THE FOUNDATIONS OF BEHAVIORAL ECONOMIC ANALYSIS

Volume III: Behavioral Time Discounting

SANJIT DHAMI

The Foundations of Behavioral Economic Analysis: Volume 3 The Foundations of Behavioral Economic Analysis is also available in seven newly revised volumes published by Oxford University Press

The Foundations of Behavioral Economic Analysis: Volume 1 Behavioral Economics of Risk, Uncertainty, and Ambiguity

The Foundations of Behavioral Economic Analysis: Volume 2 Other-Regarding Preferences

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Peter Wakker, Professor of Economics, Erasmus University Rotterdam.

"Sanjit Dhami's *The Foundations of Behavioral Economic Analysis* is a major and most impressive achievement. It provides an exhaustive account and a masterful synthesis of the state of the art after more than three decades of behavioral economics. It has proven to be an indispensable reference for researchers in economics and psychology. The second, updated edition comes in seven volumes, and it is bound to become the standard text in graduate and advanced undergraduate courses on behavioral and experimental economics for many years to come."

Klaus M. Schmidt, Professor of Economics, University of Munich.

"This is the most complete and stimulating series of books on behavioral economics. With elegance and unprecedented elaborateness, it ties together a wealth of experimental findings, rigorous theoretical insights and exciting applications across all relevant fields of behavioral research. Sanjit Dhami's work has been shaped by numerous comments of the leaders in the field. Now, in the years to come, it will be the standard that shapes how the next generation of students and researchers think about behavior and its science."

Axel Ockenfels, University of Cologne, Speaker of the Cologne Excellence Center of Social and Economic Behavior.

"The expansion of behavioral economics during the past quarter century has been remarkable, much of it concerning strategic interaction and using tools from game theory. Sanjit Dhami's amazing book, now available in a convenient multi-volume format, summarizes—and even defines—the field, broadly as well as in depth. His coverage of theory as well as of experiments is superb. *The Foundations of Behavioral Economic Analysis* will be an indispensable resource for students and scholars who wish to understand where the action is."

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"This is a unique and truly remarkable achievement. It is a magnificent overview of behavioral economics, by far the best there is, and it should define the field for at least a generation. But it is much more than that. It is also a brilliant set of original discussions, with pathbreaking thinking on every important topic. An invaluable resource for policymakers, students, and professors— and if they want to try something really special, for everyone else."

Cass Sunstein, coauthor of Nudge and Founder and Director of the Program on Behavioral Economics and Public Policy, Harvard Law School.

"This is truly an amazing work. It is unique in both comprehensiveness and depth. The author is to be applauded for producing what will surely be the standard reference for both researchers and students. And breaking it into seven volumes will greatly enhance its usability. I highly recommend these volumes to any serious reader in behavioral economics."

Gary Charness, Professor of Economics, University of California, Santa Barbara.

The Foundations of Behavioral Economic Analysis: Volume 3

Behavioral Time Discounting

Sanjit Dhami



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PREFACE TO VOLUME 3: BEHAVIORAL TIME DISCOUNTING

The Foundations of Behavioral Economic Analysis (henceforth, FBEA) was published by Oxford University Press in November 2016. It was the culmination of more than a decade of dedicated work. The book was quite well received and it was heartening to receive messages of support, encouragement, and appreciation from many quarters. Several reviews of FBEA have been published and they have praised the comprehensiveness, formal analysis, and the attention to empirical detail in the book. The book is increasingly taught around the world in behavioral and experimental economics courses in the leading economics departments. Encouragingly, it is also being used in more enlightened courses in economic theory, which was always an important objective of writing this book. The practice of ignoring the empirical evidence and the theoretical models in behavioral economics, in many courses in microeconomics, game theory, and contract theory, is one of the most retrogressive practices in the profession and a form of self-handicapping that is difficult to understand.

At 1,796 pages (including unnumbered pages), FBEA is probably one of the longest economics books ever to have been published in a single volume. Binding the book was a major challenge, which Oxford University Press accomplished with great competence. Some friends have written on a lighter note about the physical size and the weight of the book. Samuel Bowles wrote to say that Herbert Gintis had presented him with a copy of the book on Christmas and that he had to hire a truck to take it home. In one of his reviews, Daniel Read congratulated me on writing the "War and Peace" of behavioral economics. Andrew Schotter wrote to say that he keeps one copy at home and another in his office in NYU to avoid carrying it on the New York subway. A friend who had purchased the paperback version took the drastic step of physically separating Part 4 on behavioral game theory (a good 320 pages long) to carry around with him. Xavier Gabaix is one of many readers who prefers the electronic version that makes issues of the size of the book irrelevant. However, at least some readers, and I am part of this group, tend to be old fashioned and prefer the printed version.

We did explore the idea of splitting FBEA into two volumes before it was published and this was put to an informal vote among 30 of the leading behavioral economists. They were almost equally split. OUP took the casting vote to decide on a single volume, understandably because there are not too many multiple volume mainstream texts in economics. As more feedback from the users of the book emerged, Adam Swallow, the commissioning editor at OUP, began exploring with me the possibility of splitting the book into multiple volumes. Just as publishing such a long book and making it available for teaching to several instructors prior to its publication was a novel and bold experiment in publishing, so too is the proposal to split it into multiple volumes. After extensive discussions at OUP, I was given the go ahead to pursue this exciting and unprecedented opportunity.

What we present to you here, after considerable thought, is a seven-volume book on behavioral economics that splits the nine parts of FBEA into the following topics: Behavioral economics of risk uncertainty and ambiguity (Volume 1); Other-regarding preferences (Volume 2); Behavioral

economics of time discounting (Volume 3); Behavioral game theory (Volume 4); Bounded rationality (Volume 5); Behavioral models of learning (Volume 6); Further topics in behavioral economics that include emotions, behavioral welfare economics, and neuroeconomics (Volume 7). Other possible splits of FBEA were possible (e.g., combining Volumes 1 and 3; and Volumes 2 and 4), but none of these proposals offers the clean separation into the main topics in behavioral economics that the current split offers.

We believe that these seven volumes improve on FBEA for several reasons aside from just better portability of the print edition. First, it is a welcome opportunity to correct several typos and errors, as well as to improve the clarity of the text in many places. Second, it allows the updating of some of the material to reflect important recent scholarship in the form of a "guide to further reading" at the end of each volume. This allows me to introduce several new concepts and tie them back to the discussion in the main text. Third, it gives readers the option to buy individual volumes, depending on their current research and teaching interests. However, those with a serious interest in economics, certainly all university academics, ought to consider reading all of the seven volumes. Fourth, given how daunting the prospect of revising the 1,800-page FBEA would have been, the split volumes increase the likelihood of a second edition to some, or all, of the volumes in due course.

For the benefit of readers who buy the separate volumes, or just a few of the volumes, we have taken several steps. Each of the volumes will have a new preface, a new introduction, and carry a reprint of the original preface in FBEA. This will give readers an opportunity to get acquainted with how and why this book came to be. The introductory chapter in FBEA covered important ground. In particular, the first 25 pages outlined the antecedents of behavioral economics, the role of scientific methodology, and the rationale for the experimental method. A lack of proper understanding and appreciation of these critical prerequisites may seriously hamper an understanding of the subject matter. For this reason, in each volume, we shall also print an edited version of the first 25 pages in FBEA. In these pages, I have also added a brief new subsection on replication of experiments. The remaining part of the introductory chapter in FBEA (pages 25–64) is printed only in Volume 1. I have taken care to remove as many typos and errors from the introduction of FBEA as I could find, and improved the clarity of the material in many places.

Readers will find that we have done many of the same things that we might have done in bringing out a second edition of FBEA in these seven volumes. We hope that our efforts in this direction will lead to a better understanding and appreciation of the subject matter of behavioral economics.

PREFACE TO THE FOUNDATIONS OF BEHAVIORAL ECONOMIC ANALYSIS

We print below the original preface to *The Foundations of Behavioral Economic Analysis* in Dhami (2016).

Neoclassical economics is a logically consistent and parsimonious framework of analysis that is based on a relatively small set of core assumptions, and it offers clear, testable, predictions. However, extensive and growing empirical evidence reveals human behavior that is difficult to reconcile within the typical neoclassical models. There has been a parallel development in rigorous theoretical models that explains better the emerging stylized facts on human behavior. These models have borrowed insights from psychology, sociology, anthropology, neuroscience, and evolutionary biology. Yet, these models maintain a distinct economic identity in terms of their approach, rigor, and parsimony. Collectively, these models form the subject matter of behavioral economics, which is possibly the fastest growing and most promising area in economics.

This book is an account of behavioral economics that starts with the basics and takes the reader to the research frontiers in the subject. Depending on how one chooses to use it, the book is suitable for courses at the advanced undergraduate, postgraduate, and research level in economics, and the related social sciences, including, but not restricted to, psychology, management, finance, political science, and sociology. The book should also serve as an essential reference book for anyone generally interested in behavioral economics at any level, and also serve to stimulate the interests of non-specialist academics, specialist academics who are looking for a bird's-eye view of the entire field, and policymakers looking for policy applications of behavioral economics. It would be desirable to assign this book as background reading to courses in economic theory. The book is also, in my view, the minimum subject matter that anyone who writes behavioral economics as their research interest, should be deeply familiar with.

In November 2003, two months after I joined the department of economics at the University of Leicester, I chanced upon an invitation to attend a talk by a colleague, Ali al-Nowaihi, on the subject of *prospect theory*. Ali, a mathematician by training, an economist by profession, and a keen student of the philosophy of science, put forward a Popperian view to evaluate economic theories. He argued that *expected utility theory* was decisively rejected by the evidence, and prospect theory was the most satisfactory decision theory currently available. As a purely neoclassically trained economist, I was troubled by the claims, but also extremely skeptical. For a start, prospect theory sounded like a strange name for a theory, and the evidence was largely "experimental," a data source, that I knew little about. As my defensive instincts started to kick in, I wondered if prospect theory really was so important, then surely my graduate courses, many taught by leading decision theorists, would have found some reason to mention it. Nor was there any mention of such a theory in conversations with colleagues at the two British universities where I had taught so far, or at seminars or conferences that I had attended.

However, rather than just dismiss Ali, a very likeable and respected figure in the department, I decided to put his seemingly extreme views to the test. One of my majors was in public

economics, so I decided to conduct a prospect theory analysis of tax evasion in the hope of explaining the *tax evasion puzzles*, which had been outstanding for three decades (details in Part 1). There was already some preliminary work in this area that Ali had mentioned in passing, but none of the papers explained all the puzzles in one fell swoop, using all components of prospect theory. It took me just a few weeks to work out the results. To my utter amazement, prospect theory explained the qualitative and quantitative tax evasion puzzles. By contrast, the predictions based on an expected utility analysis were wrong by a factor of up to 100. This led to my first joint publication with Ali, with whom I have spent many years of fruitful collaboration since then.

This initial, and successful, encounter with prospect theory convinced me that I needed to explore behavioral economics in greater depth. Yet, around 2004, there was no definitive graduate text on behavioral economics. To be sure, there were many excellent sets of collected readings, and several insightful surveys and commentaries on selected aspects of behavioral economics that I eagerly read. In particular, while there were many excellent discussions of the experimental evidence, a full treatment of behavioral economic theory and its applications was missing. One could always pursue the journal articles, but the literature was already enormous, rapidly expanding, and scattered, which made it difficult to spot the links between the various models or to clearly visualize how the various pieces of the jigsaw fitted together. This book was motivated initially by the lack of a serious graduate book on the entire subject matter of behavioral economics, and to support my growing research agenda with Ali. In due course, and as the full range of the subject matter gradually dawned upon me, the scope of the book naturally became more ambitious and daring.

I strive to strike a balance between behavioral economic theory, the experimental evidence, and applications of behavioral economics. The choice of theoretical models in this book is dictated, first and foremost, by their ability to explain the empirical evidence. In some cases, where no decisive empirical evidence is available, I make a judgment on which models are more promising than others, although I give a wide berth to most models.

The main prerequisite for the book is training in the first two to three years of a reasonably good British or North American undergraduate degree in economics, or its equivalent. Any further concepts and techniques are introduced in the book, where needed. A prior course in behavioral economics is not a prerequisite for the book.

The book is divided into nine parts that cover decision making under risk, uncertainty, and ambiguity; other-regarding preferences; behavioral time discounting; models of behavioral game theory and learning; role of emotions in decision making; models of bounded rationality; judgment heuristics and mental accounting; behavioral welfare economics; and neuroeconomics. The book also considers a range of applications of the theory to most areas in economics that include microeconomics, contract theory, macroeconomics, industrial organization, labor economics, development economics, public economics, political economy, and finance. A set of exercises at the end of each part, except the part on neuroeconomics, serves to enhance the reader's understanding of the subject.

Behavioral economics is now a mainstream area in economics. One just has to look at the growing and large number of journal publications and Ph.D. theses every year; the Nobel Prizes to Herbert Simon, Daniel Kahneman, Robert Shiller, Alvin Roth, Vernon Smith, and George Akerlof; the John Bates Clarke medal to Matthew Rabin; the growing importance of behavioral economics among policymakers, as witnessed by the 2015 World Bank Development Report, and the formation of the behavioral insights team in the UK; and the choice of Richard Thaler as the incoming President of the American Economic Association.

It is fair to say that no self-respecting economics department can now afford to omit a course in behavioral economics from its undergraduate or graduate curriculum; indeed, doing so would be grossly unjust to its students and a retrogressive step. Nor can any academic economist, who wishes to retain professional honesty and a balanced opinion on the subject, afford to be unfamiliar with the subject matter of behavioral economics; I am often amused by the ignorance and arrogance of many who pass judgment on behavioral economics with supreme confidence, yet appear to have little understanding of it.

This book has taken more than ten years to write, and my debts are deep and profound. My first and foremost debt and gratitude is to my loving family without which this book could not have been written. To my parents, Manohar and Baljeet, for their unconditional lifelong love and support, and instilling in me the core values of honesty, commitment, and hard work. To my wife, Shammi, and my son, Sahaj, for their patience, sacrifice, unflinching support, and constant encouragement. When I started writing this book, Sahaj was in primary school, and in the month of its first publication, he could be packing his bags to join a university. I do not recommend this as the best template to encourage your son to write any books in the future. However, there are close parallels between Sahaj's educational journey from primary school to university, with my own journey in behavioral economics.

I owe a deep intellectual debt to my long-time coauthor and friend, Ali al-Nowaihi. I first learnt about prospect theory from him. I also owe my appreciation of methodology and the philosophy of science entirely to him. He has undertaken a larger burden of our joint research in the last few years, allowing me to be immersed in the book. For all these reasons, he is very much a coauthor of the book in spirit.

I am extremely grateful to many academics and Ph.D. students who unselfishly and generously contributed their time and efforts to reading drafts of various parts of the book. The participation of so many leading behavioral economists in the making of this book is unprecedented and has really made it into a public project for which I shall always be very grateful. Herbert Gintis, Martin Dufwenberg, and Vincent Crawford deserve special mention for being so very gracious with their inputs into most parts of the book, and very quickly responding to my queries.

Many others also played a critical role in the writing of this book and commented on material closer to their areas of interest, and/or offered valuable encouragement and advice. In particular, I wish to thank Mohammed Abdellaoui, Ali al-Nowaihi, Dan Ariely, Douglas Barrett, Björn Bartling, Karna Basu, Kaushik Basu, Pierpaolo Battigalli, Roland Bénabou, Florian Biermann, Gary Bolton, Subir Bose, David Colander, Andrew Colman, Patricio Dalton, Alexandra Dias, Florian Englmaier, Armin Falk, Ernst Fehr, Urs Fischbacher, Xavier Gabaix, Sayantan Ghosal, Uri Gneezy, Werner Güth, Shaun Hargreaves Heap, Fabian Herweg, Karla Hoff, Philippe Jehiel, David Laibson, George Loewenstein, Michel Marechal, Friederike Mengel, Joshua Miller, Axel Ockenfels, Amnon Rapoport, Ludovic Renou, Alvin Roth, Klaus Schmidt, Andrei Shleifer, Dennis Snower, Joe Stiglitz, Cass Sunstein, Richard Thaler, Jean-Robert Tyran, Klaus Waelde, Peter Wakker, Eyal Winter, and Peyton Young. I owe a profound intellectual debt to many others who did not read the book manuscript but whose work has greatly inspired me. These include Daniel Kahneman, Amos Tversky, Colin Camerer, Matthew Rabin, Herbert Simon, Robert Shiller, and George Akerlof. I am also very grateful to two successive Heads of the economics department at Leicester, Steve Hall and Chris Wallace, who tried to free up as much of my time as possible for writing the book.

I would like to specially acknowledge the enormous amount of work put in by two extremely conscientious and able Ph.D. students, Teimuraz Gogsadze and Junaid Arshad. They closely read and commented on successive drafts of the manuscript at all stages, offered very useful advice,

and served as excellent sounding boards for new ideas. Jingyi Mao came up with a very nice cover for the book in a burst of creativity, for which I am very grateful. Other Ph.D. students who carefully read and commented on selected parts of the manuscript include: Ala Avoyan, Nino Dognohadze, Sneha Gaddam, Narges Hajimoladarvish, Emma Manifold, Jingyi Mao, Alexandros Rigos, David Tsirekidze, Yongli Wang, Mengxing Wei, and Mariam Zaldastanishvili.

I would be remiss not to thank the large number of other researchers whose work has made this book possible. I must also sincerely apologize to authors who feel that their work has been inadequately cited or not given the importance they feel that it deserves. To such authors, I say, omission of your papers does not mean that I necessarily viewed your papers as unimportant. In mitigation, I do not intend my book to be a survey of all the experimental results on all topics in behavioral economics; there are already excellent sources with this objective. And, quite possibly, I was simply unaware of your important work, which is in keeping with the evidence on limited attention and bounded rationality that plays an important role in this book.

I am very grateful to the team at Oxford University Press who have done an excellent job at all stages of this book. In particular, I would like to thank Adam Swallow, the commissioning editor for economics and finance at OUP for his patience, good cheer, organizational skills, and sound advice. Scott Parris, the economics editor at the US office of OUP, who retired just as this book was about to come out, was the first to spot the importance of this project. He offered very valuable advice and encouragement throughout the writing stage and played a key role in my decision to go with OUP. I must also thank Niko Pfund, the President of Oxford University Press USA, for his continued interest in the manuscript over several years, despite his many other responsibilities. The production and marketing teams at OUP were a pleasure to work with. Jon Billam took on the challenge of copy-editing an unusually large book with great enthusiasm. I am also very grateful to Emma Slaughter, the production editor for the book; Kim Stringer, the indexer; Kim Allen, the proofreader; Carla Hodge-Degler who took over as production editor from Emma; and to Leigh-Ann Bard, the marketing manager for the book.

CONTENTS

List of Figures List of Tables	xxi xxiii
Introduction to Volume 3	1
Introduction to Behavioral Economics and the Book Volumes	5
1 Some antecedents of behavioral economics	7
2 On methodology in economics	8
3 The experimental method in economics	14
3.1 Experiments and internal validity	15
3.2 Subject pools used in lab experiments	17
3.3 Stake sizes in experiments	18
3.4 The issue of the external validity of lab findings	18
3.5 The role of incentives in economics	20
3.6 Is survey data of any use?	23
3.7 Replications in experimental economics	25
4 Approach and organization of the book	26
5 Appendix A: The random lottery incentive mechanism	31
6 Appendix B: In lieu of a problem set	31
References for Introduction	36
1 The Evidence on Temporal Human Choice	40
1.1 Introduction	40
1.2 The discounted utility model	41
1.3 The exponential discounted utility model (EDU)	42
1.3.1 Some salient properties of the EDU model	43
1.3.2 Time consistency of consumption plans under EDU	44
1.3.3 A note on eliciting time preferences under EDU	46
1.3.4 Axiomatic foundations of EDU	47
1.4 Anomalies of the EDU model	48
1.4.1 Hyperbolic discounting and the common difference effect	48
1.4.2 The gain-loss asymmetry	51
1.4.3 The absolute magnitude effect	52
1.4.4 The delay-speedup asymmetry	53
1.4.5 Front-end delay dependence	55
1.4.6 Subadditive discounting	55
1.4.7 Cyclical or non-transitive choices	55
1.4.8 Preferences for increasing sequences	57
1.4.9 Violations of consumption independence	57
1.4.10 Effects of individual-specific traits on the discount rate	58

2	Behavioral Models of Time Discounting	59
	2.1 Introduction	59
	2.2 Explaining the sign and magnitude effects	61
	2.2.1 The Loewenstein–Prelec explanation	61
	2.2.2 The class of simple increasing elasticity utility functions	63
	2.3 Explaining the common difference effect	65
	2.3.1 Hyperbolic discounting	66
	2.3.2 Subadditive discounting	73
	2.3.3 Uncertainty	77
	2.4 Attribute-based models	81
	2.4.1 Vague time preferences model	82
	2.4.2 The similarity relation and time preference	83
	2.4.3 Trade-off attribute model of intertemporal choice	85
	2.5 The reference time theory (RT)	86
	2.5.1 A basic description of RT	87
	2.5.2 The implications of additivity of discount functions for RT	88
	2.5.3 Explanation of intransitive preferences under RT	89
	2.5.4 Recasting common discount functions in terms of RT	90
	2.5.5 Explanation of the EDU anomalies in RT	91
	2.5.6 Intransitive preferences and relative discounting	95
3	Applications of Present-Biased Preferences	98
	3.1 Introduction	98
	3.2 Two frameworks for modeling present-biased preferences	100
	3.2.1 Planner-doer models	101
	3.2.2 Multiple selves and the degree of awareness	104
	3.3 Optimal consumption under hyperbolic discounting	105
	3.3.1 Benchmark case: time consistent preferences	106
	3.3.2 The solution under limited awareness	107
	3.3.3 Mitigating self-control problems in the life-cycle model	109
	3.3.4 Euler equations in a general life-cycle problem	112
	3.3.5 Missing precautionary savings effects	116
	3.3.6 Relation between intertemporal substitution and risk	117
	3.3.7 Patience heterogeneity: covariation with wealth and age	118
	3.4 Endogenous retirement decisions	118
	3.5 Procrastination and preproperation	123
	3.5.1 The case of immediate costs	125
	3.5.2 The case of immediate rewards	126
	3.5.3 A brief note on welfare comparisons	128
	3.5.4 Some other features of present bias	129
	3.6 Interdependence, multiple activities, and competition	130
	5.7 Optimal sin taxes	132
	3.7.1 First best allocation	134
	3.7.2 Privately optimal choice	134
	3.7.3 Implementation of the first best	135
	3.7.4 Population heterogeneity	135

3.8 Investment and leisure goods	137
3.8.1 Investment goods	137
3.8.2 Leisure goods	141
3.8.3 Empirical results	141
3.9 Other applications of hyperbolic discounting	142
4 A Guide to Further Reading	145
4.1 Some confounds in the measurement of discount functions	145
4.1.1 Time and risk	145
4.1.2 Non-linearities in utility	146
4.1.3 Arbitrage between lab and market interest rates	147
4.2 Are time preferences stationarity?	147
4.3 The pervasiveness of subadditivity	150
4.4 A smorgasbord of topics in time discounting	153
4.5 Exercises for Volume 3	155
References for Volume 3	165
Author Index	173
Subject Index	176