Hume's Problem Solved

The Optimality of Meta-Induction

Gerhard Schurz

The MIT Press
Cambridge, Massachusetts
London, England

Contents

Preface ix

1 The Problem of Induction 1

1.1 The Notion of Induction: Conceptual Clarifications 1
1.2 David Hume and the Problem of Justifying Induction 5
1.3 Plan of the Book 8

2 On Failed Attempts to Solve the Problem of Induction 11

2.1 Can Induction Be Avoided? 11
2.2 Is Induction Rational "by Definition"? Rationality and Cognitive Success 13
2.3 Can Induction Be Justified by Assumptions of Uniformity? 16
2.4 Can Circular Justifications of Induction Have Epistemic Value? 18
2.5 Can Induction Be Justified by Abduction or Inference to the Best Explanation? 22
2.6 The Role of Induction and Abduction for Instrumentalism and Realism 24

3 The Significance of Hume's Problem for Contemporary Epistemology 27

3.1 The Aims of Epistemology 27
3.2 Foundation-Oriented Epistemology and Its Main Problems 29
3.3 Coherentism and Its Shortcomings 35
3.4 Externalism and Its Shortcomings 38
3.5 The Necessity of Reliability Indicators for the Social Spread of Knowledge 43
3.6 Conclusion: A Plea for Foundation-Oriented Epistemology 44

4 Are Probabilistic Justifications of Induction Possible? 47

4.1 Why Genuine Confirmation Needs Induction Axioms 47
4.2 Digression: Goodman's Paradox and the Problem of Language Relativity 52
4.3 Statistical Principal Principle and Narrowest Reference Classes 57
4.4 Statistical Principal Principle and Exchangeability as Weak Induction Axioms 61
4.5 Indifference Principle as an Induction Axiom 68
4.6 Inductive Probabilities without the Principle of Indifference? 72
4.7 Is Skepticism Unavoidable? 75

5 A New Start: Meta-Induction, Optimality Justifications, and Prediction Games 77

5.1 Reichenbach's Best Alternative Approach 77
5.2 Reliability Justifications versus Optimality Justifications 78
5.3 Shortcomings of Reichenbach's Best Alternative Approach 81
5.4 Object-Induction versus Meta-Induction 82
5.5 Prediction Games 85
5.6 Classification of Prediction Methods and Game-Theoretic Reflections 90
5.7 Definitions of Optimality, Access-Optimality, and (Access-) Dominance 94
5.8 Three Related Approaches: Formal Learning Theory, Computational Learning Theory, and Ecological Rationality Research 99
5.9 Simple and Refined (Conditionalized) Inductive Methods 102

6 Kinds of Meta-Inductive Strategies and Their Performance 109

6.1 Imitate the Best (ITB): Achievements and Failures 110
6.2 Epsilon-Cautious Imitate the Best (εITB) 122
6.3 Systematic Deception: Fundamental Limitations of One-Favorite Meta-Induction 126
6.3.1 General Facts about Nonconverging Frequencies 126
6.3.2 Nonconvergent Success Oscillations and Systematic Deceivers 127
6.3.3 Limitations of One-Favorite Meta-Induction 129
6.4 Deception Detection and Avoidance Meta-Induction (ITBN) 131
6.5 Further Variations of One-Favorite Meta-Induction 135
6.6 Attractivity-Weighted Meta-Induction (AW) for Real-Valued Predictions 138
6.6.1 Simple AW 140
6.6.2 Exponential AW 144
6.6.3 Access-Superoptimality 145

6.7 Attractivity-Weighted Meta-Induction for Discrete Predictions 147
6.7.1 Randomized AW Meta-Induction 149
6.7.2 Collective AW Meta-Induction 153
6.8 Further Variants of Weighted Meta-Induction 156
6.8.1 Success-Based Weighting 157
6.8.2 Worst-Case Regrets and Division of Epistemic Labor 161

7 Generalizations and Extensions 163

7.1 Bayesian Predictors and Meta-Inductive Probability Aggregation 163
7.2 Intermittent Prediction Games 169
7.2.1 Take the Best (TTB) 172
7.2.2 Intermittent AW 177
7.3 Unboundedly Growing Numbers of Players 180
7.3.1 New Players with Self-Completed Success Evaluation 181
7.3.2 Meta-Induction over Player Sequences 183
7.4 Prediction of Test Sets 186
7.5 Generalization to Action Games 188
7.6 Adding Cognitive Costs 191
7.7 Meta-Induction in Games with Restricted Information 194

8 Philosophical Conclusions and Refinements 197

8.1 A Noncircular Solution to Hume's Problem 197
8.1.1 Epistemological Explication of the Optimality Argument 197
8.1.2 Radical Openness and Universal Learning Ability 203
8.1.3 Meta-Induction and Fundamental Disagreement 204
8.1.4 Fundamentalistic Strategies and the Freedom to Learn 206
8.1.5 A Posteriori Justification of Object-Induction 208
8.1.6 Bayesian Interpretation of the Optimality Argument 210
8.1.7 From Optimal Predictions to Rational (Degrees of) Belief 212
8.2 Conditionalized Meta-Induction 215
8.3 From Optimality to Dominance 222
8.3.1 Restricted Dominance Results 222
8.3.2 Discriminating between Inductive and Noninductive Prediction Methods 224
8.3.3 Bayesian Interpretation of Dominance 228

9 Defense against Objections 233

9.1 Meta-Induction and the No Free Lunch Theorem 233
9.1.1 The Long-Run Perspective 235
9.1.2 The Short-Run Perspective 245
9.2 The Problem of Infinitely Many Prediction Methods 260

9.2.1 Infinitely Many Methods and Failure of Access-Optimality 260
9.2.2 Restricted Optimality Results for Infinitely Many Methods 262
9.2.3 Defense of the Cognitive Finiteness Assumption 266
9.2.4 The Problem of Selecting the Candidate Set 268
9.2.5 Goodman's Problem at the Level of Prediction Methods 270

10 Interdisciplinary Applications 273

10.1 Meta-Induction and Ecological Rationality: Application to Cognitive Science 273
10.2 Meta-Induction and Spread of Knowledge: Application to Social Epistemology 284
10.2.1 Prediction Games in Epistemic Networks 287
10.2.2 Local Meta-Induction and Spread of Reliable Information 289
10.2.3 Imitation without Success Information: Consensus Formation without Spread of Knowledge 293
10.2.4 Conclusion 295
10.3 Meta-Induction, Cooperation, and Game Theory: Application to Cultural Evolution 297

11 Conclusion and Outlook: Optimality Justifications as a Philosophical Program 305

11.1 Optimality Justifications as a Means of Stopping the Justificational Regress 305
11.2 Generalizing Optimality Justifications 307
11.2.1 The Problem of the Basis: Introspective Beliefs 307
11.2.2 The Choice of the Logic 307
11.2.3 The Choice of a Conceptual System 310
11.2.4 The Choice of a Theory 310
11.2.5 The Justification of Abductive Inference 311
11.3 New Foundations for Foundation-Oriented Epistemology 314

12 Appendix: Proof of Formal Results 315

Formal Symbols and Abbreviations 347
Memos, Definitions, Propositions, Theorems, Figures, and Tables 351
References 355
Subject Index 371
Author Index 383