Can resources save rationality? "Anti-Bayesian" updating in cognition and perception

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Abstract

Resource rationality may explain suboptimal patterns of reasoning; but what of "anti-Bayesian" effects where the mind updates in a direction *opposite* the one it should? We present two phenomena – belief polarization and the size-weight illusion – that are not obviously explained by performance- or resource-based constraints, nor by the authors' brief discussion of reference repulsion. Can resource rationality accommodate them?

Resource rationality takes seemingly irrational behaviors and reframes them as rational or optimal given other constraints on agents. For example, anchoring-and-adjustment and overestimating extreme events turn out be "rational" after all, by reflecting the rational *allocation* of cognitive resources. Thus, even for such classically irrational phenomena, "the resulting train of thought eventually converges to the Bayes-optimal inference" (p. 38).

In such cases, reasoners *fall short* of perfectly rational updating, and it is illuminating that resource- and performance-based constraints can accommodate such suboptimal reasoning. But what about cases where we behave not merely suboptimally, but rather *against* the norms of Bayesian inference? Here, we explore cases where the mind is moved by prior knowledge in precisely the *reverse* direction of what a rational analysis would recommend. These cases are not merely suboptimal, but rather "*anti*-Bayesian," for actively defying Bayesian norms of inference. We consider two such phenomena: belief polarization and sensory integration (Fig. 1). Can resource rationality handle them?

First, belief polarization: Receiving evidence contrary to your beliefs should soften those beliefs, even if ever-so-slightly. But, this isn't what actually happens when the beliefs in question are central to one's identity – in belief polarization, contrary or disconfirming evidence causes more *extreme* beliefs, not more moderate ones. A classic example was vividly documented by Festinger et al. (1956): Cult members who predict the world will end on some date – but who then see that date come and go with no

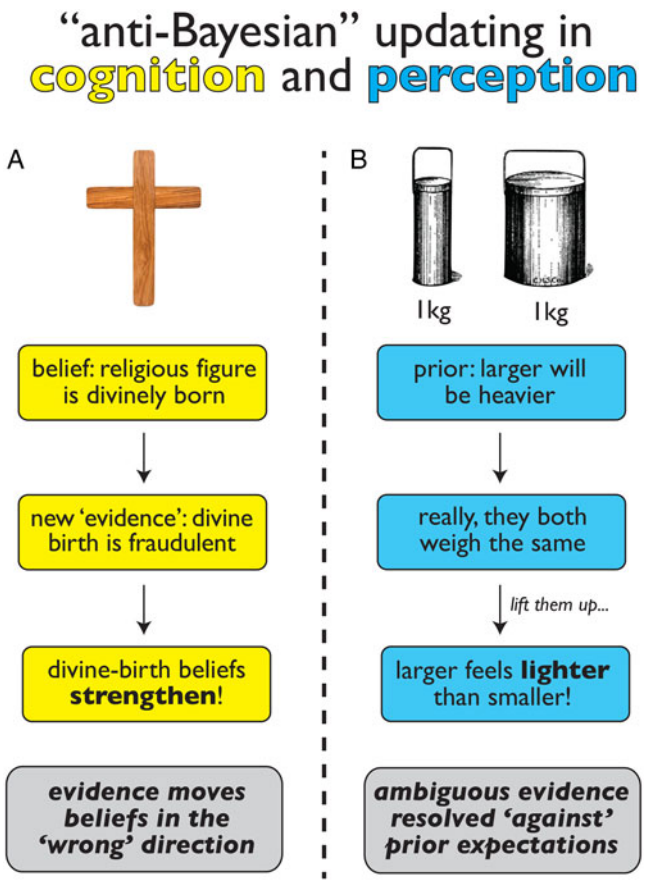

Figure 1. (**Mandelbaum et al.**) Examples of "anti-Bayesian" updating in the mind. (A) Under conditions of cognitive dissonance, acquiring – and affirming – evidence *against* one's beliefs can cause those beliefs to strengthen (Batson 1975), whereas Bayesian norms of inference recommend softening those beliefs. (B) In the size-weight illusion, one is shown two objects of different sizes but equal weights; when one lifts them up, the *smaller* one feels illusorily heavier than the larger one (Buckingham 2014; Charpentier 1891; Won et al. 2019). In other words, ambiguous sensory data about which of two objects is heavier is resolved "against" one's prior expectations, rather than in favor of one's priors as recommended by Bayesian norms of inference. Can resource rationality accommodate such paradigmatically "irrational" phenomena?

cataclysm – end up *strengthening* their beliefs in the cult's tenets, not softening them. In other words, credible evidence *against* their worldview only makes them hold that worldview more strongly – directly defying Bayesian inference norms.

The same phenomenon can be found under laboratory conditions. For example, one study exposed people who believe that Jesus is the Son of God to a (fake) news article reporting that archeologists had unearthed carbon-dated letters from the New-Testament authors; the letters said the Bible was fraudulent and that its authors knew Jesus was not divinely born (Batson 1975). Subjects who did not believe the article's content left their beliefs about Jesus unchanged; but, fascinatingly, subjects who did believe the article's content ended up *strengthening* their belief that Jesus was the Son of God. In other words, *affirming* new evidence *against* Jesus's divine birth ($\sim P$) caused stronger beliefs in Jesus's divine birth (P). Similar "backwards" updating is also observed for beliefs about nuclear safety (Plous 1991), health (Liberman & Chaiken 1992), and affirmative action and gun control (Taber & Lodge 2006; see also Mandelbaum 2019).

Why does this happen? In fact, belief polarization is not so mysterious: It has been known for decades, and it is even a predictable consequence of dissonance theory – "the psychological immune system" (Gilbert et al. 1998) – applied to one's values. What *is* mysterious is why this should occur *in a Bayesian mind* – even one constrained by "resources." Belief polarization is irrational not because people are *insufficiently moved* by evidence, but rather because people are moved in the direction *opposite* the one they should be. And, importantly, these patterns cannot be explained by biased attitudes toward the evidence's source. For example, Bayesian models of milder forms of belief polarization (e.g., Jern et al. 2014) suggest that subjects infer that contrary evidence must have come from unreliable sources (e.g., biased testimony); but this seems inapplicable to the above cases, where the sources are either nature itself (e.g., the world failing to end), or evidence the subject has actively accepted (e.g., news articles they endorsed).

Indeed, "anti-Bayesian" updating is widespread, occurring even in basic perceptual processes. When we have prior expectations about new and uncertain sensory data, rational norms of inference say we should interpret such data with respect for those priors; "people should leverage their prior knowledge about the statistics of the world to resolve perceptual uncertainty" (p. 40). But, sensory integration frequently occurs the opposite way. Consider the size-weight illusion, wherein subjects see two equally weighted objects – one large and one small – and then lift them both to feel their weight. Which feels heavier? We "should" resolve the ambiguous haptic evidence about which object is heavier *in favor* of our priors; but instead, the classic and much-replicated finding is that we experience the smaller object as *heavier* than the equally-weighted larger object (Buckingham 2014; Charpentier 1891). This too is "irrational" – not for *falling short* of Bayesian norms of inference, but for proceeding opposite to them, because we resolve the ambiguous sensory evidence – two equally weighted objects – *against* the larger-is-heavier prior, not in favor of it (Brayanov & Smith 2010; Buckingham & Goodale 2013). Indeed, this backwards pattern of updating is so strong that it can produce outcomes that are not merely odd or improbable, but even "impossible" (Won et al. 2019): If subjects are shown three boxes in a stack – Boxes A, B, and C – such that Box A is heavy (250 g) but Boxes B and C are light (30 g), then subjects who lift Box A alone and then Boxes A +B+C together report that Box A feels heavier than Boxes A+B+C – an "impossible" experience of weight (because a group could never weigh less than a *member of that group*).

How can a "rational" account – even a resource-rational one – explain this? Lieder and Griffiths accommodate other sensory "repulsion" effects (Wei & Stocker 2015; 2017), but that modeling work seems inapplicable to the size-weight illusion. And whereas the original size-weight illusion could perhaps have a tortuous Bayesian explanation (Peters et al. 2016), Won et al.'s modification seemingly cannot: First, it's unclear if previous models of simultaneous lifting apply to Won et al.'s temporally-extended case; but second, there is just no logical chain of reasoning that should end with A alone being heavier than A+B+C together.

More generally: What are the principles that lead to perverse "anti-Bayesian" updating? Perhaps resource rationality wasn't intended to cover all cases (in which case it is not an "Imperial Bayesian" theory; Mandelbaum 2019). But, the problem isn't merely that there are counterexamples to resource rationality, but rather that these are predictable, law-like counterexamples that do not reflect performance constraints between interacting mental processes. Indeed, when it comes to these more entrenched patterns, even "resources" may not save rationality.

References

[The letters "a" and "r" before author's initials stand for target article and response references, respectively]

Aerts, D., Gabora, L. & Sozzo, S. (2013) Concepts and their dynamics: A quantum–theoretic modeling of human thought. *Topics in Cognitive Science* **5**:737–72. [HA]

Allais, M. (1953) Le comportement de l'homme rationnel devant le risque: critique des postulats et axiomes de l'école américaine. *Econometrica: Journal of the Econometric Society* **21**(4):503–46. [rFL]

Allers, R. & Minkoff, R. (1994) *The Lion King*. Walt Disney Pictures. [CJK]

Allport, D. A., Antonis, B. & Reynolds, P. (1972) On the division of attention: A disproof of the single channel hypothesis. *The Quarterly Journal of Experimental Psychology* **24** (2):225–35. doi:10.1080/00335557243000102. [aFL]

Anderson, J. R. (1978) Arguments concerning representations for mental imagery. *Psychological Review* **85**(4):249–77. doi:10.1037/0033-295X.85.4.249. [aFL]

Anderson, J. R. (1983) *The architecture of cognition*. Psychology Press. [CD]

Anderson, J. R. (1989) A rational analysis of human memory. In: *Varieties of memory and consciousness: Essays in honour of Endel Tulving*, ed. H. L. Roediger & F. I. M. Craik, pp. 195–210. Lawrence Erlbaum Associates. [KP]

Anderson, J. R. (1990) *The adaptive character of thought*. Psychology Press. [aFL, CD]

Anderson, J. R. (1991) The adaptive nature of human categorization. *Psychological Review* **98**:409–29. [CD]

Anderson, J. R. (1996) ACT: A simple theory of complex cognition. *American Psychologist* **51**(4):355. [aFL]

Anderson, J. R. (2007) *How can the human mind occur in the physical universe?* Oxford University Press. [CD]

Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C. & Qin, Y. (2004) An integrated theory of the mind. *Psychological Review* **111**(4):1036–60. doi:10.1037/0033-295X.111.4.1036. [aFL]

Anderson, J. R., Bothell, D., Lebiere, C. & Matessa, M. (1998) An integrated theory of list memory. *Journal of Memory and Language* **38**:341–80. [CD]

Anderson, J. R. & Milson, R. (1989) Human memory: An adaptive perspective. *Psychological Review* **96**(4):703–19. doi:10.1037/0033-295X.96.4.703. [aFL, CD]

Anderson, J. R. & Schooler, L. J. (1991) Reflections of the environment in memory. *Psychological Science* **2**(6):396–408. doi:10.1111/j.1467-9280.1991.tb00174.x. [aFL, CD]

Anderson, J. R., Zhang, Q., Borst, J. P. & Walsh, M. M. (2016) The discovery of processing stages: Extension of Sternberg's method. *Psychological Review* **123**:481–509. [CD]

Anderson, M. L. (2010) Neural reuse: A fundamental organizational principle of the brain. *Behavioral and Brain Sciences* **33**(4):245–66. [JH]

Ariely, D. (2009) *Predictably irrational*. Harper Collins. [aFL]

Atkinson, R. C., Holmgren, J. E. & Juola, J. F. (1969) Processing time as influenced by the number of elements in a visual display. *Perception & Psychophysics* **6**(6):321–26. doi:10.3758/BF03212784. [aFL]

Atmanspacher, H. & Römer, H. (2012) Order effects in sequential measurements of non-commuting psychological observables. *Journal of Mathematical Psychology* **56**(4):274–80. [HA]

Attwell, D. & Laughlin, S. B. (2001) An energy budget for signaling in the grey matter of the brain. *Journal of Cerebral Blood Flow & Metabolism* **21**(10):1133–45. Available at: https://doi.org/10.1097/00004647-200110000-00001. [JET]

Austerweil, J. & Griffiths, T. (2011) Seeking confirmation is rational for deterministic hypotheses. *Cognitive Science* **35**(3):499–526. doi:10.1111/j.1551-6709.2010.01161.x. [aFL, ESD]

Bacon, P.-L., Harb, J. & Precup, D. (2017) The option-critic architecture. In: *Proceedings from AAAI-17: The 31st Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence* (San Francisco, CA), pp. 1726–34. [aFL]

Barlow, H. B. (1961) Possible principles underlying the transformation of sensory messages. *Sensory Communication* **1**:217–34. [WJM]

Baron, J., Baron, J. H., Barber, J. P. & Nolen-Hoekseman, S. (1990) Rational thinking as a goal of therapy. *Journal of Cognitive Psychotherapy* **4**(3):293. [rFL]

Barrett, L. F. (2017a) *How emotions are made: The secret life of the brain*. Pan Macmillan. [JET]

Barrett, L. F. (2017b) The theory of constructed emotion: An active inference account of interoception and categorization. *Social Cognitive and Affective Neuroscience* **12**(1):1–23. Available at: https://doi.org/10.1093/scan/nsw154. [JET]

Barrett, L. F. & Finlay, B. L. (2018) Concepts, goals and the control of survival-related behaviors. *Current Opinion in Behavioral Sciences* **24**:172–79. Available at: https://doi.org/10.1016/j.cobeha.2018.10.001. [JET]

Barrett, L. F., Quigley, K. S. & Hamilton, P. (2016) An active inference theory of allostasis and interoception in depression. *Philosophical Transactions of the Royal Society B: Biological Sciences* **371**(1708):20160011. Available at: https://doi.org/10.1098/rstb.2016.0011. [JET]

Barrett, L. F. & Satpute, A. B. (2019) Historical pitfalls and new directions in the neuroscience of emotion. *Neuroscience Letters* **693**:9–18. Available at: https://doi.org/10.1016/j.neulet.2017.07.045. [JET]

Barutchu, A., Crewther, D. P. & Crewther, S. G. (2008) The race that precedes coactivation: Development of multisensory facilitation in children. *Developmental Science* **12**(3):464–73. doi:10.1111/j.1467-7687.2008.00782.x. [VRB]

Basieva, I., Cervantes, V. H., Dzhafarov, E. N. & Khrennikov, A. (2019) True contextuality beats direct influences in human decision making. *Journal of Experimental Psychology: General*. Online April 25, 2019. Available at: https://psycnet.apa.org/doiLanding?doi=10.1037%2Fxge0000585. [CM]

Basieva, I., Khrennikova, P., Pothos, E. M., Asano, M. & Khrennikov, A. (2018) Quantum-like model of subjective expected utility. *Journal of Mathematical Economics* **78**:150–62. [HA]

Bass, I., Shafto, P. & Bonawitz, E. (2018) That'll teach 'em: How expectations about teaching styles may constrain inferences. In: *Proceedings of the 40th Annual Conference of the Cognitive Science Society* (Madison, WI). Cognitive Science Society. [KP]

Bates, C. J. & Jacobs, R. A. (2019) Efficient data compression leads to categorical bias in perception and perceptual memory. In: *Proceedings of the 41st Annual Meeting of the Cognitive Science Society*, July 24–27, Montreal, Canada. [CJB]

Bates, C. J., Lerch, R. A., Sims, C. R. & Jacobs, R. A. (2019) Adaptive allocation of human visual working memory capacity during statistical and categorical learning. *Journal of Vision* **19**(2):11, 1–23. [CJB]

Bateson, M., Healy, S. D. & Hurly, T. A. (2002) Irrational choices in hummingbird foraging behaviour. *Animal Behaviour* **63**(3):587–96. [aFL]

Batson, C. D. (1975) Rational processing or rationalization? The effect of disconfirming information on a stated religious belief. *Journal of Personality and Social Psychology* **32**:176–84. [EM]

Battaglia, P. W., Hamrick, J. B. & Tenenbaum, J. B. (2013) Simulation as an engine of physical scene understanding. *Proceedings of the National Academy of Sciences* **110**(45):18327–32. [rFL]

Bays, P. M. (2014) Noise in neural populations accounts for errors in working memory. *Journal of Neuroscience* **34**(10):3632–45. [WJM]

Beck, A. T. (1979) *Cognitive therapy of depression*. Guilford Press. [EMR]

Beck, J. M., Ma, W. J., Pitkow, X., Latham, P. & Pouget, A. (2012) Not noisy, just wrong: The role of suboptimal inference in behavioral variability. *Neuron* **74**(1):30–39. doi:10.1016/j.neuron.2012.03.016. [aFL, ANS]

Beer, R. D. (2000) Dynamical approaches to cognitive science. *Trends in Cognitive Sciences* **4**(3):91–99. [aFL]

Bejjanki, V. R., Knill, D. C. & Aslin, R. N. (2016) Learning and inference using complex generative models in a spatial localization task. *Journal of Vision* **16**(5):9. doi:10.1167/16.5.9. [VRB]

Bejjanki, V. R., Randrup, E. R. & Aslin, R. N. (2019) Young children combine sensory cues with learned information in a statistically efficient manner: But task complexity matters. *Developmental Science* e12912. doi:10.1111/desc.12912. [VRB]

Bender, A. & Beller, S. (2014) Mangarevan invention of binary steps for easier calculation. *Proceedings of the National Academy of Sciences* **111**(4):1322–27. doi:10.1073/pnas.1309160110. [MD]

Berniker, M., Voss, M. & Kording, K. (2010) Learning priors for Bayesian computations in the nervous system. *PLoS One* **5**(9):e12686. doi:10.1371/journal.pone.0012686. [VRB]

Best, J. R. & Miller, P. H. (2010) A developmental perspective on executive function. *Child Development* **81**(6):1641–60. [VRB]

Bhui, R. & Gershman, S. J. (2017) Decision by sampling implements efficient coding of psychoeconomic functions. *Psychological Review* **125**(6):985-1001. doi:10.1037/rev0000123. [aFL]

Bless, H., Schwarz, N. & Kemmelmeier, M. (1996) Mood and stereotyping: The impact of moods on the use of general knowledge structures. In: European review of social psychology, vol. 7, ed. M. Hewstone & W. Stroebe, pp. 63–93. Wiley. [KP]

Blume, L. E. & Easley, D. (1984) Rational expectations equilibrium: An alternative approach. *Journal of Economic Theory* **34**(1):116–29. [WJM]

Böckler, A., Knoblich, G. & Sebanz, N. (2010) Socializing cognition. In: *Towards a theory of thinking*, ed. B. Glatzeder, V. Goel & A. Müller, pp. 233–50. doi:10.1007/978-3-642-03129-8_16. Heidelberg. [MD]

Bogacz, R., Brown, E., Moehlis, J., Holmes, P. & Cohen, J. (2006) The physics of optimal decision making: A formal analysis of models of performance in two-alternative forced-choice tasks. *Psychological Review* **113**(4):700–65. doi:10.1037/0033-295x.113.4.700. [aFL, ANS]

Borst, J. P. & Anderson, J. R. (2017) A step-by-step tutorial on using the cognitive architecture ACT-R in combination with fMRI data. *Journal of Mathematical Psychology* **76**:94–103. [CD]

Bossaerts, P. & Murawski, C. (2017) Computational complexity and human decision-making. *Trends in Cognitive Sciences* **21**(12):917–29. doi:10.1016/j.tics.2017.09.005. [aFL]

Bossaerts, P., Yadav, N. & Murawski, C. (2018) Uncertainty and computational complexity. *Philosophical Transactions of the Royal Society B* **374**(1766):20180138. [aFL]

Botvinick, M. (2008) Hierarchical models of behavior and prefrontal function. *Trends in Cognitive Sciences* **12**(5):201–08. doi:10.1016/j.tics.2008.02.009. [aFL]

Botvinick, M. & Braver, T. (2015) Motivation and cognitive control: From behavior to neural mechanism. *Annual Review of Psychology* **66**:83–113. [JH]

Botvinick, M. M. & Cohen, J. D. (2014) The computational and neural basis of cognitive control: Charted territory and new frontiers. *Cognitive Science* **38**(6):1249–85. [JH]

Botvinick, M., Weinstein, A., Solway, A. & Barto, A. (2015) Reinforcement learning, efficient coding, and the statistics of natural tasks. *Current Opinion in Behavioral Sciences* **5**:71–77. [CJB]

Boureau, Y.-L., Sokol-Hessner, P. & Daw, N. D. (2015) Deciding how to decide: Self-control and meta-decision making. *Trends in Cognitive Sciences* **19**(11):700-10 doi:10.1016/j.tics.2015.08.013. [aFL]

Bowers, J. S. & Davis, C. J. (2012a) Bayesian just-so stories in psychology and neuroscience. *Psychological Bulletin* **138**:389–414. [MC]

Bowers, J. S. & Davis, C. J. (2012b) Is that what Bayesians believe? Reply to Griffiths, Chater, Norris, and Pouget. *Psychological Bulletin* **138**:423–26. [MC]

Braine, M. D. (1978) On the relation between the natural logic of reasoning and standard logic. *Psychological Review* **85**(1):1–21. doi:10.1037/0033-295X.85.1.1. [aFL]

Bramley, N. R., Dayan, P., Griffiths, T. L. & Lagnado, D. A. (2017) Formalizing Neurath's ship: Approximate algorithms for online causal learning. *Psychological Review* **124**(3):301–38. doi:10.1037/rev0000061. [aFL]

Bray, D. (2009) *Wetware. A computer in every living cell*. Yale University Press. [KPK]

Brayanov, J. B. & Smith, M. A. (2010) Bayesian and "anti-Bayesian" biases in sensory integration for action and perception in the size–weight illusion. *Journal of Neurophysiology* **103**:1518–31. [EM]

Briggs, R. A. (2017) Normative theories of rational choice: Expected utility. In: *The Stanford Encyclopedia of Philosophy*, ed. E. N. Zalta, Metaphysics Research Lab. Stanford University. [MC]

Brown, P. (2012) *Through the eye of a needle: Wealth, the fall of Rome, and the making of Christianity in the West, 350–550 AD*. Princeton University Press. [HMC]

Brown, P. (2015) *The ransom of the soul: Afterlife and wealth in early western Christianity*. Harvard University Press. [HMC]

Brown, R. L. (2013) What evolvability really is. *The British Journal for the Philosophy of Science* **65**(3):549–72. [JH]

Bruton, M. & O'Dwyer, N. (2018) Synergies in coordination: A comprehensive overview of neural, computational, and behavioral approaches. *Journal of Neurophysiology* **120**:2761–74. [ND]

Bruza, P. D., Wang, Z. & Busemeyer, J. R. (2015) Quantum cognition: A new theoretical approach to psychology. *Trends in Cognitive Sciences* **19**(7):383–93. [HA]

Buckingham, G. (2014) Getting a grip on heaviness perception: A review of weight illusions and their probable causes. *Experimental Brain Research* **232**:1623–29. [EM]

Buckingham, G. & Goodale, M. A. (2013) When the predictive brain gets it really wrong. *Behavioral and Brain Sciences* **36**:208–09. [EM]

Budiu, R. & Anderson, J. R. (2004) Interpretation-based processing: A unified theory of semantic sentence comprehension. *Cognitive Science* **28**:1–44. [CD]

Busemeyer, J. & Bruza, P. (2012) *Quantum models for cognition and decision*. Cambridge University Press. [CM]

Busemeyer, J. R., Pothos, E. M., Franco, R. & Trueblood, J. S. (2011) A quantum theoretical explanation for probability judgment errors. *Psychological Review* **118**(2):193–218. [ANS]

Buss, D. M. (1995) Evolutionary psychology: A new paradigm for psychological science. *Psychological Inquiry* **6**(1):1–30. [aFL]

Butko, N. J. & Movellan, J. R. (2008) I-POMDP: An infomax model of eye movement. *In: Proceedings from ICDL 2008: 7th IEEE International Conference on Development and Learning* (Monterey, CA), pp. 139–44. doi:10.1109/DEVLRN.2008.4640819. [aFL]

Calcott, B. (2014) The creation and reuse of information in gene regulatory networks. *Philosophy of Science* **81**(5):879–90. [JH]

Calkins, S. D. & Bell, M. A. E. (2010) *Child development at the intersection of emotion and cognition*. American Psychological Association. [KP]

Callaway, F., Gul, S., Krueger, P.M., Griffiths, T.L., Lieder, F. (2018a) Learning to select computations. In: *Uncertainty in Artificial Intelligence: Proceedings of the Thirty-Fourth Conference*. [arFL]

Callaway, F., Lieder, F., Das, P., Gul, S., Krueger, P. M. & Griffiths, T. L. (2018b) A resource-rational analysis of human planning. In: *Proceedings from 40th Annual Conference of the Cognitive Science Society*. Cognitive Science Society. [aFL]

Callaway, F., Gul, S., Krueger, P. M., Griffiths, T. L. & Lieder, F. (in preparation). Discovering rational heuristics for risky choice. [aFL]

Camerer, C. & Hua Ho, T. (1999) Experience-weighted attraction learning in normal form games. *Econometrica* **67**(4):827–74. [rFL]

Caplin, A. & Dean, M. (2015) Revealed preference, rational inattention, and costly information acquisition. *American Economic Review* **105**(7):2183–203. doi:10.3386/w19876. [aFL]

Caplin, A., Dean, M. & Leahy, J. (2017) *Rationally inattentive behavior: Characterizing and Generalizing Shannon Entropy*. NBER Working Paper No. 23652. National Bureau of Economic Research. [aFL]

Caplin, A., Dean, M. & Martin, D. (2011) Search and satisficing. *American Economic Review* **101**(7):2899–922. doi:10.1257/aer.101.7.2899. [aFL]

Carlson, S. M., Zelazo, P. D. & Faja, S. (2013) Executive function. In: *The Oxford handbook of developmental psychology: Vol. 1. Body and mind*, ed. P. D. Zelazo, pp. 706–742. Oxford University Press. [VRB]

Carver, C. S. & Scheier, M. F. (2001) *On the self-regulation of behavior*. Cambridge University Press. [aFL]

Cervantes, V. H. & Dzhafarov, E. N. (2018) Snow Queen is evil and beautiful: Experimental evidence for probabilistic contextuality in human choices. *Decision* **5**:193–204. [CM]

Chambers, C., Sokhey, T., Gaebler-Spira, D. & Kording, K. P. (2018) The development of Bayesian integration in sensorimotor estimation. *Journal of Vision* **18**(12):8. [VRB]

Chanes, L. & Barrett, L. F. (2016) Redefining the role of limbic areas in cortical processing. *Trends in Cognitive Sciences* **20**(2):96–106. Available at: https://doi.org/10.1016/j.tics.2015.11.005. [JET]

Charpentier, A. (1891) Analyse experimentale: De quelques elements de la sensation de poids. [Experimental analysis: On some of the elements of sensations of weight]. *Archives de Physiologie Normale et Pathologique* **3**:122–35. [EM]

Chater, N. & Oaksford, M. (1999) Ten years of the rational analysis of cognition. *Trends in Cognitive Sciences* **3**(2):57–65. doi:10.1016/S1364-6613(98)01273-X. [aFL]

Chater, N., Tenenbaum, J. B. & Yuille, A. (2006) Probabilistic models of cognition: Conceptual foundations. *Trends in Cognitive Sciences* **10**(7):287–91. doi:10.1016/j.tics.2006.05.007. [aFL]

Chi, M. T. & Ceci, S. J. (1987) Content knowledge: Its role, representation, and restructuring in memory development. In: Advances in child development and behavior, vol. 20, ed. H. W. Reese, pp. 91–142. Academic Press. [KP]

Chomsky, N. (1965) *Aspects of the theory of syntax*. MIT Press. [MD]

Clark, A. (1997) *Being there*. MIT Press. [DRo]

Clark, A. (1998) Magic words: How language augments human computation. In: *Language and thought: Interdisciplinary themes*, ed. P. Carruthers & J. Boucher, pp. 162–83. Cambridge University Press. [MD]

Clark, A. (2003) *Natural born cyborgs*. Oxford University Press. [DRo]

Clark, A. (2006) Material symbols. *Philosophical Psychology* **19**(3):291–307. doi:10.1080/09515080600689872. [MD]

Clark, A. (2013) Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences* **36**(3):1–24. Available at: https://doi.org/10.1017/S0140525X12000477. [JET]

Clark, A. (2015) *Surfing uncertainty: Prediction, action, and the embodied mind*. Oxford University Press. [JET]

Clark-Polner, E., Wager, T. D., Satpute, A. B. & Barrett, L. F. (2016) Neural fingerprinting: Meta-analysis, variation and the search for brain-based essences in the science of emotion. In: *The handbook of emotion*, 4th edition, ed. L. F. Barrett, M. Lewis & J. M. Haviland-Jones, pp. 146–65. Guilford Press. [JET]

Cohen, J. D., Dunbar, K. & McClelland, J. L. (1990) On the control of automatic processes: A parallel distributed processing account of the Stroop effect. *Psychological Review* **97**(3):332–61. [JH]

Colombo, M. (2019) Learning and reasoning. In: *The Routledge handbook of the computational mind*, ed. M. Sprevak & M. Colombo, pp. 381–96. Routledge. [MC]

Colombo, M., Elkin, L. & Hartmann, S. (forthcoming) Being realist about Bayes, and the predictive processing theory of mind. *The British Journal for the Philosophy of Science* (first online 03 August 2018). Available at: https://doi.org/10.1093/bjps/axy059. [MC]

Colombo, M. & Hartmann, S. (2017) Bayesian cognitive science, unification, and explanation. *The British Journal for Philosophy of Science* **68**:451–84. [MC]

Colombo, M. & Seriès, P. (2012) Bayes in the brain. On Bayesian modelling in neuroscience. *The British Journal for Philosophy of Science* **63**:697–723. [MC]

Constantino, S. M., Dalrymple, J., Gilbert, R. W., Varanese, S., Di Rocco, A. & Daw, N. D. (2017) A neural mechanism for the opportunity cost of time. *bioRxiv* **173443**. Available at: http://doi.org/10.1101/173443. [EMR]

Cook, J. & Lewandowsky, S. (2016) Rational irrationality: Modeling climate change belief polarization using Bayesian networks. *Topics in Cognitive Science* **8**(1):160–79. [rFL]

Cook, M. & Mineka, S. (1989) Observational conditioning of fear to fear-relevant versus fear-irrelevant stimuli in rhesus monkeys. *Journal of Abnormal Psychology* **98**(4):448–59. Available at: https://doi.org/10.1037/0021-843X.98.4.448. [JET]

Cooper, W. S. (2001) *The evolution of reason*. Cambridge University Press. [MC]

Crone, E. A., Bunge, S. A., Van Der Molen, M. W. & Ridderinkhof, K. R. (2006) Switching between tasks and responses: A developmental study. *Developmental Science* **9**(3):278–87. [KP]

Cubitt, T. S., Perez-Garcia, D. & Wolf, M. (2015) Undecidability of the spectral gap. *Nature* **528**:207. [CM]

Damasio, A. R. (1999) *The feeling of what happens: Body and emotion in the making of consciousness*. Houghton Mifflin Harcourt. [KPK]

Darnton, R. (1984) *The great cat massacre and other episodes in French cultural history*. Vintage. [HMC]

Dasgupta, I., Schulz, E. & Gershman, S. J. (2017) Where do hypotheses come from? *Cognitive Psychology* **96**:1–25. doi:10.1016/j.cogpsych.2017.05.001. [aFL, ANS]

Dasgupta, I., Schulz, E., Goodman, N. D. & Gershman, S. J. (2018) Remembrance of inferences past: Amortization in human hypothesis generation. *Cognition* **178**:67-81. doi:10.1016/j.cognition.2018.04.017. [aFL]

Davidson, M. C., Amso, D., Anderson, L. C. & Diamond, A. (2006) Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia* **44**(11):2037–78. [KP, VRB]

Davies, P. (2019) *The Demon in the machine: How hidden webs of information are solving the mystery of life*. Allen Lane Pub. [KPK]

d'Avray, D. L. (2010) *Rationalities in history: A Weberian essay in comparison*. Cambridge University Press. [HMC]

Daw, N., Niv, Y. & Dayan, P. (2005) Uncertainty-based competition between prefrontal and dorsolateral striatal systems for behavioral control. *Nature Neuroscience* **8**(12):1704–11. doi:10.1038/nn1560. [aFL]

Dawes, R. M. & Mulford, M. (1996) The false consensus effect and overconfidence: Flaws in judgment or flaws in how we study judgment? *Organizational Behavior and Human Decision Processes* **65**(3):201–11. [aFL]

Dayan, P. & Abbott, L. F. (2001) Theoretical neuroscience: Computational and mathematical modeling of neural systems, *1st edition*. MIT Press. [aFL]

de Barros, J. A. & Oas, G. (2015) Some examples of contextuality in physics: Implications to quantum cognition. *arXiv* **1512**.00033. [CM]

de Barros, J. A. & Oas, G. (2016) Some examples of contextuality in physics: Implications to quantum cognition. In: *Contextuality from quantum physics to psychology*, ed. E. Dzhafarov, J. Jordan, R. Zhang & V. Cervantes, pp. 153–84. World Scientific. [CM]

de Barros, J. A. & Suppes, P. (2009) Quantum mechanics, interference and the brain. *Journal of Mathematical Psychology* **53**:306–313. [CM]

Denève, S. & Jardri, R. (2016) Circular inference: Mistaken belief, misplaced trust. *Current Opinion in Behavioral Sciences* **11**:40–48. Available at: https://doi.org/10.1016/j.cobeha.2016.04.001. [JET]

Deutsch, D. (2011) *The beginning of infinity*. The Penguin Press. [AS]

Dickhaut, J., Rustichini, A. & Smith, V. (2009) A neuroeconomic theory of the decision process. *Proceedings of the National Academy of Sciences* **106**(52):22145–50. doi:10.1073/pnas.0912500106. [aFL]

Diggins, J. P. (1978) *The bard of savagery: Thorstein Veblen and modern social theory*. Seabury Press. [HMC]

Dimov, C. M. & Link, D. (2017) Do people order cues by retrieval fluency when making probabilistic inferences? *Journal of Behavioral Decision Making* **30**:843–54. [CD]

Dingemanse, M. (2017) On the margins of language: Ideophones, interjections and dependencies in linguistic theory. In: *Dependencies in language*, ed. N. J. Enfield, pp. 195–202. doi:10.5281/zenodo.573781. Language Science Press. [MD]

Dingemanse, M., Roberts, S. G., Baranova, J., Blythe, J., Drew, P., Floyd, S., Gisladottir, R. S., Kendrick, K. H., Levinson, S. C., Manrique, E., Rossi, G. & Enfield, N. J. (2015) Universal principles in the repair of communication problems. *PLoS One* **10**(9): e0136100. doi:10.1371/journal.pone.0136100. [MD]

Dolan, R. & Dayan, P. (2013) Goals and habits in the brain. *Neuron* **80**(2):312–25. doi:10.1016/j.neuron.2013.09.007. [aFL]

Dounskaia, N. (2005) The internal model and the leading joint hypothesis: Implications for control of multi-joint movements. *Experimental Brain Research* **166**:1–16. [ND]

Dounskaia, N. (2010) Control of human limb movements: The leading joint hypothesis and its practical applications. *Exercise and Sport Sciences Reviews* **4**:201–08. [ND]

Dounskaia, N. & Shimansky, Y. (2016) Strategy of arm movement control is determined by minimization of neural effort for joint coordination. *Experimental Brain Research* **234**:1335–50. [ND]

Dukas, R., ed. (1998a) *Cognitive ecology: The evolutionary ecology of information processing and decision making*. University of Chicago Press. [aFL]

Dukas, R. (1998b) Constraints on information processing and their effects on behavior. In: *Cognitive ecology: The evolutionary ecology of information processing and decision making*, ed. R. Dukas. University of Chicago Press. [aFL]

Dukas, R. (2004) Evolutionary biology of animal cognition. *Annual Review of Ecology, Evolution, and Systematics* **35**:347–74. [aFL]

Dzhafarov, E. N. & Kujala, J. V. (2014) Contextuality is about identity of random variables. *Physica Scripta* **T163**:014009. [CM]

Dzhafarov, E. N. & Kujala, J. V. (2016) Context-content systems of random variables: The contextuality-by-default theory. *Journal of Mathematical Psychology* **74**:11–33. [CM]

Eckstein, M. P. (1998) The lower visual search efficiency for conjunctions is due to noise and not serial attentional processing. *Psychological Science* **9**(2):111–18. doi:10.1111/1467-9280.00020. [aFL]

Edwards, W. (1954) The theory of decision making. *Psychological Bulletin* **51**(4):380. [aFL]

Elliott, R., Zahn, R., Deakin, J. F. W. & Anderson, I. M. (2011) Affective cognition and its disruption in mood disorders. *Neuropsychopharmacology* **36**(1):153–82. Available at: http://doi.org/10.1038/npp.2010.77. [EMR]

Elman, J. L. (1993) Learning and development in neural networks: The importance of starting small. *Cognition* **48**(1):71–99. doi:10.1016/0010-0277(93)90058-4. [VRB]

Enfield, N. J. (2013) *Relationship thinking: Agency, enchrony, and human sociality*. Oxford University Press. [MD]

Enfield, N. J. (2017) *How we talk: The inner workings of conversation*. Basic Books. [MD]

Epley, N. & Gilovich, T. (2004) Are adjustments insufficient? *Personality and Social Psychology Bulletin* **30**(4):447–60. doi:10.1177/0146167203261889. [aFL]

Evans, J. S. B. (2003) In two minds: Dual-process accounts of reasoning. *Trends in Cognitive Sciences* **7**(10):454–59. [CM]

Evans, J. St. B. T. (2008) Dual-processing accounts of reasoning, judgment and social cognition. *Annual Review of Psychology* **59**:255–78. doi:10.1146/annurev.psych.59.103006.093629. [aFL]

Fanselow, M. S. (2018) Emotion, motivation and function. *Current Opinion in Behavioral Sciences* **19**:105–09. Available at: https://doi.org/10.1016/j.cobeha.2017.12.013. [JET]

Fanselow, M. S. & Lester, L. S. (1988) A functional behavioristic approach to aversively motivated behavior: Predatory imminence as a determinant of the topography of defensive behavior. In: *Evolution and learning*, ed. R. C. Bolles & M. D. Beecher, pp. 185–212. Lawrence Erlbaum Associates, Inc. [JET]

Fantino, E., Kulik, J., Stolarz-Fantino, S. & Wright, W. (1997) The conjunction fallacy: A test of averaging hypotheses. *Psychonomic Bulletin & Review* **4**(1):96–101. [ANS]

Fawcett, T. W., Fallenstein, B., Higginson, A. D., Houston, A. I., Mallpress, D. E., Trimmer, P. C. & McNamara, J. M. (2014) The evolution of decision rules in complex environments. *Trends in Cognitive Sciences* **18**(3):153–61. [aFL]

Fechner, H. B., Pachur, T., Schooler, L. J., Mehlhorn, K., Battal, C., Volz, K. G. & Borst, J. P. (2016) Strategies for memory-based decision making: Modeling behavioral and neural signatures within a cognitive architecture. *Cognition* **157**:77–99. [CD]

Feng, S. F., Schwemmer, M., Gershman, S. J. & Cohen, J. D. (2014) Multitasking versus multiplexing: Toward a normative account of limitations in the simultaneous execution of control-demanding behaviors. *Cognitive, Affective, & Behavioral Neuroscience* **14**(1):129–46. doi:10.3758/s13415-013-0236-9. [aFL]

Festinger, L., Riecken, H. W. & Schachter, S. (1956) *When prophecy fails*. University of Minnesota Press. [EM]

Fischer, R. & Plessow, F. (2015) Efficient multitasking: Parallel versus serial processing of multiple tasks. *Frontiers in Psychology* **6**:1366. doi:10.3389/fpsyg.2015.01366. [aFL]

Fiser, J. & Aslin, R. N. (2002) Statistical learning of new visual feature combinations by infants. *Proceedings of the National Academy of Sciences of the United States of America* **99**(24):15822–26. [VRB]

Fiser, J., Berkes, P., Orbán, G. & Lengyel, M. (2010) Statistically optimal perception and learning: From behavior to neural representations. *Trends in Cognitive Sciences* **14**(3):119–30. doi:10.1016/j.tics.2010.01.003. [aFL]

Fitts, P. M. (1954) The information capacity of the human motor system in controlling the amplitude of movement. *Journal of Experimental Psychology* **47**:381–91. [ND]

Fodor, J. A. (1987) Modules, frames, fridgeons, sleeping dogs, and the music of the spheres. In: *The robot's dilemma: The frame problem in artificial intelligence*, ed. Z. W. Pylyshyn, pp. 139–50. Ablex. [aFL]

Fox Tree, J. E. (1995) The effects of false starts and repetitions on the processing of subsequent words in spontaneous speech. *Journal of Memory and Language* **34**(6):709–38. doi:10.1006/jmla.1995.1032. [MD]

Fox Tree, J. E. (2001) Listeners' uses of um anduh in speech comprehension. *Memory & Cognition* **29**(2):320–26. doi:10.3758/BF03194926. [MD]

Frank, M. C. & Goodman, N. D. (2012) Predicting pragmatic reasoning in language games. *Science* **336**(6084):998. doi:10.1126/science.1218633. [aFL, MD]

Frank, R. H. (1988) *Passions within reason: The strategic role of the emotions*. WW Norton & Co. [rFL]

Frauchiger, D. & Renner, R. (2018) Quantum theory cannot consistently describe the use of itself. *Nature Communications* **9**:Article 3711. [CM]

Friedman, M. & Savage, L. J. (1948) The utility analysis of choices involving risk. *The Journal of Political Economy* **56**(4):279–304. doi:10.1086/256692. [aFL]

Friedman, M. & Savage, L. J. (1952) The expected-utility hypothesis and the measurability of utility. *Journal of Political Economy* **60**(6):463–74. [aFL]

Frijda, N. H., Kuipers, P. & ter Schure, E. (1989) Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology* **57**(2):212–28. Available at: http://doi.org/10.1037/0022-3514.57.2.212. [EMR]

Friston, K. (2010) The free-energy principle: A unified brain theory? *Nature Reviews Neuroscience* **11**(2):127–38. Available at: https://doi.org/10.1038/nrn2787. [aFL, JET]

Friston, K., FitzGerald, T., Rigoli, F., Schwartenbeck, P. & Pezzulo, G. (2017) Active inference: A process theory. *Neural Computation* **29**(1):1–49. Available at: https://doi.org/10.1162/NECO_a_00912. [JET]

Fudenberg, D., Strack, P. & Strzalecki, T. (2018) *Speed, accuracy, and the optimal timing of choices* (Working paper). MIT Press. [aFL]

Fusaroli, R., Tylén, K., Garly, K., Steensig, J., Christiansen, M. H. & Dingemanse, M. (2017) Measures and mechanisms of common ground: Backchannels, conversational repair, and interactive alignment in free and task-oriented social interactions. In: *Proceedings of the 39th annual meeting of the cognitive science society*, ed. G. Gunzelmann, A. Howes, T. Tenbrink & E. Davelaar, pp. 2055–60. [MD]

Gabaix, X. (2014) A sparsity-based model of bounded rationality. *The Quarterly Journal of Economics* **129**(4):1661–710. doi:10.1093/qje/qju024. [aFL]

Gabaix, X. (2016) *Behavioral macroeconomics via sparse dynamic programming*. NBER Working Paper No. w21848. National Bureau of Economic Research. [aFL]

Gabaix, X. (2017) *Behavioral inattention*. NBER Working Paper No. 24096. National Bureau of Economic Research. [aFL]

Gabaix, X. & Laibson, D. (2005) *Bounded rationality and directed cognition* (NBER and Harvard working paper). National Bureau of Economic Research. [aFL]

Gabaix, X., Laibson, D., Moloche, G. & Weinberg, S. (2006) Costly information acquisition: Experimental analysis of a boundedly rational model. *American Economic Review* **96**(4):1043–68. doi:10.1257/aer.96.4.1043. [aFL]

Gagne, C., Dayan, P. & Bishop, S. J. (2018) When planning to survive goes wrong: Predicting the future and replaying the past in anxiety and PTSD. *Current Opinion in Behavioral Sciences* **24**:89–95. [rFL]

Gaissmaier, W. & Schooler, L. J. (2008) The smart potential behind probability matching. *Cognition* **109**(3):416–22. [AS]

Galileo, G. (1632/2001) *Dialogue concerning the two Chief World Systems*. Translated by S. Drake. Random House. [CJK]

Ganguli, D. & Simoncelli, E. P. (2014) Efficient sensory encoding and Bayesian inference with heterogeneous neural populations. *Neural Computation* **26**(10):2103–34. doi:10.1162/NECO_a_00638. [aFL, WJM]

Gershman, S. J., Horvitz, E. J. & Tenenbaum, J. B. (2015) Computational rationality: A converging paradigm for intelligence in brains, minds, and machines. *Science* **349**(6245):273–78. doi:10.1126/science.aac6076. [aFL]

Gershman, S. J., Markman, A. B. & Otto, A. R. (2014) *Retrospective revaluation in sequential decision making: A tale of two systems*. Journal of Experimental Psychology: General *143(1):182*. [rFL]

Gibson, E. J. (1982) The concept of affordances in development: The renascence of functionalism. In: *The concept of development: The Minnesota symposia on child psychology, vol. 15*, ed. W. A. Collins, pp. 55–81. Lawrence Erlbaum. [KPK]

Gigerenzer, G. (2010) *Rationality for mortals: How people cope with uncertainty*, 1st edition. Oxford University Press. [CJK]

Gigerenzer, G. (2015) On the supposed evidence for libertarian paternalism. *Review of Philosophy and Psychology* **6**:363–83. doi:10.1007/s13164- 015-0248-1. [aFL]
Gigerenzer, G., Fiedler, K. & Olsson, H. (2012) Rethinking cognitive biases as environmental consequences. In: *Ecological rationality: Intelligence in the world*, ed. P. M. Todd, G. Gigerenzer & ABC Research Group, pp. 80–110. Oxford University Press. [aFL]
Gigerenzer, G. & Gaissmaier, W. (2011) Heuristic decision making. *Annual Review of Psychology* **62**(1):451–82. doi:10.1146/annurev-psych-120709-145346. [aFL]
Gigerenzer, G. & Goldstein, D. G. (1996) Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review* **103**(4):650–69. doi:10.1037/0033-295X.103.4.650. [aFL]
Gigerenzer, G. & Hoffrage, U. (1995) How to improve Bayesian reasoning without instruction: Frequency formats. *Psychological Review* **102**(4):684–704. doi:10.1037/0033-295X.102.4.684. [aFL]
Gigerenzer, G. & Selten, R., eds. (2001) *Bounded rationality: The adaptive toolbox*. MIT Press. [AWS]
Gigerenzer, G. & Selten, R. (2002) *Bounded rationality: The adaptive toolbox*. MIT Press. [aFL]
Gigerenzer, G., Todd, P. M. & ABC Research Group. (1999) *Simple heuristics that make us smart*. Oxford University Press. [aFL]
Gilbert, D. T., Pinel, E. C., Wilson, T. D., Blumberg, S. J. & Wheatley, T. P. (1998) Immune neglect: A source of durability bias in affective forecasting. *Journal of Personality and Social Psychology* **75**:617–38. [EM]
Gilovich, T., Griffin, D. & Kahneman, D., eds. (2002) *Heuristics and biases: The psychology of intuitive judgment*. Cambridge University Press. [aFL, KPK]
Gintis, H. (2009) *The bounds of reason*. Princeton University Press. [MC]
Giszter, S. F. (2015) Motor primitives – New data and future questions. *Current Opinion Neurobiology* **33**:156–65. [ND]
Gleason, A. M. (1957) Measures on the closed subspaces of a Hilbert space. *Journal of Mathematics and Mechanics* **6**(6):885–93. [HA]
Glymour, C. (1987) Android epistemology and the frame problem. In: *The robot's dilemma: The frame problem in artificial intelligence*, ed. Z. W. Pylyshyn, pp. 63–75. Ablex. [aFL]
Gobet, F., Lane, P. C. R., Croker, S., Cheng, P. C. H., Jones, G., Oliver, I. & Pine, J. M. (2001) Chunking mechanisms in human learning. *Trends in Cognitive Sciences* **5**(6):236–43. doi:10.1016/S1364-6613(00)01662-4. [aFL]
Goffman, E. (1967) *Interaction ritual*. Aldine. [MD]
Gold, J. I. & Shadlen, M. N. (2007) The neural basis of decision making. *Annual Review of Neuroscience* **30**:535–74. [rFL]
Gopnik, A., O'Grady, S., Lucas, C. G., Griffiths, T. L., Wente, A., Bridgers, S., Aboody, R., Fung, H. & Dahl, R. E. (2017) Changes in cognitive flexibility and hypothesis search across human life history from childhood to adolescence to adulthood. *Proceedings of the National Academy of Sciences* **114**(30):7892–99. [KP]
Gopnik, A., Sobel, D. M., Schulz, L. E. & Glymour, C. (2001) Causal learning mechanisms in very young children: Two-, three-, and four-year-olds infer causal relations from patterns of variation and covariation. *Developmental Psychology* **37**(5):620–29. [VRB]
Gori, M., Del Viva, M., Sandini, G. & Burr, D. C. (2008) Young children do not integrate visual and haptic form information. *Current Biology* **18**(9):694–98. doi:10.1016/j.cub.2008.04.036. [VRB]
Gottlieb, J., Oudeyer, P.-Y., Lopes, M. & Baranes, A. (2013) Information-seeking, curiosity, and attention: Computational and neural mechanisms. *Trends in Cognitive Sciences* **17**(11):585–93. doi:10.1016/j.tics.2013.09.001. [aFL]
Green, D. W. & Abutalebi, J. (2013) Language control in bilinguals: The adaptive control hypothesis. *Journal of Cognitive Psychology* **25**(5):515–30. [JH]
Griffiths, T., Chater, N., Kemp, C., Perfors, A. & Tenenbaum, J. (2010) Probabilistic models of cognition: Exploring representations and inductive biases. *Trends in Cognitive Sciences* **14**(8):357–64. doi:10.1016/j.tics.2010.05.004. [aFL]
Griffiths, T. L., Chater, N., Norris, D. & Pouget, A. (2012) How the Bayesians got their beliefs (and what those beliefs actually are): Comments on Bower and Davis. *Psychological Bulletin* **138**:415–22. [MC]
Griffiths, T. L., Kemp, C. & Tenenbaum, J. B. (2008) Bayesian models of cognition. In: *The Cambridge handbook of computational cognitive modeling*, ed. R. Sun. Cambridge University Press. [aFL]
Griffiths, T. L., Lieder, F. & Goodman, N. D. (2015) Rational use of cognitive resources: Levels of analysis between the computational and the algorithmic. *Topics in Cognitive Science* **7**(2):217–29. doi:10.1111/tops.12142. [aFL]
Griffiths, T. L. & Tenenbaum, J. B. (2001) Randomness and coincidences: Reconciling intuition and probability theory. In: *Proceedings from The 23rd Annual Conference of the Cognitive Science Society* (Edinburgh, Scotland), pp. 370–75. Cognitive Science Society. [aFL]
Griffiths, T. L. & Tenenbaum, J. B. (2006) Optimal predictions in everyday cognition. *Psychological Science* **17**(9):767–73. doi:10.1111/j.1467-9280.2006.01780.x. [aFL]
Griffiths, T. L. & Tenenbaum, J. B. (2009) Theory-based causal induction. *Psychological Review* **116**(4):661–716. doi:10.1037/a0017201. [aFL]
Griffiths, T. L., Vul, E. & Sanborn, A. N. (2012) Bridging levels of analysis for probabilistic models of cognition. *Current Direction in Psychological Science* **21**(4):263–68. doi:10.1177/0963721412447619. [aFL]
Griskevicius, V., Shiota, M. N. & Neufeld, S. L. (2010) Influence of different positive emotions on persuasion processing: A functional evolutionary approach. *Emotion* **10**(2):190–206. [KP]
Guillory, S. A. & Bujarski, K. A. (2014) Exploring emotions using invasive methods: Review of 60 years of human intracranial electrophysiology. *Social Cognitive and Affective Neuroscience* **9**(12):1880–89. Available at: https://doi.org/10.1093/scan/nsu002. [JET]
Gul, S., Krueger, P. M., Callaway, F., Griffiths, T. L. & Lieder, F. (2018) Discovering rational heuristics for risky choice. *KogWis 2018* [Abstract]. [rFL]
Hahn, U. & Oaksford, M. (2007) The rationality of informal argumentation: A Bayesian approach to reasoning fallacies. *Psychological Review* **114**(3):704–32. doi:10.1037/0033-295X.114.3.704. [aFL]
Hahn, U. & Warren, P. A. (2009) Perceptions of randomness: Why three heads are better than four. *Psychological Review* **116**(2):454–61. doi:10.1037/a0017522. [aFL]
Hájek, A. (2008) Arguments for – or against – probabilism? *British Journal for the Philosophy of Science* **59**:793–819. [MC]
Hall, B. (2007) *Strickberger's evolution*, 4th edition. Jones and Bartlett Publishers. [CJK]
Halpern, J. Y. & Pass, R. (2015) Algorithmic rationality: Game theory with costly computation. *Journal of Economic Theory* **156**(C):246–68. doi:10.1016/j.jet.2014.04.007. [arFL]
Hammond, K. R. (2000) Coherence and correspondence theories in judgment and decision making. In: *Judgment and decision making: An interdisciplinary reader*, 2nd edition, ed. T. Conolly, K. R. Hammond & H. Arkes, pp. 53–65. Cambridge University Press. [AS]
Harman, G. (2013) Rationality. In: International Encyclopedia of Ethics. ed. H. LaFollette, J. Deigh & S. Stroud. Blackwell Publishing Ltd. [aFL]
Harrison, G. & Ross, D. (2017) The empirical adequacy of cumulative prospect theory and its implications for normative assessment. *Journal of Economic Methodology* **24**:150–65. [DRo]
Harrison, G. & Swarthout, J. T. (2016) *Cumulative prospect theory in the laboratory: A reconsideration* (CEAR Working Paper No. 2016-05). Center for Economic Analysis of Risk, Robinson College of Business, Georgia State University. Available at: https://cear.gsu.edu/files/2016/06/WP_2016_05_Cumulative-Prospect-Theory-in-the-Laboratory-A-Reconsideration_MAR-2017.pdf. [DRo]
Hartwell, L. H., Hood, L., Goldberg, M., Reynolds, A. E. & Silver, L. (2011) *Genetics: From genes to genomes. 4th Edition*. McGraw Hill. [CJK]
Haselton, M. G. & Nettle, D. (2006) The paranoid optimist: An integrative evolutionary model of cognitive biases. *Personality and Social Psychology Review* **10**(1):47–66. [aFL]
Hassabis, D., Kumaran, D., Summerfield, C. & Botvinick, M. (2017) Neuroscience-inspired artificial intelligence. *Neuron* **95**(2):245–58. doi:10.1016/j.neuron.2017.06.011. [aFL]
Hauser, T. U., Moutoussis, M., Purg, N., Dayan, P. & Dolan, R. J. (2018) Beta-blocker propranolol modulates decision urgency during sequential information gathering. *Journal of Neuroscience* **38**(32):7170–78. Available at: http://doi.org/10.1523/JNEUROSCI.0192-18.2018. [EMR]
Hawkins, J. A. (2004) *Efficiency and complexity in grammars*. Oxford University Press. [aFL]
Hedström, P. & Stern, C. (2008) Rational choice and sociology. In: *The new Palgrave dictionary of economics* (2nd edition), ed. S. N. Durlauf & L. E. Blume. Palgrave Macmillan. [aFL]
Herrnstein, R. J. (1961) Relative and absolute strength of responses as a function of frequency of reinforcement. *Journal of the Experimental Analysis of Behaviour* **4**:267–72. doi:10.1901/jeab.1961.4-267. [aFL]
Herron, J. C. & Freeman, S. (2013) *Evolutionary analysis*, 5th edition. Pearson. [CJK]
Hertwig, R. & Hoffrage, U. (2013) *Simple heuristics in a social world*. Oxford University Press. [aFL]
Hertwig, R., Pachur, T., & Kurzenhäuser, S. (2005) Judgments of risk frequencies: Tests of possible cognitive mechanisms. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **31**(4):621. doi:10.1037/0278-7393.31.4.621. [aFL]
Heyes, C. (2018) *Cognitive gadgets: The cultural evolution of thinking*. Harvard University Press. [MD]
Hilbert, M. (2012) Toward a synthesis of cognitive biases: How noisy information processing can bias human decision making. *Psychological Bulletin* **138**(2):211–37. doi:10.1037/a0025940. [aFL]
Hirsch, J., Adam Noah, J., Zhang, X., Dravida, S. & Ono, Y. (2018) A cross-brain neural mechanism for human-to-human verbal communication. *Social Cognitive and Affective Neuroscience* **13**(9):907–20. doi:10.1093/scan/nsy070. [MD]
Hoffman, B. L., Felter, E. M., Chu, K. H., Shensa, A., Hermann, C., Wolynn, T. & Primack, B. A. (2019) It's not all about autism: The emerging landscape of anti-vaccination sentiment on Facebook. *Vaccine* **37**(16):2216–23. [KPK]
Holmes, P. & Cohen, J. D. (2014) Optimality and some of its discontents: Successes and shortcomings of existing models for binary decisions. *Topics in Cognitive Science* **6**(2):258–78. doi:10.1111/tops.12084. [aFL]
Horvitz, E. J. (1987) Reasoning about beliefs and actions under computational resource constraints. *In:* Proceedings of the third conference on uncertainty in artificial intelligence, pp. 429-44. [aFL]
Horvitz, E. J. (1990) Computation and action under bounded resources. PhD Dissertation, Stanford University. [aFL]

Horvitz, E. J., Cooper, G. F. & Heckerman, D. E. (1989) Reflection and action under scarce resources: Theoretical principles and empirical study. In: *Proceedings from IJCAI-89: The 11th international joint conference on artificial intelligence* (Detroit, Michigan), *Volume* 2, pp. 1121–27. [aFL]

Houston, A. I. & McNamara, J. M. (1999) *Models of adaptive behaviour: An approach based on state*. Cambridge University Press. [aFL]

Howes, A., Duggan, G. B., Kalidindi, K., Tseng, Y. -C. & Lewis, R. L. (2016) Predicting short-term remembering as boundedly optimal strategy choice. *Cognitive Science* **40** (5):1192–223. doi:10.1111/cogs.12271. [aFL]

Howes, A., Lewis, R. L. & Vera, A. H. (2009) Rational adaptation under task and processing constraints: Implications for testing theories of cognition and action. *Psychological Review* **116**(4):717–51. doi:10.1037/a0017187 [RLL, aFL]

Howes, A., Warren P. A., Farmer, G., El-Deredy, W. & Lewis, R. L. (2016) Why contextual preference reversals maximize expected value. *Psychology Review* **123**(4):368–91. doi:10.1037/a0039996. [aFL]

Hudson Kam, C. L. & Newport, E. L. (2005) Regularizing unpredictable variation: The roles of adult and child learners in language formation and change. *Language Learning and Development* **1**(2):151–95. [VRB]

Hume, D. (1739–40/2000) *A treatise of human nature*, ed. D. F. Norton & M. J. Norton. Oxford University Press. [CJK]

Hutchins, E. (1995) *Cognition in the wild*. MIT Press. [MD]

Hutchinson, B. & Barrett, L. F. (2019) The power of predictions: An emerging paradigm for psychological research. *Current Directions in Psychological Science* **28**(3):280–91. Available at: https://doi.org/10.1177/0963721419831992. [JET]

Huys, Q. J. M., Lally, N., Faulkner, P., Eshel, N., Seifritz, E., Gershman, S. J., Dayan, P. & Roiser, J. P. (2015) Interplay of approximate planning strategies. *Proceedings of the National Academy of Sciences* **112**(10):3098–103. doi:10.1073/pnas.1414219112. [aFL]

Huys, Q. J. M. & Renz, D. (2017) A formal valuation framework for emotions and their control. *Biological Psychiatry* **82**(6):413–20. Available at: http://doi.org/10.1016/j.biopsych.2017.07.003. [EMR]

Icard, T. (2014) Toward boundedly rational analysis. In: *Proceedings from the 36th annual conference of the Cognitive Science Society* (Quebec, Canada), Volume 1, pp. 637–42. Cognitive Science Society. [aFL]

Icard, T. & Goodman, N. D. (2015) A resource-rational approach to the causal frame problem. In: *Proceedings from the 37th annual meeting of the Cognitive Science Society* (Pasadena, CA). Cognitive Science Society. [aFL]

Jain, Y. R., Gupta, S., Rakesh, V., Dayan, P., Callaway, F. & Lieder, F. (in press) Testing models of how people learn how to plan. [rFL]

Jazayeri, M. & Shadlen, M. N. (2010) Temporal context calibrates interval timing. *Nature Neuroscience* **13**(8):1020–26. doi:10.1038/nn.2590. [VRB]

Jern, A., Chang, K.-M. K. & Kemp, C. (2014) Belief polarization is not always irrational. *Psychological Review* **121**(2):206–24. [EM, rFL]

Johnstone, R. A., Dall, S. R. X. & Dukas, R. (2002) Behavioural and ecological consequences of limited attention. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, **357**. Available at: http://doi.org/10.1098/rstb.2002.1063. [aFL]

Jusczyk, P. W. & Aslin, R. N. (1995) Infants' detection of the sound patterns of words in fluent speech. *Cognitive Psychology* **29**(1):1–23. doi:10.1006/cogp.1995.1010. [VRB]

Juslin, P., Nilsson, H. & Winman, A. (2009) Probability theory, not the very guide of life. *Psychological Review* **116**(4):856–74. [ANS]

Kahneman, D. (2003) Maps of bounded rationality: Psychology for behavioral economics. *American Economic Review* **93**(5):1449-75. doi:10.1257/000282803322655392. [aFL]

Kahneman, D. & Frederick, S. (2002) Representativeness revisited: Attribute substitution in intuitive judgment. In: *Heuristics and biases: The psychology of intuitive judgment*, ed. T. Gilovich, D. Griffin & D. Kahneman. Cambridge University Press. doi:10.1017/CBO9780511808098.004. [aFL]

Kahneman, D. & Frederick, S. (2005) A model of heuristic judgment. In: *The Cambridge handbook of thinking and reasoning*, ed. K. J. Holyoak & R. G. Morrison, pp. 267–93. Cambridge University Press. [aFL]

Kahneman, D. & Tversky, A. (1972) Subjective probability: A judgment of representativeness. *Cognitive Psychology* **3**(3):430–54. doi:10.1016/0010-0285(72)90016-3. [aFL]

Kahneman, D. & Tversky, A. (1979) Prospect theory: An analysis of decision under risk. *Econometrica* **47**(2):263–91. doi:10.2307/1914185. [arFL]

Kauffman, S. A. (1993) *The origins of order: Self-organization and selection in evolution*. Oxford University Press. [KPK]

Kemp, C. & Regier, T. (2012) Kinship categories across languages reflect general communicative principles. *Science* **336**(6084):1049–54. doi:10.1126/science.1218811. [aFL]

Kemp, C. & Tenenbaum, J. B. (2008) The discovery of structural form. *Proceedings of the National Academy of Sciences* **105**(31):10687–92. [KP]

Kempson, R., Cann, R., Gregoromichelaki, E. & Chatzikyriakidis, S. (2016) Language as mechanisms for interaction. *Theoretical Linguistics* **42**(3–4):203–76. doi:10.1515/tl-2016-0011. [MD]

Keramati, M., Dezfouli, A. & Piray, P. (2011) Speed/accuracy trade-off between the habitual and the goal-directed processes. *The Public Library of Science Computational Biology* **7**(5):e1002055, 1–21. doi:10.1371/journal.pcbi.1002055. [aFL]

Keramati, M., Smittenaar, P., Dolan, R. J. & Dayan, P. (2016) Adaptive integration of habits into depth-limited planning defines a habitual-goal-directed spectrum. *Proceedings of the National Academy of Sciences* **113**(45):12868–73. doi:10.1073/pnas.1609094113. [aFL]

Kersten, A. W. & Earles, J. L. (2001) Less really is more for adults learning a miniature artificial language. *Journal of Memory and Language* **44**(2):250–73. [VRB]

Khaw, M. W., Li, Z. & Woodford, M. (2017) *Risk aversion as a perceptual bias*. NBER Working Paper No. 23294. National Bureau of Economic Research. [aFL]

Khrennikov, A., Basieva, I., Pothos, E. M. & Yamato, I. (2018) Quantum probability in decision making from quantum information representation of neuronal states. *Scientific Reports* **8**(1):16225. [HA]

Kirkham, N. Z., Slemmer, J. A. & Johnson, S. P. (2002) Visual statistical learning in infancy: Evidence for a domain general learning mechanism. *Cognition* **83**(2):B35–B42. [VRB]

Kleckner, I. R., Zhang, J., Touroutoglou, A., Chanes, L., Xia, C., Simmons, W. K., Quigley, K. S., Dickerson, B. C. & Barrett, L. F. (2017) Evidence for a large-scale brain system supporting allostasis and interoception in humans. *Nature Human Behaviour* **1** (5):0069. Available at: https://doi.org/10.1038/s41562-017-0069. [JET]

Klein, C. (2018) Mechanisms, resources, and background conditions. *Biology and Philosophy* **33**:36. [JH]

Knill, D. C. & Pouget, A. (2004) The Bayesian brain: The role of uncertainty in neural coding and computation. *Trends in Neurosciences* **27**(12):712–19. doi:10.1016/j.tins.2004.10.007. [aFL]

Knill, D. C. & Richards, W. (1996) *Perception as Bayesian inference*. Cambridge University Press. [aFL]

Konvalinka, I. & Roepstorff, A. (2012) The two-brain approach: How can mutually interacting brains teach us something about social interaction? *Frontiers in Human Neuroscience* **6**:215. doi:10.3389/fnhum.2012.00215. [MD]

Kool, W. & Botvinick, M. M. (2013) The intrinsic cost of cognitive control. *The Behavioral and Brain Sciences* **36**(6):697–98. doi:10.1017/S0140525X1300109X. [aFL]

Körding, K. P. & Wolpert, D. M. (2004) Bayesian integration in sensorimotor learning. *Nature* **427**(6971):244–47. doi:10.1038/nature02169. [aFL, VRB]

Krajbich, I., Lu, D., Camerer, C. & Rangel, A. (2012) The attentional drift-diffusion model extends to simple purchasing decisions. *Frontiers in Psychology* **3**:193. [rFL]

Kreiner, J. (2014) *The social life of hagiography in the Merovingian kingdom*. Cambridge University Press. [HMC]

Krueger, P. M. & Griffiths, T. (2018) Shaping model-free habits with model-based goals. In: *CogSci 2018*. [rFL]

Krueger, P. M., Lieder, F. & Griffiths, T. (2017) Enhancing metacognitive reinforcement learning using reward structures and feedback. In: *CogSci 2017*. [rFL]

Kuhl, P. K. & Meltzoff, A. N. (1982) The bimodal perception of speech in infancy. *Science* **218**(4577):1138–41. [VRB]

Kurkul, K. E. & Corriveau, K. H. (2018) Question, explanation, follow-up: A mechanism for learning from others? *Child Development* **89**(1):280–94. [KP]

Kwon, O.-S. & Knill, D. C. (2013) The brain uses adaptive internal models of scene statistics for sensorimotor estimation and planning. *Proceedings of the National Academy of Sciences* **110**(11):E1064–73. doi:10.1073/pnas.1214869110. [VRB]

Lake, B. M., Salakhutdinov, R. & Tenenbaum, J. B. (2015) Human-level concept learning through probabilistic program induction. *Science* **350**:1332–38. [HA]

Lake, B. M., Ullman, T. D., Tenenbaum, J. B. & Gershman, S. J. (2017) Building machines that learn and think like people. *Behavioral and Brain Sciences* **40**(253):1-72. doi:10.1017/S0140525X16001837. [aFL]

Langley, P., Laird, J. E. & Rogers, S. (2009) Cognitive architectures: Research issues and challenges. *Cognitive Systems Research* **10**(2):141–60. doi:10.1016/j.cogsys.2006.07.004. [aFL]

Larrick, R. P. (2004) Debiasing. In: *Blackwell handbook of judgment and decision making*, ed. D. J. Koehler & N. Harvey, pp. 316–38. Blackwell Publishing. [aFL]

Latty, T. & Beekman, M. (2010) Irrational decision-making in an amoeboid organism: Transitivity and context-dependent preferences. *Proceedings of the Royal Society B: Biological Sciences* **278**(1703): 307–12. [aFL]

Laughlin, S. (1981) A simple coding procedure enhances a neuron's information capacity. *Zeitschrift für Naturforschung C* **36**(9–10):910–12. [WJM]

Lennie, P. (2003) The cost of cortical computation. *Current Biology* **13**(6):493–97. doi:10.1016/S0960-9822(03)00135-0. [aFL]

Lerch, R. A. & Sims, C. R. (2019) Rate-distortion theory and computationally rational reinforcement learning. In: *Proceedings of Reinforcement Learning and Decision Making (RLDM) 2019*, July 7–10, Montreal, Canada. [CJB]

Lestrade, S. (2017) Unzipping Zipf's law. *PLoS One* **12**(8):e0181987. doi:10.1371/journal.pone.0181987. [MD]

Levelt, W. J. M. (1989) *Speaking: From intention to articulation*. MIT Press. [MD]

Levinson, S. C. (2000) *Presumptive meanings: The theory of generalized conversational implicature*. MIT Press. [MD]

Levinson, S. C. (2016) Turn-taking in human communication – origins and implications for language processing. *Trends in Cognitive Sciences* **20**(1):6–14. doi:10.1016/j.tics.2015.10.010. [MD]

Levy, W. B. & Baxter, R. A. (1996) Energy efficient neural codes. *Neural Computation* **8** (3):531–43. doi:10.1162/neco.1996.8.3.531. [aFL]

Levy, W. B. & Baxter, R. A. (2002) Energy-efficient neuronal computation via quantal synaptic failures. *Journal of Neuroscience* **22**(11):4746–55. [aFL]

Lewis, M. (2008) The emergence of human emotions. In: *Handbook of emotions*, 3rd edition, ed. M. Lewis, J. M. Haviland-Jones & L. F. Barrett, pp. 304–19. Guilford Press. [KP]

Lewis, R. L., Howes, A. & Singh, S. (2014) Computational rationality: Linking mechanism and behavior through bounded utility maximization. *Topics in Cognitive Science* **6** (2):279–311. doi:10.1111/tops.12086. [aFL, RLL]

Li, V., Castañon, S. H., Solomon, J. A., Vandormael, H. & Summerfield, C. (2017) Robust averaging protects decisions from noise in neural computations. *PLoS Computational Biology* **13**(8):e1005723. [WJM]

Liberman, A. & Chaiken, S. (1992) Defensive processing of personally relevant health messages. *Personality and Social Psychology Bulletin* **18**:669–79. [EM]

Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M. & Combs, B. (1978) Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory* **4**(6):551–78. [aFL]

Lieder, F. (2018) Beyond bounded rationality: Reverse-engineering and enhancing human intelligence (Doctoral dissertation). University of California, Berkeley. [aFL, WJM]

Lieder, F., Callaway, F., Krueger, P. M., Das, P., Griffiths, T. L. & Gul, S. (2018a) Discovering and teaching optimal planning strategies. In: *The 14th biannual conference of the German Society for Cognitive Science, GK*. [aFL]

Lieder, F., Griffiths T. L. & Hsu, M. (2018b) Overrepresentation of extreme events in decision making reflects rational use of cognitive resources. *Psychological Review* **125**(1):1–32. doi:10.1037/rev0000074.

Lieder, F., Callaway F., Jain, Y. R., Krueger P. M., Das, P., Gul S. & Griffiths, T. L. (2019a) A cognitive tutor for helping people overcome present bias. *RLDM* 2019. doi:10.13140/RG.2.2.10467.20006. [aRF]

Lieder, F., Chen O. X., Krueger, P. M. & Griffiths, T. L. (2019b) Cognitive prostheses for goal achievement. *Nature Human Behavior* **3**:1096–1106. [aFL]

Lieder, F. & Griffiths, T. L. (2017) Strategy selection as rational metareasoning. *Psychological Review* **124**(6):762–94. doi:10.1037/rev0000075. [aFL, AS]

Lieder, F., Griffiths, T. L. & Goodman, N. D. (2012) Burn-in, bias, and the rationality of anchoring. In: *Advances in Neural Information Processing Systems*, vol. **26**, ed. P. Bartlett, F. C. N. Pereira, L. Bottou, C. J. C. Burges & K. Q. Weinberger, pp. 2690–798. Curran Associates, Inc. [aFL]

Lieder, F., Griffiths, T. L. & Hsu, M. (2018b) Overrepresentation of extreme events in decision making reflects rational use of cognitive resources. *Psychological Review* **125**(1):1–32. doi:10.1037/rev0000074. [aFL, EMR]

Lieder, F., Griffiths, T. L., Huys, Q. J., & Goodman, N. D. (2018c) Empirical evidence for resource-rational anchoring and adjustment. *Psychonomic Bulletin & Review* **25** (2):775-84. doi:10.3758/s13423-017-1288-6. [aFL]

Lieder, F., Griffiths, T. L., Huys, Q. J. M. & Goodman, N. D. (2018d) The anchoring bias reflects rational use of cognitive resources. *Psychonomic Bulletin & Review* **25**(1):322–49. doi:10.3758/s13423-017-1286-8. [aFL, WJM]

Lieder, F., Hsu, M. & Griffiths, T. L. (2014) The high availability of extreme events serves resource-rational decision-making. in *Proceedings of the Annual Meeting of the Cognitive Science Society*. Cognitive Science Society. [aFL, WJM]

Lieder, F., Krueger, P. M. & Griffiths, T. L. (2017) An automatic method for discovering rational heuristics for risky choice. In: *Proceedings from the 39th annual conference of the Cognitive Science Society* (London, UK), pp. 2567–72. Cognitive Science Society. [aFL]

Lieder, F., Shenhav, A., Musslick, S. & Griffiths, T. L. (2018e) Rational metareasoning and the plasticity of cognitive control. *The Public Library of Science Computational Biology* **14**(4):e1006043. https://doi.org/10.1371/journal.pcbi.1006043. [aFL]

Locke, E. & Latham, G. (2002) Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist* **57**(9):705–17. doi:10.1037/0003-066x.57.9.705. [aFL]

Lohmann, S. (2008) Rational choice and political science. In: *The new Palgrave dictionary of economics*, 2nd edition, ed. S. N. Durlauf & L. E. Blume. Palgrave Macmillan. doi:10.1007/978-1-349-58802-2_1383. [aFL]

Luciana, M. & Nelson, C. A. (1998) The functional emergence of prefrontally-guided working memory systems in four- to eight-year-old children. *Neuropsychologia* **36** (3):273–93. [VRB]

Machina, M. (2009) Risk, ambiguity, and the rank-dependence axioms. *Journal of Economic Review* **99**(1):385–92. [CM]

MacKenzie, D. (2006) *An engine, not a camera: How financial models shape markets*. MIT Press. [HMC]

Mackowiak, B. & Wiederholt, M. (2009) Optimal sticky prices under rational inattention. *American Economic Review* **99**(3):769–803. [WJM]

Mahowald, K., Fedorenko, E., Piantadosi, S. T. & Gibson, E. (2013) Info/information theory: Speakers choose shorter words in predictive contexts. *Cognition* **126**(2):313–18. doi:10.1016/j.cognition.2012.09.010. [aFL]

Mandelbaum, E. (2019) Troubles with Bayesianism: An introduction to the psychological immune system. *Mind & Language* **34**:141–57. [EM]

Marblestone, A. H., Wayne, G. & Kording, K. P. (2016) Toward an integration of deep learning and neuroscience. *Frontiers in Computational Neuroscience* **10**:94. doi:10.3389/fncom.2016.00094. [MC]

Marcus, G. (2008) *Kluge: The haphazard evolution of the human mind*. Houghton Mifflin Harcourt. [ESD, aFL]

Marewski, J. N. & Schooler, L. J. (2011) Cognitive niches: An ecological model of strategy selection. *Psychological Review* **118**:393–437. [CD]

Marr, D. (1982) *Vision: A computational investigation into the human representation and processing of visual information*. MIT Press. [arFL, AS]

Matějka, F. & McKay, A. (2015) Rational inattention to discrete choices: A new foundation for the multinomial logit model. *American Economic Review* **105**(1):272–98. doi:10.1257/aer.20130047. [aFL]

Mathews, A. & MacLeod, C. (2005) Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology* **1**(1):167–95. Available at: http://doi.org/10.1146/annurev.clinpsy.1.102803.143916. [EMR]

Maylor, E. A., Chater, N. & Jones, G. V. (2001) Searching for two things at once: Evidence of exclusivity in semantic and autobiographical memory retrieval. *Memory & Cognition* **29**(8):1185–95. [ANS]

McNamara, J. M. & Weissing, F. J. (2010) Evolutionary game theory. In: *Social behaviour: genes, ecology and evolution*, ed. T. Székely, A. J. Moore & J. Komdeur, pp. 88–106. Cambridge University Press. [aFL]

Meyer, D. E. & Kieras, D. E. (1997a) A computational theory of executive cognitive processes and multiple-task performance: Part I. Basic mechanisms. *Psychological Review* **104**(1):3–65. doi:10.1037/0033-295X.104.1.3. [aFL, CD]

Meyer, D. E. & Kieras, D. E. (1997b) A computational theory of executive cognitive processes and multiple-task performance: Part 2. Accounts of psychological refractory-period phenomena. *Psychological Review* **104**(4):749–91. doi:10.1037//0033-295X.104.4.749. [aFL, CD]

Mill, J. S. (1882) *A system of logic, ratiocinative and inductive*, 8th edition. Harper and Brothers. [aFL]

Milli, S., Lieder, F. & Griffiths, T. L. (2017) When does bounded-optimal metareasoning favor few cognitive systems? In: *Proceedings from AAAI-17: The 31st Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence*, vol. 31, 4422–28. Palo Alto, CA: Association for the Advancement of Artificial Intelligence Press. [aFL]

Milli, S., Lieder, F. & Griffiths, T. L. (2019) *A rational reinterpretation of dual-process theories*. Preprint. doi:10.13140/RG.2.2.14956.46722/1. [aFL]

Mineka, S., Davidson, M., Cook, M. & Keir, R. (1984) Observational conditioning of snake fear in rhesus monkeys. *Journal of Abnormal Psychology* **93**(4):355–72. Available at: https://doi.org/10.1037/0021-843X.93.4.355. [JET]

Młynarski, W. F. & Hermundstad, A. M. (2018) Adaptive coding for dynamic sensory inference. *Elife* **7**:e32055. [WJM]

Moore, D. A. & Healy, P. J. (2008) The trouble with overconfidence. *Psychological Review* **115**(2):502–17. [aFL]

Moore, G. E. (1903) *Principia ethica*. Cambridge University Press. [CJK]

Moreira, C., Haven, E., Sozzo, S. & Wichert, A. (2018) Process mining with real world financial loan applications: Improving inference on incomplete event logs. *PLoS One* **13**(12):e0207806. [CM]

Mossio, M. & Moreno, A. (2015) Biological autonomy: A philosophical and theoretical enquiry. History, philosophy, and theory of life sciences series. Springer. [KPK]

Musslick, S., Dey, B., Ozcimder, K., Patwary, M. M. A., Willke, T. L. & Cohen, J. D. (2016) Controlled vs. automatic processing: A graph-theoretic approach to the analysis of serial vs. parallel processing in neural network architectures. In: *Proceedings from The 38th Annual Conference of the Cognitive Science Society* (Philadelphia, PA), pp. 1547–52. Cognitive Science Society. [arFL]

Musslick, S., Saxe, A. M., Ozcimder, K., Dey, B., Henselman, G. & Cohen, J. D. (2017) Multitasking capability versus learning efficiency in neural network architectures. In: *Proceedings from The 39th Cognitive Science Society Conference* (London, UK), pp. 829–34. Cognitive Science Society. [arFL]

Nagel, T. (2012) *Mind and cosmos: Why the materialist Neo-Darwinian conception of nature is almost certainly false*, 1st edition. Oxford University Press. [CJK]

Nardini, M., Bedford, R. & Mareschal, D. (2010) Fusion of visual cues is not mandatory in children. *Proceedings of the National Academy of Sciences* **107**(39):17041–46. doi:10.1073/pnas.1001699107. [VRB]

Nardini, M., Jones, P., Bedford, R. & Braddick, O. (2008) Development of cue integration in human navigation. *Current Biology* **18**(9):689–93. doi:10.1016/j.cub.2008.04.021. [VRB]

Navon, D. & Gopher, D. (1979) On the economy of the human-processing system. *Psychological Review* **86**(3):214–55. doi:10.1037/0033-295X.86.3.214. [aFL]

Neil, P. A., Chee-Ruiter, C., Scheier, C., Lewkowicz, D. J. & Shimojo, S. (2006) Development of multisensory spatial integration and perception in humans. *Developmental Science* **9**(5):454–64. [VRB]

Netzer, N. (2009) Evolution of time preferences and attitudes toward risk. *American Economic Review* **99**(3):937–55. [WJM]

Neuman, R., Rafferty, A. & Griffiths, T. (2014) A bounded rationality account of wishful thinking. In: *Proceedings from the 36th annual meeting of the Cognitive Science Society*. Cognitive Science Society. [aFL]

Newell, A. (1990) *Unified theories of cognition*. Harvard University Press. [CD, RLL]

Newell, A., Shaw, J. C. & Simon, H. A. (1958) Elements of a theory of human problem solving. *Psychological Review* **65**(3):151–66. doi:10.1037/h0048495. [aFL]

Newell, A. & Simon, H. A. (1972) *Human problem solving*. Prentice-Hall. [aFL]

Newell, B. R. (2005) Re-visions of rationality? *Trends in Cognitive Sciences* **9**(1):11–15. [AS]

Newell, B. R. & Shanks, D. R. (2014) Unconscious influences on decision making: A critical review. *Behavioral and Brain Sciences* **37**(1):1–19. [AS]

Newport, E. L. (1990) Maturational constraints on language learning. *Cognitive Science* **14** (1):11–28. doi:10.1016/0364-0213(90)90024-Q. [VRB]

Niven, J. E. & Laughlin, S. B. (2008) Energy limitation as a selective pressure on the evolution of sensory systems. *Journal of Experimental Biology* **211**(11):1792–804. Available at: https://doi.org/10.1242/jeb.017574. [aFL, JET]

Nobandegani, A. (2017) *The minimalist mind: On minimality in learning, reasoning*. McGill-Queen's University Press. [aFL]

Nobandegani, A. S., Castanheira, K. da S., Otto, A. R. & Shultz, T. R. (2018) Over-representation of extreme events in decision-making: A rational metacognitive account. In: *Proceedings from the 40th annual conference of the Cognitive Science Society*, pp. 2394–99. Cognitive Science Society. [aFL]

Nobandegani, A. S. & Psaromiligkos, I. N. (2017) The causal frame problem: An algorithmic perspective. In: *Proceedings from the 39th annual conference of the Cognitive Science Society* (London, UK), pp. 2567–72. Cognitive Science Society. [aFL]

Oaksford, M. & Chater, N. (1994) A rational analysis of the selection task as optimal data selection. *Psychological Review* **101**(4):608–31. doi:10.1037/0033-295X.101.4.608. [aFL, CD, ESD]

Oaksford, M. & Chater, N. (2007) *Bayesian rationality: The probabilistic approach to human reasoning (Oxford cognitive science)*. Oxford University Press. [aFL]

Okasha, S. (2013) The evolution of Bayesian updating. *Philosophy of Science* **80**(5):745–57. [DS]

Olshausen, B. A. & Field, D. J. (1996) Emergence of simple-cell receptive field properties by learning a sparse code for natural images. *Nature* **381**(6583):607–09. doi:10.1038/381607a0. [aFL, WJM]

Olshausen, B. A. & Field, D. J. (1997) Sparse coding with an overcomplete basis set: A strategy employed by V1? *Vision Research* **37**(23):3311–25. doi:10.1016/S0042-6989(97)00169-7. [aFL]

Olshausen, B. A. & Field, D. J. (2004) Sparse coding of sensory inputs. *Current Opinion in Neurobiology* **14**(4):481–87. doi:10.1016/j.conb.2004.07.007. [aFL]

Orhan, A. E., Sims, C. R., Jacobs, R. A. & Knill, D. C. (2014) The adaptive nature of visual working memory. *Current Directions in Psychological Science* **23**(3):164–70. doi:10.1177/0963721414529144. [aFL]

Park, I. M. & Pillow, J. W. (2017) Bayesian efficient coding. bioRxiv. Preprint. doi:10.1101/178418. [WJM]

Pashler, H. E. & Sutherland, S. (1998) *The psychology of attention*, vol. **15**. MIT Press. [aFL]

Pavlov, I. P. (1927) *Conditioned reflexes*. Oxford University Press. [KPK]

Payne, J. W., Bettman, J. R. & Johnson, E. J. (1993) *The adaptive decision maker*. Cambridge University Press. [aFL]

Peil, K. T. (2012) Emotion: A self-regulatory sense? EFS International. Available at: http://www.academia.edu/7208004/Emotion_. [KPK]

Peil, K. T. (2014) The self-regulatory sense. *Global Advances in Health Medicine* **3**(2):80–108. [KPK]

Peil, K. T. (2017) The resonant biology of emotion. *Constructivist Foundations* **12**(2):232–33. [KPK]

Pert, C. (1998) *The molecules of emotion*. Touchstone. [KPK]

Peters, M. A. K., Ma, W. J. & Shams, L. (2016) The size-weight illusion is not anti-Bayesian after all: A unifying Bayesian account. *Peer J* **4**:e2124. [EM]

Petrini, K., Remark, A., Smith, L. & Nardini, M. (2014) When vision is not an option: Children's integration of auditory and haptic information is suboptimal. *Developmental Science* **17**(3):376–87. doi:10.1111/desc.12127. [VRB]

Pettit, M. (2017) The great cat mutilation: Sex, social movements and the utilitarian calculus in 1970s New York City. *BJHS: Themes* **2**:57–78. [HMC]

Piantadosi, S. T., Tily, H. & Gibson, E. (2011) Word lengths are optimized for efficient communication. *Proceedings of the National Academy of Sciences* **108** (9):3526–29. doi:10.1073/pnas.1012551108. [aFL]

Piantadosi, S. T., Tily, H. & Gibson, E. (2012) The communicative function of ambiguity in language. *Cognition* **122**(3):280–91. doi:10.1016/j.cognition.2011.10.004. [MD]

Piccinini, G. & Schulz, A. (2019) The ways of altruism. *Evolutionary Psychological Science* **5**:58–70. [AWS]

Pittendrigh, C. (1958) Adaptation, natural selection, and behavior. In: *Behavior and evolution*, ed. A. Roe & G. G. Simpson. Yale University Press. [CJK]

Plous, S. (1991) Biases in the assimilation of technological breakdowns: Do accidents make us safer? *Journal of Applied Social Psychology* **21**:1058–82. [EM]

Plous, S. (1993) *The psychology of judgment and decision making*. McGraw-Hill. [ESD]

Polania, R., Woodford, M. & Ruff, C. C. (2019) Efficient coding of subjective value. *Nature Neuroscience* **22**(1):134. [aFL]

Pontzer, H. (2015) Energy expenditure in humans and other primates: A new synthesis. *Annual Review of Anthropology* **44**(1):169–87. Available at: https://doi.org/10.1146/annurev-anthro-102214-013925. [JET]

Pothos, E. M. & Busemeyer, J. R. (2009) A quantum probability model explanation for violations of "rational" decision theory. *Proceedings of the Royal Society B: Biological Sciences* **276**(1665):2171–78. [CM]

Pothos, E. M. & Busemeyer, J. R. (2013) Can quantum probability provide a new direction for cognitive modeling? *Behavioral and Brain Sciences* **36**(3):255–74. [CM, HA]

Radley, J. J., Kabbaj, M., Jacobson, L., Heydendael, W., Yehuda, R. & Herman, J. P. (2011) Stress risk factors and stress-related pathology: Neuroplasticity, epigenetics and endophenotypes. Stress **14**(5):481–97. [KPK]

Rahnev, D. & Denison, R. N. (2018a) Suboptimality in perceptual decision making. *Behavioral and Brain Sciences* **41**:e223, 1–66. doi:10.1017/S0140525X18000936. [DRa, MC]

Rahnev, D. & Denison, R. N. (2018b) Behavior is sensible but not globally optimal: Seeking common ground in the optimality debate. *Behavioral and Brain Sciences* **41**:e251. Available at: https://www.cambridge.org/core/product/identifier/S0140525X18002121/type/journal_article [Accessed January 10, 2019]. [DRa]

Ramsay, F. (1931) *The foundations of mathematics and other logical essays*. Harcourt Brace and Company. [DS]

Rao, R. P. N. & Ballard, D. H. (1999) Predictive coding in the visual cortex: A functional interpretation of some extra-classical receptive-field effects. *Nature Neuroscience* **2**(1):79–87. Available at: https://doi.org/10.1038/4580. [JET]

Ratcliff, R. (1978) A theory of memory retrieval. *Psychological Review* **85**(2):59–108. doi:10.1037/0033-295X.85.2.59. [aFL]

Ratcliff, R. & McKoon, G. (2008) The diffusion decision model: Theory and data for two-choice decision tasks. *Neural Computation* **20**(4):873–922. [ANS]

Raymer, E. J. (2013) A man of his time: Thorstein Veblen and the University of Chicago Darwinists. *Journal of the History of Biology* **46**(4):669–98. [HMC]

Regier, T., Kay, P. & Khetarpal, N. (2007) Color naming reflects optimal partitions of color space. *Proceedings of the National Academy of Sciences* **104**(4):1436–41. doi:10.1073/pnas.0610341104. [aFL]

Reis, R. (2006) Inattentive consumers. *Journal of Monetary Economics* **53**(8):1761–1800. doi:10.3386/w10883. [aFL]

Risko, E. F. & Gilbert, S. J. (2016) Cognitive offloading. *Trends in Cognitive Sciences* **20** (9):676–88. doi:10.1016/j.tics.2016.07.002. [MD]

Roberts, S. G. & Levinson, S. C. (2017) Conversation, cognition and cultural evolution: A model of the cultural evolution of word order through pressures imposed from turn taking in conversation. *Interaction Studies* **18**(3):404–31. doi:10.1075/is.18.3.06rob [MD]

Robinson, D. N. (2007) *Consciousness and mental life*, 1st edition. Columbia University Press. [CJK]

Robson, A. & Whitehead, L. A. (2016) *Rapidly adaptive hedonic utility*. Working paper. Simon Fraser University. [WJM]

Robson, A. J. (2001) The biological basis of economic behavior. *Journal of Economic Literature* **39**(1):11–33. [WJM]

Rolls, E. T. (2013) *Emotion and decision-making explained*. Oxford University Press. [DS]

Rowlands, M. (2010) *The new science of the mind: From extended mind to embodied phenomenology*. MIT Press. [KPK]

Rozenblit, L. & Keil, F. (2002) The misunderstood limits of folk science: An illusion of explanatory depth. *Cognitive Science* **26**(5):521–62. doi:10.1207/s15516709cog2605_1. [aFL]

Rumelhart, D. E. & McClelland, J. L. (1987) Parallel distributed processing, *vol. 1*. MIT Press. [aFL]

Ruse, M. (2017) *On purpose*. Princeton University Press. [CJK]

Russell, S. J. (1997) Rationality and intelligence. *Artificial Intelligence* **94**(1–2):57–77. doi:10.1016/S0004-3702(97)00026-X. [aFL]

Russell, S. J. & Subramanian, D. (1995) Provably bounded-optimal agents. *Journal of Artificial Intelligence Research* **2**(1):575–609. doi: 10.1613/jair.133. [aFL, RLL]

Saffran, J. R., Aslin, R. N. & Newport, E. L. (1996) Statistical learning by 8-month-old infants. *Science* **274**(5294):1926–28. doi:10.1126/science.274.5294.1926. [VRB]

Salvucci, D. D. & Taatgen, N. A. (2010) *The multitasking mind*. Oxford University Press. [CD]

Samuels, R., Stich, S. & Bishop, M. (2002) Ending the rationality wars: How to make disputes about human rationality disappear. In: *Common sense, reasoning and rationality*, ed. R. Elio, pp. 236–68. Oxford University Press. [MC]

Sanborn, A. N. & Chater, N. (2016) Bayesian brains without probabilities. *Trends in Cognitive Sciences* **20**(12):883–93. doi:10.1016/j.tics.2016.10.003. [aFL, ANS]

Sanborn, A. N., Griffiths, T. L. & Navarro, D. J. (2010) Rational approximations to rational models: Alternative algorithms for category learning. *Psychological Review* **117** (4):1144–67. doi:10.1037/a0020511. [aFL, HA]

Sanjurjo, A. (2017) Search with multiple attributes: Theory and empirics. *Games and Economic Behavior* **104**:535–62. doi:10.2139/ssrn.2460129. [aFL]

Savage, L. J. (1954) *The foundations of statistics*. Wiley. [DS]

Scherer, K. R. (2009) The dynamic architecture of emotion: Evidence for the component process model. *Cognition & Emotion* **23**(7):1307–51. Available at: http://doi.org/10.1080/02699930902928969. [EMR]

Schilbach, L., Timmermans, B., Reddy, V., Costall, A., Bente, G., Schlicht, T. & Vogeley, K. (2013) Toward a second-person neuroscience. *Behavioral and Brain Sciences* **36** (4):393–414. doi:10.1017/S0140525X12000660. [MD]

Schneider, D. W. & Anderson, J. R. (2012) Modeling fan effects on the time course of associative recognition. *Cognitive Psychology* **64**:127–60. [CD]

Scholz, J. P. & Schoner, G. (1999) The uncontrolled manifold concept: Identifying control variables for a functional task. *Experimental Brain Research* **126**:289–306. [ND]
Schulz, A. (2018) *Efficient cognition: The evolution of representational decision making*. MIT Press. [AWS]
Schulze, C. & Newell, B. R. (2016) More heads choose better than one: Group decision making can eliminate probability matching. *Psychonomic Bulletin & Review* **23**:907–14. [AS]
Schwarz, N. (2002) Situated cognition and the wisdom of feelings: Cognitive tuning. In: *The wisdom in feelings*, ed. L. Feldman Barrett & P. Salovey, pp. 144–66. Guilford Press. [KP]
Schwarz, N. & Clore, G. L. (2007) Feelings and phenomenal experiences. In: *Social psychology: A handbook of basic principles*, 2nd edition, ed. E. T. Higgins & A. Kruglanski, pp. 433–65. Guilford Press. [KP]
Sedlmeier, P. & Gigerenzer, G. (2001) Teaching Bayesian reasoning in less than two hours. *Journal of Experimental Psychology: General* **130**(3):380–400. doi:10.1037//0096-3445.130.3.380. [aFL]
Segev, Y., Musslick, S., Niv, Y. & Cohen, J. D. (2018) Efficiency of learning vs. processing: Towards a normative theory of multitasking. In: *Proceedings from the 40th annual conference of the Cognitive Science Society* (Madison, WI). Cognitive Science Society. [arFL]
Selye, H. (1957/1978) *The stress of life*. McGraw-Hill. [KPK]
Sengupta, B., Stemmler, M. B. & Friston, K. J. (2013) Information and efficiency in the nervous system – a synthesis. *PLoS Computational Biology* **9**(7):e1003157. Available at: https://doi.org/10.1371/journal.pcbi.1003157. [JET]
Seth, A. K. (2015) The cybernetic Bayesian brain: From interoceptive inference to sensorimotor contingencies. In: *Open mind*, ed. T. Metzinger & J. M. Windt, pp. 1–24. MIND Group. Available at: http://www.open-mind.net/DOI?isbn=9783958570108. [JET]
Shadlen, M. N. & Shohamy, D. (2016) Decision making and sequential sampling from memory. *Neuron* **90**(5):927–39. [ANS, rFL]
Shadmehr, R., Smith, M. A. & Krakauer, J. W. (2010) Error correction, sensory prediction, and adaptation in motor control. *Annual Review of Neuroscience* **33**(1):89–108. Available at: https://doi.org/10.1146/annurev-neuro-060909-153135. [JET]
Shafir, S., Waite, T. A. & Smith, B. H. (2002) Context-dependent violations of rational choice in honeybees (*Apis mellifera*) and gray jays (*Perisoreus canadensis*). *Behavioral Ecology and Sociobiology* **51**(2):180–87. [aFL]
Shanks, D., Tunney, R. & McCarthy, J. (2002) A re-examination of probability matching and rational choice. *Journal of Behavioral Decision Making* **15**(3):233–50. doi:10.1002/bdm.413. [aFL]
Shannon, C. & Weaver, W. (1949/1964) *The mathematical theory of communication*, 10th edition. The University of Illinois Press. [JET]
Shaw, M. L. & Shaw, P. (1977) Optimal allocation of cognitive resources to spatial locations. *Journal of Experimental Psychology: Human Perception and Performance* **3**(2):201. [WJM]
Shenhav, A., Botvinick, M. M. & Cohen, J. (2013) The expected value of control: An integrative theory of anterior cingulate cortex function. *Neuron* **79**(2):217–40. doi:10.1016/j.neuron.2013.07.007. [aFL]
Shenhav, A., Musslick, S., Lieder, F., Kool, W., Griffiths, T. L., Cohen, J. D. & Botvinick, M. M. (2017) Toward a rational and mechanistic account of mental effort. *Annual Review of Neuroscience* **40**:99–124. doi:10.1146/annurev-neuro-072116-031526. [aFL, RLL]
Shimansky, Y. P. & Rand, M. K. (2013) Two-phase strategy of controlling motor coordination determined by task performance optimality. *Biological Cybernetics* **107**:107–29. [ND]
Shrager, J. & Siegler, R. S. (1998) SCADS: A model of children's strategy choices and strategy discoveries. *Psychological Science* **9**(5):405–10. [aFL]
Shugan, S. M. (1980) The cost of thinking. *Journal of Consumer Research* **7**(2):99–111. doi:10.1086/208799. [aFL]
Siegler, R. & Jenkins, E. A. (1989) *How children discover new strategies*. Psychology Press. [aFL]
Simon, H. A. (1955) A behavioral model of rational choice. *The Quarterly Journal of Economics* **69**(1):99–118. doi:10.2307/1884852. [aFL]
Simon, H. A. (1956) Rational choice and the structure of the environment. *Psychological Review* **63**(2):129–38. doi:10.1037/h0042769. [aFL]
Simon, H. A. (1982) Models of bounded rationality: Empirically grounded economic reason, *vol. 3*. MIT Press. [aFL]
Simon, H. A. (1996) *The sciences of the artificial*. MIT Press. [JH]
Sims, C. A. (2003) Implications of rational inattention. *Journal of Monetary Economics* **50**(3):665–90. doi:10.1016/S0304-3932(03)00029-1. [aFL, WJM]
Sims, C. A. (2006) Rational inattention: Beyond the linear-quadratic case. *American Economic Review* **96**(2):158–63. doi:10.1257/000282806777212431. [aFL]
Sims, C. R. (2016) Rate-distortion theory and human perception. *Cognition* **152**:181–98. doi:10.1016/j.cognition.2016.03.020. [aFL, CJB]
Sims, C. R. (2018) Efficient coding explains the universal law of generalization in human perception. *Science* **360**:6389, 652–56. [CJB]
Sims, C. R., Jacobs, R. A. & Knill, D. C. (2012) An ideal observer analysis of visual working memory. *Psychological Review* **119**(4):807–30. doi:10.1037/a0029856. [aFL, CJB, WJM]
Sims, C. R., Neth, H., Jacobs, R. A. & Gray, W. D. (2013) Melioration as rational choice: Sequential decision making in uncertain environments. *Psychological Review* **120**:139–54. [CD]
Singh, S., Lewis, R. L., Barto, A. G. & Sorg, J. (2010) Intrinsically motivated reinforcement learning: An evolutionary perspective. *IEEE Transactions on Autonomous Mental Development* **2**(2):70–82. [RLL]
Slovic, P., Finucane, M., Peters, E. & MacGregor, D. G. (2002) The affect heuristic. In: *Heuristics and biases: The psychology of intuitive judgment*, ed. T. Gilovich, D. Griffin & D. Kahneman, pp. 397–420. Cambridge University Press. [KPK]
Smith, V. L. (2008) *Rationality in economics: Constructivist and ecological forms*. Cambridge University Press. [MC]
Smith, V. L. (2009) *Rationality in economics*. Cambridge Books. [WJM]
Solway, A., Diuk, C., Córdova, N., Yee, D., Barto, A. G., Niv, Y. & Botvinick, M. M. (2014) Optimal behavioral hierarchy. *The Public Library of Science Computational Biology* **10**(8):e1003779. doi:10.1371/journal.pcbi.1003779. [aFL]
Sorg, J., Singh, S. & Lewis, R. L. (2010) Internal rewards mitigate agent boundedness. In: *Proceedings of the International Conference on Machine Learning (ICML)*, Haifa, Israel. [RLL]
Sosis, C. & Bishop, M. (2014) Rationality. *Wiley Interdisciplinary Reviews: Cognitive Science* **5**(1):27–37. doi:10.1002/wcs.1263. [aFL]
Spicer, J. & Sanborn, A. N. (2019) What does the mind learn? A comparison of human and machine learning representations. *Current Opinion in Neurobiology* **55**:97–102. [ANS]
Spurrett, D. (2019) The descent of preferences. *British Journal for the Philosophy of Science* axz020. Available at: https://doi.org/10.1093/bjps/axz020. [DS]
Stanovich, K. E. (2011) *Rationality and the reflective mind*. Oxford University Press. [aFL]
Steiner, J. & Stewart, C. (2016) *Perceiving prospects properly*. American Economic Review *106(7):1601–31*. [WJM]
Sterelny, K. (2003) *Thought in a hostile world*. Blackwell. [DRo, DS]
Sterelny, K. (2012) *The evolved apprentice*. MIT Press. [DRo]
Sterling, P. (2004) Principles of allostasis: Optimal design, predictive regulation, pathophysiology, and rational therapeutics. In: *Allostasis, homeostasis, and the costs of physiological adaptation*, ed. J. Schulkin, pp. 17–64. Cambridge University Press. Available at: https://doi.org/10.1017/CBO9781316257081.004. [JET]
Sterling, P. (2012) Allostasis: A model of predictive regulation. *Physiology & Behavior* **106**(1):5–15. Available at: https://doi.org/10.1016/j.physbeh.2011.06.004. [JET]
Sterling, P. & Eyer, J. (1988) Allostasis: A new paradigm to explain arousal pathology. In: *Handbook of life stress, cognition and health*, ed. S. Fisher & J. Reason, pp. 629–49. John Wiley & Sons. [JET]
Sterling, P. & Laughlin, S. (2015) *Principles of neural design*. MIT Press. [aFL, JET]
Sternberg, S. (1966) High-speed scanning in human memory. *Science* **153**(3736):652–54. doi:10.1126/science.153.3736.652. [aFL]
Stewart, N. (2009) Decision by sampling: The role of the decision environment in risky choice. *The Quarterly Journal of Experimental Psychology* **62**(6):1041–62. doi:10.1080/17470210902747112. [aFL]
Stewart, N., Chater, N. & Brown, G. D. A. (2006) Decision by sampling. *Cognitive Psychology* **53**(1):1–26. doi:10.1016/j.cogpsych.2005.10.003. [aFL]
Stigler, G. J. (1961) The economics of information. *Journal of Political Economy* **69**(3):213–25. [aFL, WJM]
Stocker, A., Simoncelli, E. & Hughes, H. (2006) Sensory adaptation within a Bayesian framework for perception. In: *Advances in neural information processing systems*, vol. **18**, ed. Y. Weiss, B. Schölkopf & J. Platt, pp. 1291–98. MIT Press. [aFL]
Stocker, A. A. & Simoncelli, E. P. (2006) Noise characteristics and prior expectations in human visual speed perception. *Nature Neuroscience* **9**(4):578–85. [VRB]
Suchow, J. W. (2014) *Measuring, monitoring, and maintaining memories in a partially observable mind* (Doctoral dissertation). Harvard University. [aFL]
Suchow, J. W. & Griffiths, T. L. (2016) Deciding to remember: Memory maintenance as a Markov decision process. In: *Proceedings from the 38th annual conference of the Cognitive Science Society*, pp. 2063–68. Cognitive Science Society. [aFL]
Sutherland, S. (2013) *Irrationality: The enemy within*. Pinter & Martin Ltd. [aFL]
Swinnen, S. P. (2002) Intermanual coordination: From behavioural principles to neural-network interactions. *Nature Reviews Neuroscience* **3**:348–59. [ND]
Szollosi, A., Liang, G., Konstantinidis, E., Donkin, C. & Newell, B. R. (2019) Simultaneous underweighting and overestimation of rare events: Unpacking a paradox. *Journal of Experimental Psychology: General* **148**(12):2207–17. Available at: http://dx.doi.org/10.1037/xge0000603. [AS]
Taatgen, N. A. & Anderson, J. R. (2002) Why do children learn to say "broke"? A model of learning the past tense without feedback. *Cognition* **86**:123–55. [CD]
Taber, C. S. & Lodge, M. (2006) Motivated skepticism in the evaluation of political beliefs. *American Journal of Political Science* **50**:755–69. [EM]
Tajima, S., Drugowitsch, J. & Pouget, A. (2016) Optimal policy for value-based decision-making. *Nature Communications* **7**:12400–11. doi:10.1038/ncomms12400. [aFL]
Tassinari, H., Hudson, T. E. & Landy, M. S. (2006) Combining priors and noisy visual cues in a rapid pointing task. *The Journal of Neuroscience* **26**(40):10154–63. doi:10.1523/JNEUROSCI.2779-06.2006. [VRB]
Tenenbaum, J. & Griffiths, T. (2001) The rational basis of representativeness. In: *Proceedings from the 23rd annual conference of the Cognitive Science Society*, 84–98. Cognitive Science Society. [aFL]
Tenenbaum, J. B., Kemp, C., Griffiths, T. L. & Goodman, N. (2011) How to grow a mind: Statistics, structure, and abstraction. *Science* **331**:1279–85. [HA]

Theriault, J. E., Young, L. L. & Barrett, L. F. (2019) The sense of should: A biologically-based model of social pressure. *PsyArXiv. Preprint 10.31234/osf.io/x5rbs*. Available at: https://doi.org/10.31234/osf.io/x5rbs. [JET]
Tilman, R. (1991) *Thorstein Veblen and his critics, 1891–1963: Conservative, liberal, and radical perspectives*. Princeton University Press. [HMC]
Todd, P. M. & Brighton, H. (2016) Building the theory of ecological rationality. *Minds and Machines* **26**(1–2):9–30. doi:10.1007/s11023-015-9371-0. [aFL]
Todd, P. M. & Gigerenzer, G. (2012) *Ecological rationality: Intelligence in the world*. Oxford University Press. [aFL]
Todorov, E. (2004) Optimality principles in sensorimotor control. *Nature Neuroscience* **7**(9):907–15. doi:10.1038/nn1309. [aFL]
Todorov, E. & Jordan, M. I. (2002) Optimal feedback control as a theory of motor coordination. *Nature Neuroscience* **5**(11):1226. [WJM]
Tooby, J. & Cosmides, L. (2000) Evolutionary psychology and the emotions. *Handbook of Emotions* **2**:91–115. [KPK]
Tran, R., Vul, E. & Pashler, H. (2017) How effective is incidental learning of the shape of probability distributions? *Royal Society Open Science* **4**(8):170270. [AS]
Treisman, A. M. & Gelade, G. (1980) A feature-integration theory of attention. *Cognitive Psychology* **12**(1):97–136. doi:10.1016/0010-0285(80)90005-5. [aFL]
Tsetsos, K., Moran, R., Moreland, J., Chater, N., Usher, M. & Summerfield, C. (2016) Economic irrationality is optimal during noisy decision making. *Proceedings of the National Academy of Sciences* **113**(11):3102–07. doi:10.1073/pnas.1519157113. [aFL]
Tversky, A. & Kahneman, D. (1973) Availability: A heuristic for judging frequency and probability. *Cognitive Psychology* **5**(2):207–32. doi:10.1016/0010-0285(73)90033-9. [aFL]
Tversky, A. & Kahneman, D. (1974) Judgment under uncertainty: Heuristics and biases. *Science* **185**(4157):1124–31. doi:10.1126/science.185.4157.1124. [arFL, ANS]
Tversky, A. & Kahneman, D. (1992) Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty* **5**(4):297–323. doi:10.1007/BF00122574. [aFL]
van den Berg, R. & Ma, W. J. (2018) A resource-rational theory of set size effects in human visual working memory. *ELife* **7**:e34963. [aFL, WJM]
van der Meer, M., Kurth-Nelson, Z. & Redish, A. D. (2012) Information processing in decision-making systems. *The Neuroscientist* **18**(4):342–59. [rFL]
Van Ravenzwaaij, D., van der Maas, H. L. J. & Wagenmakers, E.-J. (2012) Optimal decision making in neural inhibition models. *Psychological Review* **119**(1):201–15. doi:10.1037/a0026275. [aFL]
Van Rooij, I. (2008) The tractable cognition thesis. *Cognitive Science* **32**(6):939–84. doi:10.1080/03640210801897856. [aFL]
Van Rooij, I., Kwisthout, J., Blokpoel, M., Szymanik, J., Wareham, T. & Toni, I. (2011) Intentional communication: Computationally easy or difficult? *Frontiers in Human Neuroscience* **5**:1–18. doi:10.3389/fnhum.2011.00052 [MD]
Varela, F. J., Thompson, E. & Rosch, E. (1991) *The embodied mind: Cognitive science and human experience*. MIT Press. [KPK]
Veblen, T. (1899) *The theory of the leisure class: An economic study of institutions*. Macmillan & Co. [HMC]
Verrecchia, R. E. (1982) Information acquisition in a noisy rational expectations economy. *Econometrica: Journal of the Econometric Society* **50**(6):1415–30. doi:10.2307/1913389. [aFL]
Von Neumann, J. & Morgenstern, O. (1944) *The theory of games and economic behavior*. Princeton University Press. [aFL]
Vourdas, A. (2019) Probabilistic inequalities and measurements in bipartite systems. *Journal of Physics A: Mathematical and Theoretical* **52**:085301. [CM]
Vul, E., Goodman, N. D., Griffiths, T. L. & Tenenbaum, J. B. (2014) One and done? Optimal decisions from very few samples. *Cognitive Science* **38**(4):599–637. doi:10.1111/cogs.12101. [aFL, ANS, WJM]
Vulkan, N. (2000) An economist's perspective on probability matching. *Journal of Economic Surveys* **14**(1):101–18. doi:10.1111/1467-6419.00106. [aFL]
Wald, A. (1950) *Statistical decision functions*. John Wiley & Sons. [ANS]
Waldron, V. R. & Cegala, D. J. (1992) Assessing conversational cognition: Levels of cognitive theory and associated methodological requirements. *Human Communication Research* **18**(4):599–622. doi:10.1111/j.1468-2958.1992.tb00573.x. [MD]
Walleczek, J., ed. (2006) *Self-organized biological dynamics and nonlinear control: Toward understanding complexity, chaos and emergent function in living systems*. Cambridge University Press. [KPK]
Wang, Z., Solloway, T., Shiffrin, R. M. & Busemeyer, J. R. (2014) Context effects produced by question orders reveal quantum nature of human judgments. *Proceedings of the National Academy of Sciences* **111**(26):9431–36. [HA]
Wang, Z., Wei, X.-X., Stocker, A. A. & Lee, D. D. (2016) Efficient neural codes under metabolic constraints. In: *Advances in neural information processing systems*, vol. **29**, ed. D. D. Lee, M. Sugiyama, U. V Luxburg, I. Guyon & R. Garnett, pp. 4619–27. Curran Associates, Inc. [aFL]
Wason, P. C. (1968) Reasoning about a rule. *Quarterly Journal of Experimental Psychology* **20**(3):273–81. doi:10.1080/14640746808400161. [aFL]
Wegner, D. M. & Vallacher, R. R. (1986) Action identification. In: *Handbook of motivation and cognition: Foundations of social behavior*, ed. R. M. Sorrentino & E. T. Higgins, pp. 550–82. Guilford Press. [KP]
Wei, X.-X. & Stocker, A. A. (2015) A Bayesian observer model constrained by efficient coding can explain "anti-Bayesian" percepts. *Nature Neuroscience* **18**(10):1509–17. doi:10.1038/nn.4105. [aFL, EM, WJM]
Wei, X.-X. & Stocker, A. A. (2017) Lawful relation between perceptual bias and discriminability. *Proceedings of the National Academy of Sciences* **114**(38):10244–49. doi:10.1073/pnas.1619153114. [aFL, EM]
Weibel, E. R. (2000) *Symmorphosis: On form and function in shaping life*. Harvard University Press. [JET]
Wells, A. (2011) *Metacognitive therapy for anxiety and depression*. Guilford Press. [EMR]
Westermann, G., Mareschal, D., Johnson, M. H., Sirois, S., Spratling, M. W. & Thomas, M. S. C. (2007) Neuroconstructivism. *Developmental Science* **10**(1):75–83. Available at: https://doi.org/10.1111/j.1467-7687.2007.00567.x. [JET]
Whitton, A. E., Treadway, M. T. & Pizzagalli, D. A. (2015) Reward processing dysfunction in major depression, bipolar disorder and schizophrenia. *Current Opinion in Psychiatry* **28**(1):7–12. Available at: http://doi.org/10.1097/YCO.0000000000000122. [EMR]
Wilson, M. (2002) Six views of embodied cognition. *Psychonomic Bulletin & Review* **9**(4):625–36. [aFL]
Wolfe, J. M. (1994) Guided search 2.0 a revised model of visual search. *Psychonomic Bulletin & Review* **1**(2):202–38. doi:10.3758/BF03200774. [aFL]
Wolpert, D. M. & Ghahramani, Z. (2000) Computational principles of movement neuroscience. *Nature Neuroscience* **3**(11):1212–17. doi:10.1038/81497. [aFL]
Won, I., Gross, S. & Firestone, C. (2019) Impossible somatosensation. *PsyArXiv*. [EM]
Wood, I. (2013) Entrusting western Europe to the Church, 400-750. *Transactions of the Royal Historical Society* **23**:37–73. [HMC]
Woodford, M. (2012) Prospect theory as efficient perceptual distortion. *American Economic Review* **102**(3):41–46. [WJM]
Woodford, M. (2014) Stochastic choice: An optimizing neuroeconomic model. *American Economic Review* **104**(5):495–500. doi:10.1257/aer.104.5.495. [aFL]
Woodford, M. (2016) *Optimal evidence accumulation and stochastic choice* (Technical report). Columbia University. [aFL]
World Health Organization. (2019) *Ten threats to global health*. Available at: https://www.who.int/emergencies/ten-threats-to-global-health-in-2019. [KPK]
Xu, F. & Garcia, V. (2008) Intuitive statistics by 8-month-old infants. *Proceedings of the National Academy of Sciences* **105**(13):5012–15. doi:10.1073/pnas.0704450105. [VRB]
Yu, Y., Bonawitz, E. & Shafto, P. (2019) Pedagogical questions in parent-child conversations. *Child Development* **90**(1):147–61. [KP]
Yukalov, V. I. & Sornette, D. (2011) Decision theory with prospect interference and entanglement. *Theory and Decision* **70**(3):283–328. [HA]
Zaslavsky, N., Kemp, C., Regier, T. & Tishby, N. (2018) Efficient compression in color naming and its evolution. *Proceedings of the National Academy of Sciences* **115**(31):7937–42. doi:10.1073/pnas.1800521115. [aFL, WJM]
Zelazo, P. D., Anderson, J. E., Richler, J., Wallner-Allen, K., Beaumont, J. L. & Weintraub, S. (2013) NIH toolbox cognition battery (CB): Measuring executive function and attention. *Monographs of the Society for Research in Child Development* **78**(4):16–33. [VRB]
Zénon, A., Solopchuk, O. & Pezzulo, G. (2019) An information-theoretic perspective on the costs of cognition. *Neuropsychologia* **123**(4):5–18. Available at: https://doi.org/10.1016/j.neuropsychologia.2018.09.013. [JET]
Zhang, H. & Maloney, L. T. (2012) Ubiquitous log odds: A common representation of probability and frequency distortion in perception, action, and cognition. *Frontiers in Neuroscience* **6**:1. Available at: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3261445&tool=pmcentrez&rendertype=abstract [Accessed September 5, 2015]. [DRa]
Zhu, J.-Q., Sanborn, A. N. & Chater, N. (2018a) The Bayesian sampler: Generic Bayesian inference causes incoherence in human probability judgments. Available at: https://doi.org/10.31234/osf.io/af9vy. [ANS]
Zhu, J.-Q., Sanborn, A. N. & Chater, N. (2018b) Mental sampling in multimodal representations. In: Advances in neural information processing systems, vol. 31, ed. S. Bengio, H. Wallach, H. Larochelle, K. Grauman, N. Cesa-Bianchi & R. Garnett, pp. 5752–63. Curran Associates, Inc. [ANS]
Zipf, G. K. (1949) *Human behavior and the principle of least effort: An introduction to human ecology*. Addison-Wesley Press. [aFL, MD]