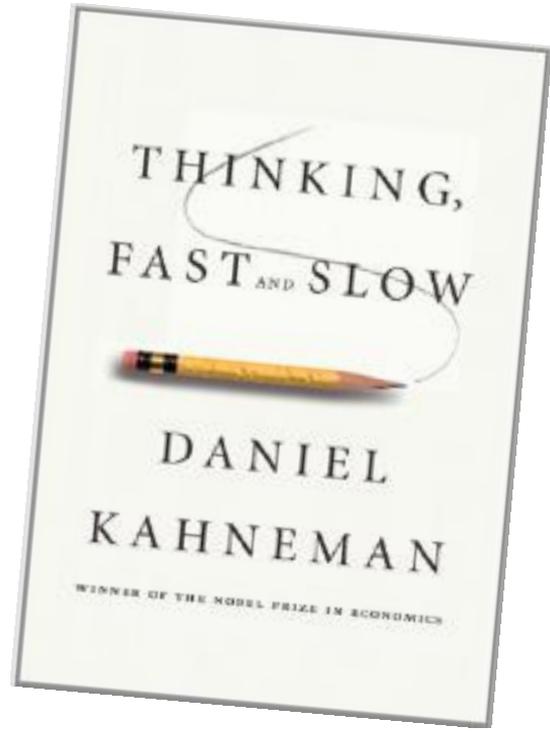




THINKING FAST & SLOW FOR ACTUARIES

Gavin R. Maistry, FSA, FSAS, CERA, CFA

*Regional Chief Actuary & CRO, Asia Pacific; Middle East & Africa
Singapore*



Authors

Eric Ehm
 Eric Ehm
 PD/Dr. Bernhard Straucher
 Department of Psychology
 Ludwig-Maximilians-Universität München,
 Germany

Dr. Esther Sachs
 Munich RE
 Tel.: +49 89 3891-6824
 esachs@munichre.com
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The history of risk management is characterized by continually developing methods for modelling risks. The trend towards ever more consistent risk quantification (Michael, Tang & Embrechts, 2005; Wolan, 2008) is inevitable, while the study of so-called emerging risks has increasingly gained in importance in the insurance sector. These risks are notifiable for the high degree of uncertainty regarding the probability of occurrence and the amount of loss and, at the same time, for the large potential scale of loss. Emerging risks should nevertheless be taken into account in controlling and in risk management.

This article gives an overview of important academic insights into the extent to which psychological factors influence individual risk assessments. It presents the opportunities and limitations of intuitive risk judgment.

Intuition and risk assessment

We can respond to practically any question with quick, intuitive answers. Inevitably and effortlessly – seemingly automatically – we form impressions which give us answers to quite complex questions, for example whether a new product is probably successful or an investment profitable. In order to be able to evaluate intuitive impressions, it is first necessary to understand how intuition works. Intuition is mostly directed towards “hot” knowledge that cannot be explicitly explained. Most of the processes in the human brain remain unconscious. Thoughts of our lives, our tracks serve for storing information and links to other information and emotions. The brain constantly associates us. The brain constantly associates new situations with stored ones and their affective assessments. Thus, for example, when dealing with a specific risk, a gut feeling may arise that is based on unconsciously available experiences. From this perspective, an intuitive judgment – for example about the extent of a risk – may well form the basis of good decisions (Gigerenzer & Gaissner, 2012; Slovic, Tversky, & Kahneman, 2004; Peters & MacGregor, 2004).

Authors

Dr. Eva Lerner
 Department of Psychology
 Ludwig-Maximilians-University Munich,
 Germany

Prof. Dr. Bernhard Straucher
 Institute for Applied Psychology
 University for Health Sciences, LMU,
 MUM (TUM)

Eric Ehm
 Munich RE
 Tel.: +49 89 3891-6824
 esachs@munichre.com

Dr. Esther Sachs
 Munich RE
 Tel.: +49 89 3891-6824
 esachs@munichre.com

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When insurers assess risk, they often assume that group discussions are better than individual assessments, i.e. the more numerous the experts, the more accurate the assessment. However, psychological research has shown that risk assessment by groups is associated with a range of problems. The quality of risk identification and evaluation depends significantly on taken into account, and whether appropriate methods have been used. For example, Munich RE uses several structured and expert elicitation methods in its emerging risk context which allows the experts' available experience to generate accurate risk assessments that remain as undistorted as possible.

When dealing with new risks, organizations have to rely on intuitive estimates by experts, especially since like to be factored into the risk calculations, or often sparse. Although expert estimates are indispensable in alternatives given the lack of visible information, insurers must keep in mind that intuitive assessments are more susceptible to distortion in a range of ways (see Emerging Risk Discussion Paper 09/2012: Psychological influences on the individual assessment of risks). Industry experience has shown that an expert assessment often means having a group of experts come together to discuss the respective topic and then collectively make an assessment or decision. In this regard, it is often assumed that group discussions are better than individual assessments, i.e. that the more numerous the experts, the more accurate the assessment. However, research over the last few decades has identified a

number of group effects that can lead to distorted results, especially with regard to risk assessments.

Groups are very important to people. Our judgments and our identities result, among other things, from our belonging to certain groups, from the feedback we receive from other group members, and from comparing ourselves with other groups. Groups create roles and norms, compliance with which is important to gain acceptance within the group, and which therefore influence the behaviour of group members. These and other social factors lead to people making decisions perfectly rationally. On the contrary, when a group makes a decision, social factors are always involved, in addition to objective reasons, in determining each individual member's behaviour. The simple fact of being in a group already influences members' behaviour. In the present paper we will discuss these findings that are important for risk assessment in groups:

1. Groups are less creative than individuals in their identification of risks.
2. Groups rarely manage to exchange information properly.
3. Groups have a tendency to make extreme judgments in their risk assessment.

A Quick Exercise to Start...



IMAGINE YOU ARE A PHYSICIAN and a patient of yours just had a positive test result for a certain condition:

- the condition has a 0.1% prevalence
- if the person has the condition, there is a 100% probability of detection
- If the person does not have the condition, there is a 5% chance of a false positive

What do you tell your patient is the probability they actually have the condition?

What's your intuition saying? Think Fast (use System 1)

Now, Thinking Slow, Using System II

Base Rate Neglect & apply some Bayesian Thinking...

Pr(condition)	=	0.1%
Pr(positive condition)	=	100%
Pr(positive no-condition)	=	5%
Pr(condition positive)	≠	Pr(positive condition)
Pr(condition positive)	=	$\frac{\text{Pr(positive condition)} \times \text{Pr(condition)}}{\text{Pr(positive condition)} \times \text{Pr(condition)} + \text{Pr(positive no-condition)} \times \text{Pr(no-condition)}}$
	=	1.96%

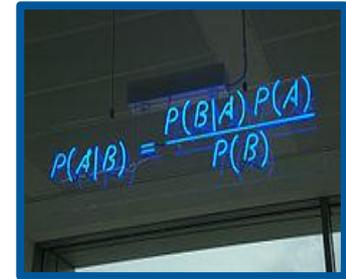
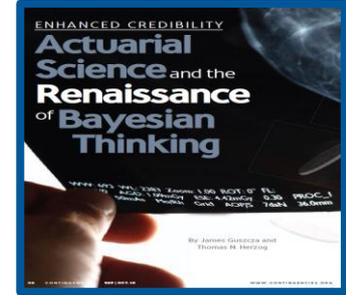
Or more simply, consider a population of 10'000 people:

- assume everyone gets tested
- then 10 have the condition & get a positive test
- also, 500 people have a false positive test
- Hence, 510 have a positive test

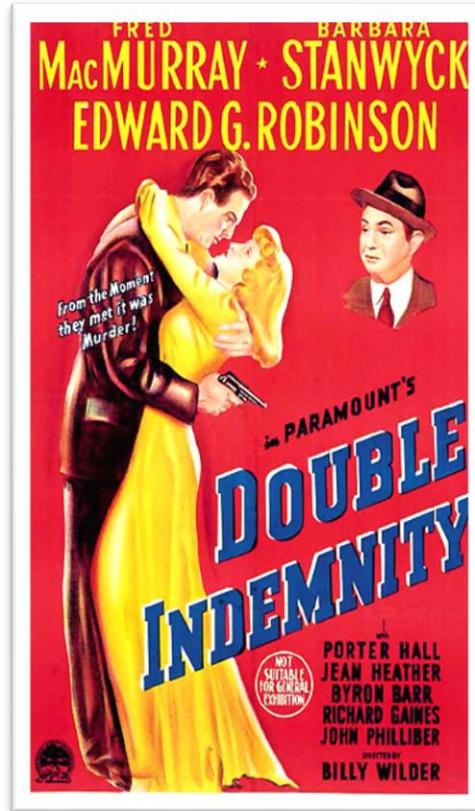
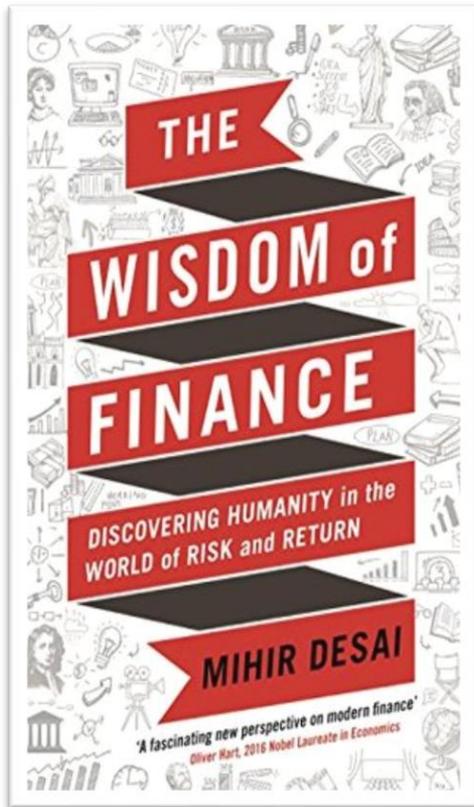
Then probability of actually having the condition when you have a positive test

= 10/510

= **1.96%**



The Wonderful World of Insurance... the best industry to work in?



- “Going into insurance is the **ultimate contrarian bet**, given the popular image of insurance executives today —boring, nerdy, and vaguely evil as they profit from the woes of others.”
- “It wasn’t always so —insurance executives were once heroes, such as the characters played by Fred MacMurray and Edward G. Robinson in the greatest film noir ever, **Double Indemnity**.”
- “**Warren Buffett**, built his business on insurance. So did that paradigmatic American”
- **Ben Franklin**, who founded the first fire insurance company in the colonies.
- Insurance binds people together by **mutualizing risk**: we’re all in this together...
- insurance tries to make sense of the **chaos of human experience** by capitalizing on **patterns** and...
- then creating **pooling mechanisms** for us to be able to manage that chaos

The Challenge of Underwriting

Stock Broker
End of transaction

Investment Analyst
End of quarter

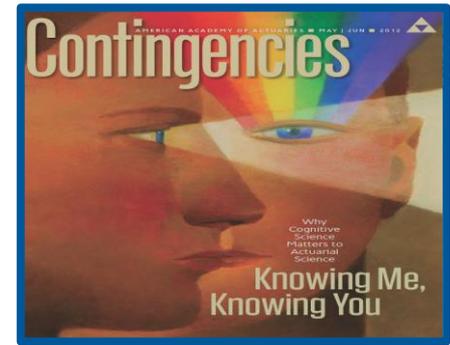
Accountant
Year-end

Economist
End of cycle

Actuary
50 – year pension plan solvency

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Q1
Random variable X has the following cdf:

$$F(x) = \begin{cases} 0 & \text{if } x < 0 \\ 0.01x^2 & \text{if } 0 \leq x \leq 5 \\ 1 & \text{if } x > 5 \end{cases}$$

Calculate $E(X)$.

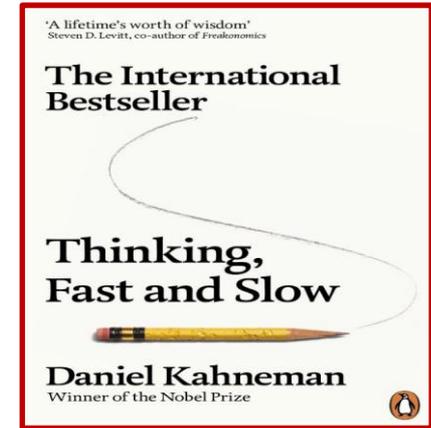
A 3.1 B 3.3 C 3.5 D 3.7 E 3.9

$E(X) = \int_{-\infty}^{\infty} x f(x) dx = \int_{0}^{5} x (0.02x) dx = \int_{0}^{5} 0.02x^2 dx = \frac{1}{3} (0.08x^3) \Big|_0^5 = \frac{1}{3} (0.08) 5^3$

$F(x) = \int_{-\infty}^x f(t) dt = \int_{0}^x 0.02t dt = 0.01t^2 \Big|_0^x = 0.01x^2$

$E(X) = \int_{-\infty}^{\infty} x f(x) dx = \int_{0}^{5} x (0.02x) dx = \int_{0}^{5} 0.02x^2 dx = \frac{1}{3} (0.08x^3) \Big|_0^5 = \frac{1}{3} (0.08) 5^3$

- Underwriting is considered to be part art, part science
- Cannot be based totally on analytical data and models
- Underwriters have to deal with real life uncertainty and incomplete information which cannot be captured in models
- Hence, underwriting requires analytical & good judgement
- Both intuitive & deliberate judgements...requiring *System 1* & *System 2* thinking



Traits of “Super-Underwriter” Ajit Jain...

“In Ajit Jain, we have an underwriter equipped with...

- the **intelligence** to properly rate most risks;
- the **realism** to forget about those he can't evaluate;
- the **courage** to write huge policies when the premium is appropriate; and
- the **discipline** to reject even the smallest risk when the premium is inadequate.

It is rare to find a person possessing any one of these talents. For one person to have them all is remarkable.”

Warren Buffett letter to Berkshire shareholders in 1999



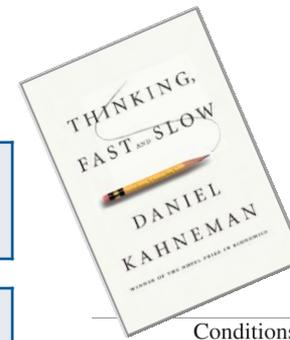
Berkshire Hathaway
Specialty Insurance.



Conditions for Expertise...

Kahneman/Klein Requirement	<i>Training Component</i>	Notes
1. Practice	<i>Scripts</i>	<ul style="list-style-type: none"> ▪ “Think alouds” ▪ Lots of examples
2. Systemized Knowledge	<i>Simple Rules</i>	Environment of high validity (provides valid cues)
3. Feedback	<i>Process / Mindfulness/ Control Cycle</i>	Rapid & clear

Training Design Should Include the Key Ingredients for Developing Expertise...



Conditions for Intuitive Expertise A Failure to Disagree

Daniel Kahneman Princeton University
Gary Klein Applied Research Associates

This article reports on an effort to explore the differences between two approaches to intuition and expertise that are often viewed as conflicting: heuristics and biases (HB) and naturalistic decision making (NDM). Starting from the obvious fact that professional intuition is sometimes marvelous and sometimes flawed, the authors attempt to map the boundary conditions that separate true intuitive skill from overconfident and biased impressions. They conclude that evaluating the likely quality of an intuitive judgment requires an assessment of the predictability of the environment in which the judgment is made and of the individual's opportunity to learn the regularities of that environment. Subjective experience is not a reliable indicator of judgment accuracy.

Keywords: intuition, expertise, overconfidence, heuristics, judgment

In this article we report on an effort to compare our views on the issues of intuition and expertise and to discuss the evidence for our respective positions. When we launched this project, we expected to disagree on many issues, and with good reason: One of us (GK) has spent much of his career thinking about ways to promote reliance on expert intuition in executive decision making and identifies himself as a member of the intellectual community of scholars and practitioners who study naturalistic decision

still separated in many ways: by divergent attitudes, preferences about facts, and feelings about fighting words such as “bias.” If we are to understand the differences between our respective communities, such emotions must be taken into account.

We begin with a brief review of the origins and precursors of the NDM and HB approaches, followed by a discussion of the most prominent points of contrast between them (NDM: Klein, Orasanu, Calderwood, & Zsombok, 1995; HB: Glösvick, Griffin, & Kahneman, 2002; Tversky & Kahneman, 1974). Next we present some claims about the conditions under which skilled intuitions develop, followed by several suggestions for ways to improve the quality of judgments and choices.

Two Perspectives

Origins of the Naturalistic Decision Making Approach

The NDM approach, which focuses on the successes of expert intuition, grew out of early research on master chess players conducted by deGroot (1946/1978) and later by Chase and Simon (1973). DeGroot showed that chess grand masters were generally able to identify the most promising moves rapidly, while mediocre chess players often did not even consider the best moves. The chess masters mainly differed from weaker players in their



Daniel Kahneman



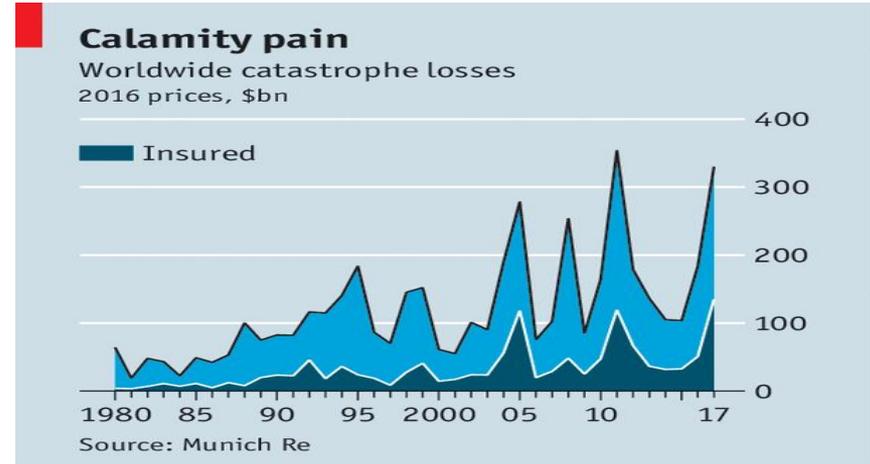
Gary Klein

Are any of these Experts?



Impact of Insurance Risk Underwriting Training...

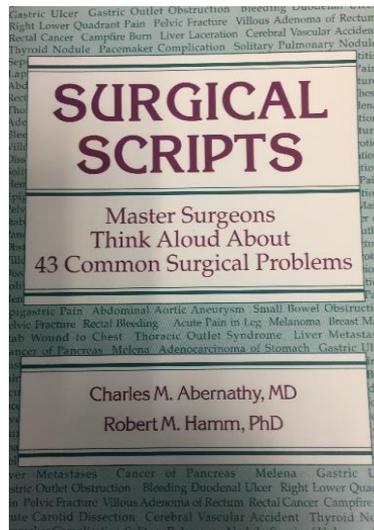
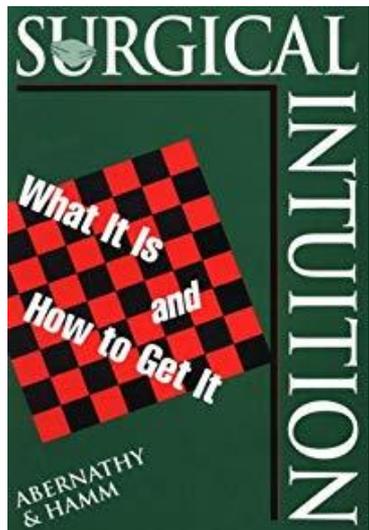
- **accelerated** underwriting expertise
- save **billions** of dollars in poor underwriting decisions
- change **training** of actuaries / underwriters - (focus has been on analytical training and some HB)
- prepared for underwriting in the age of **IFRS17**; continued **low interest rates** that make uw profits more transparent
- prepared for underwriting with **innovation** & new business models (stick to the simple rules)
- Equip underwriters better for a **riskier world**....



Economist.com



Scripts / “Think Alouds” ... to Train Intuitive Judgement...



30. PACEMAKER COMPLICATION

You are in the OR and you have begun to put a ventricular single-lead pacemaker in a 79-year-old woman using the subclavian approach. She is awake on the operating table, and the anesthesiologist is monitoring her. You have inserted a needle twice and have gotten nothing back. On the third attempt, the syringe is filled with what appears to you to be arterial blood. What do you do?

1st-Year Resident	3rd-Year Resident	Attending Surgeon
<p>I withdraw the needle and apply pressure for about 10 minutes. Then I attempt to reinsert the cannula.</p> <p>Same side? Yes. ☐</p>	<p>The natural thing to do is just to pull out and put pressure on the area. With the subclavian approach you are not going to be able to put adequate pressure on some patients' arteries. ☐</p>	<p>I am worried about her hemodynamic status. Initially I would want to make sure that she is ventilating adequately. I then make sure that she is not bleeding into her chest.</p> <p>At this point, I'd like to look at her, to make sure she is ventilating effectively on both sides and that her heart rate and blood pressure haven't changed. Her brain is a reasonably good way of assessing how well she is perfusing—whether she is thinking, able to talk. I ask her a question, and she responds.</p> <p>As a first step, I use her mental state to assess her airway, breathing, and circulation. I am most worried about invisible bleeding in her chest, so I use her heart rate and blood pressure as a monitor of that.</p> <p>I still have the needle in her subclavian space. If the needle is 20 gauge or smaller and if arterial blood is coming back, I would be comfortable pulling the needle out and seeing what happens. ☐</p>

- 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.
- *scripts* vs cases: with cases, there is no right answer; no clear criterion that distinguishes good from bad decisions (Hogarth, 2001); does not develop expertise (Mintzberg, 2004).



#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.

#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
<p>“ACCEPT. There are detailed statistics on SoA pass rates that can be used to determine the probability of claim.”</p>  	<p>“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.”</p>	<p>“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!”</p>

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.

Risk Range: Have Range before Specialize...

- tactical vs strategic
- analogical mind
- “kind” vs “wicked” environments

‘Makes me thoroughly enjoy the experience of being told that everything I thought about something was wrong. I loved *Range*.’
Malcolm Gladwell, bestselling author of *Outliers*

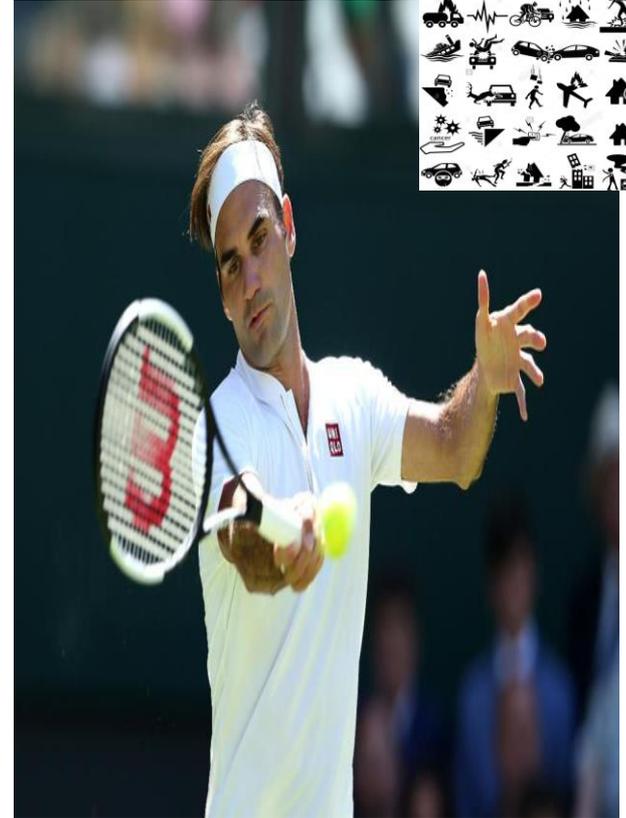


Range

How Generalists Triumph
in a Specialized World

David Epstein

New York Times bestseller

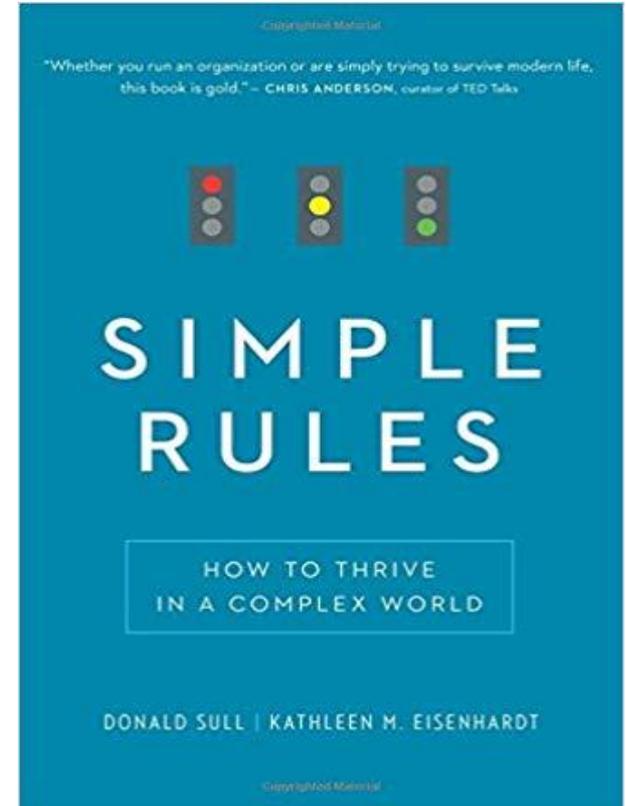


Simple Rules...

to train deliberate judgement & ensure consistency...

- The problem with *scripts* 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
- 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 how to extract them...

HB	FFH	<i>Simple Rules</i>
universal	universal	idiosyncratic
automatic	automatic	consciously
biases X	environment ✓	strategy ✓



7 Simple Rules of Insurable Risks... ILE²R²A

Rule	Description...
#1. I ndemnity	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. <u>moral hazard</u> .
#2. L arge # independent events	Ideally, there should be a <u>large</u> group of roughly <u>similar</u> , 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?
#3. E vent 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).
#4. E quitable	Each policyholder should pay a fair premium according to the risk of loss that they bring to the pool.
#5. R andom insurance event	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.
#6. R atetable	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.
#7. A ffordable	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.

Example of Application of *Simple Rules*: Problem with Australian Disability Insurance (vs. US)

Rule...			Risk Mitigation		
#1. I ndemnity	✗ ⇐ 140% replacement! ratio ⇒ moral hazard huge	✓ Replacement ratios ≤ 70%	Alignment of Interest	✗ ↓ retention	✓ ↑ retention
#2. L arge # independent events	✓ ✗ (70% market share)	✓ Mainly mortality	Product Design	✗	✓
#3. E vent definable	✗ ⇐ own occupation	✓ Not own occup for blue collar / highly specialized	Re-pricing Rights	✗ Misaligned with clients	✓
#4. E quitable Premiums	✓ YRT premiums	✓ Level premium	Product Diversification	✗ Not always get LS with DI	✓ Mainly mortality
#5. R andom insurance event	✗ ⇐ anti-selection; Mental illness; information asymmetry	✓ Mental illness benefit limited to 2 years			
#6. R atetable	✓ ✗ ⇐ 20 year out of date	✓ ↑ Updated			
#7. A ffordable	✗ ⇐ ↑↑P ⇒ anti-selective lapses & dangerous cross- subsidy	✓ Level premium ⇒ anti-selective lapses & no cross-subsidies			

Example of Application of *Simple Rules*: Agro market in India



Principles	Evaluation
#1. I ndemnity	✓ ⇐ mostly based on input cost and historical yield
#2. L arge # independent	✓ ⇐ >200m Indian farmers with 25% pen
#3. E vent definable	✓ standing crop: $\frac{(\text{Threshold Yield} - \text{Actual Yield})}{\text{Threshold Yield}} \times \text{Sum Insured}$ ✓ prevented sowing, post harvest
#4. E quitable Premiums	✓
#5. R andom insurance event	✓ ⇐ weather, fire, pests, diseases and other perils
#6. R atetable	✓ ✗ ⇐ analytics + R&D
#7. A ffordable	✓ ✗ ⇐ fix rates, rest is government subsidised ⇒ creates political risk?

Risk Mitigation	What is it about
Diversification	Spread risks across India
Client selection	Target top private insurers
Alignment of interest	Introduce MR toolbox services



Underwriting Process...

1. Risk Assessment: Is the risk Insurable?

Insurance risk **selection**
simple rules

- Large #
- Definable
- Random
- Rateable
- Indemnity
- Premium aff

2. Risk Mitigants to reduce risk

Procedural simple rules

to manage risk

- Reviewable rates
- UW questions
- Terms & conditions
- Hedging
- Diversification
- Alignment
- Limits

3. Decision to Accept/Decline Residual Risk

- reconciling intuition & analysis
- making trade-offs
- decision implementation

4. Monitor Experience & Feedback

- awareness of learning structures
- openness to feedback
- self-serving attributions

Corresponding Mindfulness Steps:

framing
the decision

gathering information

coming to conclusions

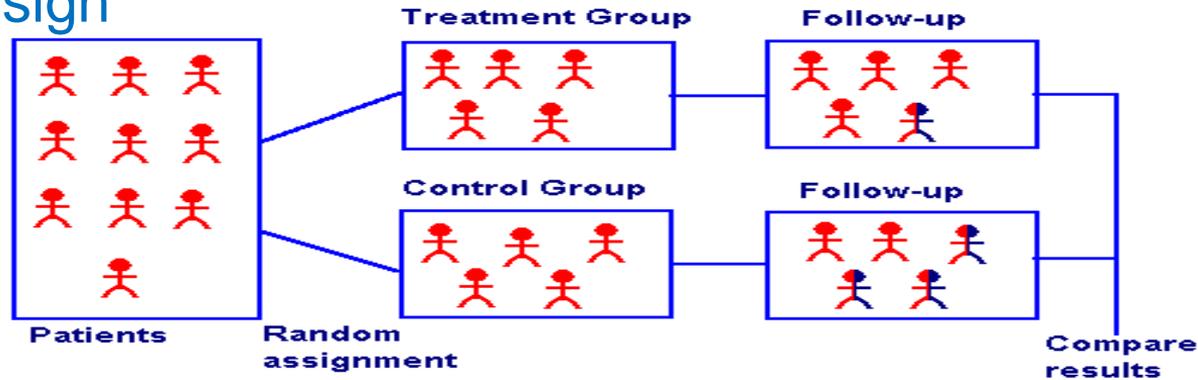
learning from feedback

Testing the Effectiveness of a Training Programme to Improve Decision Making in Insurance Risk Underwriting:

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 <i>Scripts</i> for 20 Questions	
13:30:13:40	10 min	Summary of <i>Simple Rules</i>	
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

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

Training Design



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



Kahneman on Expertise, Bias in the Investment Industry delivered at a CFA conference in Hong Kong. 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.

<http://cfainstitute.gallery.video/annual18/detail/videos/archive/video/5784632684001/daniel-kahneman--thinking-fast-and-slow---conference-live-%7C-day-4-%7C-cfa-institute-annual-conference-%7C-16-may-18?autoStart=true&page=3>

Training Work Sample Tests...

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



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
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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

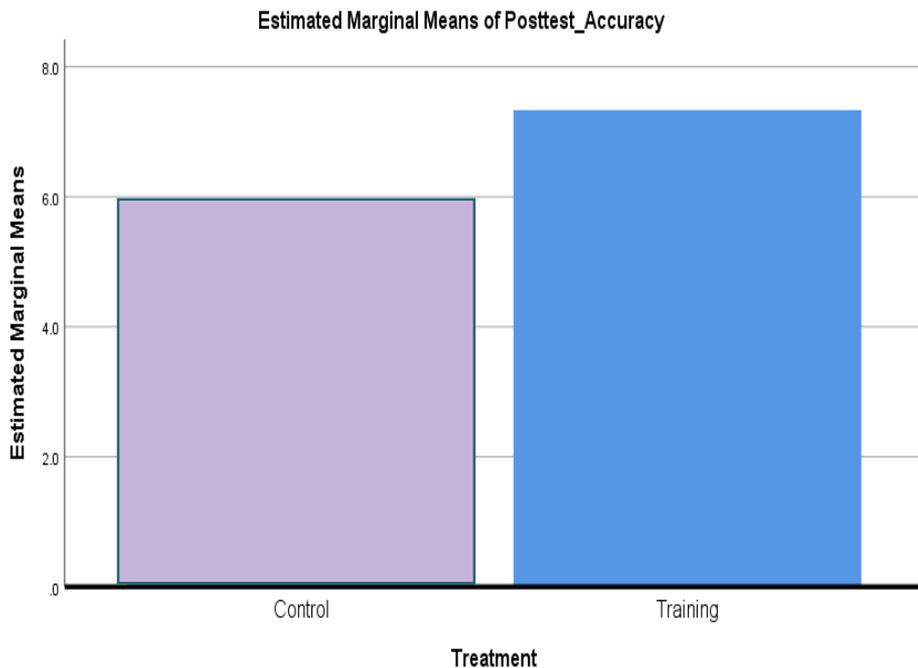
Pre-test

Post-test

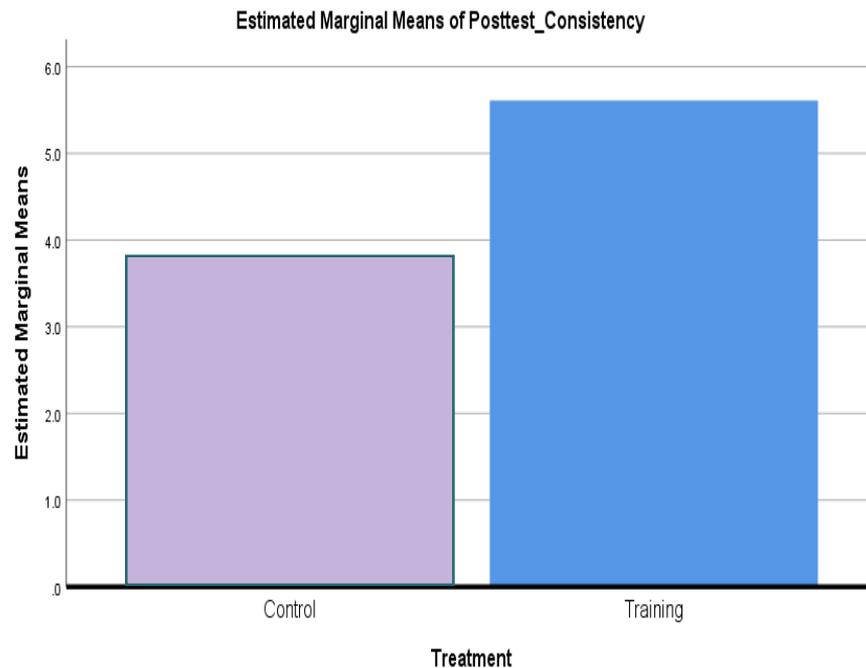
Training Data...

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Treatment	Participant ID	Age	Gender	Status	Experience	Education	Pretest - attention	Pretest - awareness	Posttest - attention	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
...

Training Results...



Covariates appearing in the model are evaluated at the following values: Pretest_Accuracy = 5.666



Covariates appearing in the model are evaluated at the following values: Pretest_Consistency = 3.625

Training Results...Statistical Tests...



	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 – Pretest_Accuracy	1.7	1.4	14.24	.000**	0.2	1.48	1.46	.148
Posttest_Consistency – Pretest_Consistency	1.9	1.9	12.45	.000**	0.3	1.64	1.81	.074

Paired Samples t-test

	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

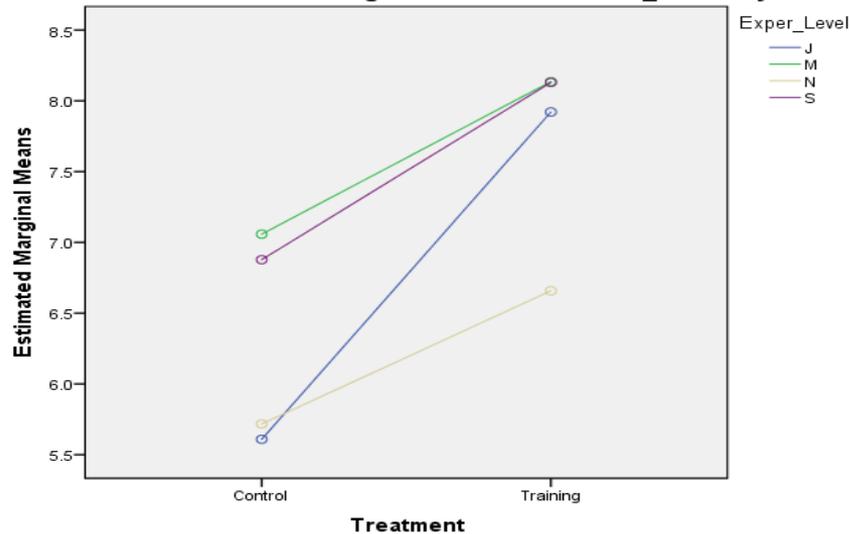
ANCOVA & ANOVA

Training Results...Moderating Impact of Experience...

	Posttest adjusted means (adjusted for pretest score)								ANCOVA Test statistics Treatment × Experience_Level		
	Training				Control				F-value	p-Value	η ²
	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

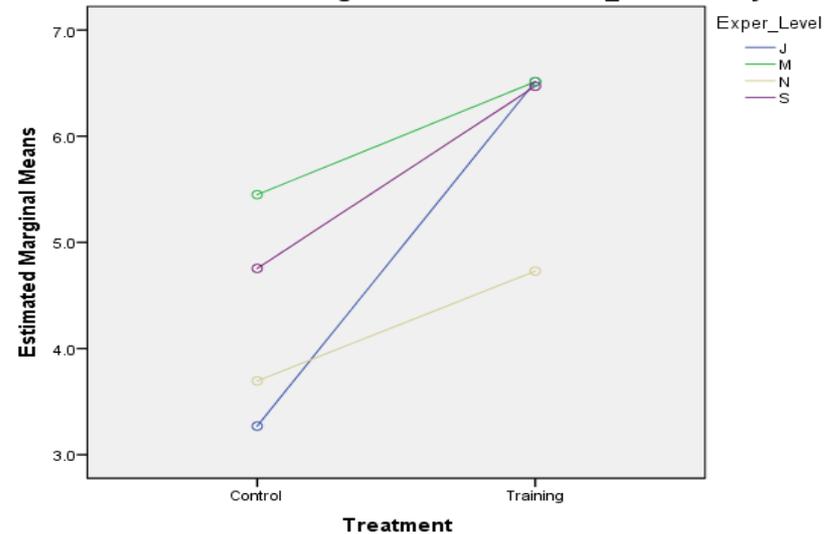
Code	Experience Level	Experience Range	Number
N	Novice	0	111
J	Junior	1 to 4	67
M	Mid-career	5 to 9	18
S	Senior	10+	24
TOTAL			220

Estimated Marginal Means of Posttest_Accuracy



Covariates appearing in the model are evaluated at the following values: Pretest_Accuracy = 5.666

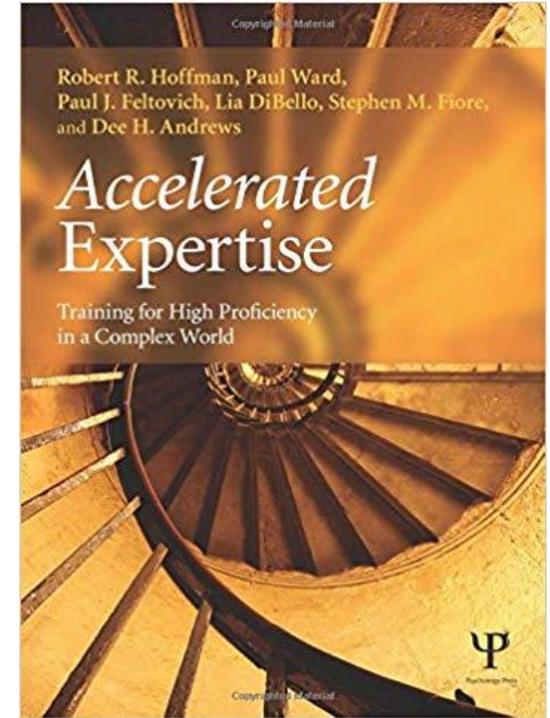
Estimated Marginal Means of Posttest_Consistency



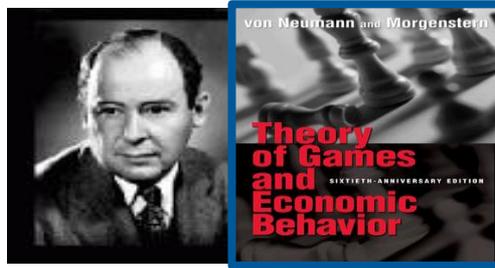
Covariates appearing in the model are evaluated at the following values: Pretest_Consistency = 3.625

Key Takeaway...Underwriting Expertise Can be Accelerated Through Appropriate Training...

1. Need the **3 components** for **expertise** to develop viz. practice; rules & feedback
2. Thinking Fast & **Slow** in Underwriting – with deliberate underwriting **rules**
3. There appears to be **statistical evidence** that training (using *scripts & simple Rules*) can improve insurance risk underwriting – for both accuracy and consistency
4. The training impact seems to have a greater impact on increasing **consistency**
5. The training impact for **Students** is lower than for **Professionals**
6. The training impact appears to be **greater** for Professionals with **lower** levels of **experience**
7. It's worthwhile to get your **younger actuaries / underwriters trained!**

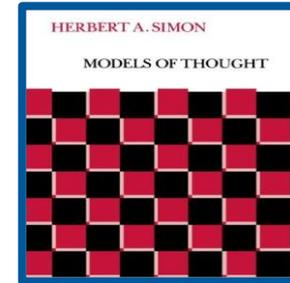


Judgment & Decision Making (JDM) References...



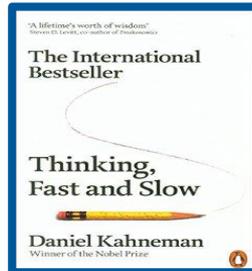
Von Neumann & Morgenstern

Rational Decision Making (RDM) with Utility Theory

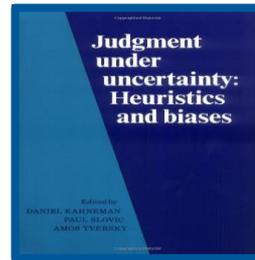


Simon

Bounded Rationality & Satisficing

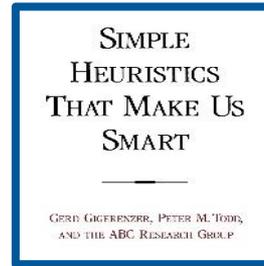


Kahneman



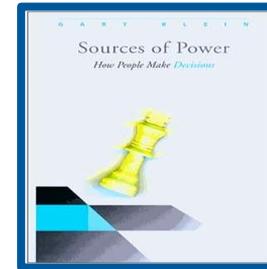
Tversky

Heuristics & Biases (HB)



Gigerenzer

Fast & Frugal Heuristics (FFH)



Klein

Naturalistic Decision Making (NDM)