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978-0-521-70978-1 - Decision Behaviour, Analysis and Support

Simon French, John Maule and Nadia Papamichail

Frontmatter

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Advance praise

‘Decision analysis has evolved in recent years to be increasingly synthetic, and this text is an impressive achievement in bringing together the diverse ingredients. It is highly recommended as a timely, integrated and practical course book.’

DEREK W. BUNN, Professor of Decision Sciences, London Business School

‘This text makes a valuable contribution to the literature in decision making. The explicit goal of the authors has been to help the reader to understand the multifaceted field and learn the essentials in practical decision support. There is a balanced coverage of both descriptive and normative models with a strong emphasis on the process. The discussion of the social aspects and methods of participation in decision support contributes to the understanding of the big picture of this important field. The comprehensive list of up-to-date references gives the interested reader easy access to current research in the area.’

RAIMO P. HÄMÄLÄINEN, Professor and Director of the Systems Analysis Laboratory, Helsinki University of Technology

‘The authors lead us in an exciting waltz through descriptive, prescriptive and normative models for decision aid. Other authors have addressed all three approaches, but none has woven together such a tapestry in which each modelling approach informs and is informed by the other approaches. Between them, the authors bring together expertise from a wide range of disciplines ranging from quantitative analysis, information systems and cognitive psychology. The text is a must for those wishing to gain comprehensive understanding of the subtleties of decision science.’

THEO STEWART, Professor of Statistical Sciences, University of Cape Town

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Frontmatter

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Decision Behaviour, Analysis and Support

Behavioural studies have shown that, while we humans may be the best decision makers on the planet, we are not quite as good as we think we are. We are regularly subject to biases, inconsistencies and irrationalities in our decision making. *Decision Behaviour, Analysis and Support* explores perspectives from many different disciplines in order to help decision makers to deliberate and make better decisions. It considers the use of computers and databases to support decisions, as well as aids to building analyses and some ‘fast-and-frugal’ tricks to facilitate more consistent decision making. In its exploration of decision support the book draws together results and observations from decision theory, behavioural and psychological studies, artificial intelligence and information systems, philosophy, operational research and organisational studies. This provides a valuable resource for managers with decision-making responsibilities and students from a range of disciplines, including management, engineering and information systems.

SIMON FRENCH is Professor of Information and Decision Sciences at Manchester Business School, the University of Manchester.

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Frontmatter
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Frontmatter
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Simon French, John Maule and Nadia Papamichail

Frontmatter

[More information](#)

Contents

<i>List of figures</i>	<i>page</i> xiv
<i>List of tables</i>	xvii
<i>List of case vignettes</i>	xix
<i>List of abbreviations and notation</i>	xx
<i>Preface</i>	xxiii
<i>Acknowledgements</i>	xxvii

1	Introduction	3
	1.1 Decisions, decisions, decisions!	3
	1.2 The strategy pyramid	4
	1.3 Rationalistic versus evolutionary strategic decision making	9
	1.4 Players in a decision	11
	1.5 Representation of decision problems	13
	1.6 Some other terminology	21
	1.7 Outline of the book	23
	1.8 Background reading	24
	1.9 Exercises and questions for discussion	25
2	Behavioural decision studies	26
	2.1 Introduction	26
	2.2 Do people choose in accordance with the rational SEU model?	27
	2.3 The sure-thing axiom	29
	2.4 Invariance and framing	33
	2.5 Prospect theory	37
	2.6 Judgements of risk and probability	41
	2.7 Judgemental heuristics and biases	44
	2.8 Emotion	48
	2.9 Developing decision-thinking skills	51
	2.10 Concluding remarks and further reading	54
	2.11 Exercises and questions for discussion	55

Cambridge University Press

978-0-521-70978-1 - Decision Behaviour, Analysis and Support

Simon French, John Maule and Nadia Papamichail

Frontmatter

[More information](#)

x

Contents

3	Decision analysis and support	57
	3.1 Introduction	57
	3.2 An introduction to normative modelling	59
	3.3 An axiomatic development of the SEU model	65
	3.4 Prescriptive decision analysis and requisite modelling	78
	3.5 Value-focused thinking	80
	3.6 The process of decision analysis and support	81
	3.7 Decision support software and systems	82
	3.8 Good heuristics	85
	3.9 Concluding remarks and further reading	88
	3.10 Exercises and questions for discussion	89
4	Information and knowledge management	91
	4.1 Introduction	91
	4.2 Human memory	93
	4.3 Data, information and knowledge	95
	4.4 Databases, data warehouses and data mining	100
	4.5 Knowledge management	106
	4.6 Statistics and decision support	110
	4.7 Concluding remarks and further reading	111
	4.8 Exercises and questions for discussion	113
5	Artificial intelligence and expert systems	115
	5.1 Introduction	115
	5.2 Human versus artificial intelligence	116
	5.3 AI technologies	120
	5.4 Expert systems	121
	5.5 Artificial neural networks	131
	5.6 Genetic algorithms	135
	5.7 Other intelligent systems	136
	5.8 Concluding remarks and further reading	138
	5.9 Exercises and questions for discussion	139
6	Operational research and optimisation	140
	6.1 Introduction	140
	6.2 Optimisation: the heart of OR?	141
	6.3 Interactive multi-objective programming	149
	6.4 OR-based DSSs	154

Cambridge University Press

978-0-521-70978-1 - Decision Behaviour, Analysis and Support

Simon French, John Maule and Nadia Papamichail

Frontmatter

[More information](#)

xi	Contents	
	6.5 The OR process	155
	6.6 Sequential decision processes	157
	6.7 Concluding remarks and further reading	159
	6.8 Exercises and questions for discussion	160
7	Decision analysis and multiple objectives	162
	7.1 Introduction	162
	7.2 Choice behaviour in the face of complex alternatives and multi-attribute value analysis	165
	7.3 Consequence and multi-attribute modelling	170
	7.4 Multi-attribute value modelling	177
	7.5 The ‘evening out’ example	181
	7.6 Absolute and relative weights	188
	7.7 Elicitation of weights and values	190
	7.8 Chernobyl case study	196
	7.9 Other schools of decision analysis	209
	7.10 Concluding remarks and further reading	211
	7.11 Exercises and questions for discussion	213
8	Decision analysis and uncertainty	218
	8.1 Introduction	218
	8.2 Modelling uncertainty	219
	8.3 The subjective expected utility model	223
	8.4 Risk attitude and SEU modelling	236
	8.5 SEU modelling, decision trees and influence diagrams: an example	239
	8.6 Elicitation of subjective probabilities	247
	8.7 Elicitation of utilities	250
	8.8 Chemical scrubbers case study	256
	8.9 Concluding remarks and further reading	263
	8.10 Exercises and questions for discussion	264
9	Issue formulation and problem structuring	266
	9.1 Introduction	266
	9.2 Brainstorming and soft modelling	268
	9.3 Checklists	271
	9.4 Simple two-dimensional plots	275
	9.5 Trees and networks	278

	9.6 Management models	282
	9.7 Rich picture diagrams	287
	9.8 Scenario planning	290
	9.9 From qualitative to quantitative modelling	292
	9.10 Concluding remarks and further reading	293
	9.11 Exercises and questions for discussion	295
10	Strategic decision analysis	299
	10.1 Introduction	299
	10.2 The decision analysis cycle	300
	10.3 Sensitivity analysis	305
	10.4 Incorporation of expert and stakeholder opinions	308
	10.5 Risk analysis	314
	10.6 Concluding remarks and further reading	317
	10.7 Exercises and questions for discussion	319
11	Groups of decision makers	320
	11.1 Introduction	320
	11.2 Review of research on decision making in groups	322
	11.3 Arrow's impossibility theorem	328
	11.4 Procedures for improving decision making in groups	334
	11.5 Facilitated workshops and decision conferencing	338
	11.6 Game theory, negotiation and bargaining	344
	11.7 Concluding remarks and further reading	346
	11.8 Exercises and questions for discussion	347
12	Organisational decision support	349
	12.1 Introduction	349
	12.2 A historical perspective on organisational decision making	350
	12.3 Organisational decision-making models	353
	12.4 The internal and external contexts of organisations	355
	12.5 Organisational decision-making practices	357
	12.6 Organisational decision analysis and support	361
	12.7 Emergency management support	364
	12.8 Concluding remarks and further reading	366
	12.9 Exercises and questions for discussion	367

13	Societal decision making	368
	13.1 Introduction	368
	13.2 A brief look at cost–benefit analysis	370
	13.3 Public perception and risk communication	374
	13.4 Deliberative democracy and public participation	381
	13.5 E-participation and e-democracy: a panacea?	387
	13.6 Concluding remarks and further reading	390
	13.7 Exercises and questions for discussion	392
14	Decision support systems	394
	14.1 Introduction	394
	14.2 Decision support systems	394
	14.3 Group decision support systems	399
	14.4 Intelligent decision support systems	403
	14.5 Design of DSSs	405
	14.6 Evaluation of decision support systems	410
	14.7 Latest trends in decision support	412
	14.8 Further reading	413
	14.9 Exercises and questions for discussion	413
15	Conclusions	415
	15.1 The key messages	415
	15.2 Linking prescriptive and behavioural approaches	416
	15.3 The challenges to decision support brought by Web 2.0	421
	<i>References</i>	423
	<i>Index</i>	467

Figures

1.1	Factors that affect decision making	<i>page</i> 4
1.2	The strategy pyramid	5
1.3	The cynefin model	7
1.4	The cynefin model and the structured/unstructured dimension of decision making	9
1.5	The interplay between rationalistic and emergent strategic decision making	10
1.6	The players in a decision	13
1.7	A decision tree for a plant investment problem	19
1.8	An influence diagram for the plant investment problem	20
2.1	The form of the value function in prospect theory representing risk aversion for gains and risk proneness for losses	39
2.2	The form of the decision-weighting function, $\pi(p)$	41
2.3	An illustration of the availability bias	47
3.1	Prescriptive decision support	58
3.2	Consistency of belief relative to common but disjoint events	67
3.3	A probability wheel	67
3.4	A probability wheel with a sector of angle θ	72
3.5	Illustration of the idea underlying the continuity assumption	75
3.6	The phases of decision analysis	81
3.7	Categorisation of a variety of DSSs according to domain and level of support	85
3.8	Quick frequency calculation for the example in section 2.6	88
4.1	(Previously learnt) knowledge must be applied to transform data to information and information to knowledge; and also to make inferences, forecasts or decisions	98
4.2	Nonaka's perspective on knowledge creation	99

List of figures

4.3	The progression through unconflicted adherence, unconflicted change and vigilance towards a requisite decision	106
4.4	The differing emphases on tacit and explicit knowledge in the <i>cynefin</i> domains	109
4.5	How statistical inference and forecasting fit into decision support	111
5.1	Criteria for assessing the viability of ES development	125
5.2	An ANN for credit assessment	132
5.3	Typical applications of ANNs	133
6.1	A very(!) simple example of a linear programme	144
6.2	The OR process	156
7.1	An attribute tree for the risks from nuclear waste management	172
7.2	The attribute tree for the warehouse example	176
7.3	The necessity for a monotonicity condition	180
7.4	The ‘evening out’ example	182
7.5	The value scale for cost	183
7.6	The value scale for travel time	184
7.7	The value scale for enjoyment	185
7.8	Swing weighting	185
7.9	A Pareto plot of enjoyment versus cost	186
7.10	The sensitivity analysis on w_{Cost}	188
7.11	Absolute and relative weights	189
7.12	Assessment of marginal value functions	191
7.13	Measuring off the scale length – i.e. weight – in swing weighting	195
7.14	The attribute hierarchy used in the fifth decision conference	203
7.15	Sensitivity analysis of the weight on <i>resources</i>	205
7.16	Plots of different <i>effects</i> attributes against <i>resources</i>	207
8.1	The proportion of sixes in repeated throws of a die	223
8.2	Some probability wheels	225
8.3	The DM’s utility curve	227
8.4	Plot of the permissible region for p and q	233
8.5	The effect of lowering the upper boundary of region A	235
8.6	Utility modelling of risk attitudes	237
8.7	The airliner purchasing problem	240
8.8	The decision tree for the airliner example with the probabilities and NPVs of the outcomes attached	244

Cambridge University Press

978-0-521-70978-1 - Decision Behaviour, Analysis and Support

Simon French, John Maule and Nadia Papamichail

Frontmatter

[More information](#)**xvi****List of figures**

8.9	An influence diagram representation of the airliner purchasing problem	247
8.10	Assessment of a utility function by the bisection method	251
8.11	The four lotteries in the illustration of utility independence	253
8.12	The decision to install scrubbers	258
8.13	Sensitivity plot on the percentage reduction in health and safety attribute if scrubbers had already been installed	261
8.14	Cumulative distributions of monetary equivalent outcomes	262
9.1	Stakeholder identification	276
9.2	Identifying uncertainties	278
9.3	Cognitive map of issues arising in defining a supplies strategy for a trust hospital	281
9.4	Porter's five forces model	283
9.5	Simons' levers of control model	284
9.6	The strategy space model	285
9.7	Rich picture representing the hypothetical scenario of a tomato health scare	288
9.8	Detail from a rich picture diagram of the issues relating to the hole in the ozone layer	289
10.1	Overview of the decision process	301
10.2	A hypothetical calibration curve	310
10.3	The risk management process and the support offered by a risk register	315
12.1	The internal and external contexts of organisations	356
12.2	Decision quality elements	359
12.3	The nine characteristics of a smart organisation	360
12.4	Criteria for assessing organisational decision-making practices	361
14.1	The main DSS sub-fields	397
14.2	Group decision support environments	402
14.3	Two representations of the same set of probabilities	406
14.4	An attribute tree for assessing DSSs	411

Tables

1.1	A decision table	<i>page</i> 14
1.2	The decision table for the family meal example	15
1.3	The decision table for the family meal example with probabilities and utilities	18
2.1	Allais' paradox	31
2.2	Allais' paradox explicated in terms of a lottery	31
2.3	Ellsberg's paradox	32
2.4	The seven stages of vigilant decision making	50
3.1	Levels of decision support	84
4.1	From data to knowledge	96
5.1	Three types of expert system	125
5.2	Tasks that may be undertaken by an ES	126
7.1	General characteristics of decision strategies	167
7.2	Some details on the strategies	204
8.1	The investment problem	224
8.2	Assessed probabilities of the tone of the report given the airliner's actual reliability	242
8.3	Probabilities of R&D outcomes	259
8.4	Probability of different levels of public acceptability conditional on whether new scrubbers are installed and the worker limits set by the European Union	260
9.1	Prompts that may help in identifying uncertainties	273
9.2	Format of a SWOT table	273
9.3	Checkland's CATWOE	274
10.1	The support offered by sensitivity analysis to the different players	308
11.1	Arrow's impossibility theorem	332
11.2	Hall's group interaction rules	336
13.1	How a DM might perceive different time eras	374
13.2	Examples of hazard classification for two primary factors in risk perception	376

Cambridge University Press
978-0-521-70978-1 - Decision Behaviour, Analysis and Support
Simon French, John Maule and Nadia Papamichail
Frontmatter
[More information](#)

xviii**List of tables**

13.3	'Fright factors'	377
13.4	Languages of risk communication	377
13.5	'Media triggers'	380
13.6	Eight stages towards partnership	383

Case vignettes

4.1	Data mining, beer and diapers	<i>page</i> 103
4.2	An example of an EIS at a power company	105
4.3	Eureka, a KMS for Xerox field engineers	108
5.1	XCON, DEC's computer configuration ES	127
5.2	MYCIN, an ES shell developed for medical applications but much more widely used	127
5.3	Bankruptcy prediction	133
6.1	Minimising shipping costs	145
6.2	OR helps in the design of an automated warehouse	148
6.3	Interactive methods in vendor selection	152
6.4	Networked DSSs at United Sugars Corporation	154
7.1	Consequence modelling in the RODOS nuclear emergency DSS	173
7.2	The marking of paintings in an art examination	175
9.1	Stakeholder plot developed in a training exercise based around a hypothetical scenario	277
9.2	Mindmap of information system requirements drawn during a merger	280
10.1	Support for the process of selecting R&D projects in an oil company	317
11.1	Reflections on the Chernobyl decision conferences	343
12.1	Cultural issues in the use of GISs	357
12.2	Cascaded budgeting processes in organisations	362
12.3	The RODOS system for supporting the management of nuclear accidents	365
13.1	Stakeholder involvement in sustainable forest management planning	384
13.2	Virtual Slaithwaite: the use of a GIS in formulation and discussion	387
13.3	A case of lake regulation policy	391

Abbreviations and notation

Abbreviation/notation Meaning

a_i	The i^{th} action in the action space $A = \{a_1, a_2, \dots, a_m\}$
$a \succcurlyeq b$	The DM holds a to be at least as good as b
$a \succ b$	The DM strictly prefers a to b
$a \sim b$	The DM is indifferent between a and b
AHP	Analytic hierarchy process
AI	Artificial intelligence
ANN	Artificial neural network
CBA	Cost–benefit analysis
c_{ij}	The consequence of taking action a_i when the state of the world is θ_j
CSCW	Computer-supported cooperative work
DA	Decision analyst
DBMS	Database management system
DM	Decision maker
DSS	Decision support system
D2P	Decisioning for decision support
EBA	Elimination by aspects
EIS	Executive information system
ES	Expert system
$Eu[a]$	Expected utility of action a
GDSS	Group decision support system
GIS	Geographic information system
HCI	Human–computer interface
KB-DSS	Knowledge-based decision support system
KMS	Knowledge management system
MAU	Multi-attribute utility
MAVA	Multi-attribute value analysis
MCDAd	Multi-criteria decision aid
MCDM	Multi-criteria decision making
MIS	Management information system

MODM	Multi-objective decision making
NPV	Net present value
OR	Operational research
$P(\theta)$	Subjective probability representing a DM's likelihood for the state θ
SEU	Subjective expected utility
SMART	Simple multi-attribute rating technique
SQL	Structured query language
$u(\cdot)$	A utility function representing a DM's preferences in conditions of uncertainty
$v(\cdot)$	An (ordinal) value function representing a DM's preferences in conditions of certainty
wGDSS	Web-based group decision support system
θ_j	The j^{th} possible state of the world lying in the state space, $\Theta = \{\theta_1, \theta_2, \dots, \theta_n\}$

Cambridge University Press

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Frontmatter

[More information](#)

Preface

An article by Ian Ayres in the *Financial Times Magazine* of 1 September 2007 begins:

How can a mathematical formula outperform a wine connoisseur? Or predict how the US Supreme Court will vote more accurately than a panel of legal experts? The answer lies partly in the overconfidence of humans and partly in the fast improving powers of database analysis.

In many ways these sentences chart the course we shall be steering in exploring decision making: how we do it and how we could do it better. Many behavioural studies have shown that, while we humans may be the best decision makers on the planet, we are not as good as we think we are. We are subject to biases, inconsistencies and – dare we say it? – irrationalities in our decision making. We could do better. Therefore, it is not surprising, perhaps, that computers bringing advanced forecasting algorithms to bear on vast modern databases that bulge with fact upon fact are able to outperform even the best experts in highly structured forecasting tasks.

Of course, this is not to suggest that computers are more intelligent than humans (we designed and programmed them, after all!), just that they are more consistent, able to keep more facts ‘in mind’ and less likely to be distracted by some outlying fact that runs against the broad thrust of evidence or, worse, some personal pet theory. They are not prone to overconfidence. Experts tend not to notice their failures. They fail to moderate their future predictions with the humility of their past inaccuracies.

Nor shall we suggest that we should leave prediction and decision making to computers: far from it. We believe that if we support people properly, perhaps with computers or perhaps just with a paper and pencil, then we can improve their decision-making behaviour. Most importantly, we believe that the responsibility for decision making should be left with the human. We do not seek to supplant humans, only support them.

Moreover, our book is about decision making, not forecasting. Certainly, forecasting is central to good decision making. It is surely impossible to

choose rationally if we cannot predict to some degree the possible consequences of our actions. We also need to consider and listen to our values, however. Decision making is about how much we care about the possible outcomes as well as how likely these are. Which do we prefer? Keeney in his seminal 1992 book *Value-focused Thinking* exhorts us to use values to drive our decision making. If we do not focus on our objectives and goals, can we really select a course of action to achieve them? Accordingly, much of our text focuses on how we might understand our values and use them to drive our decision making. Once we understand what we are trying to achieve, how do we combine that self-knowledge with our understanding of the world and our forecasts of what might result from our actions? In short, how do we balance our values and uncertainties?

All this assumes that we know what our options are. Sometimes they are obvious; but many times we face a mess of ill-comprehended issues without any idea of what we might do – and, yes, in decision science ‘mess’ is a technical term! Our opening quotation from Ayres misses perhaps the most difficult aspect of much decision making, and the one that computers, as yet at least, cannot address: novel situations. Another skill that we emphasise, therefore, is issue and problem formulation. We need to learn to understand the world and to think creatively about the different decisions we can take in response to it.

Our text, then, is about supporting decision makers. This is not a task that a single discipline can address alone. Certainly, artificial intelligence, cognitive science, economics, information systems, mathematics, management science, psychology, philosophy and many other disciplines all have much that is cogent to say about decision making. Alone, however, they do not say enough. Only when we draw on many complementary perspectives can we see how to support and improve decision making. Thus our text is multidisciplinary.

For the last six paragraphs we have been committing a failing that we attribute to many others: we have been talking about ‘decisions’ without acknowledging that there are many types of decision that occur in many contexts. While many texts focus on one type of decision, perhaps strategic or operational, ours is more catholic. We consider many different types of decision that occur in many different contexts, and we recognise that the type of support that each needs may vary from context to context. That and our multidisciplinary are, we believe, the contribution that this text makes to the literature.

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Frontmatter

[More information](#)

To be more precise, our objectives are:

- to demonstrate that decision making permeates the activities of individuals, groups, organisations and society and that the characteristics of the choices faced vary greatly from context to context;
- to introduce cognitive and behavioural theories of how people make judgements and take decisions and the ‘errors and biases’ that may be found in these activities;
- to introduce some of the normative theories of how people should make decisions;
- to show how prescriptive approaches to decision support and analysis draw together our behavioural understandings of human judgement with the imperatives of normative theories to help improve decision making;
- to outline how such prescriptive decision support may be embedded in information systems; and
- to provide a guide to a very wide range of literature offering valuable perspectives on analysing and supporting decision making, thus reflecting the multidisciplinary nature of our topic.

We have written for a varied audience. Some of the material has been used with undergraduates in business studies, computer science, economics, mathematics and operational research. Other parts have been used to teach Masters students in a similar variety of subjects. Some have been used with Master of Business Administration (MBA) students, and some to support executive education. Many sections have served at more than one level. Other parts of the text derive from our research. We hope, nonetheless, that we have woven all the sections into a coherent whole. One of the joys of working across disciplines is that usually our students, whatever their background, find some new idea, theory or procedure to intrigue them. We hope that you do too.

Our one little indulgence has been to begin the majority of sections with what we believe are relevant quotations. This is possibly a dangerous indulgence. French began his 1986 book *Decision Theory: An Introduction to the Mathematics of Rationality* with the quotation “‘I used to be indecisive, but now I am not so sure.’” Boscoe Pertwee (18th-Century wit)’ (Rees, 1978: 37). He had originally heard it on the long-running BBC radio quiz *Quote...Unquote* in the late 1970s. Some thirty years after that broadcast, the show’s presenter, Nigel Rees, admitted on another series of the same programme that he had been conned. Someone had made up

Cambridge University Press

978-0-521-70978-1 - Decision Behaviour, Analysis and Support

Simon French, John Maule and Nadia Papamichail

Frontmatter

[More information](#)

xxvi

Preface

the quotation and the life of the eighteenth-century wit to whom it was attributed purely to hoodwink Rees. That he also hoodwinked French was an unintended, and probably unnoticed, side effect! So, if you spot some further mistakes in the quotations that we have used: laugh quietly to yourself and don't tell us!

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Frontmatter

[More information](#)

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Reason is, and only ought to be, the slave of the Passions.

David Hume