

Human Reasoning and Cognitive Science

Keith Stenning and Michiel van Lambalgen

A Bradford Book
The MIT Press
Cambridge, Massachusetts
London, England

©2008 Massachusetts Institute of Technology

All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher.

MIT Press books may be purchased at special quantity discounts for business or sales promotional use. For information, please email special_sales@mitpress.mit.edu or write to Special Sales Department, The MIT Press, 55 Hayward Street, Cambridge, MA 02142.

This book was set in latex by the authors. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

Stenning, Keith.

Human reasoning and cognitive science / Keith Stenning and Michiel van Lambalgen.

p. cm. – (A Bradford book)

Includes bibliographical references and index.

ISBN 978-0-262-19583-6 (hardcover : alk. paper) 1. Cognitive science. 2. Reasoning. 3. Logic. I. Lambalgen, Michiel van, 1954- II. Title.

BF311.S67773 2008

153.4–dc22

2007046686

10 9 8 7 6 5 4 3 2 1

General Index

- abduction, *see* inference, abductive
abnormality, 35, 36, 149, 151, 184,
188, 197, 200, 201, 205, 206,
209, 212, 229, 233, 235, 236,
238, 251, 252, 255, 266, 273,
287, 365
abstraction, 277, 283, 303, 305
Achourioti, Theodora, 9
adaptation, 39, 140, 142, 145–147,
153, 164, 167, 170, 171, 177,
282, 296, 365, 366
adaptationism, 141, 145, 146, 296
affect, 241, 243, 276, 277
affirmation of the consequent, 181,
183, 189, 192, 196, 200, 201,
210–212, 231, 232, 266, 269,
271
agent, 4, 40, 185, 192, 250, 251
algorithm, 24, 46, 120, 177, 217,
222, 231, 283, 304, 308, 321,
322, 325, 332, 333, 337, 348,
350, 351, 354, 365
Darwinian, 120, 139, 148, 153
fast and frugal, 7, 361, 365
altriciality, 152, 164, 169, 280, 288,
290, 296, 365
altruism, 146, 153, 156, 157
analogy, 9, 244, 267, 277, 301
anaphora, 53, 75, 82, 91, 98, 111,
115, 329
Aristotle, 9, 11, 81, 306, 320, 321,
323
Aspberger, *see* developmental syn-
drome, Asperger's
astrocyte, 151, 285
attention deficit hyperactivity dis-
order (ADHD), *see* develop-
mental syndrome
authority, 22, 45, 60, 75, 85, 111,
128, 132, 167
autism, *see* developmental syn-
drome, autism
backpropagation, 219, 231
Bayes, 6, 66, 95, 102, 105, 114,
213, 215, 216
Biston betularia, 158
bottom–up, 126, 244, 277, 284,
317, 341
cell death, 285
cerebellum, 168, 284, 285, 296
cerebral lateralisation, 119, 134,
339
cheater detection, 15, 120, 139,
152, 153, 177
chimpanzee, 151, 161, 165, 167,
170, 241, 242, 248, 294, 296
circumscription, 189, 193
COBUILD, 83
communication
adversarial, 85, 97, 107, 115,
128, 130, 310, 328

- cooperative, 22, 85, 97, 107, 115, 127, 160, 309, 312, 314, 328
- phatic, 140
- competence theory, 6, 15, 50, 122, 136, 189, 320, 347–350, 355, 360, 364
- completion, 58, 188–190, 194, 196, 198, 199, 201, 207, 230, 237, 351, 354
- compositionality, 79
- computation
 - Marr's level of, 120, 216, 348, 349, 354, 361
 - symbolic/subsymbolic compatibility, 16, 217
 - tractability of, 148, 239, 298
- concordance, 288, 289
- conditional
 - additional, 181, 182, 207, 210, 212, 215, 267, 354
 - alternative, 181–183, 199, 201–203, 205, 209, 212, 213, 216, 266–268
 - deontic, 47, 48, 53, 56, 57, 66, 80
 - descriptive, 47, 48, 85, 94, 95, 112, 154
 - exception tolerant, 203, 205, 235, 264, 275
 - IF-THEN-ELSE, 104, 273
 - law-like, 64, 69, 183, 184, 247
 - material, 19, 26, 34, 45, 52, 54, 111, 132, 160, 183, 189, 198, 202, 203, 213
 - natural language, *see also* semantics, natural language, 193
 - probabilistic, 213, 214, 216
- connective, 26, 35, 49, 51, 57, 61, 80, 85, 99, 107, 117, 184, 196, 202, 227, 333, 353
- consolidation, 283, 286
- constant
 - logical, 20, 79, 115, 192, 340
- contingency of response, 70, 85, 89, 96, 100, 105, 109, 111
- cooperation, *see also* communication, cooperative; credulous stance; skeptical stance; social coordination, 141, 153, 165, 166, 365
- copy number variation, 293
- cortex, 119, 150, 151, 162, 283, 284, 287, 295, 339
 - frontal, 162, 245, 264, 276, 280, 285, 287, 291, 292, 294
- Counihan, Marian, 40, 59, 69, 81, 133
- counterexample, 5, 27, 33, 45, 58, 64, 65, 68, 81, 85, 87, 89, 102, 107, 124, 156, 184, 315, 333, 334, 339, 364
- credulous stance, 22, 25, 127, 128, 136, 139, 176, 177, 209, 212, 216, 217, 298, 308, 312, 315, 317, 320, 329, 341, 352, 357, 361, 363
- critical individual, 320, 322, 323, 329
- critical thinking, 7
- Darwin, 142, 146, 157
- database, 18, 33, 41, 127, 189, 190, 192, 238, 247, 357, 358, 363, 364
- decision, 4, 5, 7, 9, 19, 28, 43, 90, 122, 161, 360
- deduction, *see* inference, deductive natural, 340
- default, 18, 58, 133, 186, 193, 202, 239, 277, 286, 329, 330, 356, 361, 363, 365
- denial of the antecedent, 181, 183,

- 189, 196, 197, 199, 205, 206,
211, 232, 266, 269, 271, 352
- dentate gyrus, 151
- descriptiveness of psychology, 3
- development, 8, 39, 40, 107, 113,
127, 130, 140, 142, 144, 149,
151, 152, 163, 165, 167, 169,
170, 176, 242, 248, 254, 255,
277, 280, 284, 286, 287, 289,
291, 293
- developmental syndrome
- ADHD, 246, 269, 274, 281, 347
 - Angelman's, 293
 - autism, 16, 35, 94, 126, 151,
180, 205, 207, 235, 241, 347,
354, 366
 - Beckwith-Wiedemann, 293
 - Prader-Willi, 293
 - schizophrenia, 126, 134, 151,
245
 - Silver-Russell, 293
 - Williams, 169
- diagram, 43, 118, 297, 301, 353
- discourse
- credulous stance toward, *see*
credulous stance
 - of adversarial argument, *see*
communication, adversarial,
see system 2
 - referent, 321
 - skeptical stance toward, *see*
skeptical stance
- discourse representation theory,
119, 340
- domain, 7, 13, 14, 19, 20, 22, 23,
28, 43, 54, 61, 69, 115, 214,
216, 300, 307, 308, 320, 329,
332, 339–341, 362
- domain generality, 20, 27, 36, 120,
136, 139, 159, 277
- domain specificity, 25, 27, 39, 41,
58, 148, 152, 153
- ecthesis, 320
- education, 7, 37, 45, 91, 113, 115,
117, 123, 127, 129, 130, 132,
133, 135, 177, 183, 357, 364
- efficiency, 125, 148, 149, 159, 163,
180, 186, 192, 194, 237
- environment, 142–144, 158, 161,
165, 243, 288, 366
- epigenetics, 145, 288, 294, 366
- Euler circles, 301, 320, 328, 352
- event calculus, 38, 185, 251
- evolution, ix, 15, 40, 46, 112, 113,
120, 126, 130, 135, 139, 140,
158, 177, 241, 242, 249, 279,
288, 291, 294, 296, 366
- exaptation, 39, 141, 145–147, 177,
296, 365, 366
- exception, *see also* conditional, ex-
ception tolerant; abnormality,
37, 45, 53, 58, 61, 62, 68, 69,
85, 87, 95, 132, 184, 197, 203,
206, 235, 236, 242, 247, 251,
254, 264, 266, 268, 271, 274,
275, 304, 347
- excitation, 218, 219, 227, 234, 284,
287
- excluded middle, 14, 27, 31
- executive function, 126, 162, 176,
218, 235, 242, 245, 250, 258,
259, 262, 273, 276, 291
- experimental paradigms, 11, 41,
124, 247, 259, 352
- exploration, 16, 90, 93, 99, 312,
316, 341
- expressiveness, 186, 301
- fallacy, *see also* affirmation of
the consequent; denial of the
antecedent, 5, 181, 189, 197,
219, 267, 268, 271, 313
of illicit conversion, 313, 316,
329

- falsity, *see also* truth; semantics;
 validity, 51, 52, 60, 63, 218,
 220, 229, 288
 strong, 65
- familiarity, 46, 53, 154
- fitness, 159
- formalization, 18, 26–28, 33, 38,
 41, 47, 54, 55, 122, 123, 136,
 185, 196, 259, 275, 278, 358,
 365
- frame problem, 125, 185
- Frege, 9, 307
- GABA, 151, 255, 287, 289
- gene, 144, 150, 158, 281, 289, 290,
 293
- gene expression, 140, 145, 149,
 158, 289, 291, 293, 295, 366
- gene switches, 140, 149, 152, 165,
 290, 296
- generalization, 48, 69, 85, 283, 302
- genetic control elements, *see* gene
 switches
- genotype, 158, 243
- glia, 168, 285
- glutamate, 287
- goal, 4, 6, 8, 22, 124, 161, 185,
 190, 245, 250, 258, 264, 276,
 308, 355
- Gödel, 14
- Haldane, 291
- head size, 149, 150, 152, 168, 169,
 280–282, 285, 292, 294
- Hebb, 234
- Henlé, 7
- heritability, 144, 145, 158, 171,
 288, 366
- hesitancy, 312, 314, 315, 319
- hidden figures, 244
- hippocampus, 151, 283, 286, 296
- Homo sapiens*, 151, 164, 169, 170,
 280, 289, 295, 356, 365
- human accelerated region (HAR),
 295
- Husserl, 3, 9, 352
- idealization, 350, 351
- IF-THEN-ELSE, *see* conditional,
 IF-THEN-ELSE
- immune reaction, 285
- implementation, *see also* represen-
 tation, 16, 41, 118, 120, 124,
 130, 135, 143, 163, 176, 186,
 192, 200, 216, 218, 237, 258,
 276, 280, 282, 287, 306, 348,
 352, 354, 366
- implication, *see* conditional
- implicature, 83, 160, 310, 311, 330,
 341
- imprinting, 145, 282, 289, 292, 293
- incremental computation, 189
- individual differences, 123, 297,
 309, 317, 320, 323, 327, 341
- inertia of belief, 38, 40, 250, 258–
 260, 262, 277, 354
- inference, *see also* logic; reasoning
 ; interpretation; semantics;
 implicature
- abduction, 79
- abductive, 189, 247
- backward, 33, 36, 176, 185, 189,
 192, 196, 197, 200, 231, 232,
 286
- deductive, 9, 118, 121, 332, 333,
 337
- forward, 8, 176, 189, 196, 200,
 232, 286, 341, 351, 354
- inflammation, 285
- information state, 54, 252, 259
- information–packaging, 315
- information-packaging, 298
- informational analysis, 3, 118, 356
- inhibition, 151, 218, 219, 226, 227,
 229, 233, 236, 237, 245, 250,

- 252, 255–258, 266, 275, 278,
283–285, 287, 347
- innateness, 15, 46, 112, 139, 140,
143, 149, 238, 264, 288
- innovation in evolution, 141, 142,
149, 152, 160, 162–164, 169–
171, 280, 291, 294, 365
- integrity constraints, 189–192, 200,
201, 209, 231
- interneuron, 151, 283, 287
- interpretation, *see also* logic; rea-
soning; inference; semantics;
domain, 7, 11, 12, 16–19, 43,
45, 47–53, 56, 58, 60, 66,
69, 72, 74–76, 79, 80, 85, 87,
90, 91, 93, 94, 103, 104, 107,
110–113, 115, 122–126, 128,
130, 135, 136, 139, 154, 156,
160, 163, 166, 170, 175–177,
180, 182, 183, 195, 198, 199,
212–214, 216, 247, 267, 283,
286, 308, 309, 311–313, 315–
317, 323–325, 328–330, 341,
353, 357–361, 363
- as process, 11, 15, 21
- localness, 330
- localness of, 21, 24, 29, 69, 87,
160, 307
- necessity of, 17
- of syllogisms, 298
- variability, 51
- variability of, 298, 309, 331
- vs. derivation, 11, 19, 297, 351
- intersubjectivity, 243
- iteration
- of conditional, 25, 34, 184, 278,
297, 333
- of fixed-point operator, 193
- of fixed-point operator, 193–195,
217
- joint attention, 243, 248
- Kant, 9, 12, 309, 351
- Kleene, 27, 32, 54, 177, 187, 193,
225
- knowledge, *see also* reasoning, do-
main dependence of; reason-
ing, as affected by knowledge;
perception, as cause of belief
implicit/explicit, *see also* System
1; System 2; 41, 257, 275,
276, 323
- knowledge base, *see* database
- Köhler, 161
- language
- formal, 12, 19, 24, 25, 50, 52,
183, 202, 251, 340, 351
- natural, 14, 21, 27, 29, 43, 49,
50, 58, 61, 68, 69, 79, 91, 95,
113, 115, 122, 139, 147, 159,
162, 170, 183–185, 197, 339,
353, 359
- language faculty, 141, 160, 163
- law
- legal, 23, 46–48, 72, 74, 87, 94,
129, 159
- logical, 9–14, 20, 25, 31, 124
- scientific, 34, 110, 129, 183, 247
- learning, 8, 44, 124, 127, 129, 130,
137, 143, 165, 183, 217, 219,
231, 232, 237, 238, 246, 248,
262, 276, 282, 284, 286, 304,
330, 360, 364
- levels of analysis, 4, 49, 121, 296
- literacy, 37, 124, 125, 128, 130,
131, 133, 136
- logic, *see also* semantics; reason-
ing; inference; interpretation
classical, *see also* validity, 6–8,
15, 19, 25, 27, 29, 31, 33,
34, 37, 38, 41, 45, 46, 49, 52,
54, 62, 65, 93, 95, 96, 104,
109, 114, 125, 129, 130, 133,

- 136, 139, 148, 152, 161, 162,
 175, 177, 178, 186, 193, 200,
 204, 207, 208, 218, 237, 239,
 276, 298, 309, 310, 312, 313,
 316, 320, 322, 324, 325, 334,
 347, 350, 351, 353, 355, 357,
 359–361, 365
 closed world-reasoning, *see*
 reasoning, closed-world
 defeasible, 136, 139, 161, 175,
 330
 deontic, 32, 48
 epistemic, 257, 330
 fuzzy, 24, 30
 intuitionistic, 14, 31, 350
 non-standard, 41
 nonmonotonic, 26, 34, 130, 177,
 185, 188, 195, 197, 202, 216,
 238, 246, 268, 347, 355, 356,
 358
 planning, *see also* logic pro-
 graming, 161, 176
 probabilistic, 6, 30, 114, 175,
 184, 213, 214, 216, 354, 355
 syllogistic, *see* syllogism
 three-valued, 27, 54, 177, 187,
 193, 217, 225, 229
 logic program, 188
 definite, 187, 192, 194–196, 222,
 225, 227, 230, 235, 236
 positive, 186, 187, 222
 logic programing, *see also* logic,
 planning
 logic programming, 16, 185, 217,
 222, 224, 227, 237, 239, 266,
 351
 recursive program, 221
 logic teaching, 135, 136
 logical consequence, 9, 12, 23, 25,
 27, 33, 34, 41, 50, 129, 160,
 188, 195, 224
 logical independence, 309, 312

 Łukasiewicz, 30, 32

 Malinowski, 140
 Marr, 4, 9, 29, 145, 216, 348, 351,
 361
 mathematics, 10, 12, 14, 20, 24,
 27, 31, 41, 50
 memory, 17, 75, 118, 133, 151,
 161, 162, 233, 318, 331, 338,
 358, 365
 episodic, 147, 255, 283, 286
 first-in, first-out, 322, 338
 long-term, 18, 118, 124, 129,
 232, 239
 working, 18, 75, 106, 118, 124,
 147, 151, 162, 163, 178, 186,
 232, 234, 236–238, 249, 250,
 258, 279, 283, 286, 358, 363,
 365
 mental models, 10, 15, 44, 104,
 113, 114, 119, 181, 298, 312,
 322, 331, 339
 metalogic, 13, 225, 305, 308, 330,
 336
 Mill, 9, 14
 minicolumns, 285
 minimization, 189, 198
 model, *see also* mental modal
 theory
 discourse, 39, 119, 125, 133, 356
 forward, 286
 in planning, 125, 161, 185, 237
 mental process, *see also* reason-
 ing, as process, 3, 4, 7, 10, 11,
 15, 43, 44, 48, 52, 59, 86, 91,
 108, 114, 118, 119, 122, 124,
 135, 145, 175, 181, 186, 216,
 238, 246, 297, 298, 304, 317,
 328, 332, 340, 341, 347–349,
 352, 354, 355
 minimal, 185, 189, 192, 194,
 198, 220, 224, 236, 354

- source founding, 298, 320, 323, 324, 326, 327, 329, 341
- statistical, 182, 317, 318, 320, 325–327, 341
- model theory, *see* semantics
- modularity, 15, 39, 46, 112, 120, 139, 141–143, 148, 149, 159, 160, 163, 166, 170, 171, 238, 242, 244, 246, 248, 259, 290, 291, 365
- modus ponens, 8, 26, 119, 181, 183, 189, 196, 203–205, 208, 211, 215, 216, 232, 266, 269, 270, 351, 354
- modus tollens, 6, 37, 118, 132, 136, 181, 189, 196, 200–202, 205, 210, 211, 231, 232, 239, 266, 269, 270
- monotonicity, *see* logic, classical; logic, nonmonotonic, 192, 193, 241, 256
- myelination, 168, 284

- negation, 32, 34, 51, 87, 115, 155, 193, 222, 312, 340
 - implementation of, 217, 219, 221, 228
 - of conditional, 65
- negation as failure, 185, 187, 189, 194, 200, 218, 228, 230, 239
- negations paradigm, 87, 108
- neural net
 - fast functional link, 232, 233
 - logic gates, 218, 228
 - recurrent, 217, 221–224, 227, 229, 231
 - retinotopic mapping, 234
 - sheets of units, 226, 230, 234, 288
 - spreading activation in, 233
 - stable state of, 189, 217, 220, 224, 230, 234, 352
 - wiring up, 232
- neural network
 - feedforward, 219–222, 286
- neural networks, 8, 16, 19, 119, 120, 124, 145, 151, 163, 175, 176, 180, 186, 189, 217, 247, 249, 251, 254, 258, 259, 261, 268, 276, 277, 280, 283, 286, 287, 339, 348, 352, 354
- neurogenesis, 149, 151, 167, 283, 284, 286
- neuron, *see also* adult neurogenesis; unit, computational;, 121, 217, 218, 234
 - firing, 218–220, 231, 236
- neuronal migration, 151, 283, 295
- neurotransmitter, *see* GABA, *see* glutamate
- no empty sets assumption, *see* existential presupposition
- node, 226, 228, 230, 234, 254, 258
- nonmonotonicity, *see* logic, nonmonotonic
- nonsuppression, 208
- normativity, 3, 5, 6, 9, 11–14, 19, 32, 56, 175, 320, 347, 349, 350, 352, 361

- obsetrics, 169, 296
- operator
 - awareness, 258
 - belief, 257, 258, 275
 - fixed-point, 186, 192, 193

- Paiget, 136, 243, 274, 297
- parameter setting, 19, 20, 25, 34, 41, 50, 58, 63, 87, 122, 143, 175, 182, 183, 352, 358
- perception, 9, 17, 29, 90, 123, 127, 148, 286, 331, 345, 358
 - as cause of belief, 40
 - as cause of belief, 163, 250, 354
- perceptron, 231, 239

- Perner, 275
- phenotype, 142, 144, 148, 158, 289, 290, 293, 366
- phenotypic description, 144, 147, 157
- Pijnacker, Judith, 205
- plan recognition, 163
- planning, *see also* executive function, 4, 6, 15, 24, 33, 36, 39, 41, 52, 61, 72, 105, 125–127, 139, 161, 162, 165, 170, 177, 185, 186, 219, 235, 237, 243, 245, 250, 258, 262, 263, 265, 273, 276, 278, 291, 355, 365
- as phylogenetic origin of language, 161, 162, 165, 291, 365
- reactive, 70, 105, 107, 161, 353
- plasticity, 232
- poverty of the stimulus, 143
- pragmatics, 41, 60, 62, 74, 79, 85, 101, 107, 113, 114, 127, 136, 147, 204, 329, 330, 339, 355
- presupposition, 209, 212, 268
- existential, 300, 321
- probability, 5, 6, 28, 30, 58, 122, 175, 184, 213–216, 354, 360, 361
- problem solving, 125, 127, 244, 245
- process
- conscious, 90
- processes
- automatic, 7, 8, 86, 124, 126, 128, 177, 186, 189, 238, 247, 266, 330, 347, 354
- conscious, 7, 124, 125, 127, 128, 177, 178, 238, 351
- program, 27
- program clause, 187, 189, 190, 217
- programmed cell death, *see* pruning
- pruning, 168, 169, 235, 283, 284, 287
- psychiatric syndrome, *see also* developmental syndrome
- anxiety, 245
- Aspberger's, 241, 262
- bipolar disorder, 134
- depression, 126, 245
- psycholinguistics, 43, 126, 355, 358
- psychologism, 9, 11, 12, 19
- query, 190–192, 200, 231, 253
- rare-allels model, 293
- rashness, 312, 314, 316, 317, 326
- rationality, *see also* normativity, *see also* reasoning, 4–6, 13, 17, 19, 51, 56, 60, 75, 90, 99, 124, 175, 214, 347, 352, 357, 359, 361
- Apologist, 7
- bounded, 6
- Eliminativist, 7
- Meliorist, 7
- Panglossian, 6
- reaction time, 121, 268
- reasoning, *see also* rationality
- as affected by knowledge, 5, 13, 17, 18, 22, 29, 33, 43, 48, 90, 104, 124, 129, 131, 136, 148, 175, 185, 198, 214, 238, 253, 257, 275, 310, 323, 332, 354, 362
- as process, 11, 130, 177, 179, 181, 197, 283, 317, 339, 340
- causal, 38, 40, 41, 127, 260
- closed–world, 6, 15, 22, 33, 35, 37–40, 125, 127, 161, 162, 180, 184, 186, 189, 190, 195, 197, 199, 202, 205, 207, 218, 231, 237, 249, 254, 264, 282, 286, 287, 313, 329, 330, 347, 351

- counterfactual, 38, 83, 247, 259, 261, 262, 354
- deontic, 46–48, 53, 56, 61, 64, 74, 75, 87, 119, 154, 159, 163, 249
- epistemic, 110, 243, 257, 330
- from an interpretation, 45, 76, 182, 197, 297, 351
- meta-, 13, 104, 131, 132, 306, 308, 330
- monadic, 298
- probabilistic, 5, 6, 28, 30, 70, 114, 184, 213, 214, 354, 365
- temporal, 39, 65, 162, 185, 354
- to an interpretation, 16, 20, 91, 125, 180, 197, 203, 247, 297, 328, 351
- relativism, 11, 12, 18, 352
- representation, *see also* implementation
 - diagrammatic, 43, 118, 297, 301, 320, 353
 - direct, 332
 - external, 59, 162, 163, 170, 178, 297
 - internal, 119, 162, 254, 332
 - logic as, 8, 19, 118, 119, 122, 123, 355
- response
 - prepotent, 126, 250, 252, 256, 258, 263, 266, 273, 278
- response set, 45, 57, 65, 102, 211, 298, 309, 310, 312
- retina, 16, 234, 286, 348
- rules, 5, 9, 15, 33, 46, 60, 62, 64, 85, 96, 99, 102, 104, 118, 121, 127, 200, 235, 357
 - arbitrary, 153, 273
- satisfaction, 24, 57, 66, 89, 351
- science
 - methodology and philosophy of, 4, 14, 16, 18, 312, 320, 358
- selection
 - natural, 120, 145, 147, 168
 - sexual, 291
- selection task, 354
- self-organizing map, 283
- semantics, *see also* logic; reasoning; inference; interpretation
 - bivalent, 24, 26–28, 31, 41, 52
 - Łukasiewicz, 30, 32
 - many-valued, 28, 30
 - neglect of, 49, 122, 182, 350
 - of conditionals, *see* conditional
 - of natural language (descriptive), 61, 65, 83, 84, 107
 - possible worlds, 69, 257
 - three-valued, *see* logic, three-valued
 - truth-functional, 26, 27, 30, 49, 52, 95, 114, 184
 - two-valued, *see also* semantics, bivalent, 187, 193, 218, 220
- sex chromosome (XY), 290
- sexual
 - selection, 142
- sickle cell anaemia, 242
- sieve method for syllogism, 322
- skeptical stance, 21, 22, 128–130, 136, 139, 176, 209, 210, 298, 308, 309, 312, 315, 317, 320, 330, 341, 357, 364
- social contract, 15, 46, 98, 112, 119, 139, 153, 155, 157, 159, 166
- social coordination, 141, 165
- Socratic dialogues, *see* tutorial dialogues
- source premise, 320, 321, 328
- speciation, 164, 165, 288, 291, 294, 296
- Spencer, 146, 166
- subject
 - consistent, 212

- supernormal abilities, 244
- syllogism, 6, 9, 20, 117, 134, 136, 176, 297, 351, 352
 - metalogical generalizations, 308
- syllogisms
 - conclusion term order, 317, 320, 322, 323, 325, 328
 - counterfigural, 315
- symbol, 8, 18, 148, 217
- synapse, 169, 232, 233, 235, 283, 284, 287
- syndrome
 - developmental, *see* syndrome, psychiatric
 - psychiatric, *see also* syndrome, developmental
- syntax, 12, 15, 21, 25, 41, 50, 142, 177, 299, 332, 336, 340, 353
- system 1, 124, 125, 130, 135, 163, 237, 330, 361
- system 2, 124, 127, 128, 130, 135, 137, 163, 237

- transfer of learning, 130, 136, 316, 341
- task, 15, 19, 22, 41, 43, 44, 48, 49, 211
 - A not B, 274
 - altruism, 156
 - box, 16, 35, 37, 171, 180, 246, 259, 262, 264, 266, 272, 274, 347, 354
 - cheater detection, 154
 - conditional reasoning, 121
 - conjunctive selection, 57, 89, 99, 100, 108, 109
 - counterfactual, 40, 171, 260, 262, 354
 - false belief, 16, 38, 163, 164, 171, 245, 248, 249
 - immediate inference, 310–312, 314, 317, 341
 - individual description, 322
 - monkey working memory, 162
 - selection, 5, 15, 17, 32, 43, 44, 119–122, 126, 132, 139, 153, 157, 159, 163, 175, 182, 183, 249, 267, 297, 309, 353, 357, 359
 - suppression, 15, 58, 86, 121, 122, 171, 177, 218, 233, 235, 239, 246, 250, 259, 262, 266, 297, 309, 347, 351, 353, 355
 - syllogism, 121, 297
 - tubes, 246, 272, 355
 - two rule, 44
 - two–rule, 62, 66, 67, 87, 95, 100, 102
 - unexpected contents, 180, 248, 255
- theory of mind, 38, 127, 141, 163, 241, 242, 248, 259, 260, 277, 278
- thresholds, 217, 218, 227, 233, 236
- top-down, 126, 341
- truth, *see also* falsity; semantics; validity , 12, 13, 25, 27, 50, 60, 62, 63, 68, 70, 85, 95, 97, 104, 131, 351
- truth–functionality, *see* semantics, truth–functional
- truth–table, 26, 27, 30, 32, 55, 194, 226
- tutorial dialogues, 15, 50, 59, 61, 66, 70, 72, 75, 81, 87, 91, 93, 101, 115, 175, 180, 182, 197, 203, 267, 298
- twins, 288

- u-conclusions, 300, 306
- unit
 - computational, 218

- vagueness, 24, 28, 29, 129

validity, 5, 9, 11, 13, 19, 20, 22,
24–26, 33, 34, 36, 39, 43, 49,
51, 104, 129, 152, 178, 179,
183, 196, 198, 200, 202, 212,
300, 304, 306, 307, 309, 311,
312, 315, 318, 320–322, 324,
325, 329, 330, 334, 353

Waddington, 296

Wason, ix, 8, 15, 16, 19, 32, 43–47,
49, 52, 60, 64, 66, 68, 71, 74,
75, 79, 83, 87, 93, 102, 105,
107, 120, 136, 153, 154, 160,
246, 267, 359, 360

weak central coherence theory,
242, 244, 277, 284

white matter, 285