analysis has shown that underwriters are sometimes slow to react to new information in decision making. A theory as to why underwriters may be slow to react to new information is that they are anchored by their own prior assumptions and prices.

The *confirmation bias* (Kahneman, 2011) is the tendency to interpret new information so that it becomes compatible with our existing theories, beliefs, and convictions. In other words, we filter out any new information that contradicts our existing views ("disconfirming evidence"). The confirmation bias is alive and well in the underwriting world. One example, an underwriter decides on accepting a new type of risk. The underwriter then enthusiastically celebrates any sign that the underwriting decision is a success. Everywhere the underwriter

looks, he/she see plenty of confirming evidence, while indications to the contrary remain unseen or are quickly dismissed as “exceptions” or “special cases.” (Kahneman, 2011).

Base-rate neglect is a fallacy where the detailed description entices us to overlook the statistical reality: a disregard of fundamental distribution levels. It is one of the most common errors in reasoning. Virtually all professions including underwriters fall prey to it on a regular basis. In medicine, base-rate neglect plays an important role. Doctors in training are advised to investigate the most likely ailments before you start diagnosing exotic diseases, even if they are a specialist in that area. Doctors are the only professionals who enjoy this base-rate training. Regrettably, few people in business are exposed to base-rate training (Kahneman, 2011).

In cognitive psychology and decision science problems with *belief updating* (Bayes’ theorem) refers to the tendency to revise one's belief insufficiently when presented with new evidence. This bias describes human belief revision in which persons over-weigh the prior distribution and under-weigh new sample evidence when compared to Bayesian belief-revision. In other words, persons update their prior beliefs as new evidence becomes available, but they do so more slowly than they would if they used Bayes' theorem (Dobelli, 2013). Tredger *et al* (2016) look into this question about the weight that should be attributed to the experience to date when blending judgement with data in an actuarial context. They have carried out an empirical experiment where actuaries were asked to update their best-estimate loss frequency prediction for a particular line of business. The aim of this experiment was to look for evidence as to whether actuaries exhibit bias in their judgement compared with the Bayesian estimates (Tredger *et al*, 2016). The experiment showed that without any form of training, the judgement used by an actuary when making predictions would typically show marked deviations from the Bayesian estimate. However, Tredger *et al* (2016) found evidence of an improvement in the quality of the responses provided by participants who had received some immediate training on biases and heuristics.

Framing is the tendency for decisions to be influenced by the way an uncertain outcome is presented (Kahneman and Tversky, 1984). Many times Kahneman and Tversky (1984) demonstrated that opinions about an issue can be reversed if the issue is simply presented in a way that is logically equivalent, but expressed differently. Underwriters provide professional advice to help individuals/corporates make decisions on uncertain outcomes. While we would like to think that the individuals who use our advice do so rationally, the framing effect suggests otherwise. One plausible explanation for why the framing effect occurs is prospect theory. *Prospect theory* says that if the forecast outcome is viewed as a gain, an individual will be risk averse in their decision making (Kahneman and Tversky, 1984). However, if the outcome is viewed as a loss, prospect theory says that the individual's decision making will be risk-seeking. The implication of this is that an individual's decisions can change depending on whether the forecast outcome is framed as a gain or as a loss. To avoid the framing bias, underwriters and actuaries need to present the result of their analysis in multiple ways. There is also the power of incentives that could impact underwriting decisions. In practice underwriter's decisions are particularly affected by the way their attention is focused on critical performance targets (March and Shapira, 1987). This could result in them being less sensitive to estimates of the probabilities of possible outcomes when making business decisions.

Tversky and Kahneman (1974) found that even people who are statistically sophisticated, like underwriters / actuaries, are not always good at judging probabilities. When asked for the probability that their prediction of some future event will come true, people, especially experts, systematically seem to report a probability that is far too high. This bias could have very serious implications for insurance underwriting decision making. There is also evidence of overconfidence and the "illusion of control" from models in the insurance industry. However, there is a growing body of empirical evidence (Makridakis, 1990) showing that accurate long-term forecasting in the finance world is usually not possible. In addition, there is huge uncertainty, as practically all economic and business activities are subject to events we are

unable to predict. The fact that forecasts can be inaccurate creates a serious dilemma for insurance underwriters. Hence, there is a strong need for intuition and judgement to cope with this residual uncertainty.

To guard against our inherent biases that could lead to poor underwriting decisions, there is much that actuaries and underwriters can do. Firstly, awareness is a crucial element in mitigation of bias (Kahneman, 2011). The data hungry nature of the underwriting / actuarial professions helps reduce exposure to cognitive bias. Actuarial work in particular is in most cases guided by professional and/or regulatory standards that force the underwriter / actuary to justify their assumptions and can be an important control for reducing cognitive bias in our work. The education pathway to become a professional actuary is comprehensive and demanding and requires adherence to continuous professional development standards. Peer review of actuaries' judgements provide an independent assessment of the quality of the judgement. Checklists could be useful to the actuary with a list of factors relevant to the forecasting task and prevent them from being influenced by extraneous information (Gawande, 2011). Finally, insurance forecasts should not be overconfident and use confidence intervals, rather than point predictions, and also provide various stress tests and scenario forecasts.

While judgement can play a valuable role in insurance underwriting, it can also be subject to biases and inconsistencies (noise) arising from cognitive limitations, political influences or confusion between forecasts, targets and decisions. Cognitive limitations, in particular, have been the focus of a large body of research which has been concerned with identifying their effects on forecast accuracy. Kahneman (2011) and Kahneman and Tversky (1973) examine the psychology of prediction – looking at judgemental heuristics and biases.

Signal detection theory (Heeger, 1997) provides a good framework for further understanding why underwriters may be more inclined to "DECLINE" a case rather than "ACCEPT" under conditions of uncertainty. The starting point for signal detection theory is that nearly all reasoning and decision making takes place in the presence of some uncertainty

(Heeger, 1997). Signal detection theory provides a precise language and graphic notation for analyzing decision making in the presence of uncertainty (Heeger, 1997). Figure 2.1.2.2. shows the 4 possible outcomes of an underwriting decision at time T1 and the outcome at time T2:

		T1	
T2		Accept	Decline
	Success	Hit✓	Miss✗
	Failure	False Accept✗	Correct Rejection✓

Figure 2.1.2.2. Forced Choice : 4 possible outcomes

If an underwriting case is accepted and it proves to be loss making (a false accept – failing to detect a loss making case) there could be negative consequences for the underwriter – which could weigh heavily on their decision making. If there is a penalty for a false accept, this may influence underwriters to more easily reject cases. Further, a "miss" would be to reject a profit making case, falsely thinking it would be a loss. However, the company may not know about cases which the underwriter rejects that turn out to be a success – as the case does not enter the company accounts. Hence, this framework shows that underwriters may be more inclined to reject cases under uncertainty given the consequences of a "false accept" versus a "miss".

2.1.3. Fast and Frugal Heuristics (FFH) and Insurance Underwriting Risk

The term *heuristic* is of Greek origin, meaning ''serving to find out or discover''(Gigerenzer and Brighton, 2009). Heuristics do not always lead to bias and may be advantageous in certain circumstances. Goldstein and Gigerenzer (2009) examine the topic of fast and frugal forecasting using heuristics. The previous section on HB focused on heuristics leading to systematic errors or biases. There is another school of thought which portrays heuristics in a more positive light. The basic premise of the fast and frugal heuristic (FFH) school is that much of human decision making and reasoning can be explained in terms of simple heuristics that operate within the limits of time, knowledge, and computation imposed on the individual (Gigerenzer and Todd, 2000). A FFH approach is a way to solve problems

quickly with incomplete information. A successful application of a heuristic is governed by its ecological rationality – i.e. the match of a heuristic with a given environment. FFH models can be both descriptive and prescriptive (Gigerenzer and Todd, 2000). Forecasts in highly uncertain domains, like insurance of certain new types of risks can sometimes be, are more likely to be based on rules of thumb than the extensive analysis of all available data.

FFH do not compute quantitative probabilities or utilities, as in classical decision making models used in statistical forecasting of ADM, because these values require too much computation to serve as practical bases for forecasting and often require knowledge that is unavailable in real-world tasks (Gigerenzer and Todd, 2000). The aim of the FFH approach is to develop models of cognition that are simultaneously plausible on psychological and ecological grounds, as well as being computationally specific (Slegers, Brake and Doherty, 2000). These are computationally simple and require less information than ADM models.

When making forecasts and underwriting decisions, constant tension exists between model builders and heuristic proponents. However, both approaches have at their core a Bayesian view of how to derive the right decision, which is constantly updating your decision-making engine with new experiences. Bayesian uses Bayes' theorem to update the probability for a hypothesis as more evidence or information becomes available. The heuristic forecasters may cast a wider net for information to bring into their heuristic. The statistical forecast modellers are usually limited to specifically quantifiable information that can be put into their models. Since the heuristic group does not have a quantitative forecasting model, they do not have that constraint. However, their disadvantage is that they do not necessarily include a systematic way to incorporate new information into their forecasts.

The heuristic forming process is not necessarily a fully conscious process. In fact, explanations of heuristics are usually *post hoc*. This issue does not diminish the importance of heuristics. The traditional actuarial or statistical approach is a development of the scientific revolution, through the use of regular observation. Only a few hundred years have gone into

perfecting this approach, not the thousands of years that support human heuristic processes (Gigerenzer and Todd, 2000). Some of these heuristics can be readily explained to colleagues in the business forecasting process, but some cannot be put into words any better than explaining incredible sporting feats like a baseball player hitting a fastball (Gigerenzer and Todd, 2000). Such heuristics are called "gut instinct." The ability of experts to make judgements in this arena is usually honed by decades of experience – but we will discuss experts further in the next section.

The adaptive toolbox is the repertoire of heuristics available to decision makers and forecasters to use in different circumstances (Gigerenzer and Selten, 2002). Underwriters and actuaries have their own adaptive toolbox of satisficing and heuristic short cuts in making actuarial forecasts and underwriting decisions. Underwriters and actuaries tend not to maximize expected utility, as taught in actuarial theory (Bowers, 1997), but instead find it easier to maximize expected profits from among possibilities with acceptable downside potential. Tallying (Gigerenzer and Todd, 2000) can be used to assign equal weights to different forecasting outcomes. With lexicographic strategies, the underwriter will base the forecast on the most important factor or cue such as the type of product or alignment of interest on risk. The affect heuristics can be used by underwriters to make risk decisions by feelings or emotions – and view risk as a feeling (Slovic, 2010). There are also various decision and stopping rules that could be used based on size / materiality of the business deal being forecast; probable maximum loss (PML); whether the contract can be revised in future; etc. The underwriter could also choose to ignore immaterial phenomena that are difficult to model (e.g. remote contract options). The recognition heuristic would be used by experienced underwriters and under the similarity heuristic underwriters and actuaries can draw on actions from a similar forecast from the past.

2.1.4. Naturalistic Decision Making (NDM) and Insurance Risk Underwriting

Underwriters and actuaries are experts who have highly organized, domain-specific knowledge that allows them to encode complex insurance and financial information. This expert knowledge results in faster and more accurate underwriting decisions. Psychologist Gary Klein, in his book *Sources of Power* (Klein, 1998), describes studies of how experts make decisions – which he terms naturalistic decision making (NDM). Underwriters through extensive training and experience are experts in insurance risk management decisions. NDM is primarily a descriptive approach that seeks to explain human decision making in terms of expert performance (Klein, 1998). No attempt is made to define normative decision rules because such normative models are generally unable to adequately explain the actions of human decision makers (Gigerenzer, 1997). NDM addresses how human decision makers can deal with real constraints of time, information and high stress. In general, NDM theories are consistent with expert decision making but tend to be very general, referring to broad categories of cognitive processes such as recognition, pattern matching, and mental simulation – without explaining exactly how these processes are performed. In insurance underwriting, experienced underwriters often use such recognition, pattern matching and mental simulation techniques.

NDM is not at all similar to ADM discussed earlier. NDM is a correspondence theory interested in the way the world works and more positive about experts and judgemental forecasting. ADM and HB are coherence theories interested in the way mind works in relation to the way it ought to work. NDM also differs from FFH. NDM models are derived from expert behaviour but FFH from an analysis of the task or problem in its environmental context. NDM was developed to study real-world decision making in complex tasks, whereas the FFH approach has explored traditional, lab-based tasks which are much simpler and easy to describe. Perhaps because NDM models are, for the most part, created from accounts of experts like underwriters and actuaries, these models generally emphasize memory-based processes. FFH can make use of such processes but are not limited to them and not dependent on experience.

In studying how highly experienced people make decisions, Klein (1998) discovered that they do not typically use a rational slow process. Their natural process is to study the problem against one solution quickly selected from their mental library, which has been constructed over many years of experience. Such an approach works well for senior underwriters and actuaries who must make decisions quickly — especially when not all of the forecasting variables can readily be quantified, and when there is no single, precise model for the exact relationships among them. NDM techniques commonly used in underwriting insurance are discussed below.

Klein (1998) has described intuitive decision making as a pattern-recognition process: cues about the decision situation lead a decision maker to recognize a familiar pattern (based on prior experience) which then activates an action script, a routine way of responding that makes deliberate analysis unnecessary. Although he does not deny the value of rational analysis, Klein argues that reliance on intuition leads to more effective (faster, more accurate) decisions. As reported by Klein (1998), people with more experience are often perceived as having more or better intuitions In a review of the literature, Klein (1998) identified four key ways in which experts learn: firstly, engaging in deliberate practice, and setting specific goals and evaluation criteria; secondly, compiling extensive experience banks; thirdly, obtaining feedback that is accurate, diagnostic, and reasonably timely; and finally, enriching their experiences by reviewing prior experiences to derive new insights and lessons from mistakes. This is totally congruent with the methodology used in cognitive decision *scripts* training.

According to the complex recognition primed decision (RPD) model (Klein 1993), expert underwriters would first appraise the situation in order to classify it as familiar or not, based on their experience. The assessment of familiarity can be made by matching features of the forecast to prior forecasts, recognition of a whole pattern of features that fits a familiar story or scenario, or explicit recall of an analogy from another similar or related domain. This

recognition concept is analogous to the concept of intuition. In the famous words of Hebert Simon: "Intuition is nothing more and nothing less than recognition." (Kahneman, 2011).

When the underwriter / actuary is unable to recognize a given situation, the typical reaction is to seek more data and information or to resolve the ambiguous situation through diagnostic processes such as “story building” (Klein, 1998). With this the underwriter creates a detailed hypothesis or story that could explain the situation. Whatever the outcome of an underwriting decision, the underwriter’s clients and superiors need a story to buy into it. A convincing story that explains projected results and decision and renders them plausible is important. In fact, it is often seen by some as more vital than the forecast itself. This helps the underwriter / actuary put the results into a commercial context.

Once the underwriter / actuary has diagnosed the situation, he or she can use mental simulation (Klein, 1998) to form expectations about future results and test the working hypothesis. If there are many inconsistencies between the hypothesis and the situation, the underwriter must revise his or her hypothesis. As underwriters proceed with mental simulation, they can also generate different possible actions. These scenarios are then tested by mental simulation for their likely consequences. Underwriters / actuaries are numerate and at ease doing exercises like mental simulations.

2.1.5. Conditions for Intuitive Expertise in Insurance Risk Underwriting

Reliance on intuition does not always result in high-quality decisions and suggests that particular conditions are more conducive for the use of intuition than rational analysis. The determination of whether intuitive judgements can be trusted requires an examination of the environment in which the judgement is made and of the opportunity that the judge has had to learn the regularities of that environment (Kahneman and Klein, 2009). Kahneman and Klein (2009) describe task environments as “high-validity” if there are stable relationships between objectively identifiable cues and subsequent events or between cues and the outcomes of

possible actions. They cite medicine and firefighting as professions that are practiced in environments of fairly high validity. In contrast, outcomes are effectively unpredictable in zero-validity environments. The authors cite the future value of individual stocks and long-term forecasts of political events as being made in a zero-validity environment. Kahneman and Klein (2009) state that an environment of high validity is a necessary condition for the development of skilled intuitions and that other necessary conditions include adequate opportunities for learning the environment (prolonged practice and feedback that is both rapid and unequivocal). Kahneman and Klein (2009) conclude that if an environment provides valid cues and good feedback, skill and expert intuition will eventually develop in individuals of sufficient talent.

High-validity environments, like insurance markets, are uncertain but expert-judgment can identify good bets. Determining the validity of an environment is not always easy. Insurance markets are high validity environments as there are certain rules or principles to follow for success. There are however many complex and volatile environments such as the stock market or the political arena that are not of high validity. The inability of investment fund managers to consistently beat the market underscores this argument. According to Tetlock (2015), long-term political forecasting is doomed to fail as large-scale political developments are too complex to be forecast. The task of prediction is simply impossible in a low validity environment.

Hogarth (2001), in a similar vein to Kahneman & Klein, also stresses the point that expert judgment is only accurate in specific environments. Hogarth (2001) describes two types of environments: Firstly, “kind” learning environments where the information in the learning environment closely matches the situation in which the decision is to be made and the environments provide useful feedback to the decision maker. This contrasts with so called “wicked” learning environments where there are mismatches between the information in the learning environment and the decision situation, which are likely to lead to mistakes in decision making and the feedback is misleading or missing Hogarth (2001). Daniel Kahneman and Gary Klein refer to kind learning environments as environments with high validity.

Hogarth (2001) also underscores that kind learning environments are a necessary condition for accurate intuitive judgments, whereas intuitions acquired in wicked environments are likely to be mistaken. Intuition can be the result of expertise and skill or of self-deception through heuristics and cognitive biases. Intuitive decisions work very well in specific environments and situations. People make intuitive judgments based on recognition of cues and pattern matching. Decision makers must regularly practice their decision-making skills to recognize the available signals and also need accurate feedback on the quality of their decisions.

Kahneman and Klein (2009) state that within a profession like medicine, some specialties provide better and faster learning opportunities than others – e.g. anesthesiologists benefit from good feedback, because the effects of their actions are likely to be quickly evident and in contrast, radiologists obtain little information about the accuracy of the diagnoses and hence anesthesiologists are therefore in a better position to develop useful intuitive skills. This variation in intuitive skills could also apply to the underwriters making shorter term forecasts (e.g. property and casualty underwriters looking at one-year horizon) get greater frequency of forecasting feedback accuracy than life insurance or pension actuaries and underwriters (who may have to wait decades for their forecasts to be fully evaluated). Kahneman (Kahneman and Klein, 2009) drives this point about learning home with his conclusion that "Whether professionals have a chance to develop intuitive expertise depends essentially on the quality and speed of feedback, as well as on sufficient opportunity to practice."

With this background, we can now see two main reasons why algorithms beat people. The first is that, as Kahneman (Kahneman and Klein, 2009) writes, "Statistical algorithms greatly outdo humans in noisy environments for two reasons: they are more likely than human judges to detect weakly valid cues and much more likely to maintain a modest level of accuracy by using such cues consistently." In other words, people often miss cues (i.e. data) in the environment that would be useful to them, and even when they are aware of such cues they don't use them the same way every time. In other words, the fact that most real-world

environments are messy and noisy does not favor human experts over algorithms. The second reason is that fast, accurate feedback is not always available to a human expert – e.g. an interviewer won't always get the feedback that the person he hired flamed out on the job two years down the road. But well-designed algorithms can and do incorporate feedback and results over a long time frame, which helps explains why algorithmic approaches to pathology and talent management work so much better (Kahneman and Klein, 2009).

Intuition is something that can be honed through experiential learning and techniques to further stimulate one's intuitive sense, like *scripts* and *simple rules* training. This form of training also integrates with the three main conditions for development of intuitive expertise discussed in this section viz.: a regular environment; feedback and many opportunities to practice.

2.1.6. Combining Models and Judgement in Underwriting Insurance Risk

As mentioned earlier, there has been a long running debate on actuarial/statistical vs. clinical predictions in psychology (Dawes et al, 1989). Clinical judgement is thought to be inferior to judgement based on actuarial / statistical models in a clinical setting. However true underwriting in insurance or finance practice, not that referenced in psychology literature, is a blend of both statistical and clinical modes of thinking. Experienced underwriters / actuaries know that the most effective and most characteristically 'actuarial' way of thinking involves a subtle melding of clinical (professional judgement) and statistical (financial models) ways of thinking (Ingram, 2012). Whenever experts have valid intuition, model-expert combinations will be more accurate than either of the single inputs (Bunn and Wright , 1991).

Most researchers have concluded that decision makers combine judgement and rational analysis. Accurate underwriting requires the proper integration of both modes of thought. According to Cognitive Continuum Theory (Hammond, 1996, 2000), there are multiple modes of cognition that lie on a continuum between intuition and analysis. Cognitive (managerial)

tasks vary in their ability to induce intuition, quasi-rationality (i.e., the combination of intuitive and analytic thought) or analysis, and performance is contingent on the correspondence between task properties and cognitive mode. Bunn and Wright (1991) in their seminal paper look at the interaction of judgemental and statistical forecasting methods stating all serious forecasts require the exercise of some judgement and that a well-structured judgemental process can consistently outperform a statistical model-based extrapolation. They stress the importance of making the judgemental process explicit through a form of decomposition or audit trails

Insurance / actuarial forecasting can be performed in three main ways viz. using models based only on statistical forecasting; using models based only on judgemental forecasting (expert judgement) or using a combination of these two methods – termed combined forecasting (Armstrong, 2002). The general forecasting literature states that combined forecasting models have higher forecast accuracy than models based only on statistical forecasting or models based only on judgemental forecasting (Blattberg and Hoch, 1990); (Hoch, 2007) and (Lawrence *et al*, 1986). This relationship should also be true for underwriting / actuarial forecasting needed for making insurance underwriting decisions. In a study of expert highway engineers' use of analytical, quasi-rational (i.e., the combination of intuitive and analytic thought), and intuitive cognition, Hammond and Hamm et al (1987) show that intuitive and quasi-rational cognition frequently outperformed analytical cognition. This shows the importance of judgement in a seemingly quantitative domain like engineering.

Models and experts have complementary skills. Models combine complex data in a consistent and unbiased manner. That doesn't necessary mean that the maximum accuracy in models is higher – underscoring the difference between maximal and average accuracy. Statistical analysis can produce predictive value because the number of potentially important variables in actuarial forecasting is much larger than can be dealt with by simple heuristics. However, judgemental forecasting from experts can factor in additional insights that the pure statistical model cannot incorporate, such as customer behaviour in an insurance context.

Hence, combining models and experts for actuarial forecasting and underwriting should be more accurate as they combine the complementary skills of statistical and judgemental forecasts. In practice, there should be an optimal level of how much judgemental forecasting is factored in and how the integration is done to bring into underwriting decisions.

2.2. The Cognitive Psychology Approach and Insurance Risk Underwriting Decisions

2.2.1. *Scripts*

The general model from cognitive psychology, represented by the *script* metaphor (Schank and Abelson, 1977), offers a powerful descriptive framework which in combination with decision theory's normative framework, promises new progress for attempts to improve underwriting decision making. Descriptive models focus on how people make their decisions in their everyday lives, normative models focus on how perfectly rational agents should make decisions. The dominant view in cognitive science is that decision makers are guided by their "knowledge structures" consisting of heuristics, *scripts* or schemas. Knowledge structures are mental templates or cognitive filters that individuals use to interpret their information environment. Over time, knowledge structures become cognitive shortcuts: they allow quick behavioral responses in familiar situations, based on a "script" developed from previous experience. For example, experienced drivers in colder climates have developed *scripts* for driving in icy conditions – *scripts* that novice drivers or those in warmer regions do not possess.

Scripts have regularly been used in medical psychology to refer to complex mental representations that are used by the experienced physician in making a decision about a patient (Abernathy and Hamm, 1994, 1995). Abernathy and Hamm (1994, 1995) suggest supplementing the formal training of medical students and younger surgeons with surgical *scripts* taken from real cases involving experienced expert surgeons to acquire better intuition. They argue that much of the intuitive expertise of surgeons lies in the mental *scripts* that they have developed for dealing with cases. In other words, when confronted with a patient,

experienced surgeons are able to construct stories about how certain kinds of actions are likely to lead to specific outcomes, what to do depending on how events unfold, and so on. As experts, these surgeons reason by assessing the present states of their patients and imagining future sequences of actions and events (Abernathy and Hamm, 1994, 1995).

In Abernathy and Hamm (1994, 1995) the *scripts* take the form of recordings (presented in written format) of the verbalized thoughts of experienced surgeons who are asked to think aloud as they examine and contemplate different cases. Abernathy and Hamm (1994, 1995) argue that such *scripts* allow novices to walk through cases with experienced professionals, benefiting from their experience and tacitly acquiring their intuitions. The concept of professional *scripts* is interesting and if generalized, it suggests a way of providing the benefits of mentorship and apprenticeship, but in a much more condensed form – allowing novices to learn much more than they would in the course of a standard apprenticeship (Hogarth, 2001).

It should be emphasized that professional *scripts* are quite different from the case studies that are so popular in business schools (Hogarth, 2001). The case-study method has students discuss and debate situations taken from the real business world. They are then asked to recommend a decision and elaborate a rationale, and the professor uses the discussion to emphasize different conceptual points. In many cases, there is no right answer. A script version of the business case study would be quite different. Students would engage in little debate. Instead, they would study expert analyses made by experienced members of the business community – possibly guided by a professor. As it is typically used by business schools, the case study is not a way to build good intuitions for solving business problems. There is no clear criterion that distinguishes good from bad decisions (Hogarth, 2001). The experience is superficial, and it offers little chance to learn from expert practitioners – leading to major recent criticism of MBA programs using cases studies (Mintzberg, 2004). The script training addresses these negatives.

Judgement and decision making (JDM) has also not made sufficient use of the key concepts from cognitive psychology concerning the representation and utilization of knowledge (Hamm 2004). At the same time, it is well known that the approach is grounded in cognitive psychological theory. Although the role of complex, automated knowledge structures i.e. *scripts* has received little attention in JDM research, the field has worked with many of its components. The expert in NDM does not deliberate about probabilities and utilities to decide which alternative is best. Nor does the expert quickly and intuitively process the probabilities and utilities, using heuristic strategies. Rather, the decision to crack the problem is built into the knowledge structure that has been activated; in most cases, the action is taken without any activation of decision theoretic concepts (Hamm *et al.*, 2000). Most decisions experienced professionals make are routine – they gather information, recognize the problem as a familiar one and treat it in the usual way – consistent with the script concept.

The script framework incorporates the elements of associative memory, recognition, complex memory structures, rules, operations, search, etc. under a variety of names, to account for experts' use of knowledge in applied situations (Hamm, 2004). The term "script" is used to refer to the expert knowledge characterized by this approach. This was one of the concepts used by Schank and Abelson (1977) to describe how ambiguous sentences about everyday situations are understood through the listener's knowledge of such situations. The script is a statement describing how the professional makes the decision – understand the situation, considers responses for that sort of situation that are stored in memory, makes decisions and plans, and then carries them out (Hamm 2004). Professionals may not be fully aware of the *scripts* they use or of the strategies that are embodied in their *scripts*, particularly when their knowledge has been developed through extensive experience (Abernathy and Hamm, 1995). *Scripts* are ultimately knowledge organized into structures that hold everything one needs to know about a type of situation and that come to mind in an instant of recognition – and enables experts to take advantage of the mind's strengths so that they can handle tasks in their domain of expertise.

Another element of expert reasoning that is essential to the decision-*script* concept, but that cannot be called part of a decision script per se, is reflection (Hamm, 2004). This is involved in monitoring whether the current understanding of the situation is adequate, and in judging whether one of the script's options is likely to be effective in the situation. This reflection helps the professional become aware of the need to make changes in the approach to the current situation, and provides the conditions for the development of new *scripts*.

The script concept stems directly from cognitive psychology (Schank and Abelson, 1977). In addition, *scripts* of both novices and experts can also be analyzed using a Judgement and Decision Making (JDM) lens (see Appendix I) – incorporating analytical decision making (ADM); heuristics and biases (HB); fast and frugal heuristics (FFH) and naturistic decision making (NDM). JDM and cognitive psychology frameworks do somewhat overlap on the *scripts* concept – a characterization in terms of *scripts* is similar to *recognition primed decisions* (RPD) (Klein, 1993); *case-based reasoning* (Riesbeck and Schank, 1989); or *rule-based reasoning* (Anderson, 1990, 1993) – all as part of the same big picture concept (Hamm, 2004).

Integrity of Underwriter *Scripts* : The integrity of scripts was ensured using the two approaches of correspondence and coherence/consistency (Hammond, 2000). Correspondence is based on performance in the real world and examines the accuracy of predicting or judging empirical events. The goal of correspondence meta-theory is to describe and explain the process by which a person's judgements achieve empirical accuracy. Correspondence translates to accuracy. Correspondence theory also focuses on the empirical accuracy of judgments, irrespective of whether the cognitive activity of the judge can be justified or even described (Hammond, 2000). The performance of senior underwriter's *scripts* follows correspondence.

In contrast, coherence/consistency criteria are those that are based on normative standards of logic (or some other formal model). The goal of coherence meta-theory is to describe and explain the process by which a person's judgement achieves logical, mathematical or statistical rationality. Coherence translates into rationality and logic. It would takes very

strong empirical contradiction to overturn a highly coherent theory in which a great deal has been invested on the assumption that it is true. The *simple rules* incorporated into the training programme in this study falls within the scope of coherence.

Hence, another strength of a combined scripts and *simple rules* is that it covers both a correspondence and coherence view of the underwriting world.

Range of Underwriter *Scripts* : An interesting training design question is whether the *scripts* used for training should cover a wider or narrow range of situations or products? For example, when training underwriters in a specialized area like Life business, should they be exposed to situations outside the core Life area – like Property & Casualty? Training using a wider range of cases will give younger underwriters the benefits of breadth and diverse experience and the interdisciplinary thinking that comes with that. Training gives underwriters the power of range which they may not get in their daily jobs in an hyperspecialized world. Modern job descriptions and professional incentives are aligning to accelerate specialization, creating intellectual archipelagos (Epstein, 2019). The exposure to a wide breadth of experience is invaluable in extracting the *scripts* and *simple rules* to have the ability to apply knowledge to new situations and different domains (Epstein, 2019).

2.2.2. Rule-Based Reasoning

The script concept is similar to other concepts in cognitive psychology like *rule-based reasoning* (Anderson, 1990, 1993). This is a framework for skill acquisition that theorizes two major stages in the development of a cognitive skill: a *declarative* stage in which facts about the skill domain are interpreted (e.g. don't cover non-random risks) and a *procedural* stage in which the domain knowledge is directly embodied in procedures for performing the skill (e.g. risk-return tradeoff). Experts have extensive and highly organized knowledge. The knowledge underlying a skill begins in an initial declarative form to produce performance. As a function of its interpretive execution, this skill becomes compiled into a production-rule form. With practice, individual production rules acquire strength and become more attuned to the

circumstances in which they apply. This allows experts to think fast and to think complicated thoughts without hindrance by the limited capacity of short term memory. This general framework has been instantiated in the "*ACT*" (*Adaptive Control of Thought*) system (Anderson, 1990, 1993) in which facts are encoded in a propositional network and procedures are encoded as productions. Propositional representations (Kintsch, 1988) is a knowledge representation theory, similar to *scripts*, where reasoning is achieved through propositional calculus (Boole, 1854). A propositional network represents knowledge as simple idea units, represented by two nodes and a link (Kintsch, 1988). Productions represent knowledge about how we do things. Probably the most extensive use of such componential analysis is for intelligent tutoring systems such as computer tutors having been developed for training high school students in mathematics (Anderson, 1990, 1993). Programs make models of each student's problem-solving *scripts* and then identify incorrect rules the student uses which need to be changed.

2.2.3. Deliberate Practice

Traditionally, professional expertise has been judged by length of experience, reputation, and perceived mastery of knowledge and skill. Ericsson and Charness (2002) are careful to note, that not all practice leads to the development of expertise. In fact, observed performance does not necessarily correlate with greater professional experience. Expert performance can, however, be traced to active engagement in deliberate practice, where training is focused on improving particular tasks. Deliberate practice also involves the provision of immediate feedback, time for problem-solving and evaluation, and opportunities for repeated performance to refine behavior where deviations exist to focus on eliminating these points of discrepancy (Ericsson and Charness, 2002). This concept is consistent with the procedures and goals of *scripts* and *simple rules*-based training – which incorporates repeated exposure to expert *scripts*. Talent almost certainly plays some role but all the evidence indicates that genius is mainly perspiration that inspiration (Ericsson and Charness, 2002).

2.3. *Simple Rules* from Strategy and Insurance Risk Underwriting

Executives, including actuaries and underwriters, approach unpredictable situations as problem solvers (Simon, 1973). They develop a few *simple rules* / heuristics that fit available information (which is often spotty) and attention (which is often brief), but still provide workable solutions that are amenable to improvement. Bingham and Eisenhardt (2014) advocate that heuristics, are the essence of strategy, especially in unpredictable markets where opportunities are often numerous, fast moving, and uncertain (Bingham and Eisenhardt, 2008). Heuristics create structure thereby providing efficiency in the capture of opportunities, and yet also enable flexibility to improvise for unique features of particular opportunities.

Bingham and Eisenhardt (2014) compare the *simple rules* heuristics approach with "heuristics-and-biases" and "fast-and-frugal" heuristics research. Heuristics-and-biases focuses on universal heuristics that are automatically invoked and can lead to biased processes. Similarly, fast-and-frugal centers on universal heuristics that are automatic, but that also exploit the environment to achieve accurate predictions. *Simple rules* are idiosyncratic heuristics that are often consciously understood, combined with improvisation, and can constitute strategy especially in high-velocity environments where opportunities are superabundant, heterogeneous, and fast moving. Collectively, the three approaches offer a rich understanding of heuristics.

Simple rules heuristics have a common structure across processes that fits the goal of effectively capturing heterogeneous opportunities (Bingham and Eisenhardt, 2011). Bingham and Eisenhardt (2011) define *selection* heuristics as deliberate rules of thumb for guiding which sets of product or market opportunities to pursue (and which to ignore). An example of a selection heuristics in the insurance underwriting context could be "select only insurance risks where the insurance event is random risks". Bingham and Eisenhardt (2011) also define *procedural* heuristics as deliberate rules of thumb for guiding the execution of a selected

opportunity. An example of a procedural heuristics in the insurance underwriting context could be “ensure that interests an aligned between the insurer and client”.

Bingham and Eisenhardt (2011) indicate that firms learn heuristics that have a common structure centered on opportunity capture and are learned in a specific developmental order. This results in a deliberately small, yet increasingly strategic, portfolio of heuristics. The learning literature indicates that firms learn processes from experience (Argote, 2002). Bingham and Haleblian (2012) explore how firms learn heuristics from negative outcomes. Learning occurs as organizational members: (1) make attributions for negative outcome events; (2) communicate those attributions to others across the firm hierarchy through communication that is rhythmic, multi-hierarchical, and occurring within a fixed amount of time; and (3) arrive at convergent attributions for outcomes such that firm level heuristics can be created to prevent negative outcomes from reoccurring in the future. Prior literature has suggested that learning is strongly affected by whether attributions for negative outcomes are internal or external.

Every day, underwriters are faced with a blizzard of situations they must respond to. Without *simple rules* they would be forced to react to cases, as if we were experiencing each of them for the first time (Sull & Eisenhardt, 2016). If instead we classify these situations into types and have *simple rules* for dealing with them, we will make better decisions more quickly and have better results. Having a good set of *simple rules* is like having a good collection of recipes for success (Sull & Eisenhardt, 2016). Unfortunately, most professionals don’t do that and it’s very rare for people to write their simple down and share them. *Simple rules* improve performance by narrowing problem scope to more similar situations (efficiency) while leaving room to improvise specifics (flexibility) (Sull & Eisenhardt, 2016). They are easy to remember, communicate, and update; and can be surprisingly effective when experience is limited. This research aims to distill the key insurance underwriting *simple rules* (see Appendix II) used in the insurance industry. Rules can be refined as one encounters more experiences and to reflect on them, which will help one make better decisions.

CHAPTER 3: TRAINING DESIGN AND DEVELOPMEMNT OF THE HYPOTHESES

In this chapter we detail the design of the training intervention constructed for this study and also develop the hypotheses to be tested.

3.1 Introduction to Design of the Training

The training design has been uniquely designed for this present study. The detailed components of the training design are discussed in the sections in this chapter. In summary, our research extends the *script* training concept, used extensively in medical training, to the domain of insurance underwriting for the first time. As part of the research, we interviewed underwriters of varying levels of experience. We looked to capture the *scripts* of experienced underwriters; contrast this with novices and then use these as a training tool for underwriters. We then also looked to extract the *simple rules* that underlie the expert intuitive judgements in insurance underwriting and use these to formally train more deliberate judgements. The training intervention was administered to groups of professional underwriters and also groups of students. The impact of the training was measured for both accuracy and consistency improvements in underwriting decisions. Control groups were also established. We also examined the moderating impacts of experience and some components of mindfulness on the training impact. This is summarised in *Figure 3.1.* below:

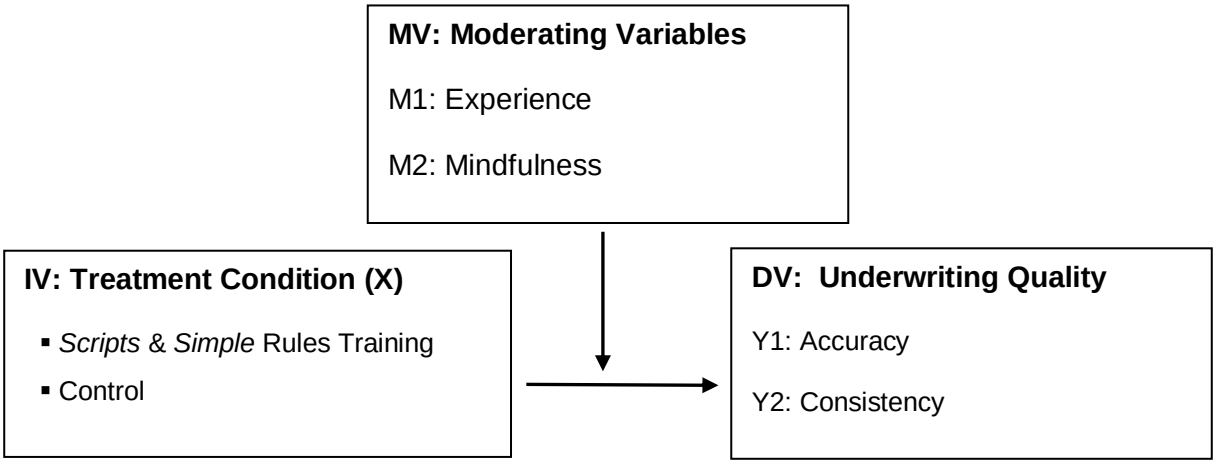

Figure 3.1. Schematic Representation of Conceptual Model

The main building blocks of the training design are described in more detail below:

3.2. Training Intervention (independent variable, X)

As discussed above, the thrust of this research is to look scientifically into the research question of whether training, using specifically *scripts* and *simple rules*, can help improve judgement and decision making in underwriting insurance risk. The aim of the study is to train insurance underwriters to do a good job by improving intuitive and deliberate judgements in insurance risk underwriting. This should hopefully accelerate the acquisition of expert judgement that is usually acquired by looking at a lot of cases over many years.

3.2.1. *Scripts* Component of Training

There is not really "one script" for being an underwriter, but rather, a large collection of *scripts* for all the tasks, all the variety of underwriting situations that may come up, for all the variety of companies (Hamm, 2004). Logically, the ability to do each of the underwriting tasks has to be built up, with attention as acquired and then automated into higher order structures or *scripts* that can be executed automatically and with the ability to focus consciously on any component when there is a problem. The distilling of learnings from the expert *scripts* into *simple rules* then helps trainees understand the reasons things are done.

Training interventions were designed to improve decision making, guided by a decision-*script* account of how experienced professionals make decisions. This contrasts with the JDM hope that people can carry out decision-theoretic analyses if trained, or by the notion that informing people about the errors that may be caused by heuristic strategies for estimating probability or value will enable them to use their heuristic strategies more judiciously. Training novices to use a *script* requires more than giving them paper copies of the specification of the strategy. *Scripts* are learned through explicit study, implicit modelling, practice, and review (Abernathy and Hamm, 1994, 1995). At intermediate stages in learning, the student or novice will have some *scripts* that are very well developed, others that are known just in outline form, and others that may not be known at all. Steps must be taken to ensure that people learn it, to support them in the practice necessary to master it, and to reward their use of the *script* on an

ongoing basis. It may be effective to also train insurance underwriters with an approach that has had success in training of surgeons; airline pilots and military officers (Hamm *et al*, 2000).

There are advantages and disadvantages of *scripts* of script training. On the plus side, the decision-*scripts* concept has face validity. It could account for results that were anomalous when observed by those working within the JDM research framework (Hamm, 2004). Script models may be viewed as more relevant to what people actually do than an approach which insists that people get as close as possible to the conclusions that could be drawn by analytical use of statistical data (Norman, 2000). On the negative side, some have criticized the *script* idea as just "rote learning" (Hamm, 2004). Also, doing research on the *scripts* requires detailed observation and this effort may have hindered researches exploring the concept in other domains (outside medicine).

Initial research was needed to discover the variety of *scripts* experienced underwriters actually have and why they use these *scripts*. This might be approached through some form of cognitive task analysis (CTA) (Klein, 1993). Underwriters could be studied while thinking aloud as they work or respond to hypothetical cases. Comparisons could be made between experts and novices (Abernathy and Hamm, 1994) or between underwriters known to underwriting cases aggressively or conservatively. The scope of this present research included discovering the approaches underwriters use for handling conflict between several of their own *scripts* that apply to the situation, as well as conflicts between underwriters who have different *scripts*. Once the *scripts* were developed, then they were analyzed to see what is the underwriting process and *simple rules* used.

Scripts were presented to a group of underwriters in a structured learning environment. This could have been delivered by pre-reads; lecture or blended learning. The underwriters were shown many *scripts* and the observations discussed in detailed. Given exposure to *script* training, the underwriter should gain underwriting skill (from learning, experience and not repeating past errors), which leads to a higher underwriting accuracy and consistency.

3.2.2. *Simple Rules* Based Component of Training

After examining many *scripts*, I attempted to extract the *simple rules* that make risks insurable and to accept/decline an offer e.g., don't cover non-random events – which Bingham and Eisenhardt (2011) define as selection heuristics. For a risk to be insured, it must have a number of specific characteristics – e.g. the risk event needs to be random (as illustrated above). Further simple selection rules for insurable risks are illustrated in Table A2.1 in Appendix II below. These *simple rules* on what is insurable are not always well know or explicit – but learnt with experience.

The insurance industry is constantly shifting the boundaries on what is insurable: what was uninsurable yesterday, we insure today and what is uninsurable today, we can insure tomorrow. We have known most of the risks for a long time in our industry – health insurance, car insurance, all these products. In addition, there are always new innovations, derived from the ongoing increase in knowledge. For example, when AIDS became an issue in the 1980s, the risk was uninsurable. Meanwhile, medical advances have made this risk more of a chronic illness and with a better understanding of the risks we now offer life insurance policies that include the risk of AIDS. Likewise, better modelling of flood risk can make previously uninsurable homes insurable.

Once it has been decided that the risk is insurable, then simple risk mitigation procedural rules should be used to manage the risk. For example, a limit could be imposed on the insurance payout for higher risks to protect the company for a very large payout. Further simple procedural risk mitigation rules for insurable risks are illustrated in Table A2.2. in Appendix II below – but are not the main rules trained on in this study. These risk mitigation rules are at the core of proper risk management – and also impact the appropriate pricing for these risk. Risk-based pricing can also influence positively the behaviour of individuals (e.g. a non-claim discount on car insurance will reduce premium and foster alignment between insurer and customer).

In the risk decision stage the underwriter needs to decide whether to "ACCEPT" or "DECLINE" the case. He needs to reconcile the analysis (quantitative) with the intuitive and deliberate judgement (qualitative). The residual risk then needs to considered relative to the premium and the risk-return trade-off assessed. Insurance companies may charge higher premiums to higher risk policyholders in order to compensate for the higher degree of uncertainty surrounding the risks they are taking on. The underwriter should be willing to walk away if the appropriate premium can't be obtained. Many underwriters are unable to consistently do this (Buffet, 2015).

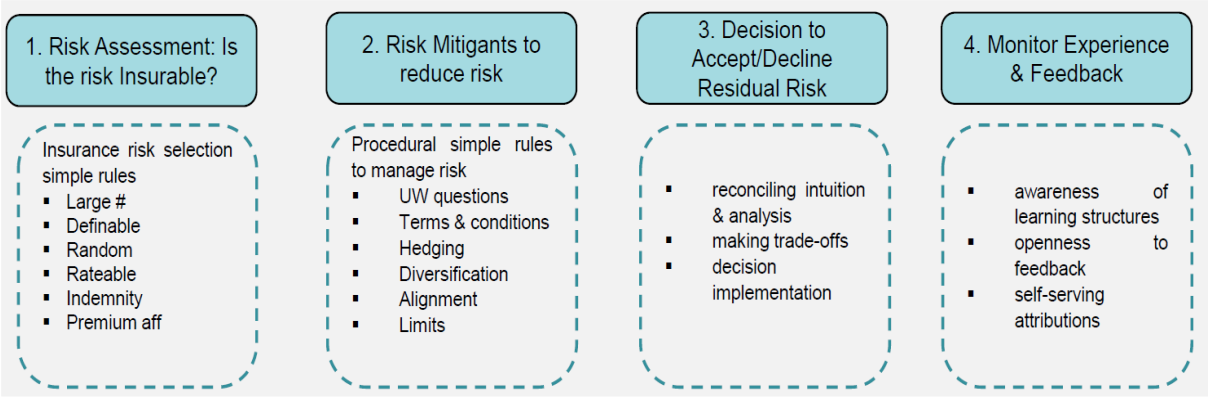

Figure 3.2.2. Steps in the Insurance Risk Underwriting Process

The distilling of learnings from the expert *scripts* into *simple rules* then develops a portfolio of *simple rules* to apply. Then in the *simple rules* training component the underwriters will be shown the basic underwriting process and the rules tables for the different stages. Given exposure to *simple rules* training, the underwriter should gain some underwriting skill, which leads to a higher underwriting accuracy and consistency.

3.2.3. Combining *Scripts* and *Simple Rules* Based Training

Now if we look at a training programme incorporating both *scripts* into *simple rules*, this has the potential to be more impactful – and greater than the impact of any of the individual trainings. This will cover the three elements to develop expertise (Kahneman and Klein, 2009) – the *scripts* technique gives exposure to many cases; the *simple rules* then provides systematised knowledge and the underwriting process ensures objective feedback.

3.3. Work Sample Tests (WST's) Used in Training

To ascertain the underwriting skill of underwriters, I used a work sample test (WST). WST's are high-fidelity assessment techniques that present conditions that are highly similar to essential challenges and situations on an actual job (Geisinger, 2013). WST's have been used for a variety of certification, training, and performance evaluation for a wide variety of jobs. Work samples can be used to evaluate the effectiveness of training programs. For example, if the objective of a training program is to improve underwriting quality, then a WST can be administered at the end of the training to determine whether the training objectives were achieved. The effectiveness of training can also be evaluated by giving WSTs to subjects before the training and immediately after to statistically test whether there has been any material improvement. WST can also be administered on a follow-up basis to ascertain if the knowledge and skills learned in training have been transferred to the work setting (Felker, Curtin and Rose, 2007).

As with any test, a WST is only a sample; here, the sample is an important sample of the domain of tasks in underwriting. This sample may be relatively narrow, but it is essential for effective job performance. The WST should contain the problems and challenges encountered on the job i.e. content fidelity. Situational fidelity ensures that features such as the industry and setting, time pressure, and stress match the actual conditions that underwriters are subject to. Psychological fidelity implies that the WST is measuring the knowledge, skills, abilities, and other characteristics required for effective job performance. In addition, as with all tests, the administration and scoring of WST's is controlled. Underwriting internships, defined as structured and career relevant underwriting experiences under a senior underwriter, may have a higher fidelity level (Geisinger, 2013) because interns tend to complete more than a small portion of the tasks that are required to perform well at the particular job.

Validity on a test / measure is achieved if it measures what it is supposed to measure (Geisinger, 2013). If the results of the underwriter test claimed that a poor underwriter was in

fact good, the test would be invalid. Regarding valid measurement, the key issue is whether there are any objectively, factually correct answers to the choices that participants make. Reliability is another term for consistency. If one person takes the same underwriting test several times and always receives the same results, the test is reliable. Reliability and validity are independent of each other (Geisinger, 2013). Validity evidence is typically gathered using subject matter experts who review test items and rate them with respect to their relevance and appropriateness for measuring the construct and with respect to the adequacy with which test content is congruent with the purpose of testing (Geisinger, 2013). Such analyses are important because they represent independent appraisals of what is intended to be measured. The *scripts* training, by definition, has face validity.

Test delivery options could be made on paper or online. The test answers should either be an "ACCEPT" or a "DECLINE". For explanations on the decision making process can be extracted in follow-up interviews. There was a schedule for pilot testing (a small-scale activity) followed by field testing (a larger activity likely to yield statistical results) (Geisinger, 2013). There should also be a plan for equating test forms over time – in terms of breadth of questions; difficulty; etc. The more thoughtful and detailed this test design, the more likely it is that the resulting test will meet its measurement goals. An example of a WST that can be used to determine underwriting quality in pre and post training interventions is presented in Appendix IV.

The use of WST in the training also has benefits for the learning process. WST's will force participants to generate answers to underwriting problems and this should help improve subsequent learning even if the generated answer is wrong (Epstein, 2019). The short-term struggle caused by being forced to provide answers in the test has the long-term benefit of facilitating "deep learning" by making connections (Epstein, 2016). The format of training and learning with WST's is more active than a passive lecture format – and this active learning facilitates improvements in skill levels.

3.4. Measuring Underwriting Quality (dependent variable, Y)

Insurance underwriting quality has 2 main dimensions: accuracy and consistency. These two aspects are covered in the sections below:

3.4.1. Underwriting Accuracy (Y1)

The accuracy of an insurance underwriting decision is determined by whether the underwriter gets the underwriting decision correct. Underwriting is the process of evaluating the risk of insuring an event and to determine if it's profitable for the insurance company to take the chance. After determining risk, the underwriter sets a premium (price) and terms and conditions under which the risk will be covered by the insurer/reinsurer. Underwriters are trained insurance professionals who understand risks, both Life and Health (L&H) and Property and Casualty (P&C) – and how to prevent them. They have specialized knowledge in risk assessment and use this to underwrite.

An insurance underwriter's role is to choose who and what the insurance company will insure based on this risk assessment – following the following key steps:

i. Reviews specific information to determine what the actual risk is and whether it is insurable.

ii. Determines what is the price and terms/conditions under which the insurance agreement is. May restrict or alter coverage by endorsement. Looks for proactive solutions that may reduce or eliminate the risk of future insurance claims i.e. risk mitigation.

iii. Based on the risk-return profile decides to “ACCEPT” or “DECLINE” the insurance cover.

iv. Finally, monitors the performance of the treaty and provide important feedback into the next coverage period.

The accuracy of the underwriting decision is whether the underwriter makes the correct decision which will be determined ultimately by the profitability of the deal. This could be known within a year for most forms of P&C business. However, the profitability for L&H business could take time to emerge. The insurance industry has lost billions of USD’s based on poor underwriting decisions in recent times. Hence, these underwriting decisions are crucial.

3.4.2. Underwriting Consistency (Y2)

The concept of "noise" or "variance" has recently been promoted by Kahneman (2018) and Gigerenzer and Brighton (2009) as a source of errors and somewhat distinctive from bias. The term "bias" has entered the public consciousness to the extent that the words "error" and "bias" are often used interchangeably. This is incorrect. In fact, better decisions are not achieved merely by reducing general biases (such as optimism) or specific social and cognitive biases (such as discrimination against women or anchoring effects). Executives who are concerned with accuracy should also confront the prevalence of inconsistency in professional judgements - i.e. noise. Noise is more difficult to appreciate than bias, but it is no less real or less costly.

Kahneman (2018) emphasizes one point: where there is judgement there is noise, and there's usually more of it than you think. Kahneman described noise as inconsistent and arbitrary decision making, whereas, bias is defined as a consistent, formulaic error. Further research needs to be done on the sources of noise – perception, internal judgement and more. People put attention toward different things when making decisions at different moments – and these differences lead to inconsistency or noise.

Kahneman (2018) shared his results from a consulting job with a leading insurance company to explain how noise and bias can lead to error in human decision-making, which can have significant financial consequences for companies Kahneman gave six cases to fifty underwriters at a leading insurance company. The underwriters were to assess these cases as if they were real. Kahneman collected the underwriters assessments of each case and the average amount of money they gave out. Many people believe that in a well-run organization there should be about 10-15% variability among each employee regarding the amount of money they would give to a case. However, Kahneman's findings were striking. When he computed the results, he discovered there was a 56% variability among the underwriters and claim adjusters regarding the amount of money they gave out in each case. This level of noise is shocking to executives and that level of noise is intolerable (Kahneman, 2018). If underwriters are that

noisy, it undermines the purpose of the professions. The work of Kahneman also mostly showed that experience did not reduce noise. Comparing people with more than 5 years of experience on the job to novices, the experienced people had just as much noise.

Replacing human decisions with an algorithm should be considered whenever professional judgements are noisy, but in most cases this solution will be too radical or simply impractical – until further trust is gained in these algorithms (Liebowitz *et al*, 2018). An alternative is to adopt procedures and judgement tool that promote consistency by ensuring that employees in the same role use similar methods to seek information, integrate it into a view of the case, and translate that view into a decision. Training is crucial, of course, professionals should be offered user-friendly tools, such as checklists (Gawande, 2011) and carefully formulated questions, to guide them as they collect information about a case, make intermediate judgements, and formulate a final decision. Unwanted variability occurs at each of those stages, and firms can—and should—test how much such tools reduce it. Ideally, the people who use these tools and are more mindful will view them as aids that help them do their jobs effectively and economically. The task of constructing judgement tools that are both effective and user-friendly is more difficult than many executives think (Kahneman, 2018).

When measuring the quality of decisions we look not only at the accuracy of decisions – but also at the consistency of the decisions or noise. We will examine the research question if *scripts* and *simple rules* training will also reduce the level of noise in underwriting decisions. The noise in underwriting decisions can cost insurers millions and any training intervention to reduce the noise will well be worth the effort. The training will give underwriters a greater awareness and understanding of the process, factors and resulting principles (from *scripts* and *simple rules*) going into underwriting decisions. Hence, they will be more consistent and less affected by the factors that can lead to noise in decisions.

As the above described training is designed to improve underwriting quality, as measured through accuracy and consistency in the work sample tests, hence we hypothesize that:

H1: Impact of Combined *Scripts and Simple Rules* Training on Insurance Risk Underwriting Quality

H1a: Insurance risk underwriting combined scripts and simple rules training will have a positive effect on accuracy in insurance risk underwriting decisions.

H1b:Insurance risk underwriting combined scripts and simple rules training will have a positive effect on consistency in insurance risk underwriting decisions.

3.5. The Impact of Moderating Variables on Insurance Risk Underwriting Training (moderating variable, M)

3.5.1. The Impact of Experience on Insurance Underwriting Training

Experience will have a moderating impact on the main effect relationship described above between training and underwriting accuracy / consistency. As the number of years of experience working as an underwriter increases, the impact of training on skill levels is dampened due to the already higher skills levels of experienced underwriters, which leads to a lower underwriting accuracy improvement. With experience, underwriters gain highly organized, domain-specific knowledge that allows them to encode complex insurance and financial information (Hoffman *et al*, 2014). This skill results in faster and more accurate underwriting performance. In underwriting tasks, experienced underwriters regularly employ recognition, pattern matching and mental simulation techniques. This relationship does not hold in all domains and hence it will be interesting to explore in the insurance underwriting domain. Expertise, unlike experience, does not just develop over time (Hoffman *et al*, 2014). The conditions needed for expertise to develop are exposure to many cases; systematised knowledge and objective feedback (Kahneman and Klein, 2009). Overall, the above suggests both a main effect and a moderating effect of experience. Hence, more formally, we hypothesize the following:

H2: Main Effect of Experience on Underwriting Quality

H2a: Experience will be positively associated with accuracy in insurance risk underwriting decisions.

H2b: Experience will be positively associated with consistency in insurance risk underwriting decisions.

H3: Moderating Effect of Experience on the Effect of Training on Underwriting Quality

H3a: Experience will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter.

H3b: Experience will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter.

3.5.2. The Impact of Mindfulness on Insurance Underwriting Training

Mindfulness, most often defined as the state of being openly attentive to and aware of what is taking place in the present, both internally and externally (Reb and Atkins, 2015) should help underwriters maker better forecasts and ultimately better insurance underwriting decisions. Mindfulness is characterized by a non-judgmental awareness of and attention to moment-by-moment cognition, emotion, and sensation without fixation on thoughts of past and future (cf. Kabat-Zinn, 1990).

Tetlock (2015) and Silver (2012) were able to extract some common personality traits of the very best forecasters, whom he termed "superforecasters" (Tetlock, 2015) – citing traits like openness, willingness to accept they made mistakes, revising believes; etc. Superforecasters harness the clarity of hindsight to develop more vivid pictures of the future. This actually relates very well to the objectives of mindfulness training. Tetlock (2015) observed that superforecasters are clever, on average, but by no means geniuses. More

important than sheer intelligence was mental attitude. Humility in the face of a complex world makes superforecasters subtle thinkers. They tend to be comfortable with numbers and statistical concepts such as "regression to the mean" – which essentially says that most of the time things are pretty normal, so any large deviation is likely to be followed by a shift back towards normality. However, Tetlock (2015) noted that superforecasters rarely use sophisticated mathematical models to make their forecasts, though they are uniformly highly numerate. Comfort with numbers seems a prerequisite for making good forecasts but fancy quantitative models are not. This is an interesting observation, given the numerical bent of underwriters and actuaries.

We have proposed that mindfulness can help individuals at each stage of underwriting decision – similar to decision making (Karelaia and Reb, 2015). The mindfulness framework described below also provides a good framework for making sound insurance underwriting decisions and links in with the actuarial control cycle. The framework can be summarised in Table 3.5.2. (Karelaia and Reb, 2015) below:

framing the decision	gathering information	coming to conclusions	learning from feedback
▪ seeing a decision opportunity ▪ goal awareness ▪ option generation ▪ avoiding irrational escalation of commitment ▪ recognising ethical dilemmas	▪ scope of information search ▪ confirmation seeking and overconfidence ▪ relevant vs irrelevant information ▪ appreciating uncertainty	▪ reconciling intuition and analysis ▪ making trade-offs ▪ decision implementation	▪ awareness of learning structures ▪ openness to feedback ▪ self-serving attributions

Table 3.5.2. Steps in the Mindfulness Process

At the stage of *framing the underwriting decision*, mindfulness may increase decision goal awareness thereby enhancing decision consistency with one's objectives and reducing post-forecasting regret (Karelaia and Reb, 2015). Greater goal clarity will in turn facilitate option generation, which will be further enhanced by creativity that mindfulness is likely to spark. Mindfulness may also promote using a forecast range (rather than a point forecast) or scenarios to underscore the uncertainty in the forecast.

At the stage of *information gathering and processing*, mindfulness may reduce the scope of information search and simultaneously increase the quality of information considered. In particular, mindful individuals are likely to be less prone to confirmation-seeking and overconfidence (Lakey et al., 2007), have a better ability to separate relevant from irrelevant information, and rely less on stereotypes. Furthermore, Karelaia and Reb (2015) posit that mindful individuals are more likely to objectively assess uncertainty and productively work with it. Mindfulness also has the potential to reduce illusory pattern detection, although they acknowledge that more research is clearly needed to shed further light on these effects (Karelaia and Reb, 2015). Tetlock (2015) states that superforecasters do have a healthy appetite for information, a willingness to revisit their predictions in light of new data, and the ability to synthesise material from sources with very different outlooks on the world. Tetlock (2015) also observes that superforecasters think in fine gradations – so rather than assigning something a probability of 60 to 40, for instance, a superforecaster might, after careful consideration and many small revisions to take account of newfound subtleties, settle on odds of 62 to 38. Most important is what Tetlock (2015) calls a "growth mindset": a mix of determination, self-reflection and willingness to learn from one's mistakes. Tetlock (2015) noted that the best forecasters were less interested in whether they were right or wrong than in <u>why</u> they were right or wrong - they were always looking for ways to improve their performance. This involves a lot of hard work.

At the *coming to conclusions* stage, when the underwriter has to choose a course of action, mindfulness can help by improving one's ability to use both judgement and analysis to reach a forecast, even when the two systems suggest different choices (Karelaia and Reb, 2015). Moreover, making trade-offs should be easier for more mindful decision makers, which will reduce forecast deferral and forecast avoidance (Karelaia and Reb, 2015). Mindfulness is also likely to facilitate forecasting implementation by reducing the intention-behaviour gap (Chatzisarantis and Hagger, 2007). Tetlock (2015) noted that scepticism, learning from mistakes, openness and hard work enabled smart amateurs using publicly available information to outperform skilled intelligence

analysts. Tetlock (2015) observed that superforecasters displayed certain behaviours like basing their predictions on data and logic; trying to eliminate personal bias; keeping track of records so that they know how accurate they are; thinking in terms of probabilities; recognizing that everything is uncertain; unpacking a question into its component parts; distinguishing between what is known and unknown, and scrutinizing their assumptions. Tetlock (2015) divides people into two categories: hedgehogs, whose understanding of the world depends on one or two big ideas, and foxes, who think the world is too complicated to boil down into a single slogan. Tetlock (2015) concludes that superforecasters are drawn exclusively from the ranks of the foxes. Hedgehogs are confident in their deep knowledge and are often guided by one or two theories (e.g. Keynesianism; post-liberalism; communism; etc.). Foxes are sceptical about such theories, open-minded, cautious in their forecasts and quick to adjust their ideas as events change. Rather than rely on one or two simplifying ideas to explain events, Tetlock's (2015) superforecaster foxes embraced complexity and were comfortable with ambiguity and a sense of doubt.

Finally, mindful underwriters are more likely to *learn from feedback* and, importantly, learn the right lessons (Karelaia and Reb, 2015). Perhaps most encouragingly, Tetlock (2015) found that people can be trained to be better forecasters and even with just one hour of training results could be raised by 10 percent. For individuals, the training focused on thinking in terms of probabilities and removing thinking biases – for instance, focussing on the limitations of one's own knowledge and being open to alternative views. In other words, prediction is not only possible, it is teachable. Politics and human affairs are not inscrutable mysteries (Tetlock, 2015). Instead, they are a bit like weather forecasting, where short-term predictions are possible and reasonably accurate (Silver, 2012).

The *Actuarial Control Cycle* (Lyon et al,2010) is similar to the process described above and is based on a simple problem-solving algorithm: define the problem; design the solution; and monitor the results. The whole process, or control cycle, is conducted within an

environment or context that shapes the decisions taken. The cycle is iterative: the three steps may be repeated or at any stage we may return to an earlier step. This problem-solving process is universal. It applies to any field of activity. What makes the *Actuarial Control Cycle* distinctly actuarial is the nature of the work carried out at each stage of the cycle. The problem will usually involve uncertain future cash flows. The process of defining the problem includes understanding the background, fully identifying all the issues and specifying them clearly to ensure that the client and the actuary / underwriter agree on the work to be done. The design of a solution will almost always involve modelling (analysis) and judgement. The actuary / underwriter may have ongoing responsibility for monitoring the experience as it develops and advising on the response. Underwriting decisions will never be perfectly accurate. Underwriters / actuaries use these observations and experience to update their models; assumptions and judgement. This feedback cycle is termed the *Actuarial Control Cycle* (Lyon, 2010) and systematically addresses discrepancies between the underwriter's decisions and observed reality. There is overlap with the general underwriting process; actuarial control cycle and mindfulness process, as illustrated in *Figure 3.5.2.* below:

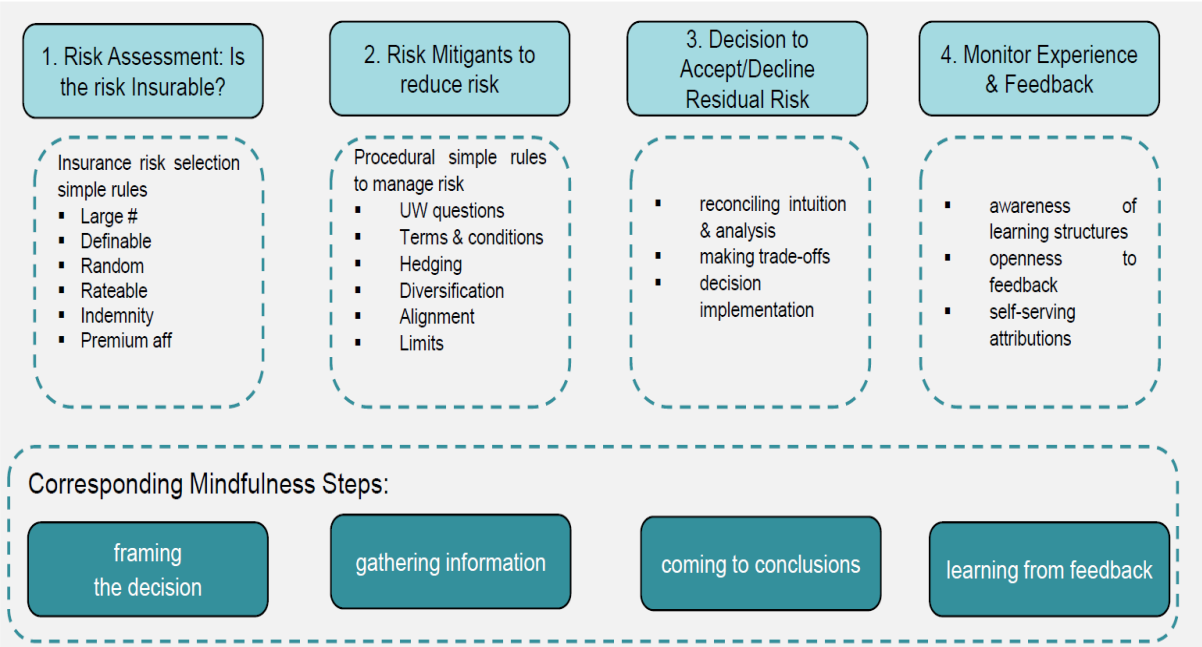

Figure 3.5.2. Overlaps between the Insurance Risk Underwriting Process and Mindfulness Process

Underwriters / actuaries who follow the above processes will be more mindful in their decision making. We will investigate later the moderating influence of mindfulness on the impact of *scripts* and *simple rules* training and hypothesize the impact being lesser / greater for those having more mindfulness working as an underwriter. The mindfulness framework outlined above is fully congruent with the processes needed for *scripts* and *simple rules* training to be effective.

Mindfulness will have a moderating impact on the main effect relationship described above between training and underwriting accuracy. As the mindfulness as an underwriter increases, the impact of training on skill levels is dampened. Underwriters with higher mindfulness will already understand the process to gain highly organized, domain-specific knowledge that allows them to encode complex insurance and financial information. This skill results in faster and more accurate underwriting performance. The impact of training on skill levels for more mindful subjects is hence dampened due to them already being more attune with the concepts of *scripts* and/or *simple rules*. Overall, the above suggests both a positive main effect of mindfulness, as well as a negative moderating effect.

A distinction can also be made between mindfulness as a trait and mindfulness as a state. Mindfulness as trait can be viewed in terms of one's predisposition to be mindful in daily life (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). The above mentioned mindfulness refer to the trait mindfulness. Mindfulness can also be conceptualized as a state that captures the attention levels of participants during the training (Lau *et al*., 2006) We also hypothesize that state mindfulness will have a positive main effect with underwriting quality and also a positive moderating effect. With higher state mindfulness attention, participants should show higher improvements in both accuracy and consistency post-training. The higher attention levels should resulted in them benefiting more from the training and being more focussed during the posttest work sample test (WST).

More formally, we hypothesize the following:

H4: Main Effect of Mindfulness on Underwriting Quality

H4a: Trait Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions.

H4b: Trait Mindfulness will be positively associated with consistency in insurance risk underwriting decisions.

H4c: State Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions.

H4d: State Mindfulness will be positively associated with consistency in insurance risk underwriting decisions.

H5: Moderating Effect of Mindfulness on the Effect of Training on Underwriting Quality

H5a: Trait Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those higher on Trait Mindfulness.

H5b: Trait Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those for those higher on Trait Mindfulness.

H5c: State Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being higher for those higher on State Mindfulness.

H5d: State Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being higher for those for those higher on State Mindfulness.

3.6. Summary of Hypotheses

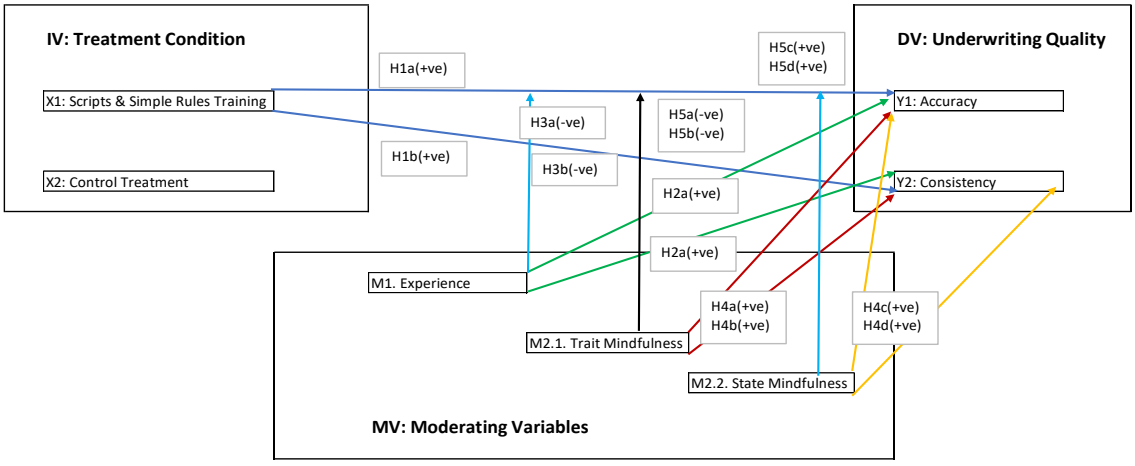

Figure 3.6. Schematic Representation of Variables & Hypotheses (with expected results)

Table 3.6. Hypotheses Summary

Hypothesis #	Description
H1: Both *Scripts* and *Simple Rules* Training	H1a: Insurance risk underwriting combined *scripts* and *simple rules* training will have a positive effect on accuracy in insurance risk underwriting decisions. H1b:Insurance risk underwriting combined *scripts* and *simple rules* training will have a positive effect on consistency in insurance risk underwriting decisions.
H2: Main Effect of Experience	H2a: Experience will be positively associated with accuracy in insurance risk underwriting decisions. H2b: Experience will be positively associated with consistency in insurance risk underwriting decisions.
H3:Moderating Effect of Experience	H3a: Experience will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter. H3b: Experience will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter.
H4: Main Effect Impact of Mindfulness	H4a: Trait Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions. H4b: Trait Mindfulness will be positively associated with consistency in insurance risk underwriting decisions. H4c: State Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions. H4d: State Mindfulness will be positively associated with consistency in insurance risk underwriting decisions.
H5: Moderating Impact of Mindfulness	H5a: Trait Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those higher on mindfulness. H5b: Trait Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those for those higher on mindfulness. H5c: State Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being higher for those higher on mindfulness. H5d: State Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being higher for those for those higher on mindfulness.

CHAPTER 4: RESEARCH METHODOLOGY

4.1. Developing the *Script*s for the Training

Participants and Procedure: Initial research, before the training study, was needed to discover the variety of *scripts* or "think alouds" underwriters actually have and why they use these *scripts*. This pre-study involved interviewing underwriters face to face, of varying levels of working experience, at an international reinsurance company based in Singapore. We recruited participants with the help of the HR department who provided names and email addresses of potential participants in different experience bands. An invitation to participate in the interviews was sent out via email to 50 underwriters. Participation was voluntary.

A total of 35 underwriters volunteered for the interviews and 30 were chosen - 10 underwriters each in junior; mid-career and senior underwriting roles. Underwriters at different levels of experience were needed to compare and contrast the *scripts*. I interviewed each underwriter in the offices of the multi-national reinsurer. Each underwriter was presented 5 to 6 underwriting situations and asked to decide to accept or decline the particular risk. We developed the underwriting situations from real-life examples and they were thought to be representative of real situations that underwriters have to deal with in practice (Geisinger, 2013 and Kahneman, 2018). I knew the real-life underwriting situations from working as a senior underwriter for many years in a reinsurance company that deals with a wide variety of underwriting situations. They were asked to think aloud so that their thought process to arrive at the decision could be recorded. Participants were allowed to skip any questions which they are not comfortable answering during the interviews. Participants were able to withdraw from the study at any point in time by informing the interviewer – but none did. The interviews took approximately 30 minutes and were not audio-recorded but only detailed notes transcribed to capture the *scripts*. The interviews were not audio-recorded as this seemed to make the underwriters uncomfortable in some early trials.

The interview process yielded 150 *scripts* (5 each from 30 underwriters with varying levels of experience) across 50 unique underwriting problems (from the 50 underwriting problems a sample of 5 or 6 were presented to each underwriter). The *scripts* take the form of recordings (presented in written format) of the verbalized thoughts of underwriters who were asked to think aloud as they examined and contemplated the different presented risks. Each of the particular risks was presented to a junior; mid-career and senior underwriter. Responses were compared and contrasted in the training, between experts and novices or between underwriters known to be underwriting cases aggressively or conservatively. I was able to judge this given my dual role as both researcher and senior underwriter. Once the *scripts* were developed, I noted some observations on the thought processes of the underwriters. The full collection of *scripts* were also analyzed in detail to see what the underwriting process is and what are the *simple rules* used (see Appendix I and Appendix II).

Example of Underwriter *Scripts* (or "Think Alouds"): The following are 2 simple examples of *scripts* from insurance underwriting – one where the risk should be "DECLINED" and one where it should be "ACCEPTED". The risk should be accepted/rejected on the criteria of whether the risk will be profitable for the company (premiums greater than claims).

#1. Divorce Insurance: Insurance product providing coverage for divorce costs in the event of an unhappy marriage that leads to an expensive divorce.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. There are detailed statistics on divorce rates that can be used to determine the probability of claim."	"Could be – under certain circumstances. We would need to interview the couple at the outset to determine the risk."	"DECLINE. We don't cover that, quite apart from the dubious ethics involved. A simple rule of our industry is that we insure random risks. This is not the case in your example. A spouse could claim that he is unhappy and separate from his partner, just to get the money from the insurance. It would be naive to insure something like that. Hence, it's a clear DECLINE"
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. He recognizes immediately the non-random potential of the event and the high risk of anti-selection. The Junior Underwriter is focused more on the analytical aspects of pricing the risk and misses the obvious risk of anti-selection. The Mid-career Underwriter misses the point that the risk is not random.		

#**2. Agro Insurance**: Insurance product coverage for input costs to farmers for costs stemming from damage to crops from drought/hail/etc.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. Does not feel like something that could be insured. We will be ruined looking at the recent droughts."	"DECLINE. Does not feel like something that could be insured. The trend of global warming makes this uninsurable"	"This can be viewed as innovative insurance where there is real demand. Yes, it's a new type of insurance with limited data and models. But with proper underwriting, the risk should be insurable. The benefit amount meets a financial loss. We could spread the risk through global geographic diversification. We could look at accumulation control and capacity budget through limits. Farmers are an important political block in certain countries so price increases could create some Political Risk. Overall, given the higher premiums we could extract, I will ACCEPT this risk."
Observations: The Chief Underwriter is very methodical is checking through some *simple rules* of what makes a risk insurable. He/she also manages the residual risk through diversification and imposing claim limits. He finally looks at the risk-return profile as attractive. The more junior underwriters appear paralyzed by the availability bias that prevents them from seeing the insurance opportunity.		

Figure 4.1. Examples of Underwriting *Scripts*

Of the 50 unique underwriting situations and associated *scripts* created, 40 were selected for the training and 10 held as reserve (in case issues in the pilot training indicated problematic problems). A set of 20 problems was carefully selected for the pretest and training (where the *scripts* for the problems were discussed in detail). The 20 problems had to reveal the various rules of underwriting. Another set of 20 problems was selected for the posttest and care was taken to have it at a similar level of difficulty to the pretest and also covering all *simple rules*.

Integrity of Underwriter *Scripts*: The integrity of *scripts* was ensured using the two approaches of coherence (consistency) and correspondence (Hammond, 2000). As described earlier, correspondence is based on performance in the real-world. Correspondence criteria are based on the accuracy of predicting or judging empirical events (Hammond, 2000).The performance of senior underwriters follows correspondence. Most of the *scripts* of senior underwriters and are backed up by a track record of successful underwriting judged by profitability – with mistakes and losses made earlier in their careers. I was able to use my role as a senior underwriter to identify the successful *scripts* from senior underwriters that have led

in practice to profitable business. In contrast, I was also able to use my role as a senior underwriter to evaluate flaws in the *scripts* of more junior underwriters and point to situations where these would have led to losses.

Range of Underwriter *Scripts* : An discussed earlier, there are benefits of including a wide range of underwriting situations in the training design. Hence, the training design covered many different situations by design across Life & Health; Property & Casualty; special lines like Space insurance and newer innovative risks like Cyber risk. Training using this wider range of cases gives younger underwriters the benefits of breadth and diverse experience and the interdisciplinary thinking that comes with that (Epstein, 2019). It also underscores that the *simple rules* extracted from these varied situations are quite universal within the domain of insurance and can be applied across a wide range of risks.

4.2. Extracting the *Simple Rules* of Insurance Risk Underwriting for Training

Procedure: From the 50 unique problems and associated *scripts*, 10 *simple rules* were extracted (see Appendix II). An example from the "Divorce Insurance" example above is that we should only be insuring random events (which the client cannot influence) as underlined in the script below:

<table>
<tr><td colspan="3">#1. Divorce Insurance: Insurance product providing coverage for divorce costs in the event of an unhappy marriage that leads to an expensive divorce.</td></tr>
<tr><td>1st year trainee
Junior Underwriter</td><td>Mid-career
Underwriter</td><td>Experienced
Chief Underwriter</td></tr>
<tr><td>"ACCEPT. There are detailed statistics on divorce rates that can be used to determine the probability of claim."</td><td>"Could be – under certain circumstances. We would need to interview the couple at the outset to determine the risk."</td><td>"DECLINE. We don't cover that, quite apart from the dubious ethics involved. <u>A simple rule of our industry is that we insure random risks.</u> This is not the case in your example. A spouse could claim that he is unhappy and separate from his partner, just to get the money from the insurance. It would be naive to insure something like that. Hence, it's a clear DECLINE"</td></tr>
<tr><td colspan="3"><u>Observations</u>: The Chief Underwriter is very sure in his assessment that this risk is not insurable. He recognizes immediately the non-random potential of the event and the high risk of anti-selection. The Junior Underwriter is focused more on the analytical aspects of pricing the risk and misses the obvious risk of anti-selection. The Mid-career Underwriter misses the point that the risk is not random.</td></tr>
</table>

The main rules are then further developed by expanding on the description and defining some of the key terms. For example, we developed the "event must be random" rule further as:

Rule	Rule description...
The risk <u>event</u> must be <u>Random</u>	The insured event should be random and unintentional. Ideally, the loss should be unforeseen and unexpected by the insured and outside of the insured's control. Thus, if an individual deliberately causes a loss, he or she should not be indemnified for the loss. <u>Moral hazard/ anti-selection</u> is increased if the insured deliberately intends to cause a loss. Adverse selection is the tendency of persons with a higher-than-average chance of loss to seek insurance at standard rates. Moral Hazard is dishonesty or character defects in an individual that increase the frequency or severity of loss.

Figure 4.2. Examples of *simple rules* Developed from an underwriting script.

The extant literature on insurance does not cover the *simple rules* extracted in this study in a comprehensive way. The existing literature may go deep into one of the principles e.g. the principle or "rule of indemnity" – but does not provide a comprehensive list or look into how these rules emerge from underwriting *scripts*. Hence, this study also contributes to the existing insurance literature by providing a comprehensive set of *simple rules* to apply to assess the viability of an insurance scheme. I did draw on some insurance literature to define key terms (e.g. moral hazard) and develop the rules further (Thoyts, 2010; Redja & McNamara, 2017). The full list of simple rules needed for insurance underwriting is presented in Appendix II.

The *simple rules* incorporated into the training programme in this study falls within the scope of coherence (Hammond, 2000). The *simple rules* are congruent with the concept of coherence or consistency criteria that are based on normative standards of and rationality. The set of rules emerging from this study is also relatively few at 10 (see Appendix II) – and as mentioned earlier, quite universal within the domain of insurance.

4.3. Training and Control Participants and Samples

In total, we held 6 sessions (4 training; 2 control) to collect the data for this the following research. The table below gives a summary of the 6 sessions

Table 4.3. Summary of Training and Control Sessions

Status	Study	Intervention	Sample	Number of Participants		Mean Age	Std. Dev. Age
Professionals	P1	Training	International Reinsurer's Underwriters	40	110	26.0	4.1
	P2	Training	Singapore Industry Underwriters	35		31.3	7.2
	P3	Control	Singapore Industry Underwriters	35		27.6	4.3
Students	S1	Training	Actuarial Science Club	24	110	21.3	2.1
	S2	Training	JDM class pm	44		22.2	1.1
	S3	Control	JDM class am	42		22.4	1.3

NB: By coincidence the number of Professionals and Students were both 110 but 1 professional with no experience was recoded as a Student.

4.3.1. Professionals: Three training sessions were conducted using professionals working in the insurance/reinsurance industry:

Session P1: The first study and pilot involved training 40, mainly junior, underwriters at an international reinsurance company's Singapore branch. Junior underwriters with working experience of less than 5 years were mainly targeted as it was reasoned that they would have most to gain from such training. However, a few more experienced underwriters participated – but the overall experience level was skewed to the more junior underwriters. The main researcher recruited participants with the help of the HR department who gathered names and email addresses of potential participants in desired experience band. HR then sent out the recruitment email on my behalf to the mainly junior underwriters and 40 accepted. More senior underwriters also requested to attend the training and were allowed to. The training was conducted at the training facility of the reinsurance company in downtown Singapore. Participants were sent details of the training time, date, venue and synopsis of the training. There was one intern in this group with no experience who was subsequently coded as student.

Sessions P2 & P3: This study involved training underwriters of relatively junior experience levels working in Singapore insurance/reinsurance industry who attended a training session sponsored by the Singapore Actuarial Society (SAS). Participants were recruited with the help of the Singapore Actuarial Society who sent out the recruitment email to their mainly junior members to take part in the study. Potential participants were presented with two alternative dates and interested junior underwriters were assigned to the P2 training (earlier) or P3 control (later date) study based on their availability. Participants were not told which session would be training/control. The number of participants was capped at 35 for each session due to the capacity of the training venue and both sessions were over- subscribed. The training was again conducted at the training facility of the reinsurance company in downtown Singapore. Participants were sent details of the training time, date, venue and synopsis of the training.

4.3.2. Students: Three studies were conducted using students not working in the insurance/reinsurance industry – but studying at a Singaporean business school.

Sessions S1: In the first session with the students, 24 students from the Actuarial Science club of the Singaporean business school were trained. Students were from a varied backgrounds in the club and not just studying Actuarial Science – but also Economics; Law and other business majors. Participants were recruited with the help of the students running the Actuarial Science club who sent out the recruitment email to their members to take part in the study (to comply with the PDPA, the club did not copy me in the recruitment email). The training was conducted at a training facility on the business school campus in downtown Singapore. Participants were sent details of the training venue and synopsis of the training.

Sessions S2 & S3: Participants were students in a Singaporean business school taking a course in JDM. The students were informed by the instructor of the training which was conducted during one of the regular sessions of the programme. The class was broken up into 2 groups – a morning session and an afternoon session. A coin was flipped to determine that

the training intervention was conducted in the afternoon session (S2, 44 students) and the control treatment in the morning session (S3, 42 students).

4.4. Combined *Scripts* and *Simple Rules* Training Method

Training Procedure: I trained these underwriters/students in an intensive 2-hour training session focusing on underwriting *scripts* and *simple rules* (see Appendix V for schedule). 4 iterations of the training were conducted plus an additional 2 control studies. To ensure consistency across the different iterations, all training and control studies were conducted by the main researcher.

Before the training study participants read an informed consent form and indicated their consent by signing the form. Participants were also asked to sign an attendance sheet at the start of the training session and were provided a unique participant ID, which they needed to input on test/surveys during the study and acted as a unique identifier for participants to match the different surveys/data collections. No names or other personal identifiers (e.g., phone numbers) were collected but age, gender and experience (in years) recorded by participants (on pre-test sheets). Participants then completed a 10 minute pre-training mindfulness survey (Appendix III). Then a 20 minute pre-training working sample test (WST) (as in Appendix IV) to test their underwriting quality was administered. All the data was collected within the actual training session, including the pre-training mindfulness scale and the pre-test. Data was collected via hard copies as it was more convenient during the training for participants (instead of online).

The training started immediately after the pre-training mindfulness survey and the pre-test paper was collected (30 minutes into the training). The training lasted approximately one hour and a PowerPoint presentation format was used. The training started with a brief introduction to definition of insurance underwriting. This was followed by an introduction of concepts around *scripts* and *simple rules*. The main part of the training then followed with a detailed analysis of the pre-test results using the *scripts* for the 20 questions in the pre-test. The

scripts of the underwriters at varying levels of experience were presented and compared and contrasted. The observations from the researcher were discussed and the simple rules underlying good underwriting decisions were extracted from the *scripts*. The training was concluded with a summary of the *simple rules* – and an illustration of how the *simple rules* application can ensure accuracy and consistency across underwriting decisions (see Appendix II).

Immediately after the training participants underwent a 20 minute post-training test to gauge the impact of the training intervention. Participants were presented with a new set of 20 underwriting situations and again asked to ACCEPT/DECLINE the risk. As mentioned earlier, care was taken to ensure that the posttest was of a similar level of difficulty as the pretest and also covered the full range of simple underwriting rules. Once participants had completed the study, they were shown a study debrief explaining the purpose of the study and also allowed the opportunity to withdraw their data, but none did.

4.5. Control Study Training Method

The control study followed mainly the above training process – with the same surveys and pretest and posttest. However, the key change was instead of the *scripts* and *simple rules* training, a video of approximately one hour duration (same duration as the training) was presented to control participants. The video was chosen to be somewhat related to the topic but did not cover any of the *script* and *simple rule* insurance underwriting material used in the main training. The video was a talk by Daniel Kahneman on Expertise, Bias and the Investment Industry delivered at the 2018 Global CFA conference in Hong Kong. A link to this talk is given in the references section under Kahneman (2018). He covered some of the key ideas that have driven his scholarship, exploring intuition, expertise, bias, noise, and how optimism and overconfidence simultaneously drive and undermine the capitalist system (Kahneman,2018).

4.6. Measures

4.6.1. Dependent variables: The main interest of the study is to determine if the training intervention could increase underwriting quality, both accuracy and consistency (as discussed in Chapter 3). Hence, Accuracy and Consistency were the dependent variables in the study. We measured Accuracy and Consistency of underwriting using the work sample test (WST's, see Appendix IV). The Accuracy measure was simply calculated by granting ½ point for each correct answer. As there were 20 questions in the WST, the total score for Accuracy was out of 10. For the Consistency measure a point was awarded if participants got a pair of linked (by same *simple rule*) correct (see Appendix IV).

4.6.2. Moderator variables: We were interested in the moderating impact of experience and mindfulness on the results. Experience was measured in years working as an underwriter. All students were coded with 0 experience. We also used the Status measure to differentiate between working Professionals and university Students. Mindfulness was measured by using a two component model of mindfulness that may best describe these psychological states, in which one state is attentional and the other state is about meta-awareness (Bishop et al., 2004; Garland, Gaylord, and Fredrickson, 2011; Kudesia, 2019).

- *Mindful attention* refers to the state in which people continuously allocate their attention toward ongoing situations, actively gathering the available information, rather than allowing interference from unrelated thoughts and feelings (Brown and Ryan, 2003; Dane, 2011; Mrazek, Smallwood, and Schooler, 2012).
- *Mindful meta-awareness* refers to the state in which people mentally "step back" from their interpretations of ongoing situations and monitor these interpretations from a detached stance, rather than automatically assuming them (Teasdale, 1999; Bernstein et al., 2015).

The following 3 Mindfulness measures were captured:

Table 4.6.2. Description of Mindfulness Measures Used

Measure	Description
Trait mindful attention (TMAt)	A 5 item mindfulness attention measure that aims to capture the mindfulness attention trait present-moment attention (lack of absentmindedness). This was measured pretest to assess the attention trait of participants. All participants anonymously responded to a survey measure, scored on a 5-pt Likert-style scale with scale end points (1, 5) (see Appendix III for full scale). Participants reported their mindful attention using items from the Mindful Attention and Awareness Scale (Brown and Ryan, 2003), which is the most commonly used scale in management (Sutcliffe, Vogus, and Dane, 2016). These items assess the tendency for attention to drift from ongoing events and are thus reverse-scored to indicate mindful attention. Representative items include "I rush through activities without being really attentive to them." and "I find myself doing things without paying attention. "
Trait meta-awareness (TMAw) -	A 6 item mindfulness attention measure that aims to capture the mindfulness attention trait meta-awareness. This was measured pretest to assess the meta-awareness trait of participants. All participants anonymously responded to a survey measure, scored on a 5-pt Likert-style scale with scale end points (1, 5) (see Appendix III for full scale). Participants reported their mindful meta-awareness using items from the Experiences Questionnaire (Fresco et al., 2007), which is one of the few face valid scales of the metacognitive component of mindfulness that are also validated for use on non-clinical populations (Bernstein et al., 2015). These items assess the tendency to monitor thoughts and feelings in a detached manner. Representative items include "I can separate myself from my thoughts and feelings" and "I can observe unpleasant feelings without being drawn into them."
State mindful attention (SMAt)	A 5 item mindfulness attention measure that aims to capture the state of mind during the training. This was measured potsttest to assess the state of attention during the training and test. This was measured on a 5 point Likert scale with scale end points (1, 5). (see Appendix III for full scale). Participants again reported their mindful attention using items from the Mindful Attention and Awareness Scale (Brown and Ryan, 2003). Like TMAt, this scale is also reverse coded. Representative items include "I find it difficult to stay focused on what's happening in the present moment" and "I did things without paying attention. "

4.6.3. Control variables: there are numerous contextual factors which may affect the outcomes of the study and need to be controlled for. Hence, we also included the control variables of age; gender and education level. Education level was captured by highest academic qualification obtained such as undergraduate; bachelors or masters.

4.6.4. Summary of Study Variables

In summary, the following 14 study variables were captured for each participant:
Table 4.6.4. Description of Study Measures

#	Factor	Description
1	Treatment	Training or Control (Control coded 0; Training coded 1)
2	Participant ID	A unique identifier number for each participant. This is used to link the pretest & posttest measures
3	Age	Age last birthday at time of training
4	Gender	Female = F; Male =M (Female coded 0; Male coded 1)
5	Status	Professional (P) or Student (S) (Student coded 0; Professional coded 1)
6	Experience	Measured in years working as an underwriter (for all companies). All students were coded with 0 experience.
7	Education	Highest academic qualification: Undergraduate (U); Bachelors (B) or Masters (M) – (coded 0;1;2 respectively)
8	Pretest-TMAt	Trait mindful attention - a 5 item mindfulness trait attention measure. This was measured pretest on a 5 point Likert scale with scale end points (1, 5). Reverse coded so transformed by 6 – score. (see Appendix III)
9	Pretest-TMAw	Trait meta-awareness (TMAw) - 6 item mindfulness awareness measure. This was measured pretest on a 5 point Likert scale with scale end points (1, 5). (see Appendix III)
10	Posttest-SMAt	State mindful attention (SMAt) – a 5 item mindfulness attention measure. This was measured potsttest to assess the state of attention during the task. This was measured on a 5 point Likert scale with scale end points (1, 5). Reverse coded so transformed by 6 – score. (see Appendix III)
11	Pretest - Accuracy	Accuracy measured before the treatment, ½ point for each correct answer (see Appendix IV)
12	Posttest - Accuracy	Accuracy measured after the treatment, ½ point for each correct answer (see Appendix IV)
13	Pretest - Consistency	Consistency measured before the treatment, 1 point for each correct pair (see Appendix IV)
14	Posttest - Consistency	Consistency measured after the treatment, 1 point for each correct pair (see Appendix IV)

CHAPTER 5: DATA ANALYSIS AND RESULTS

5.1. Data

220 (143 for Training and 77 for the Control) rows of data was captured for the participants in the study with the 14 study variable data fields described in Chapter 4. An extract of the data is presented below:

Table 5.1.1. Sample of Data

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Treatment	Participant ID	Age	Gender	Status	Experience	Education	Pretest_ TMAt	Pretest_ TMAw	Posttest_ SMAt	Pretest - Accuracy	Posttest - Accuracy	Pretest - Consistency	Posttest - Consistency
Training	2	24	F	P	2	B	4.6	3.7	5.0	5.5	7.0	4.0	5.0
Training	13	24	M	P	1	M	3.6	3.0	4.8	6.0	9.0	4.0	8.0
Training	21	26	F	P	3	B	3.2	2.3	3.8	5.5	7.5	5.5	6.0
Training	68	27	F	P	4	B	4.4	3.8	4.0	6.5	9.0	5.0	8.0
Training	77	23	F	P	2	B	4.8	3.8	5.0	5.5	8.5	4.0	8.0
…	…	…	…	…	…	…	…	…	…	…	…	…	…
Training	28	21	M	S	0	U	1.8	1.7	3.0	7.0	9.0	5.0	8.0
Training	38	21	F	S	0	U	2.0	2.5	4.8	5.5	8.5	3.0	7.0
Training	76	22	M	S	0	U	2.8	3.8	4.8	6.0	9.0	5.0	8.0
Training	120	19	F	S	0	U	3.2	2.7	4.6	6.5	6.0	4.0	4.0
Training	132	25	M	S	0	U	1.0	3.8	1.0	5.5	6.5	5.0	6.0
…	…	…	…	…	…	…	…	…	…	…	…	…	…
Control	5001	26	M	P	2	M	3.4	3.5	3.8	6.0	6.0	3.0	4.0
Control	5002	26	M	P	4	M	4.2	3.8	5.0	6.5	6.5	5.0	4.0
Control	5003	22	M	P	1	B	3.6	3.7	4.6	5.5	6.5	3.0	4.0
Control	5004	28	M	P	4	B	3.8	3.0	4.8	6.5	5.0	4.0	3.0
Control	5005	34	M	P	10	B	2.4	3.2	4.8	8.0	5.0	3.0	1.0
…	…	…	…	…	…	…	…	…	…	…	…	…	…

Overall, we felt comfortable combining the data from the separate training sessions for Professionals (P1 & P2, see Table 4.3. below) and the separate training sessions for Students (S1 & S2, see Table 4.3. below) after checking that the training impact (in terms of mean improvements) was similar across the sessions for Professionals and Students respectively.

Table 5.1.2. below and the shows the means, standard deviations, range (min/max) and correlations of the study variables. The data was checked for outliers. We also reported below the Cronbach's alpha scale reliability for multi-item scales on the diagonal.

Correlation: The means, standard deviations, correlations for the various continuous measures are shown in the table below:

Table 5.1.2. Means, Standard Deviations, and Intercorrelations of Study Variables

Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Treatment	.7	.5	0	1	1												
2. Age	25.1	5.2	18	48	.050	1											
3. Gender	.4	.5	0	1	.025	.306**	1										
4. Status	.7	.5	0	1	-.481**	.435**	.152*	1									
5. Experience	2.6	4.6	0	25	.067	.957**	.257**	.397**	1								
6. Education	.85	.7	0	2	-.031	.492**	.250**	.510**	.445**	1							
7. Pretest_TMAt	3.5	.8	1.0	5.0	.019	.164*	.131	.189**	.171*	.207**	.822#						
8. Pretest_TMAw	3.4	.7	1.5	5.0	.044	.097	.171*	.054	.086	.024	.376**	.727#					
9. Posttest_SMAt	4.0	.82	1.0	5.0	.154*	.253**	.202**	.199**	.263**	.313**	.518**	.231**	.874#				
10. Pretest_Accuracy	5.7	1.4	1.5	8.5	.012	.350**	.160*	.196**	.398**	.281**	.091	.051	.199**	1			
11. Posttest_ Accuracy	6.8	1.4	4.0	10.0	.500**	.400**	.175**	.122	.408**	.332**	.097	.092	.232**	.349**	1		
12. Pretest_ Consistency	3.6	1.6	.0	7.0	.106	.385**	.117	.184**	.439**	.264**	.103	.089	.157*	.863**	.469**	1	
13. Posttest_Consistency	5.0	2.0	1.0	10.0	.473**	.348**	.161*	.143*	.362**	.332**	.082	.117	.218**	.308**	.938**	.440**	1

* $p < .05$. ** $p < .01$. # Cronbach's alpha scale reliability for multi-item scales is reported on the diagonal.

Treatment vs Control Groups

We needed to confirm that the treatment and control groups do not statistically differ ($p > .05$) on demographic characteristics or baseline outcome measures. Chi-square (categorical variables) and grouped t-tests (continuous measures) were performed to assess this:

Table 5.1.3. Distribution of Pretest Variables by Training and Control

#	Distribution	Training (n=143)		Control (n=77)		Test of condition differences		
	of…	Mean	SD	Mean	SD	χ^2 (df)	t	p-value
2	Age	25.3	5.6	24.8	4.0		-0.81	.419
3	Gender	M/F: 45%/55%		43%/57%		0.73		.787
4	Status	P/S: 52%/48%		P/S: 46%/54%		0.79		.373
5	Experience	2.9	4.9	2.2	3.7		-0.99	.321
6	Education	U/B/M: 32%/54%/14%		U/B/M: 32%/47%/21%		0.29		.406
7	Pretest_TMAt	3.5	0.8	3.5	0.7		-0.28	.779
8	Pretest_TMAw	3.4	0.7	3.4	0.7		-0.65	.516
10	Pretest - Accuracy	5.7	1.3	5.6	1.6		-0.18	.856
12	Pretest - Consistency	3.8	1.6	3.4	1.7		-1.57	.118

Since none of the p-values in the above tests are statistically significant, we confirmed that the treatment and control groups do not statistically differ for the various measures listed above.

We also ran a simple t-test to see how the posttest measures differed between the Treatment and Control groups:

Table 5.1.4. Distribution of Posttest Variables by Training and Control

#	Distribution	Training (n=143)		Control (n=77)		Test of condition differences	
		Mean	SD	Mean	SD	t	p-value
9	Postest_SMAt	4.1	.8	3.8	.9	-2.22	.028*
11	Posttest - Accuracy	7.4	1.3	5.9	1.1	-8.75	.000**
13	Posttest - Consistency	5.7	1.8	3.7	1.5	-7.93	.000**

* $p < .05$ & **$p < .01$

The results seem to indicate significant differences between the Training and Control groups – but given the repeated measures nature of the experiment design, more sophisticated statistical tests needed to be run to test the impact of the training. This will be done in the sections that follow.

5.2. Results and Analysis

5.2.1. Testing the Impact of the Training:

This section analyses the following hypotheses:

H1a: Insurance risk underwriting training will have a positive effect on accuracy in insurance risk underwriting decisions. H1b: Insurance risk underwriting training will have a positive effect on consistency in insurance risk underwriting decision.

Paired Samples t-test: The performance of a sample of underwriters before and after completing the *scripts* and *simple rules* training intervention was measured in a repeated-measures design. The differences were then analyzed by using a paired sample t-test. The paired sample t-test is a statistical procedure used to determine whether the mean difference between two sets of observations is zero.

Table 5.2.1.1. Output for Paired Samples t-test

	Intervention (n=143)				Control (n=77)			
	Pretest		Posttest		Pretest		Posttest	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Accuracy	5.7	1.3	7.4	1.3	5.6	1.6	5.9	1.1
Consistency	3.8	1.6	5.7	1.8	3.4	1.7	3.7	1.5

	Intervention (n=143)				Control (n=77)			
	Mean	SD	t	p-Value	Mean	SD	t	p-Value
Posttest_Accuracy – Prestest_Accuracy	1.7	1.4	14.24	.000**	0.2	1.48	1.46	.148
Posttest_Consistency – Prestest_Consistency	1.9	1.9	12.45	.000**	0.3	1.64	1.81	.074

The above results indicate that the pre-posttest difference is significant for both Accuracy and Consistency in the training sample. The pre-posttest difference is not statistically significant in the control sample. This supports the hypotheses H1a and H1b above. Checks were also performed to ensure that the assumption of the paired samples t-test are also met (dependent variable continuous; dependent variable should not contain any outliers; observations are independent of each other; dependent variable should be approximately normally distributed.)

ANCOVA & ANOVA: Many researchers employ the paired *t*-test to evaluate the mean difference between matched data points but unfortunately, in many cases this test in inefficient. The precision of this test can be increased through use of the analysis of covariance (ANCOVA). ANCOVA models also test the same primary hypotheses H1a and H1b. Differences in outcomes at posttest were examined with pretest scores entered as a covariate and Treatment condition (training/control) as a predictor. In addition, we ran a repeated measures ANOVA with Time as repeated-measures factor with 2 levels and Treatment as between-subjects factor. In the ANOVA analyses, we are looking for a significant Time × Treatment interaction. Below we report both ANCOVA and repeated-measures ANOVA results for completeness:

Table 5.2.1.2. Output for ANCOVA & ANOVA

	Posttest adjusted means (adjusted for pretest score)		ANCOVA Treatment Test statistics			ANOVA Treatment×Time Test statistics		
	Training	Control	F-value	p-Value	η^2	F-value	p-Value	η^2
Accuracy	7.4	5.9	84.37	.000	.280	49.86	.000	.186
Consistency	5.7	3.7	64.10	.000	.228	40.11	.000	.155

We conclude that the two groups (training and control) differ significantly on posttest scores after adjusting for the pretest scores. The F for the treatment variable is larger with the ANCOVA than ANOVA, indicating that the ANCOVA has more power.

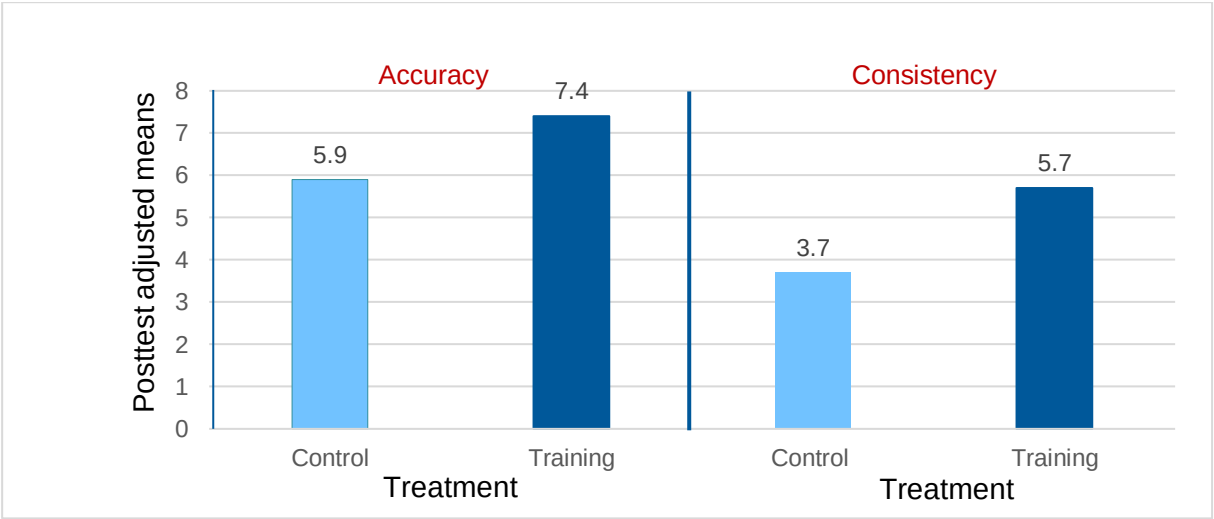

Figure 5.2.1. Posttest Adjusted Means by Treatment Condition

The above means and plots also support the hypotheses H1a and H1b that the Training will have a positive effect on the quality of insurance risk underwriting decisions, for both accuracy and consistency. The impact seems to be greater for consistency and this is discussed further in the next section.

Finally, we also checked that the various ANCOVA/ANOVA assumptions held:

Table 5.2.1.3. Assumption Checks for ANCOVA & ANOVA

#	Condition	
1	dependent variable and covariate variable should be continuous	YES, scores are
2	independent variable should consist of two or more categorical	YES, training & control
3	independent groups; have independence of observations	YES, have different participants in each group
4	no significant outliers	YES, by plot
5	homogeneity of variances	YES, by Levene's test
6	Additionally for ANOVA: dependent variable should be approximately normally distributed for each category of the independent variable.	YES, by plot
7	Additionally for ANCOVA: residuals should be approximately normally distributed for each category of the independent variable; covariate should be linearly related to the dependent variable at each level of the independent variable; shows homoscedasticity; there needs to be homogeneity of regression slopes.	YES, by tests & plots i.Accuracy Score: normality of residuals. By using Shapiro-Wilk test, p-value = 0.9071 which implies the normality assumption is hold. ii.Consistency Score: normality of residuals By using Shapiro-Wilk test, p-value = 0.6522 which implies the normality assumption is hold.

Hence, in conclusion, we accept hypotheses H1a and H1b.

5.2.2. Testing the Main Effect of Experience

This section analyses the following hypotheses:

H2a:Experience will be positively associated with accuracy in insurance risk underwriting decisions. H2b:Experience will be positively associated with consistency in insurance risk underwriting decisions.

Simple (one-variable) Regression: We ran a simple regression with experience as independent variable (IV) and Accuracy and Consistency (pre and posttest) as dependent variables (DVs):

Table 5.2.2.1. Output for Simple Regression

IV	DV	Std coeff	t	p-Value
Experience	Pretest – Accuracy	.398	6.40	.000**
Experience	Posttest – Accuracy	.408	6.60	.000**
Experience	Pretest – Consistency	.439	7.21	.000**
Experience	Posttest – Consistency	.362	5.73	.000**

The above analysis supports H2a and H2b that: Experience will be positively associated with accuracy / consistency in insurance risk underwriting decisions. The std coeff corresponds to the correlations in Table 5.1.2.

Checks were also performed to ensure that the assumption of linear regression held viz.:

Table 5.2.2.2. Assumption Checks for Linear Regression

#	Condition	& Check
1	two variables should be measured at the continuous level	YES
2	linear relationship between variables	YES, by plot
3	no significant outliers	YES, by plot
4	independence of observations	YES, have different participants in each group
5	show homoscedasticity and residuals (errors) of the regression line are approximately normally distributed	YES, by plot

5.2.3. Testing the Moderating Effect of Experience

This section analyses the following hypotheses:

H3a: Experience will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter. H3b: Experience will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter.

Firstly, given that study was targeted at mainly younger and less experienced underwriters, the distribution of participants is not normally distributed and heavily skewed towards the lower experience levels, as illustrated in *Figure 5.2.3.1.* below:

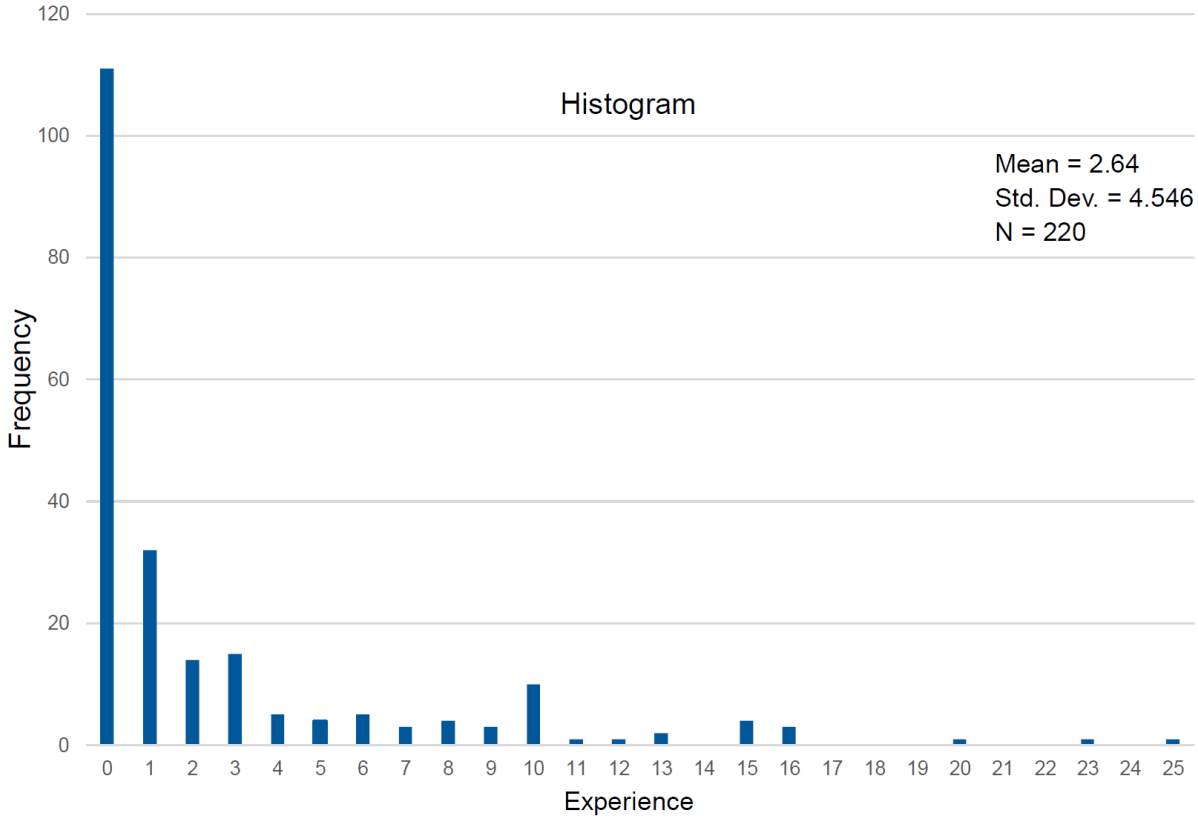

Figure 5.2.3.1. Distribution of Experience

To further analyse the impact of Experience, we looked at introducing the categorical variable Experience_Level which classified the underwriters in groups according to their years of experience e.g. an underwriter with just one to four years of experience was classified as "Junior". We used the following transformation (which was consistent with the classification of underwriters used in collecting the *script*s in the pre-study) for the Experience_Level:

Table 5.2.3.1. Experience_Level Transformation:

Code	Experience Level	Experience Range	Number
N	Novice	0	111
J	Junior	1 to 4	67
M	Mid-career	5 to 9	18
S	Senior	10+	24
TOTAL			220

We then ran an ANCOVA analysis on the transformed variable Experience_Level and the results are presented in the table and plots below:

Table 5.2.3.2. ANCOVA Output for Treatment × Experience:

	Posttest adjusted means (adjusted for pretest score)								ANCOVA Test statistics Treatment × Experience_Level		
	Training				Control				F-value	p-Value	η2
	N	J	M	S	N	J	M	S			
Accuracy	6.6	8.0	8.3	8.2	5.6	5.7	7.3	7.3	6.35	.000**	.083
Consistency	4.6	6.6	6.9	6.8	3.4	3.3	5.8	5.5	8.20	.000**	.104

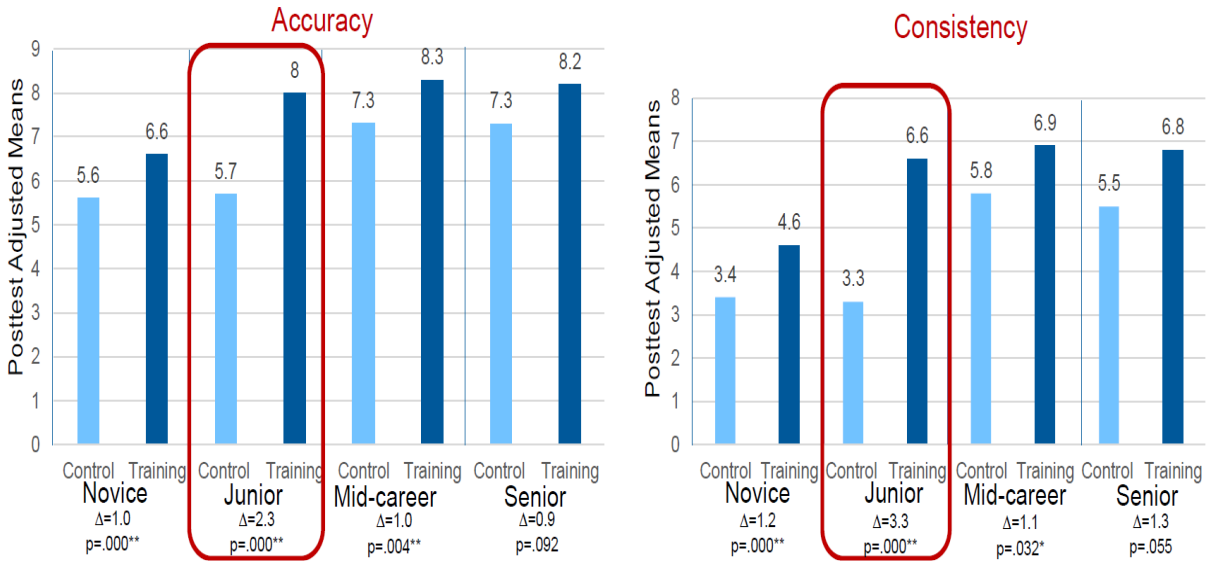

Figure 5.2.3.2. Posttest Adjusted Means by Treatment Condition for various Experience Levels.

The above charts show that the relationship between experience and training impact is non-linear. The impact for the Students appears to be subdued. For Professionals, the training appears to be most impactful for the Junior underwriters (circled). As hypothesized earlier, the impact of the training is lesser for more experience underwiters as they should have developed more of this skill over the working years. We also show in the above chart the statistical

significance of the training within each of the experience groups. The impact of the training is statistically significant for all experience groups except the Senior underwriter group.

The above analysis supports the hypothesis that Experience_Level moderates the impact of Training on undewriting quality (both consistency and accuracy). The above means and plots also sugget that the positive effect of training is lesser for those having more Experience (M and S) working as an underwriter due to the factors outlined in Chapter 3 and discussed further in the next chapter. Hence, we accept the hypotheses H3a and H3b.

The above analysis clearly illustrate that the impact of the training on Students appears to be materially different from the Professionals – with Students showing lesser benefits. Given this finding, we further investigated the difference between Students and Professionals using the Status variable. Since Status (Professional or Student) is a categorical variable, we examined its moderating impact by using an ANCOVA/ANOVA analysis. The differences in outcomes at posttest were examined with pretest scores entered as a covariate and Treatment condition (training/control) and Status as a predictor (fixed factor).

Table 5.2.3.3. Output for ANCOVA & ANOVA by Treatment & Status (P & S)

	Posttest adjusted means (adjusted for pretest score)				ANCOVA Test statistics			ANOVA Test statistics		
	Training		Control		F-value	p-Value	η2	F-value	p-Value	η2
	P	S	P	S						
Accuracy	8.1	6.6	6.3	5. 6	12.34	.001	.054	22.45	.000**	.094
Consistency	6.7	4.6	4.1	3.4	15.20	.000	.066	17.38	.000**	.074

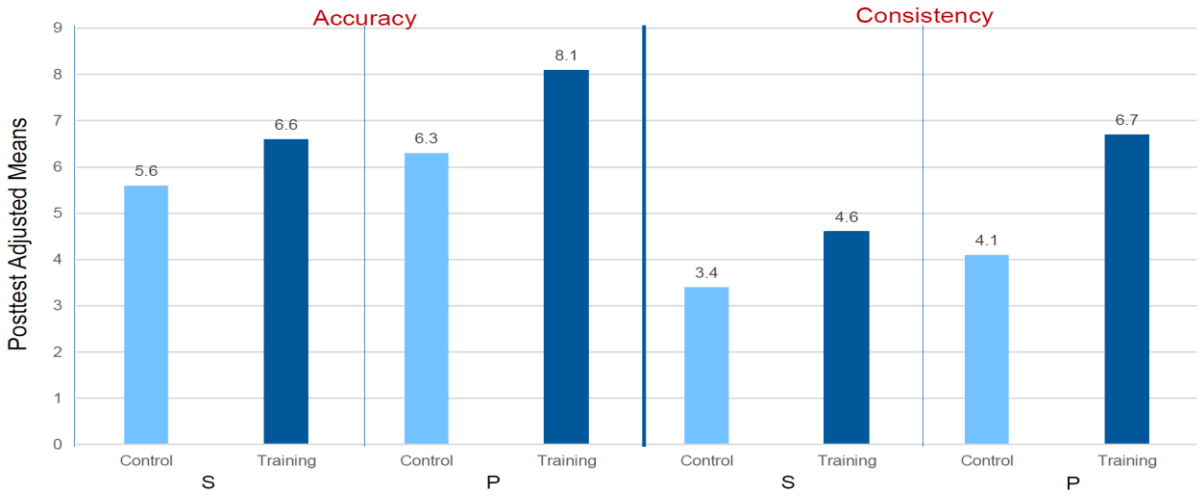

Figure 5.2.3.3. Posttest Adjusted Means by Treatment Condition for various Status Levels.

The above analysis supports the hypothesis that Status moderates the impact of Training on undewriting quality (both consistency and accuracy). The above means and plots also sugget that the positive effect of training is lesser for Students when compared to Professional. This is likely due to the fact that the Students have less familiarity with the industry and hence do not grasp the training concepts as well as the Professionals. This is discussed further in the next chapter.

Given the above result we decided to re-run the core Treatment ANCOVA & ANOVA from Table 5.2.1.2. for the Professionals and Students subsamples separately:

Table 5.2.3.4. Professionals subsample (N=109) ANCOVA & ANOVA Output for Treatment

	Posttest adjusted means (adjusted for pretest score)		ANCOVA Test statistics			ANOVA Test statistics		
	Training	Control	F-value	p-Value	η^2	F-value	p-Value	η^2
Accuracy	8.1	6.3	84.80	.000**	.444	82.69	.000**	.436
Consistency	6.7	4.1	73.62	.000**	.410	53.11	.000**	.332

Table 5.2.3.5. Students subsample (N=111) ANCOVA & ANOVA Output for Treatment

	Posttest adjusted means (adjusted for pretest score)		ANCOVA Test statistics			ANOVA Test statistics		
	Training	Control	F-value	p-Value	η^2	F-value	p-Value	η^2
Accuracy	6.6	5.6	24.08	.000**	.182	3.74	.056	.033
Consistency	4.6	3.4	13.70	.000**	.113	3.50	.064	.064

When compared to the table below, the test statistics are more statistically significant for the Professionals only group than the Students only or the Combined groups. This again indicates that the training has a stronger impact on the Professionals group, as expected.

Table 5.2.1.2. (Combined Groups) Output for ANCOVA & ANOVA for Treatment

	Posttest adjusted means (adjusted for pretest score)		ANCOVA Treatment Test statistics			ANOVA Treatment×Time Test statistics		
	Training	Control	F-value	p-Value	η^2	F-value	p-Value	η^2
Accuracy	7.4	5.9	84.37	.000**	.280	49.86	.000**	.186
Consistency	5.7	3.7	64.10	.000**	.228	40.11	.000**	.155

5.2.4. Testing the Main Effect of Mindfulness

This section analyses the following hypotheses: H4: Main Effect Impact of Mindfulness

H4a: Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions. H4b: Mindfulness will be positively associated with consistency in insurance risk underwriting decisions. H4c: State Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions. H4d: State Mindfulness will be positively associated with consistency in insurance risk underwriting decisions.

Simple (one-variable) Regression: We ran a simple regression with mindfulness measures as the independent variable (IV) and accuracy / consistency as the dependent variable (DVs):

Table 5.2.4: Output for Simple Regression with Mindfulness Measures

IV	DV	Std coeff	t	p-Value
Pretest - attention	Pretest - Accuracy	.091	1.35	.178
Pretest - attention	Posttest - Accuracy	.097	1.44	.152
Pretest - attention	Pretest - Consistency	.103	1.52	.130
Pretest - attention	Posttest - Consistency	.082	1.21	.227

IV	DV	Std coeff	t	p-Value
Pretest - awareness	Pretest - Accuracy	.051	.75	.455
Pretest - awareness	Posttest - Accuracy	.092	1.36	.176
Pretest - awareness	Pretest - Consistency	.089	1.32	.187
Pretest - awareness	Posttest - Consistency	.117	1.75	.082

IV	DV	Std coeff	t	p-Value
Posttest_SMAt	Pretest - Accuracy	.199	3.00	.003**
Posttest_SMAt	Posttest - Accuracy	.232	3.52	.001**
Posttest_SMAt	Pretest - Consistency	.157	2.35	.020*
Posttest_SMAt	Posttest - Consistency	.218	3.30	.001**

* $p < .05$ & **$p < .01$

The std coeff corresponds to the correlations in Table 5.1.2. The above analysis supports H4c and H4d only for the State Mindfulness Attention mindfulness component measured posttest (Posttest_SMAt). State Mindfulness Attention captures the attention levels of participants during the training. The higher attention levels would have resulted in them benefiting more from the training and being more focussed during the posttest work sample test.

Checks were again performed to ensure that the assumption of linear regression held.

5.2.5. Testing the Moderating Impact of Mindfulness

This section analyses the following hypotheses:

H5a: Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those higher on mindfulness.
H5b: Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those for those higher on mindfulness.
H5c: State Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being higher for those higher on mindfulness.
H5d: State Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being higher for those for those higher on mindfulness.

Multiple Regression with Moderator Analysis: When looking at the three mindfulness measures as moderators, given that they are continuous, we performed a moderation analysis in SPSS using the PROCESS macro (Hayes, 2017). The posttest scores were input as the dependent variable (with pretest scores entered as a covariate) and Treatment condition (training/control) as a predictor or independent variable and Mindfulness as the moderator (Model 1). A linear regression is fitted and on top of that, another Mindfulness variable is added in the regression as a moderator and it is interacted with the Treatment indicator. By analyzing the p-value of the interaction term, the moderating impact on the Treatment indicator is measured.

Table 5.2.5. Combined sample (N=220) PROCESS Output for Treatment × Mindfulness:

Interaction: Treatment × …	Accuracy				Consistency			
	coeff	t	F-value	p-Value	coeff	t	F-value	p-Value
Pretest_TMAt	.2271	1.08	1.18	.279	.3793	1.28	1.64	.201
Pretest_TMAw	.2377	.98	.97	.327	.2613	.77	.59	.443
Posttest_SMAt	.4044	2.14	4.56	.034*	.5626	2.12	4.50	.035*

* $p < .05$ & **$p < .01$

An interesting result is that not all Mindfulness measures appear to have a significant moderating impact. State Mindfulness Attention measured posttest (Posttest_SMAt) appears to have a significant moderating impact. The results suggest that Posttest_SMAt significantly moderates the relationship between treatment condition and underwriting quality (for both accuracy & consistency). This variable was also significant for the main effect.

We further examine the impact of by plotting the Posttest_SMAt significant interaction:

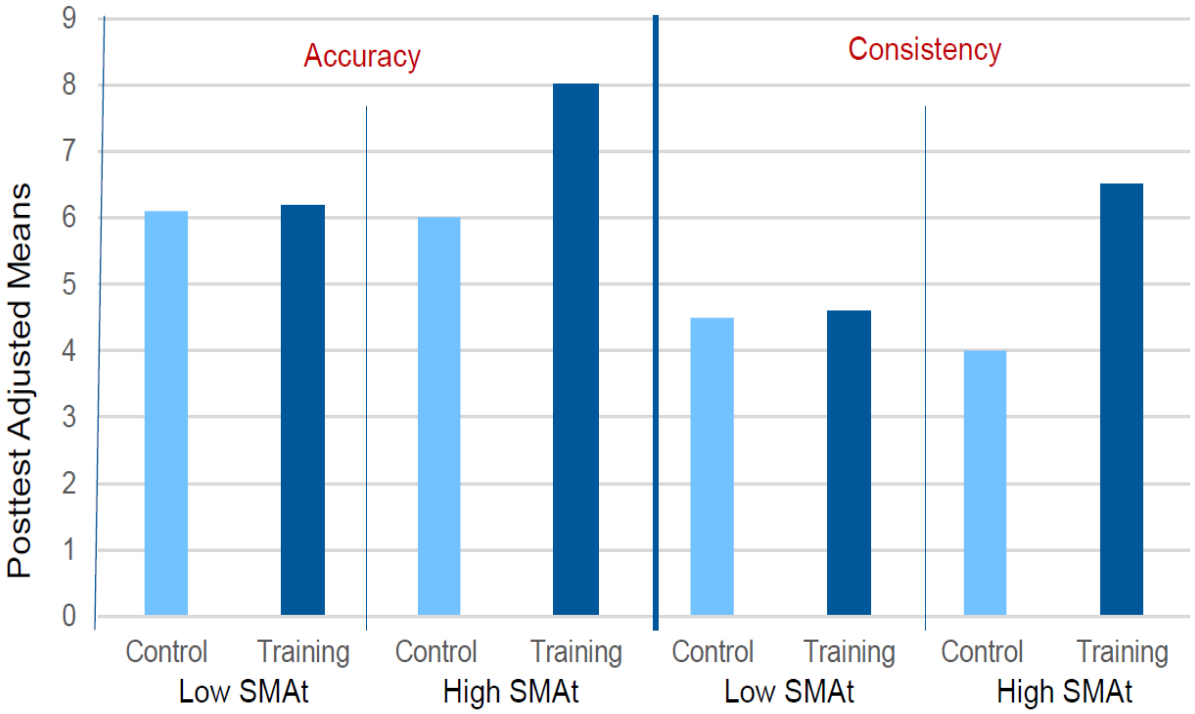

Figure 5.2.5. Posttest Adjusted Means by Treatment Condition for Posttest_SMAt Levels.

Specifically, when participants have lower Posttest_SMAt, the relationship between Treatment and underwriting quality (for both accuracy & consistency) is not statistically significant whereas for participants with high Posttest_SMAt, the relationship between Treatment and underwriting quality (both accuracy & consistency) is statistically significant and positive.

State Mindfulness Attention captures the attention levels of participants during the training. The higher attention levels would have resulted in them benefiting more from the training and being more focussed during the posttest work sample test (WST). These moderating impacts are discussed further in the next chapter.

Hence, in summary, we reject hypotheses H5a and H5b and accept H5c and H5d.

5.2.6. Testing the Moderating Impact of The Control Variables

In addition to testing the specific hypotheses above, we also conducted supplemental analyses for the impact of the some of the control variables for which we did not have enough grounds to posit theoretically derived hypotheses. We specifically looked at the moderating impact of Gender and Education (Age was excluded due to its high correlation with Experience). An especially interesting, and rather surprising, finding from these supplemental analyses is that both these variables seem to have significant moderating impacts.

Gender: Given this categorical variable, we ran an ANCOVA and were rather surprised to see that Gender does seem to have a statistically significant moderating impact on the training with the Males seeming to show more improvement from the training:

Table 5.2.6.1. Output for ANCOVA: Treatment × Gender Interaction

	Posttest adjusted means (adjusted for pretest score)				ANCOVA Test statistics		
	Training		Control		F-value	p-Value	η2
	M	F	M	F			
Accuracy	7.7	7.1	6.0	5.8	5.51	.020*	.025
Consistency	6.2	5.3	3. 8	3.7	4.97	.027*	.023

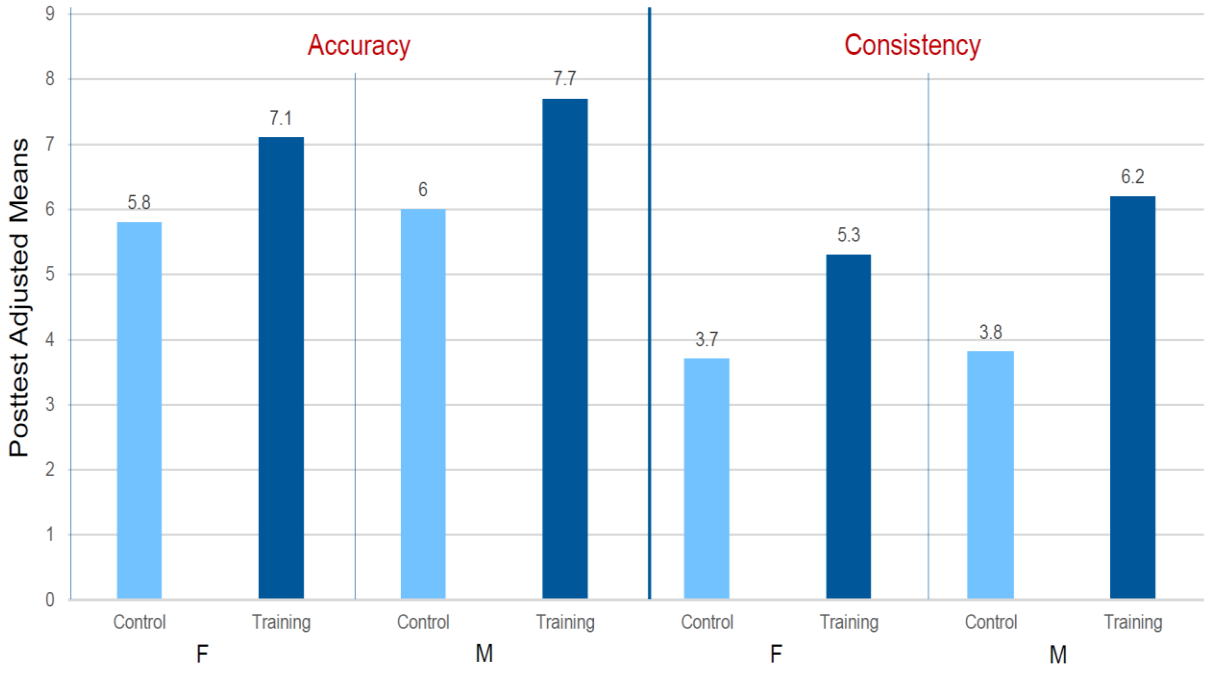

Figure 5.2.6.1. Posttest Adjusted Means by Treatment Condition for Gender Levels.

There appears to be a materially higher improvement for males (relative to females).

Education: Given this is also a categorical variable, we again ran an ANCOVA and were not too surprised to see that Education does seem to have a statistically significant moderating impact on the training with the undergraduates performing least well. This naturally mimics the impact of the Status variable (were all Students are undergraduates and all Professionals degreed). Interestingly, Masters graduates showed more improvement from the training than Bachelors.

Table 5.2.6.2. Output for ANCOVA: Treatment × Education Interaction

	Posttest adjusted means (adjusted for pretest score)						ANCOVA Test statistics		
	Training			Control			F-value	p-Value	η2
	U	B	M	U	B	M			
Accuracy	6.5	7.6	8.2	5.6	5.9	6.4	5.35	.005*	.048
Consistency	4.4	6.1	6.9	3.2	3.8	4.3	3.79	.024*	.034

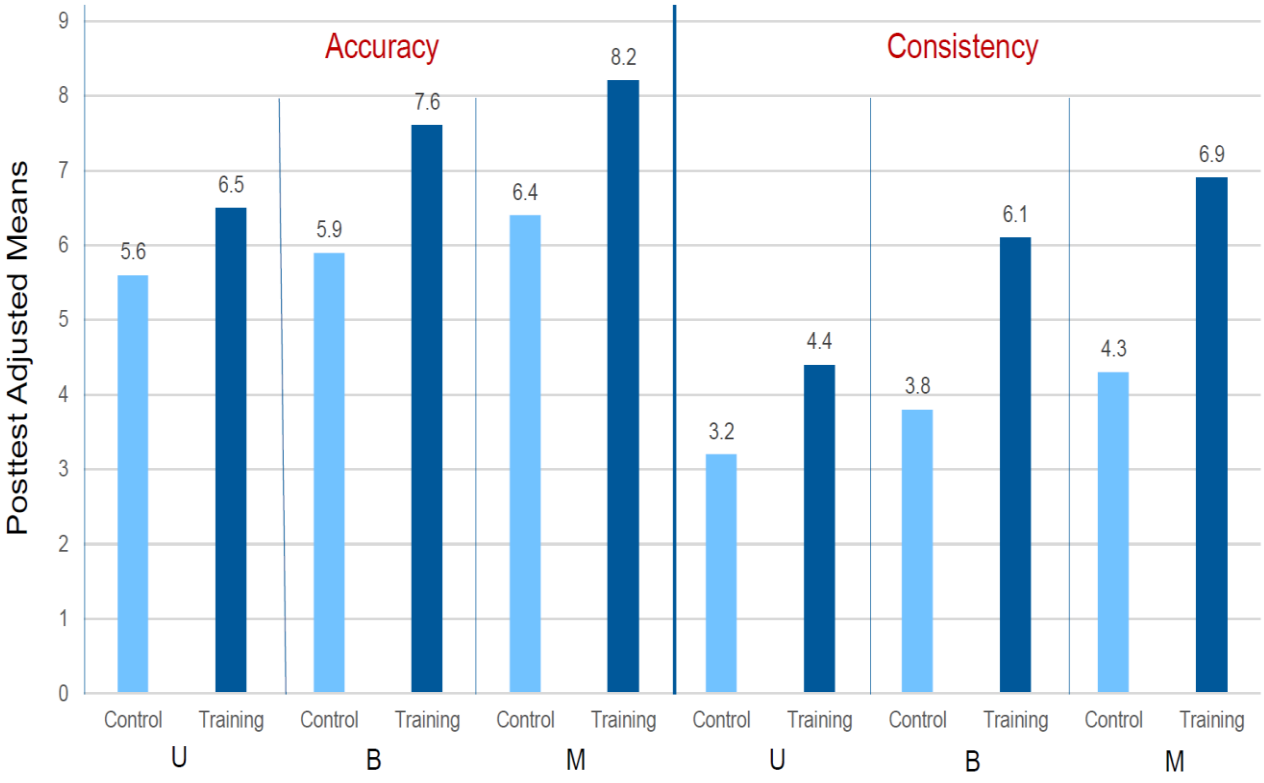

Figure 5.2.6.2. Posttest Adjusted Means by Treatment Condition for various Education Levels.

There appears to be a materially higher improvement for Masters graduates (relative to Bachelors and Undergraduates).

5.2.7. Results Summary

The table below summarizes the results of the various hypotheses tested above:

Table 5.2.7. Hypotheses Summary and Results:

Hypothesis #	Description	Test	Result
H1: Both *Scripts* and *Simple Rules* Training	H1a: Insurance risk underwriting combined *scripts* and *simple rules* training will have a positive effect on accuracy in insurance risk underwriting decisions. H1b:Insurance risk underwriting combined *scripts* and *simple rules* training will have a positive effect on consistency in insurance risk underwriting decisions.	paired t-test or ANCOVA or ANOVA on underwriting quality scores	H1a and H1b ACCEPT
H2: Main Effect of Experience	H2a: Experience will be positively associated with accuracy in insurance risk underwriting decisions. H2b: Experience will be positively associated with consistency in insurance risk underwriting decisions.	Simple regression	H2a and H2b ACCEPT
H3: Moderating Effect of Experience	H3a: Experience will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter. H3b: Experience will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter.	Multivariate regression with ANCOVA	H3a and H3b ACCEPT
H4: Main Effect Impact of Mindfulness	H4a: Trait Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions. H4b: Trait Mindfulness will be positively associated with consistency in insurance risk underwriting decisions. H4c: State Mindfulness will be positively associated with accuracy in insurance risk underwriting decisions. H4d: State Mindfulness will be positively associated with consistency in insurance risk underwriting decisions.	Simple regression	H4a and H4b REJECT H4c and H4d ACCEPT
H5: Moderating Impact of Mindfulness	H5a: Trait Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being lesser for those higher on mindfulness. H5b: Trait Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those for those higher on mindfulness. H5c: State Mindfulness will moderate the effect of insurance risk underwriting training on accuracy in insurance risk underwriting decisions, such that the positive effect of training being higher for those higher on mindfulness. H5d: State Mindfulness will moderate the effect of insurance risk underwriting training on consistency in insurance risk underwriting decisions, such that the positive effect of training being higher for those for those higher on mindfulness.	Multivariate regression with moderator analysis	H5a and H5b REJECT H5c and H5d ACCEPT

CHAPTER 6: DISCUSSION, EXTENSIONS AND CONCLUSIONS

6.1. Discussion

Underwriting excellence is paramount to company performance in the insurance industry. Recent research from McKinsey (Chester *et al*, 2019) looked at leading insurance companies over the past three decades and concluded that underwriting result, more than capital leverage or investment returns—has the greatest impact on overall financial performance. Hence, companies who struggle to achieve good underwriting results should look to make improvements in this area.

When seeking to improve performance, it is important for companies to recognize that underwriting is more than just a quantitative analysis. Good underwriting requires a comprehensive set of capabilities across hard and soft skills – and very importantly, qualitative judgments (Chester *et al*, 2019). Skilled underwriters blend quantitative analysis (Bowers, 1997) with qualitative, forward-looking judgment about how risks and exposures are likely to change (Chester *et al*, 2019). Chester *et al* (2019) also observed that the highest-performing underwriters are those with a structured, intentional approach to analysing risks – hence displaying deliberate judgement.

Underwriting decisions are an integral part of an insurance operation and among the most important decisions managers need to make (Chester *et al*, 2019). Achieving underwriting improvement can be a Herculean task and achieving and documenting improved results in underwriting performance can take up to several years. Hence, it's is worthwhile for companies to explore accelerating underwriting expertise. Thus, we designed a training program to accelerate the development of underwriting expertise. Drawing on research on decision *scripts* in the medical domain (Abernathy and Hamm, 1994, 1995) and on *simple rules* in strategy (Bingham and Eisenhardt, 2011), we took a unique approach in the present study, designing and testing how well a combined training design, using both *scripts* and *simple rules*, could improve underlying insurance underwriting decisions.

We collected the *scripts* (Schank and Abelson, 1977) used in the training through a series of interview with underwriters of varying levels of experience. This mirrored the NDM of Klein (1998) as a correspondence studying of how underwriters make decisions. The most direct contribution of our study is that it extends the existing work in *scripts* training beyond just the medical domain (Abernathy and Hamm, 1994, 1995) and shows promising results in the insurance underwriting domain too. During the interviews to obtain the *scripts*, we noticed numerous biases in the thinking of the underwriters such as availability; anchoring and conservatism (Kahneman, 2002) described in Chapter 2. Also, the very inexperienced underwriters were more inclined to use only the quantitative approach or ADM approach consistent with the observation of Klein (1998). By design, we collected a wide range of *scripts* across a wide range of insurance underwriting cases. The exposure to a wide range of experience is invaluable in training underwriters to have the ability to apply knowledge to new situations and different domains (Epstein, 2019).

The training design in the present study combined the *scripts* with *simple rules*. *Simple rules* are idiosyncratic heuristics that are specific to a certain domain – insurance in this study. It has been argued that heuristics are more likely to work well and be applied in tasks nested in complex, dynamic, and competitive environments (Gigerenzer, 2008; Simon, 1955, 1957). Heuristics can be used to solve problems quickly with incomplete information, as is the case in many underwriting situations. The *simple rules* derived in the present study for insurance have ecological rationality (Gigerenzer & Selten, 2002; Todd et al., 2012). – i.e. the match of a heuristic with a given environment. Our study contributes to the growing research on heuristics and *simple rules* training by testing them in a challenging domain like insurance risk underwriting. As mentioned earlier, the adaptive toolbox is the repertoire of heuristics available to underwriters to use in different circumstances (Gigerenzer and Selten, 2002). Underwriters and actuaries have their own adaptive toolbox of satisficing (Simon, 1955) and heuristic short cuts through the *simple rules* in making profitability forecasts and underwriting decisions.

As described in Chapter 2, Kahneman and Klein (2009) describe task environments as "high-validity" if there are stable relationships between objectively identifiable cues and subsequent events or between cues and the outcomes of possible actions. Determining the validity of an environment is not always easy. Our present study finds the insurance markets to be a high-validity environment. There appears to be a set of rules or cues that if followed can consistently lead to profitable insurance business. This combined *scripts* and *simple rules* training, integrates with the three main conditions that Kahneman and Klein (2009) state are needed for development of intuitive expertise viz.: a regular or highly valid environment (through the *simple rules*); many opportunities to practice (through the *scripts*) and feedback.

The present study tested the effectiveness of a training programme to improve insurance risk underwriting quality. The *scripts & simple* rules training intervention ultimately resulted in a better quality of underwriting decisions based on both accuracy and consistency (defined in Section 4.6.1). Insurance risk underwriting combined *scripts* and *simple rules* training had a positive effect on both accuracy and consistency in insurance risk underwriting decisions. The results showed that only a relatively short period (2 hours in the present study) of training (see Appendix V for training schedule) could have a significant effect on improving underwriting quality. This mirrored the findings from Tetlock (2015) who saw improvements in forecasting after just an hour of appropriate training. This training technique using *scripts* and *simple rules* was used for the first time in the domain of insurance underwriting training – and it is very encouraging to see the very positive results from the training emerging.

The training had the impact of increasing both accuracy and consistency of underwriting decisions – but there was a clear higher improvement in consistency. The inconsistency in underwriting decisions can cost insurers millions (Kahneman, 2018; Chester *et al*, 2019) and any training intervention to reduce this worth the effort. The training gave underwriters a greater awareness and understanding of the process, factors and resulting principles or *simple rules* going into underwriting decisions. Hence, they were more consistent and less affected by the

factors that can lead to noise in decisions. Thus, the impact of the training appears to be larger for consistency (relative to accuracy), as mentioned below. The application of *simple rules* to the underwriting decision making process seems to have the impact of improving consistency.

Experience has a positive main effect with underwriting quality – and does appear to moderate the impact of training on underwriting quality. It is interesting to note that this moderating relationship does not appear to be linear. Firstly, the students display a relatively subdued benefit from the training relative to working professionals. This could indicate that a minimum level of working experience is needed for the concepts discussed in the training around insurance risk underwriting to be embedded in the thought processes and applied to problems. When looking within working professionals, it was interesting to note that the greatest improvement from the training is shown by the junior underwriters (1 to 4 years of experience). This is consistent with the Hypotheses H3a & H3b that experience will moderate the effect of insurance risk underwriting training on accuracy and consistency in insurance risk underwriting decisions, such that the positive effect of training being lesser for those having more experience working as an underwriter. As hypothesized in section 3.5, the impact of training on skill levels is dampened for the more experienced underwriters due to their already higher skills levels, which leads to a lower underwriting accuracy improvement.

The present study did not find all mindfulness measures to have been a statistically significant main effect with underwriting quality or a moderating influence on the impact of training on underwriting quality. The trait mindfulness measures were hypothesized to have a negative impact on underwriting quality improvement – but this did not emerge from the data in the study. Interestingly, the state mindfulness attention measure did have a significant main effect with underwriting quality and a significant moderating impact on the impact of training on underwriting quality. This measure captures the attention levels of participants during the training and participants with higher state mindfulness attention showed higher improvements in both accuracy and consistency post-training. The higher attention levels would have resulted

in them benefiting more from the training and being more focussed during the posttest work sample test (WST).

6.2. Practical Implications

Our findings have several important practical implications.

Firstly, the work of insurance underwriters in practice forces them to make underwriting decisions under time pressure and at times with limited cognitive capacity. This is consistent with the bounded rationality and "satisficing" concepts introduced by Simon (1955). The *scripts* training and application of a set of *simple rules* can greatly aid underwriters to make decisions under these conditions in a practical way.

The greatest practical implication of this study is that the training design has the practical benefit of increasing insurance underwriting expertise – especially for juniors. This study has impact and could potentially save companies many millions of dollars in bad underwriting decisions. (Chester *et al*, 2019) In particular, given the positive relation between training and underwriting quality, our research suggests that organizations may benefit from paying attention to and investing in their underwriters training.

The proposed training design could potentially fundamentally change the training of underwriters to include formal training on the important aspects of intuitive and deliberate judgement – and going beyond normal quantitative training. The training using both *scripts* and *simple rules* will help prepare underwriters for assessing new risks in the age of innovation and new business models. This form of training will also equip underwriters better for a riskier world with these new and emerging and evolving risks. For this, there is naturally no experience for even more seasoned underwriters to rely on and the *simple rules* will form a foundation that trained underwriters can use to assess these new forms of risk.

The importance of quality insurance risk underwriting is growing within most insurance / reinsurance companies. Insurance risk is now more transparent within insurance companies

driven by a low interest environment (where poor underwriting results cannot be diluted by investment returns). The introduction of new accounting standards (such as IFRS 17) also require a separate (from investment results) disclosure of underwriting result. These changes will come together to make the underwriting result more transparent, increase its significance and encourage a move towards more disciplined underwriting.

Modern day underwriting roles often are specialized and have singular focus on specific type of risk e.g. property underwriters (Chester *et al*, 2019). The underwriters of the future may want exposure to a wider array of risks and challenges. Thus, underwriting skills may need expand to encourage more cross-functional and hybrid responsibilities (Chester *et al*, 2019). The accelerated expertise needed for these roles could be developed in a practical manner through the training design in the present study. The training design includes exposure to a wider range of risks — rather than waiting for decades to acquire the required varied experience on the job (Epstein, 2019).

6.3. Strengths and Limitations

Starting with the methodological aspects, there were strengths and limitations to the training design. A clear strength was the use of a field intervention for the training and not just a quick lab manipulation. A limitation is the lack of a pure random assignment of much of the sample to condition. However, it was shown in Chapter 5 (Section 5.1., Table 5.1.3.) that the were no major differences between the treatment and control groups. Also, only one trainer was used which came with a heavy workload to complete all the studies. However, the same trainer used in all studies – and for both treatment and control conditions, ensured consistency across the sessions and was a strength of the study design.

Scripts used in training have strengths and limitations. *Scripts* are observed directly from real world applications in practice – and hence have face validity (Hamm, 2004). However, as mentioned earlier, they have been criticized as “rote learning” (Hamm, 2004). Also, the detailed observation to document *scripts* may have prevented it from being applied

more widely – beyond medical training. The effort to extract these *scripts* for this present study was a considerable. However, in practice, this should be outweighed by the benefit of having them documented.

Simple Rules – as the name suggests, should be simple to apply in practice. However, at the same time, there could be a danger of over simplifying and missing some crucial cues in the decision making process. A novice underwriter will also have very little appreciation for how these rules emerged if they have not experienced the actual situations in practice. This again underscores the benefit of combining both *scripts* and the *simple rules* in the training design. Also, extant literature on insurance does not cover the *simple rules* extracted in this study in a comprehensive way. Hence, this study also contributes to the existing insurance literature by providing a more comprehensive set of *simple rules* to apply to assess the viability of an insurance scheme.

The combination of both *scripts* and *simple rules* appears to be the most beneficial training intervention – in both theory and practice. Combined training provides the key elements for expertise to develop viz. experience and exposure to many cases (from *scripts*); systematized knowledge (from *simple rules*) and the feedback (from the training process). As described above, these are exactly the three elements needed for expertise to be developed in practice according to Kahneman and Klein (2009).

The moderating factor of experience is easier to measure and used instead of something more difficult like expertise. As mentioned above, experience does not always lead to expertise. Also, on mindfulness, some researchers have raised doubts about the possibility of assessing mindfulness through self-report scales such as the MAAS (Brown and Ryan, 2003), as is proposed to be done in this research study (Grossman 2008, 2011). Overall, recent literature (Reb, 2018) suggests that the tendency to be mindful can be measured reliably and validly by self-report. Also, mindfulness, while being significantly related to a variety of constructs, does not overlap with these constructs to an extent as to suggest redundancy (Reb, 2018).

Finally, as the test results only capture short term improvements, we should look to do more on evaluating the longer term impacts of the training using Kirkpatrick's model of training evaluation (Kirkpatrick & Kirkpatrick, 2016). The *Figure 6.4.* below illustrates the four levels of the evaluation model:

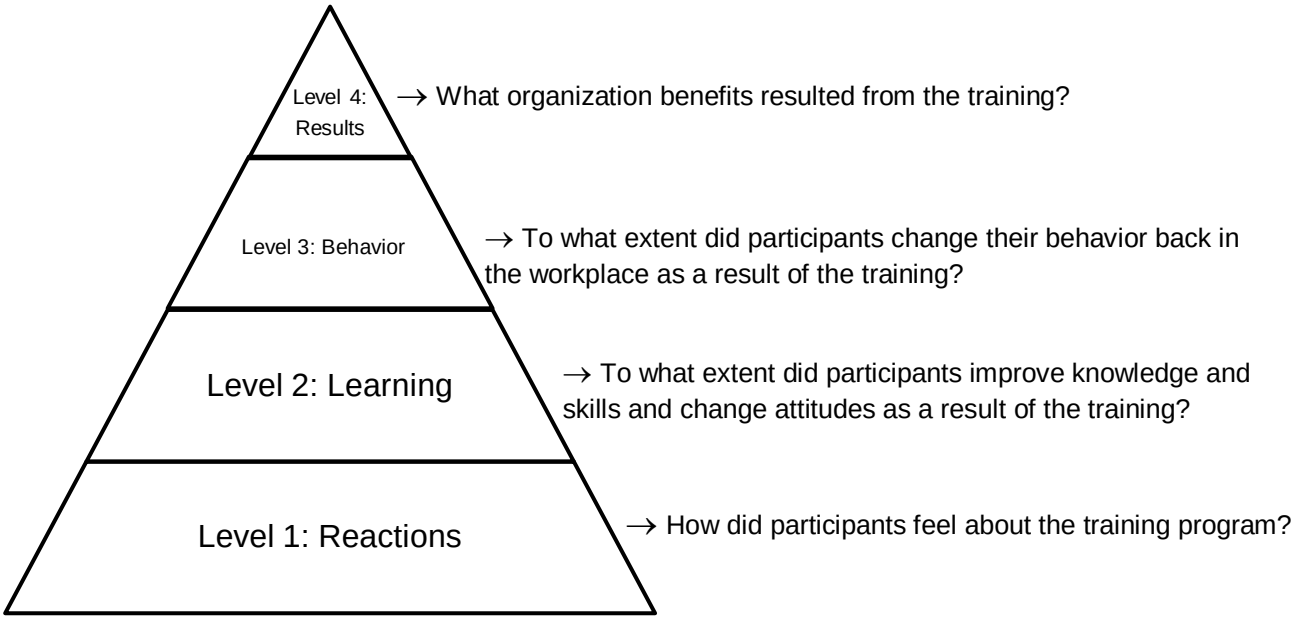

Figure 6.4. Kirkpatrick's four levels of evaluation model

In terms of the four levels of training evaluation we have in this study reached only level 2. Using this framework, we observe the following:

Level 1: On reactions from the training, we collected feedback on the training forms and received mainly positive feedback from the training invention with statements like:

- "Please create an online module which can be used for training new joiners."
- "The training was very insightful. It was a great learning experience."
- " Format was great. Please have more often."
- "Training was clear and informative. Concepts were well explained with examples that helped a lot.
- "Good training. Learnt new things."

Level 2: On the learning impact, this was measured by the difference with the pretest and posttest scores which clearly indicated a significant improvement for the trained group (vs. the control group).

Level 3: On changing behavior in the workplace, this needs further investigation. This could be done through qualitative interviews than re-testing scores. For example, there could be a follow-

up interview a with a few participants few months after the training to gauge if the skills learnt in the training programme are continuing to be used and whether they are successful in improving underwriting quality in practice.

Level 4: Finally, on impacting company results, this would eventually be judged by the future underwriting result of the business units trained and compared to pre-training levels.

6.4. Extensions and Future Direction

Extensions beyond this research should also be considered and could include – for example, *scripts* and *simple rules* training delivered using blended learning and other software tools; extending training to group decision making; developing new *scripts* over time for more innovative insurance products; looking beyond selection rules to procedural rules and investigating similar training in other domains outside insurance

The training intervention in this research proposal follows the traditional classroom approach. The use of blended learning to deliver the training interventions should be explored. Blended learning (Graham, 2006) is an education program that combines online digital media with traditional classroom methods. Face-to-face classroom practices are combined with computer-mediated activities regarding content and delivery – e.g. pre-tests and pre-readings. Blended learning is also gaining more traction in professional development training.

This research is limited to developing individual insurance risk underwriting expertise. In practice, underwriting tasks are usually performed in teams (Chester *et al*, 2019) and also have various referral triggers to higher authorities depending on size and complexity. It would be interesting in future to research how teams should be trained to optimize underwriting quality. This team dynamic is also an operational risk management safe guard against a single insurance risk underwriter making an expensive error. Leading insurance companies create a culture of cooperation and collaboration and engagement across functions (Chester *et al*, 2019), including second-line risk management. Teams should be jointly accountable for results and

are encouraged to constructively challenge and debate each other. This will foster company-wide views on underwriting performance that integrate views across functions. Another idea for underwriting structures, could be to have more team-based structures, in which groups of a few underwriters are collectively responsible for portfolios or subsegments of a portfolio.

Insurance underwriting *scripts* and *simple rules* are not static – but will change over time. There will be new and emerging risks that underwriters will have to question if they are insurable risks. As the industry becomes more digital and innovative and new players enter, underwriters will need to make decisions on situations that they have not encountered in the past - and the ability to make high-quality decisions quickly will become a fundamental dynamic underwriting capability. Hence *scripts* will need to be updated and new *scripts* established and the *simple rules* will also need to evolve with the new challenges.

In practice, it would be very rare for an underwriting situation to meet all *the simple rules* identified in this study for insurability. The are other risk mitigation procedural rules to mitigate risks which were not covered in the training. Once it has been decided that the risk is to be insured, then risk mitigation procedural rules should be used to manage the risk. For example, a limit could be imposed on the insurance payout for high risk situations, to protect the company for very large payouts. These risk mitigation rules are at the core of proper risk management – and also impact the appropriate pricing for these risk.

This present study research is entirely set within insurance/reinsurance industry. Now that the results have be shown to positive, it confirms the view that *scripts* (and *simple* rules) training can be applied beyond the medical field. Given the insights we have gained, we believe that this training be applied more widely in the research of managerial decision making and accelerating expertise in other domains. More specifically, I would be interested to extend this training technique into other risks / industries close to the insurance underwriting risk e.g. credit risk underwriting in banks is similar in many ways to insurance risk underwriting – but will require a different set of *scripts* and *simple rules* for training.

6.5. Final Conclusion

The main objective of this research was to look scientifically into the research question of whether appropriate training can help improve judgement and ultimately decision making in underwriting insurance risk. We firstly designed the training intervention using *scripts* and *simple rules*, applied to this field for the first time. We then proceeded to test the effectiveness of this training programme to improve decision making in insurance risk underwriting. We found strong evidence from the testing data that the training appears to be effective on its aims. We found broad evidence in support of most of the hypotheses indicating the viability of this new training technique in the insurance risk underwriting domain and confirmed the impact of the various moderating variables – like experience and mindfulness. Hence, the main objective of this research has been achieved along with several identified sub-objectives.

Good underwriting is a core capability needed to succeed in the insurance industry. Underwriters need to look at each risk in a fair and consistent way and to ensure that a correct level of risk is entering the industry and that this risk is matched by the right premium. Thus, companies should strive to make improvements in underwriting and strike a delicate balance to manage the tensions of art versus science, automation versus judgment, and autonomy versus control (Chester et al, 2019). Excellence in underwriting must begin with getting the basics right: ensuring that underwriters are well trained in the *scripts* and *simple rules* of assessing underwriting risk. Many underwriters will automatically decline a risk simply because it is an unusual one – but using *simple rules* will provide a framework to properly assess these risks.

The insurance markets are uncertain but, because of high validity, expert-judgment can identify good bets. The proposed training design could potentially fundamentally change the training of underwriters to include formal training on the important aspects of expert intuitive and deliberate judgement. This will then also help prepare underwriters for managing risks in an increasing innovative and riskier world and cultivate a strong underwriting culture that will allow such companies to outperform others in the industry.

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APPENDIX I: INSURANCE UNDERWRITING *SCRIPTS*

Insurance *scripts* were developed through interviews with underwriters of varying levels of experience. In this Appendix we record the *scripts* for 20 underwriting situations (in total we developed *scripts* for 50 such situations in the pre-study). These 20 situations were used in the training intervention (and which also appeared in the pretest – see Appendix IV).

We show below an example (we start with risk #5) of the detailed interview transcripts and notes and this was then used to develop the training scripts (names of the underwriters are not shown below for confidentiality):

Detailed Interview Transcripts & Notes: **#5. Divorce Insurance: Insurance product providing coverage for divorce costs in the event of an unhappy marriage that leads to an expensive divorce.**	
Underwriter	Response
1st year trainee Junior Underwriter Experience: 1 year	▪ The junior underwriter was at first stumped by this situation – it was clear that he had not seen this cover before ▪ He spent a few minutes thinking about it before providing his view ▪ He was murmuring from the start on how could we price this risk – which showed his quantitative bent ▪ His focus was to jump immediately into how to price the risk and did not consider at all if this is an insurable risk ▪ The junior underwriter is focused more on the analytical aspects of pricing the risk and misses the obvious risk of anti-selection. ▪ After around 5 minutes pondering on this risk, his final response was "ACCEPT. There are detailed statistics on divorce rates that can be used to determine the probability of claim."
Mid-career Underwriter Experience: 8 years	▪ The mid-career underwriter was also at first stumped by this situation – it was clear that he had also not seen this cover before ▪ He seemed perplexed by this unusual cover and could not come to a conclusion on whether to accept the risk or not ▪ He mentioned that he would need to assess the risk further by interviewing the couple to determine the risk ▪ The mid-career underwriter is rather unsure and misses the point that the risk is not random ▪ I attempted to push the underwriter for a conclusion so that he could feel the time pressure which exist in real life situations ▪ It feels that even with 8 years of experience, the underwriter is not familiar with the rules around insurability – which is surprising ▪ After around 5 minutes his final response is: "Could be – under certain circumstances. We would need to interview the couple at the outset to determine the risk."

Detailed Interview Transcripts & Notes (continued): **#5. Divorce Insurance: Insurance product providing coverage for divorce costs in the event of an unhappy marriage that leads to an expensive divorce.**	
Underwriter	Response
Experienced Chief Underwriter Experience: 15 years	▪ The Chief Underwriter is very sure in his assessment that this risk is not insurable. ▪ He recognizes immediately the non-random potential of the event & the high risk of anti-selection. ▪ The experienced underwriter takes less than a minute to come to his conclusion ▪ He also seems to worry about the ethical nature of this insurance and clearly is thinking beyond the quantitative aspects ▪ It becomes clear that the Chief Underwriter is aware of the rules that make a risk insurable – but appears to be using them automatically ▪ The firm statement from the experienced underwriter is: "**DECLINE**. We don't cover that, quite apart from the dubious ethics involved. A simple rule of our industry is that we insure random risks. This is not the case in your example. A spouse could claim that he is unhappy and separate from his partner, just to get the money from the insurance. It would be naive to insure something like that. Hence, it's a clear DECLINE."

We then used the above detailed interview transcripts and notes to develop a more concise script that can be used for training i.e. the training script:

Training Script: **#5. Divorce Insurance: Insurance product providing coverage for divorce costs in the event of an unhappy marriage that leads to an expensive divorce.**		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. There are detailed statistics on divorce rates that can be used to determine the probability of claim."	"Could be – under certain circumstances. We would need to interview the couple at the outset to determine the risk."	"**DECLINE**. We don't cover that, quite apart from the dubious ethics involved. A simple rule of our industry is that we insure random risks. This is not the case in your example. A spouse could claim that he is unhappy and separate from his partner, just to get the money from the insurance. It would be naive to insure something like that. Hence, it's a clear DECLINE"
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. He recognizes immediately the **non-random** potential of the event & the high risk of anti-selection. The Junior Underwriter is focused more on the analytical aspects of pricing the risk and misses the obvious risk of anti-selection. The Mid-career Underwriter is rather unsure and misses the point that the risk is not random.		

We now present the other 19 (out of a total of 20) training scripts used in the training intervention:

#1. No Underwriting Life Insurance : insurance cover that pays a flat amount of USD1 million on death with no medical/financial underwriting - sold by insurance agents to lives aged 20 to 60.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. Life insurance is low risk especially in the stated age range."	"ACCEPT. Life insurance is low risk especially in the stated age range. Mortality rates are quite predictable in the stated age-range. "	"DECLINE. This will lead to agents seeking out sickly people or even on people on their death beds. Also, the amount of benefit would be too high for poorer/younger lives and goes against the rule of indemnifying them."
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. He recognizes immediately the **non-random** potential of the event & the high risk of anti-selection. He also picks up that the amount of **cover could be too high** for certain lives. The Junior & Mid-career Underwriters do not appreciate that Life insurance can be high risk if not sold properly and do not take into account agent behaviour or over-insurance.		

#2. Terrorism Insurance: Insurance product that pays out a fixed sum assured equal to 2x annual salary if the insured is killed or hurt in an act of terrorism?		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. Statistics on terror events exit to price this risk."	"ACCEPT. The amount of benefit appears reasonable and there is data on the frequency of terror events."	"**DECLINE**. This is a classic instance of **accumulation** of risk and violates an insurance fundamental rule of pooling a large number of independent risks. The event of "terrorism" also needs to be defined more clearly.
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. The **accumulation** risk is a deal breaker. The more junior underwriters focus more on data for pricing and miss the accumulation issue totally.		

#3. Heart Attack Insurance: Insurance product that pays out €100k if insured experiences severe pain in the chest.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. This heart attack risk can be priced using medical incidence rates."	"ACCEPT. This heart attack risk can be priced using medical incidence rates. The amount of benefit also appears quite modest and relates to the cost of treatment."	"**DECLINE**. This insurable event is not clearly defined and needs to be more objective. The "heart attack" definition needs to be better defined objectively in medical terms.
Observations: The Chief Underwriter is very sure in his assessment that this risk is **not** insurable. He immediately picks on the fact that the insurance **event** is not clearly defined.		

#4. Earth Quake (EQ) Insurance in Japan: Pays for EQ damage to buildings commercial or residentialtic in Japan.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. Does not feel like something that could be insured given that Japan is a high EQ risk country."	"DECLINE. Does not feel like something that could be insured given that Japan is a high EQ risk country. Remember the 2011 Tohoku earthquake that struck Japan was one of the biggest earthquakes recorde d in the last 100 years."	**ACCEPT**. This covers a random event and indemnifies against damage costs. The risk can create accumulation risk that can be managed through geographic diversification and accumulation control through budgets. This can be accepted provided the risk is appropriately priced.
Observations: The Chief Underwriter is very methodical is checking through some ***simple rules*** of what makes a risk insurable. He/she also manages the residual risk through diversification & imposing claim accumulation limits. He finally looks at the risk-return profile as attractive. The more junior underwriters appear paralyzed by the availability bias that prevents them from seeing the insurance opportunity.		

#6. Agro Insurance: Insurance product coverage for input costs to farmers for costs stemming from damage to crops from drought/hail/etc. in India.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. Does not feel like something that could be insured. We will be ruined looking at the recent droughts."	"DECLINE. Does not feel like something that could be insured. The trend of global warming makes this uninsurable."	"**ACCEPT**. This can be viewed as innovative insurance where there is real demand. Yes, it's a new type of insurance with limited data & models. But with proper underwriting, the risk should be insurable. The benefit amount meets a financial loss and covering input costs removes the moral hazard risk. We could spread the risk through geographic diversification in a large country like India. We could look at accumulation control & capacity budget through limits. Farmers are an important political block in India so price increases could create some Political Risk. Overall, given the higher premiums we could extract, I will ACCEPT this risk."
Observations: The Chief Underwriter is very methodical is checking through some ***simple rules*** of what makes a risk insurable. He/she also manages the residual risk through diversification & imposing claim limits. He finally looks at the risk-return profile as attractive. The more junior underwriters appear paralyzed by the availability bias that prevents them from seeing the insurance opportunity.		

#7. Guaranteed Critical Illness : Insurance product that pays out up to SGD2m on certain major conditions like cancer (including minor cancers)/heart attack/stroke in China. The premiums are lifetime guaranteed not to increase.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. This is a standard insurance product that can be priced using medical data."	"ACCEPT. This is a standard insurance product that can be priced using medical data. This is quite normal coverage in the Chinese market and a lot of research has been done on this."	**DECLINE**. This is not a viable insurance product as due to the lifetime guaranteed premiums. The future trends for these conditions are uncertain making the lifetime guarantees untenable.
Observations: The Chief Underwriter is very concerned about the **lifetime guaranteed rates** given the **uncertainty** in the future trend. The more junior underwriters miss the concern around the uncertainty in future trend.		

#8. HIV +ve Life Insurance: Insurance product, providing Life insurance coverage for people who are HIV +ve up to USD1m.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. These would be high risk individuals who are not insurable."	"DECLINE. These would be high risk individuals who are not insurable."	"**ACCEPT**, HIV+ve lives now lead a close to normal life expectancy with appropriate treatment. The condition can be view as a chronic condition and is not uninsurable for life insurance. There should be a condition that the Life insured sticks to their antiretroviral drugs treatment to treat the condition.
Observations: The Chief Underwriter recognizes that previously **uninsurable risks can become insurable** over time as the risk becomes more manageable through improvements in medicine. This crucial point is missed by the more junior underwriters who do not grasp the dynamic nature of insurability of risks.		

#9. Test Tube Baby Insurance: Insurance product, providing coverage for the 2nd – 3rd trial costs if 1st trial turns out to be a failure for fertility treatment.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. Does not feel like something that could be insured."	"DECLINE. Does not feel like something that could be insured."	**DECLINE**, this is not a viable insurance product as due to the high frequency of subsequent failures, the premium could be high relative to the benefit.
Observations: The Chief Underwriter is very methodical is checking through some *simple rules* of what makes a risk insurable. The *simple rules* apply equally to new innovative insurance covers. The **high premium** will not make this a viable product. The more junior underwriters appear scared off by the non-standard nature of this risk – but cannot point to the exact reason for declining the risk.		

#10. Long Term Personal Accident (LTPA): This product pays high multiple of sum assured if insured dies due to an accident in China. The rates premium rates are guaranteed for life.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. Does not feel like something that could be insured on long term guaranteed rates."	"ACCEPT. Does not feel like something that could be insured on long term guaranteed rates."	**"ACCEPT**. This is a relatively simple product. The guaranteed rates are a concern – but the trend for traffic accidents should be favourable in China given improvements ion infrastructure and driving ability. There is a possibility of initial anti-selection but this could be priced for.
Observations: The Chief Underwriter is very quick to identify the **favourable future trend** and accept the long term guarantee. The more junior underwriters were scared off by the long term guarantee in a relatively new market.		

#11. Occupational Disability Insurance: Insurance product coverage for 110% of loss of income from the risk of not being able to perform the occupation one is trained for. Benefit will be paid in monthly instalments.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. Income replacement is a common product and hence must be an insurable risk that can be priced using data."	Yes. Income replacement is an insurable risk that can be priced using data. The benefit level appears on the high side (>100%) – but we can add in a loading for this."	"**DECLINE**. This is a classic instance of over-insurance. The insured will be tempted to claim to receive higher income. For insured on claim, there will be no incentive to return to work.
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. The **over-insurance** is a deal breaker. There will be moral hazard risk. The Junior & Mid-career Underwriters do not appreciate that disability insurance can be high risk if there is over-insurance.		

#12. Pandemic Insurance: Insurance product that pays out 2x annual salary only if insured is killed or hurt in a pandemic breakout?		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. Statistics on pandemics events exist to price this risk."	"ACCEPT. The amount of benefit appears reasonable and there is data on the frequency of pandemic events."	"**DECLINE**. This is a classic instance of accumulation of risk and violates an insurance fundamental rule of pooling a large number of independent risks. The event of "pandemic" also needs to be defined more clearly. Insurers will typically not offer pandemic cover only. Pandemic is covered in normal insurance and should not be carved out.
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. The **accumulation** risk is a deal breaker. The more junior underwriters focus more on data for pricing and miss the accumulation issue totally		

#13. Long term care: Insurance product that pays out SGD500 per month if insured becomes frail and unable to work.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. This long-term frailty risk can be priced using medical incidence rates."	"ACCEPT. This is product where there is increasing demand due to ageing population. The long-term frailty risk can be priced using medical incidence rates."	"**DECLINE**. This insurable event is not clearly defined and needs to be more objective. The definition of "frail" should be adapted to use an "activities of daily living" (ADL) type definition, for example.
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. He immediately picks on the fact that the insurance **event** is not clearly defined.		

#14. Hurricane Insurance in Florida: Pays for hurricane damage to buildings, commercial or residential, in Florida.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. Does not feel like something that could be insured given that Florida is a high hurricane risk country."	"DECLINE. Does not feel like something that could be insured given that Florida is a high hurricane risk country."	**ACCEPT**. This covers a random event and indemnifies against damage costs. The risk can create accumulation risk that can be managed through geographic diversification and accumulation control through budgets. This can be accepted provided the risk is appropriately priced.
Observations: The Chief Underwriter is very methodical is checking through some ***simple rules*** of what makes a risk insurable. He/she also manages the residual risk through diversification & imposing claim accumulation limits. He finally looks at the risk-return profile as attractive. The more junior underwriters appear paralyzed by the availability bias that prevents them from seeing the insurance opportunity.		

#15. Exam Insurance: Insurance product, providing cost of exam fees & study material for failing an actuarial exam through the Society of Actuaries.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. There are detailed statistics on SoA pass rates that can be used to determine the probability of claim."	"ACCEPT. There are detailed statistics on SoA pass rates that can be used to determine the probability of claim. The number of previous attempts will also be a key underwriting rating factor."	"**DECLINE**. We don't cover that! A simple rule of our industry is that we insure random risks. This is not the case in your example. A student less sure about passing his exam will rush out to buy this insurance. Well prepared students will not buy the insurance. Passing exams is not a random event!"
Observations: The Chief Underwriter is very sure in his assessment that this risk is not insurable. He recognizes immediately the **non-random** potential of the event & the high risk of anti-selection. The Junior & Mid-career Underwriters are focussed more on the analytical aspects of pricing the risk and miss the obvious risk of anti-selection.		

#16. Cyber Attack Insurance: Insurance product providing coverage for costs stemming from cyber attacks on SME businesses. The is an exclusion for outage of the external networks e.g. Internet.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. Does not feel like something that could be insured."	"DECLINE. Does not feel like something that could be insured."	**ACCEPT**, this risk can covered. Attacks on SME's could be more random and the accumulation of risk is limited due to the external network exclusion.
Observations: The Chief Underwriter is very methodical is checking through some ***simple rules*** of what makes a risk insurable. The *simple rules* apply equally to new innovative insurance covers. The more junior underwriters appear scared off by the non-standard nature of this risk.		

#17. Guaranteed Dementia Illness : Insurance product that pays out up to SGD2m on dementia. The rates are lifetime guaranteed.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. This is a standard insurance product that can be priced using medical data."	"ACCEPT. This risk is covered in standard insurance products and can be priced using medical research & data."	**DECLINE**. This is not a viable insurance product as due to the lifetime guaranteed premiums. The future trends for these conditions are uncertain making the lifetime guarantees untenable.
Observations: The Chief Underwriter is very concerned about the **lifetime guaranteed rates** given the **uncertainty** in the future trend. The more junior underwriters miss the concern around the uncertainty in future trend.		

#18. Sub-standards motor insurance: Coverage for the large substandard (high risk) drivers who have poor driving records, etc.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"DECLINE. The risk is too high"	"DECLINE. The risk is too high"	"**ACCEPT**. We can use data to derive the appropriate higher premiums for this higher risk. We can also extract higher margins due to the limited supply of such insurance plans. We can also closely monitor the experience to uncover the more profitable segments within sub-standards. Hence ACCEPT."
Observations: The junior underwriters miss the point that **high risk does not mean uninsurable**. The Chief Underwriter picks up that data can be used to assess the high risk and extract higher premiums. He also looks at the supply side – which illustrates a more general business savvy.		

#19. Dental Insurance: Insurance product, providing coverage for unlimited dental procedures during a year.		
1st year trainee Junior Underwriter	Mid-career Underwriter	Experienced Chief Underwriter
"ACCEPT. This feels like something that could be insured."	"ACCEPT. This feels like something that could be insured. Dental insurance products have been around for some time, I think? However, they may not be that profitable"	**DECLINE**, this is not a viable insurance product as due to the regular frequency of dentist visits, the premium could be high relative to the benefit.
Observations: The Chief Underwriter is very methodical is checking through some *simple rules* of what makes a risk insurable. The **affordability** of the cover could be a major issue. The more junior underwriters appear to miss the affordability issue.		

<table>
<tr><th colspan="3">#20. Space Rocket Insurance: Insurance product providing coverage for costs stemming from rocket failure.</th></tr>
<tr><td>1st year trainee
Junior Underwriter</td><td>Mid-career
Underwriter</td><td>Experienced
Chief Underwriter</td></tr>
<tr><td>“DECLINE. Does not feel like something that could be insured.”</td><td>“DECLINE. Does not feel like something that could be insured. There is not enough data to price this?”</td><td>“ACCEPT. The space insurance industry does not benefit from a large homogenous exposure pool of risks. Whilst the insurance industry traditionally relies on the actuarial analysis of data by ‘pooling’ individual risks with similar characteristics in order to calculate the probability of loss of a given risk, there are, on average, only 30-40 insured commercial launches a year. Combined with the continual evolution of technology of the space industry, there are very few statistical events to accurately estimate the probability of failure. Instead, launch vehicle and satellite reliability, i.e. loss records are important rate determinants for insurers. The risk event is well defined & random. The benefit amount is appropriate and indemnifies costs of future trials.”</td></tr>
<tr><td colspan="3">Observations: The Chief Underwriter is very methodical is checking through some simple rules of what makes a risk insurable. The simple rules apply equally to new innovative insurance covers. The more junior underwriters appear scared off by the non-standard nature of this risk.</td></tr>
</table>

APPENDIX II: INSURANCE UNDERWRITING *SIMPLE RULES*

This Appendix documents the Selection and Procedural *simple rules* for insurance risk underwriting:

Table A2.1: Selection Simple Rules for Insurable Risks

#	Rule	Rule description...
1	Large # of Independent Exposure Units	Ideally, there should be a large group of roughly similar, but not necessarily identical, exposure units that are subject to the same peril or group of perils. The purpose of this first requirement is to enable the insurer to predict losses based on the law of large numbers. Loss data can be compiled over time, and losses for the group as a whole can be predicted with some accuracy. The loss costs can then be spread over all insureds in the underwriting class i.e. the mutualisation of risk?
2	The risk event must be Definable	Insurance pays a benefit on a defined contingent event: There should not be room for argument as to whether or not payment meets the definition. The risk event must therefore be fully definable, in order to remove any dispute over whether the loss has occurred (and hence when a claim payment is due).
3	The risk event must be Random	The insured event should be random and unintentional. Ideally, the loss should be unforeseen and unexpected by the insured and outside of the insured's control. Thus, if an individual deliberately causes a loss, he or she should not be indemnified for the loss. Moral hazard/ anti-selection is increased if the insured deliberately intends to cause a loss. Adverse selection is the tendency of persons with a higher-than-average chance of loss to seek insurance at standard rates. Moral Hazard is dishonesty or character defects in an individual that increase the frequency or severity of loss.
4	The risk should be Rateable	The insurer must be able to calculate both the average frequency and the average severity of future losses with some accuracy. This requirement is necessary so that a proper premium can be charged that is sufficient to pay all claims and expenses and yields a profit during the policy period.
5	Benefit Amount is generally only for Indemnity	The payment made following the occurrence of an insured event should only indemnify the policyholder for the loss actually incurred; the policyholder cannot profit from the claim as this could change their behaviour to make the loss more likely i.e. moral hazard.
6	Premium Economically Feasible & Affordable	The insurer is able to charge a high enough premium to cover all claims and associated expenses while still making a profit – and still be affordable. On the other hand, the amount charged to insure an individual or entity must be a sum that the insured is willing to pay and must be substantially below that of the covered amount or it would not make sense to purchase the cover. This could lead to anti-selective lapses.
7	Principle of Equity	Each policyholder should pay a fair premium according to the risk of loss that they bring to the pool. To make sure that each insured pays a fair premium, insurers use a series of rating factors to assign the level of risk. In general, the higher the risk, the higher the premium. Terms and conditions may be applied to policies to further homogenise the risks by removing particular events or circumstances under which claims would be paid (e.g. early claims). Terms and conditions are also important to help reduce the impacts of moral hazard and adverse selection.

#	Rule	Rule description...
8	Limited Catastrophic loss	Ideally the loss should not be catastrophic. This means that a large proportion of exposure units should not incur losses at the same time.
9	The insured must have an Insurable Interest	The person wishing to take out insurance must be legally entitled to insure the article, or the event, or the life. There must be a recognisable relationship between the insured and the risk. Typically, this "insurable interest" is established by ownership or direct relationship. For example, people have insurable interests in their own homes and vehicles, but not in those of their neighbours.
10	Principle of Utmost Good Faith	A principle used in insurance contracts, legally obliging all parties to reveal to the others any information that might influence the others' decision to enter into the contract.

Table A2.2: Simple Risk Management Procedural Rules

#	Risk Mitigant	Name	Description
1	Manage Risk	UW Questions	Focus on key risk & rating factors.
2		Terms & Conditions / Exclusions	Two major categories of exclusion in insurance underwriting are moral hazard and correlated losses.
3		Re-pricing rights	Avoid long term guarantee of rate and maintain ability to re-price contracts.
4		Alignment of interest	Interest of parties in a transaction should be aligned to reduce human behavior that could disadvantages a party.
5		Hedging strategies	Balance offsetting risks e.g. mortality & longevity on the same segment of lives.
6		Geographic Diversification	Helps to spread the risk of certain types of natural perils e.g. Earthquakes.
7		Product Diversification	Combine risky products with less risky products to reduce uncertainty.
8		Accumulation Control Budgets	Limit exposure to certain types of risks – budgets set relative to resources such as capital.
9		Optionality	Observe…and learn to take on more / better risk. Justifies making a business decision
10	Transfer Risk	Reinsurance	Transfer the risk to a 3rd party. Reinsurers fulfill this role for direct insurers.
11		Securitization	Transfer the risk to capital markets
12	Avoid Risk	Policyholder retain risk	Product design can pass risk back to policyholder

APPENDIX III: MINDFULNESS ATTENTION & AWARENESS SCALES

This following Mindfulness measure scales were used in this study:

Table A3. Description of Mindfulness Measures Scales

Measure	Description
Trait mindful attention (TMAt)	1. It seems I am "running on automatic," without much awareness of what I'm doing. (R) 2. I rush through activities without being really attentive to them. (R) 3. I do jobs or tasks automatically, without being aware of what I'm doing. (R) 4. I find myself preoccupied with the future or the past. (R) 5. I find myself doing things without paying attention. (R) Reference: Mindful Attention (Brown and Ryan, 2003) (lack of absentmindedness)
Trait meta-awareness (TMAw)	1. I can separate myself from my thoughts and feelings. 2. I can treat myself kindly. 3. I view things from a broad perspective. 4. I can observe unpleasant feelings without being drawn into them. 5. I notice that I don't take difficulties so personally. 6. I am able to accept myself as I am. Reference: Mindful Metacognition (Fresco et al., 2007)
State mindful attention (SMAt)	1. I found it difficult to stay focused on what's happening in the present moment. (R) 2. I did things without paying attention. (R) 3. I was preoccupied with thoughts of the future or the past. (R) 4. I did things automatically, without being aware of what I was doing. (R) 5. I rushed through activities without being attentive to them. (R) Reference: Mindful Attention (Brown and Ryan, 2003) (lack of absentmindedness)

The measures were presented (with a 5-pt Likert-style scale) as follows to training participants, pre-training and post-training:

Pre-Training Survey

Please indicate to what extent the following statements describe your experience as it is **in general**. Please answer according to what really reflects your experience rather than what you think your experience should be.

1	2	3	4	5
Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5
I rush through activities without being really attentive to them.	1	2	3	4	5
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5
I find myself preoccupied with the future or the past.	1	2	3	4	5
I find myself doing things without paying attention.	1	2	3	4	5
I can separate myself from my thoughts and feelings.	1	2	3	4	5
I can treat myself kindly.	1	2	3	4	5
I view things from a broad perspective.	1	2	3	4	5
I can observe unpleasant feelings without being drawn into them.	1	2	3	4	5
I notice that I don't take difficulties so personally.	1	2	3	4	5
I am able to accept myself as I am.	1	2	3	4	5

Post-Training Survey

Please indicate the extent to which the following statements describe your state of mind during the training today. Please be as honest as possible – all your responses are treated confidentially and will not be shared with your employer or anyone beyond the researcher.

1	2	3	4	5
Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree

I found it difficult to stay focused on what was happening in the present moment.	1	2	3	4	5
I did things without paying attention.	1	2	3	4	5
I was preoccupied with thoughts of the future or the past.	1	2	3	4	5
I did things automatically, without being aware of what I was doing.	1	2	3	4	5
I rushed through activities without being attentive to them.	1	2	3	4	5

Please share any thoughts and feedback you have about this training:

APPENDIX IV: WORK SAMPLE TESTS (WST'S)

To ascertain the underwriting skill of underwriters, I used a work sample test (WST). WST's are high-fidelity assessment techniques that present conditions that are highly similar to essential challenges and situations on an actual job. WST's have been used for a variety of certification, training, and performance evaluation for a wide variety of jobs.

Information collected prior to WST:

Participation #	Age	Gender (M/F)	Working Experience (in years)	Highest Degree e.g. Bachelors/Masters

Instructions: On the next page are 20 underwriting proposals. Each proposal is briefly described. Your task is to make a decision to accept or decline the proposal. Note that we will not provide any further information on any of the decision problems. You have 20 minutes to make your decisions, or about 1 minute for each decision. **For the scientific validity of this study, it is crucial that you make your decisions independently of all other participants. Do not interact or communicate with any other participant while working on this task**. If you have any questions, please raise your hand and wait for the facilitator to come to your desk. Please note that your results will remain confidential and only anonymised data (with participant numbers & not names) will be used.

PLEASE TURN OVER ONLY WHEN INSTRUCTED TO…

PRE-TRAINING Insurance Underwriting Work Sample Test (WST) - test paper

Please answer as ACCEPT/DECLINE for the following underwriting cases:				
#	**Insurance Type**	**Description**	**Please Circle**	
1	No Underwriting Life Insurance	Insurance cover that pays a flat amount of USD1 million on death with no medical/financial underwriting - sold by insurance agents to lives aged 20 to 60.	ACCEPT	DECLINE
2	Terrorism Insurance	Insurance product that pays out a fixed sum assured equal to 2x annual salary if the insured is killed or hurt in an act of terrorism?	ACCEPT	DECLINE
3	Heart Attack Insurance	Insurance product that pays out €100k if insured experiences severe pain in the chest.	ACCEPT	DECLINE
4	Earth Quake (EQ) Insurance in Japan	Pays for EQ damage to buildings commercial or residential in Japan.	ACCEPT	DECLINE
5	Divorce Insurance	Insurance product providing coverage for divorce costs in the event of an unhappy marriage that leads to an expensive divorce.	ACCEPT	DECLINE
6	Agro Insurance	Insurance product coverage for input costs to farmers for costs stemming from damage to crops from drought/hail/etc. in India.	ACCEPT	DECLINE
7	Guaranteed Critical Illness	Insurance product that pays out up to SGD2m on certain major conditions like cancer/heart attack/stroke in China. The premium are lifetime guaranteed not to increase.	ACCEPT	DECLINE
8	HIV +ve Life Insurance	Insurance product, providing Life insurance coverage for people who are HIV +ve up to USD1m.	ACCEPT	DECLINE
9	Test Tube Baby Insurance	Insurance product, providing coverage for the 2nd – 3rd trial costs if 1st trial turns out to be a failure for fertility treatment.	ACCEPT	DECLINE
10	Long Term Personal Accident (LTPA)	This product pays high multiple of sum assured if insured dies due to an accident in China. The rates premium rates are guaranteed for life.	ACCEPT	DECLINE
11	Occupational Disability Insurance	Insurance product coverage for 110% of loss of income from the risk of not being able to perform occupation. Benefit will be paid in monthly instalments.	ACCEPT	DECLINE
12	Pandemic Insurance	Insurance product that pays out 2x annual salary only if insured is killed or hurt in a pandemic breakout?	ACCEPT	DECLINE
13	Long term care	Insurance product that pays out SGD500 per month if insured becomes frail and unable to work.	ACCEPT	DECLINE
14	Hurricane Insurance in Florida	Pays for hurricane damage to buildings, commercial or residential, in Florida.	ACCEPT	DECLINE
15	Exam Insurance	Insurance product, providing cost of exam fees & study material for failing an actuarial exam through the Society of Actuaries.	ACCEPT	DECLINE
16	Cyber Attack Insurance	Insurance product providing coverage for costs stemming from cyber attacks on SME businesses. The is an exclusion for outage of the external networks e.g. Internet.	ACCEPT	DECLINE
17	Guaranteed Dementia Illness	Insurance product that pays out up to SGD2m on dementia. The rates are lifetime guaranteed.	ACCEPT	DECLINE
18	Sub-standards motor insurance	Coverage for the large substandard (high risk) drivers who have poor driving records, etc.	ACCEPT	DECLINE
19	Dental Insurance	Insurance product, providing coverage for unlimited dental procedures during a year.	ACCEPT	DECLINE
20	Space Rocket Insurance	Insurance product providing coverage for costs stemming from rocket failure.	ACCEPT	DECLINE

THANK YOU FOR YOUR PARTICIPATION

Insurance Underwriting Work Sample Test (WST) - answer grid

Answer as ACCEPT/DECLINE for the following underwriting cases:					
#	Insurance Type	Description	Please Circle		Pts
1	No Underwriting Life Insurance	Insurance cover that pays a flat amount of USD1 million on death with no medical/financial underwriting - sold by insurance agents to lives aged 20 to 60.	ACCEPT	DECLINE	1/2
2	Terrorism Insurance	Insurance product that pays out a fixed sum assured equal to 2x annual salary if the insured is killed or hurt in an act of terrorism?	ACCEPT	DECLINE	1/2
3	Heart Attack Insurance	Insurance product that pays out €100k if insured experiences severe pain in the chest.	ACCEPT	DECLINE	1/2
4	Earth Quake (EQ) Insurance in Japan	Pays for EQ damage to buildings commercial or residential in Japan.	ACCEPT	DECLINE	1/2
5	Divorce Insurance	Insurance product providing coverage for divorce costs in the event of an unhappy marriage that leads to an expensive divorce.	ACCEPT	DECLINE	1/2
6	Agro Insurance	Insurance product coverage for input costs to farmers for costs stemming from damage to crops from drought/hail/etc. in India.	ACCEPT	DECLINE	1/2
7	Guaranteed Critical Illness	Insurance product that pays out up to SGD2m on certain major conditions like cancer/heart attack/stroke in China. The premium are lifetime guaranteed not to increase.	ACCEPT	DECLINE	1/2
8	HIV +ve Life Insurance	Insurance product, providing Life insurance coverage for people who are HIV +ve up to USD1m.	ACCEPT	DECLINE	1/2
9	Test Tube Baby Insurance	Insurance product, providing coverage for the 2nd – 3rd trial costs if 1st trial turns out to be a failure for fertility treatment.	ACCEPT	DECLINE	1/2
10	Long Term Personal Accident (LTPA)	This product pays high multiple of sum assured if insured dies due to an accident in China. The rates premium rates are guaranteed for life.	ACCEPT	DECLINE	1/2
11	Occupational Disability Insurance	Insurance product coverage for 110% of loss of income from the risk of not being able to perform occupation. Benefit will be paid in monthly instalments.	ACCEPT	DECLINE	1/2
12	Pandemic Insurance	Insurance product that pays out 2x annual salary only if insured is killed or hurt in a pandemic breakout?	ACCEPT	DECLINE	1/2
13	Long term care	Insurance product that pays out SGD500 per month if insured becomes frail and unable to work.	ACCEPT	DECLINE	1/2
14	Hurricane Insurance in Florida	Pays for hurricane damage to buildings, commercial or residential, in Florida.	ACCEPT	DECLINE	1/2
15	Exam Insurance	Insurance product, providing cost of exam fees & study material for failing an actuarial exam through the Society of Actuaries.	ACCEPT	DECLINE	1/2
16	Cyber Attack Insurance	Insurance product providing coverage for costs stemming from cyber attacks on SME businesses. The is an exclusion for outage of the external networks e.g. Internet.	ACCEPT	DECLINE	1/2
17	Guaranteed Dementia Illness	Insurance product that pays out up to SGD2m on dementia. The rates are lifetime guaranteed.	ACCEPT	DECLINE	1/2
18	Sub-standards motor insurance	Coverage for the large substandard (high risk) drivers who have poor driving records, etc.	ACCEPT	DECLINE	1/2
19	Dental Insurance	Insurance product, providing coverage for unlimited dental procedures during a year.	ACCEPT	DECLINE	1/2
20	Space Rocket Insurance	Insurance product providing coverage for costs stemming from rocket failure.	ACCEPT	DECLINE	1/2
				TOTAL ACCURACY SCORE	10

Consistency Score:

Pair	P1	P2	UW Decision	Simple Rule	Pts
1	#1. No Underwriting Life Insurance	#11. Occupational Disability Insurance	**DECLINE**	#1. Over-insurance / #5 Non-random event	**1**
2	#2. Terrorism Insurance	#12. Pandemic Insurance	**DECLINE**	#2. Accumulation of risk/ #3 Event not defined	**1**
3	#3. Heart Attack Insurance	#13. Long term care insurance	**DECLINE**	#3. Event not well defined	**1**
4	#4. Earth Quake (EQ) Insurance in Japan:	#14. Hurricane Insurance in Florida	**ACCEPT**		**1**
5	#5. Divorce Insurance	#15. Exam Insurance	**DECLINE**	#5. Non-random event	**1**
6	#6. Agro Insurance	#16. Cyber Attack Insurance	**ACCEPT**		**1**
7	#7. Guaranteed Critical Illness	#17. Guaranteed Dementia Illness	**DECLINE**	#6. Non-rateable	**1**
8	#8. HIV +ve Life In	#18. Sub-standards motor insurance	**ACCEPT**		**1**
9	#9. Test Tube Baby Insurance	#19. Dental Insurance	**DECLINE**	#7. Not affordable	**1**
10	#10. Long Term Personal Accident (LTPA)	#20. Space Rocket Insurance	**ACCEPT**		**1**
				TOTAL CONSISTENCY SCORE	**10**

POST-TRAINING Insurance Underwriting Work Sample Test (WST) - test paper

Participation #				
Answer as ACCEPT/DECLINE for the following underwriting cases:				
#	**Insurance Type**	**Description**	**Please Circle**	
1	Jockeys' Disability Cover	Disability cover for race horse jockeys that pays 75% of monthly salary up to age 60 if unable to perform own occupation.	**ACCEPT**	**DECLINE**
2	War Cover Insurance	Insurance product that pays out a fixed sum assured equal to 2x annual salary if the insured is killed or hurt in an act of war?	**ACCEPT**	**DECLINE**
3	Credit Card Add-on Insurance	Credit card companies selling add-on insurance with policies paying out only around 10% of premium as claims, with the remaining being commissions (and profit).	**ACCEPT**	**DECLINE**
4	Storm (EQ) Insurance in Japan	Pays for storm damage to buildings, commercial or residential, in Japan.	**ACCEPT**	**DECLINE**
5	Cosmetic Insurance Cover	Insurance product providing coverage cosmetic surgery up to an annual limit of SGD1m per annum.	**ACCEPT**	**DECLINE**
6	Flight Delay Insurance	Insurance product coverage that pays a small amount on flight delay.	**ACCEPT**	**DECLINE**
7	Estate Duty Life Insurance	Life insurance sold to people who are concerned about estate duty tax in the US. The life cover is lifetime and entry age is up to 75.	**ACCEPT**	**DECLINE**
8	Life Insurance for Diabetics	Insurance product, providing Life insurance coverage for people who are diabetic up to USD1m.	**ACCEPT**	**DECLINE**
9	Life Insurance for Terminally Ill	Insurance product providing mortality coverage for terminally ill people.	**ACCEPT**	**DECLINE**
10	Disability Income (DI) Insurance	This product pays 70% of pre-disability income on becoming disabled and unable to perform the occupation one is trained for with the rates being totally reviewable.	**ACCEPT**	**DECLINE**
11	Critical Illness Insurance	Insurance product providing fixed sum assured on diagnosis of cancer; heart attack or stroke – with rates that are not guaranteed.	**ACCEPT**	**DECLINE**
12	Taxi/Uber Fleet Motor Insurance	Motor fleet insurance for a fleet of taxi/Uber drivers which offers a bulk discount relative to standard motor insurance rates.	**ACCEPT**	**DECLINE**
13	HNW Life Insurance	Life insurance for high net worth individuals (HNW) up to an amount of €50m on one Life.	ACCEPT	**DECLINE**
14	Guaranteed Parkinson's cover	Insurance product that pays out on Parkinson's disease. The rates are lifetime guaranteed.	**ACCEPT**	**DECLINE**
15	Business Interruption Insurance	Insurance product providing coverage for costs stemming from business interruptions for SME businesses.	**ACCEPT**	**DECLINE**
16	Bankruptcy Insurance	Insurance product, providing coverage for bankruptcy costs for SME's in the event of going out of business due to financial ruin.	**ACCEPT**	**DECLINE**
17	Property Damage Liability Insurance	If you cause an accident that damages someone else's property (their car, for example), property liability coverage helps pay for repairs.	**ACCEPT**	**DECLINE**
18	Direct Marketing Insurance	Direct marketing companies sold insurance through outbound calls with policies paying out only around 20% of premium as claims, with the remaining being commissions (and profit).	**ACCEPT**	**DECLINE**
19	Unemployment Insurance	Insurance product that pays out 2xannual salary if the insured becomes unemployed.	**ACCEPT**	**DECLINE**
20	5m CI over	Insurance product coverage for SGD5m on diagnosis of a critical illness such as cancer; heart attack or stroke.	**ACCEPT**	**DECLINE**

PLEASE TURN OVER

Insurance Underwriting Work Sample Test (WST) - answer grid

Answer as ACCEPT/DECLINE for the following underwriting cases:					
#	Insurance Type	Description	Please Circle		Pts
1	Jockeys' Disability Cover	Disability cover for race horse jockeys that pays 75% of monthly salary up to age 60 if unable to perform own occupation.	ACCEPT	DECLINE	1/2
2	War Cover Insurance	Insurance product that pays out a fixed sum assured equal to 2xannual salary if the insured is killed or hurt in an act of war?	ACCEPT	DECLINE	1/2
3	Credit Card Add-on Insurance	Credit card companies selling add-on insurance with policies paying out only around 10% of premium as claims, with the remaining being commissions (and profit).	ACCEPT	DECLINE	1/2
4	Storm (EQ) Insurance in Japan	Pays for storm damage to buildings, commercial or residential, in Japan.	ACCEPT	DECLINE	1/2
5	Cosmetic Insurance Cover	Insurance product providing coverage cosmetic surgery up to an annual limit of SGD1m per annum.	ACCEPT	DECLINE	1/2
6	Flight Delay Insurance	Insurance product coverage that pays a small amount on flight delay.	ACCEPT	DECLINE	1/2
7	Estate Duty Life Insurance	Life insurance sold to people who are concerned about estate duty tax in the US. The life cover is lifetime and entry age is up to 75.	ACCEPT	DECLINE	1/2
8	Life Insurance for Diabetics	Insurance product, providing Life insurance coverage for people who are diabetic up to USD1m.	ACCEPT	DECLINE	1/2
9	Life Insurance for Terminally Ill	Insurance product providing mortality coverage for terminally ill people.	ACCEPT	DECLINE	1/2
10	Disability Income (DI) Insurance	This product pays 70% of pre-disability income on becoming disabled and unable to perform the occupation one is trained for with the rates being totally reviewable.	ACCEPT	DECLINE	1/2
11	Critical Illness Insurance	Insurance product providing fixed sum assured on diagnosis of cancer; heart attack or stroke – with rates that are not guaranteed.	ACCEPT	DECLINE	1/2
12	Taxi/Uber Fleet Motor Insurance	Motor fleet insurance for a fleet of taxi/Uber drivers which offers a bulk discount relative to standard motor insurance rates.	ACCEPT	DECLINE	1/2
13	HNW Life Insurance	Life insurance for high net worth individuals (HNW) up to an amount of €50m on one Life.	ACCEPT	DECLINE	1/2
14	Guaranteed Parkinson's cover	Insurance product that pays out on Parkinson's disease. The rates are lifetime guaranteed.	ACCEPT	DECLINE	1/2
15	Business Interruption Insurance	Insurance product providing coverage for costs stemming from business interruptions for SME businesses.	ACCEPT	DECLINE	1/2
16	Bankruptcy Insurance	Insurance product, providing coverage for bankruptcy costs for SME's in the event of going out of business due to financial ruin.	ACCEPT	DECLINE	1/2
17	Property Damage Liability Insurance	If you cause an accident that damages someone else's property (their car, for example), property liability coverage helps pay for repairs.	ACCEPT	DECLINE	1/2
18	Direct Marketing Insurance	Direct marketing companies sold insurance through outbound calls with policies paying out only around 20% of premium as claims, with the remaining being commissions (and profit).	ACCEPT	DECLINE	1/2
19	Unemployment Insurance	Insurance product that pays out 2xannual salary if the insured becomes unemployed.	ACCEPT	DECLINE	1/2
20	5m CI over	Insurance product coverage for SGD5m on diagnosis of a critical illness such as cancer; heart attack or stroke.	ACCEPT	DECLINE	1/2
				TOTAL ACCURACY SCORE	10

Consistency Score:

Pair	P1	P2	UW Decision	Simple Rule	Pts
1	#1. Jockeys' Disability Cover	#20. 5m CI over	**DECLINE**	#1. Over-insurance / #5 Non-random event	**1**
2	#2. War Cover Insurance	#19. Unemployment Insurance	**DECLINE**	#2. Accumulation of risk/ #3 Event not defined	**1**
3	#3. Credit Card Add-on Insurance	#18. Direct Marketing Insurance	**DECLINE**	#4. Not Equitable	**1**
4	#4. Storm (EQ) Insurance in Japan	#17. Property Damage Liability Insurance	**ACCEPT**		**1**
5	#5. Cosmetic Insurance Cover	#16. Bankruptcy Insurance	**DECLINE**	#5. Non-random event	**1**
6	#6. Flight Delay Insurance	#15. Business Interruption Insurance	**ACCEPT**		**1**
7	#7. Estate Duty Life Insurance	#14. Guaranteed Parkinson's cover	**DECLINE**	#6. Non-rateable	**1**
8	#8. Life Insurance for Diabetics	#13. HNW Life Insurance	**ACCEPT**		**1**
9	#9. Life Insurance for Terminally Ill	#12. Taxi/Uber Fleet Motor Insurance	**DECLINE**	#7. Not affordable	**1**
10	#10. Disability Income (DI) Insurance	#11. Critical Illness Insurance	**ACCEPT**		**1**
				TOTAL CONSISTENCY SCORE	**10**

APPENDIX V: TRAINING COURSE INVITATION LETTER & OUTLINE

Letter of Invitation to Participate in a Research Project on Training Effectiveness to Improve Insurance Underwriting (Email)

Title of Study: *An Examination of the Effectiveness of a Training Programme to Improve Decision Making in Insurance Risk Underwriting*
Principal Investigator (PI): Gavin R. Maistry, SMU PhD (GM) Candidate, Lee Kong Chian School of Business
Faculty Supervisor: SMU Associate Professor Jochen Reb, Lee Kong Chian School of Business
Principal Investigator information: My name is Gavin R. Maistry, a PhD candidate from Lee Kong Chian School of Business at Singapore Management University. I am conducting research to explore the effectiveness of training as an intervention managerial tool that could increase the quality of insurance underwriting. If proved effective, this could motivate companies to invest time, budget, resource and effort to groom their underwriters and accelerate underwriting expertise resulting in better financial performance.

Appeal for participation: I am writing to extend an invitation to you to participate in this research.

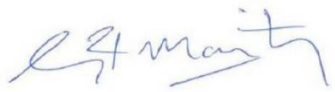
Why were you selected:
You are recognized as a student studying Actuarial Science at SMU (Study 1) OR
You are recognized as an important underwriter in your organization (Study 2 & Study 3).

What is involved: Should you choose to participate, you would partake in the 0.5day insurance underwriting training. The study would involve collecting some self-ratings at the start of the workshop; then taking a pre-training work sample test based on underwriting situations. This would then be followed by analysis of the test results plus training on the rules underlying good underwriting decisions. Finally, a post-training work sample test based on underwriting situations will be conducted. Participants will be informed on the overall effectiveness of the training programme, and there will be a follow-up interview a few months after the training to gauge if the skills learnt in the training programme are continuing to be used and whether they are successful in improving underwriting quality in practice. Participation is voluntary and participants will be able to skip certain questions or procedures, if they are uncomfortable with them, without any penalty. Participants can also choose to withdraw from the study at any point in time by informing the study team present. Participants will also be given an opportunity to withdraw their data after they have been debriefed.

Confidentiality: Participants will be asked to sign an attendance sheet at the start of the training session and will be provided a participant ID, which they will need to input on test/surveys during the study and will act as a unique identifier for participants. No names or other personal identifiers (e.g., phone numbers) will be collected. The survey questionnaires and work sample tests done at the start and end of the training will be stored using the same participant ID and will not be stored using the participants' names. Only I will have access to this data. The hardcopy informed consent forms will be stored separately from the survey questionnaires and work sample tests. Finally, there will be no risk of harm to employment status as, for example, those who show poor judgment and no learning will not be known by name.

Contact Details:
If you are interested in participating in this research study, please contact me at 9657-7276 or grmaistry.2015@phdgm.smu.edu.sg. You may also contact my supervisor, Associate Professor Jochen Reb, at 9189-3185 or jreb@smu.edu.sg.

Thanks & best regards



Date:
SMU PhD (GM) Candidate, Lee Kong Chian School of Business

Programme Facilitator

Gavin R. Maistry is a Ph.D. Candidate at the Lee Kong Chain School of Business, under the supervision of Professor Jochen Reb. His other dissertation committee members are Professor Thomas Menkhoff (SMU) & Professor Shenghua Luan (Chinese Academy of Sciences).

Gavin is currently the Regional Chief Actuary & Chief Risk Officer for Munich Re (the world's largest reinsurance company) – based in Singapore. He has responsibility for underwriting; actuarial & risk management topics for Munich Re's Life & Health (L&H) & Property Casualty (P&C) business in the Asia Pacific & Middle East & Africa region. Gavin has been with Munich Re for just over 10 years and oversees a team of close to 50 underwriters; actuaries & risk managers. He has over 25 years of experience in the re/insurance industry & has held previously senior actuarial & risk management roles with Swiss Re in Zurich & Old Mutual in London & Cape Town. Gavin holds the Fellow of the Society of Actuaries (FSA) & Chartered Enterprise Risk Analyst (CERA) designations from the US Society of Actuaries. In addition, he is a Fellow of the Singapore Actuarial Society, where he earlier chaired the Education Committee for many years. He's also a CFA Charterholder and is a graduate of the University of Cape Town (UCT) and the University of KwaZulu-Natal (UKZN) in South Africa.

Couse Outline: Training

Time	Dur	Section	Form #
12.00-12.10	10 min	**Introduction to Training Programme**	1. Recap of Invitation Letter 2. Information & Consent Form 3. Mindfulness Questionnaire
12.10-12:30	20 min	**Pre-training Work Sample Test (WST)**	4. Pre-training WST
12:30-12:45	15 min	**Introduction to Insurance Underwriting**	
12:45-13:30	45 min	**Review of *Scripts* for 20 Questions**	
13:30:13:40	10 min	**Summary of *Simple Rules***	
13:40-14:00	20 min	**Post-training Work Sample Test (WST)**	5. Post-training WST
14:00-14:05	5 min	**Debrief**	6. Debriefing Form

Couse Outline: Control

Time	Dur	Section	Form #
12.00-12.10	10 min	**Introduction to Training Programme**	1. Recap of Invitation Letter 2. Information & Consent Form 3. Mindfulness Questionnaire
12.10-12:30	20 min	**Pre-training Work Sample Test (WST)**	4. Pre-training WST
12:30-13:40	70 min	**Kahneman video**	
13:40-14:00	20 min	**Post-training Work Sample Test (WST)**	5. Post-training WST
14:00-14:05	5 min	**Debrief**	6. Debriefing Form