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## Optimal bounds, bounded optimality

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## Bibliography

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- Achen, C. H. (2005). Two-step hierarchical estimation: Beyond regression analysis. *Political Analysis*, 13(4), 447–456. doi: <http://doi.org/10.1093/pan/mpi033>
- Adelson, E. H. & Bergen, J. R. (1985). Spatiotemporal energy models for the perception of motion. *Journal of the Optical Society of America. A, Optics and Image Science*, 2(2), 284–299.
- Ahn, W.-Y., Busemeyer, J. R., Wagenmakers, E.-J. & Stout, J. C. (2008). Comparison of decision learning models using the generalization criterion method. *Cognitive Science*, 32(8), 1376–1402. doi: 10.1080/03640210802352992
- Ahn, W.-Y., Haines, N. & Zhang, L. (2016). Revealing neuro-computational mechanisms of reinforcement learning and decision-making with the hBayesDM package. *bioRxiv*. doi: <http://dx.doi.org/10.1101/064287>
- Ahn, W.-Y., Vasilev, G., Lee, S. H., Busemeyer, J. R., Kruschke, J. K. & Bechara, A. (2014). Decision-making in stimulant and opiate addicts in protracted abstinence: Evidence from computational modeling with pure users. *Frontiers in Psychology*, 5, 1–15. doi: 10.3389/fpsyg.2014.00849
- Altman, D. G. & Royston, P. (2006). The cost of dichotomising continuous variables. *British Medical Journal*, 332, 1080. doi: 10.1136/bmj.332.7549.1080
- Anderson, J. L., Sellbom, M., Ayearst, L., Quilty, L. C., Chmielewski, M. & Bagby, R. M. (2015). Associations between DSM-5 section III personality traits and the Minnesota Multiphasic Personality Inventory 2-Restructured Form (MMPI-2-RF) scales in a psychiatric patient sample. *Psychological Assessment*, 27(3), 801–815. doi: 10.1037/pas0000096
- Ashby, F. G. (1983). A biased random walk model for two choice reaction times. *Journal of Mathematical Psychology*, 27, 277–297.
- Audley, R. J. & Pike, A. R. (1965). Some Alternative Stochastic Models of Choice. *The British Journal of Mathematical and Statistical Psychology*, 18(2), 207–225.
- Austin, P. C. & Brunner, L. J. (2004). Inflation of the type I error rate when a continuous confounding variable is categorized in logistic regression analyses. *Statistics in Medicine*, 23, 1159–1178. doi: 10.1002/sim.1687

- Baayen, R. H., Davidson, D. J. & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, *59*(4), 390–412. doi: 10.1016/j.jml.2007.12.005
- Badre, D., Lebrecht, S., Pagliaccio, D., Long, N. M. & Scimeca, J. M. (2014). Ventral Striatum and the evaluation of memory retrieval strategies. *Journal of Cognitive Neuroscience*, *26*(9), 1928–1948. doi: 10.1162/jocn
- Bahadur, R. R. & Bickel, P. J. (2009). An optimality property of Bayes' test statistics. In J. Rojo (Ed.), *Optimality: The third Erich L. Lehmann symposium* (Vol. 57, pp. 18–30). Beachwood, Ohio, USA: Institute of Mathematical Statistics. doi: 10.1214/09-LNMS5704
- Balci, F., Simen, P., Niyogi, R., Saxe, A., Hughes, J. a., Holmes, P. & Cohen, J. D. (2011). Acquisition of decision making criteria: Reward rate ultimately beats accuracy. *Attention, Perception & Psychophysics*, *73*(2), 640–657.
- Balota, D. a., Yap, M. J., Cortese, M. J., Hutchison, K. a., Kessler, B., Loftis, B., . . . Treiman, R. (2007). The English lexicon project. *Behavior Research Methods*, *39*(3), 445–459. doi: 10.3758/BF03193014
- Batchelder, W. H. (1998). Multinomial processing tree models and psychological assessment. *Psychological Assessment*, *10*(4), 331–344. doi: 10.1037/1040-3590.10.4.331
- Batchelder, W. H. & Riefer, D. M. (1999). Theoretical and empirical review of multinomial process tree modeling. *Psychonomic Bulletin & Review*, *6*, 57–86.
- Bates, D., Maechler, M. & Bolker, B. (2013). *Linear mixed-effects models using S4 classes (Version 0.999999-2) [Computer software]*.
- Bayarri, M. J., Berger, J. O., Forte, A. & García-Donato, G. (2012). Criteria for Bayesian model choice with application to variable selection. *Annals of Statistics*, *40*(3), 1550–1577. doi: 10.1214/12-AOS1013
- Bechara, A., Damasio, A. R., Damasio, H. & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, *50*, 7–15. doi: 10.1016/0010-0277(94)90018-3
- Beitz, K. M., Salthouse, T. A. & Davis, H. P. (2014). Performance on the Iowa gambling task: From 5 to 89 years of age. *Journal of Experimental Psychology: General*, *143*(4), 1677–1689. doi: 10.3851/IMP2701.Changes
- Bellman, R. (2003). *Dynamic Programming*. Mineola: Dover.
- Bender, S., Resch, F., Weisbrod, M. & Oelkers-Ax, R. (2004). Specific task anticipation versus unspecific orienting reaction during early contingent negative variation. *Clinical Neurophysiology*, *115*(8), 1847–1859. doi: 10.1016/j.clinph.2004.03.023
- Bennett, C. H. (1976). Efficient estimation of free energy differences from monte carlo data. *Journal of Computational Physics*, *22*, 245–268.
- Berger, J. O. (2006). Bayes Factors. In S. Kotz, N. Balakrishnan, C. B. Read & B. Vidakovic (Eds.), *Encyclopedia of statistical sciences* (2nd ed., Vol. 1 ed.). New York: Wiley.
- Betsch, C. & Iannello, P. (2010). Measuring individual differences in intuitive and deliberate decision-making styles: A comparison of different measures. In A. Glöckner & C. Wittman (Eds.), *Foundations for tracing intuition: Challenges and methods* (pp. 251 – 267). London, UK: Psychology Press.

- Birbaumer, N., Elbert, T., Canavan, A. G. M. & Rockstroh, B. (1990). Slow potentials of the cerebral cortex and behavior. *Physiological Reviews*, *70*(1), 1–41.
- Boehm, U., Steingroever, H. & Wagenmakers, E.-J. (2016). Using Bayesian regression to incorporate covariates into hierarchical cognitive models. *Manuscript submitted for publication*.
- Boehm, U., Van Maanen, L., Forstmann, B. & Van Rijn, H. (2014). Trial-by-trial fluctuations in CNV amplitude reflect anticipatory adjustment of response caution. *NeuroImage*, *96*, 95–105.
- Bogacz, R., Brown, E., Moehlis, J., Holmes, P. & Cohen, J. D. (2006). The physics of optimal decision making: A formal analysis of models of performance in two-alternative forced-choice tasks. *Psychological Review*, *113*(4), 700–765.
- Bogacz, R., Hu, P. T., Holmes, P. J. & Cohen, J. D. (2010). Do humans produce the speed-accuracy trade-off that maximizes reward rate? *The Quarterly Journal of Experimental Psychology*, *63*(5), 863–891.
- Bowman, N. E., Kording, K. P. & Gottfried, J. A. (2012). Temporal integration of olfactory perceptual evidence in human orbitofrontal cortex. *Neuron*, *75*(5), 916–27.
- Box, G. E. & Tiao, G. C. (1992). *Bayesian Inference in Statistical Analysis*. New York: Wiley.
- Boyce, C. J., Wood, A. M. & Ferguson, E. (2016). Individual Differences in Loss Aversion. *Personality and Social Psychology Bulletin*, *42*(4), 471–484.
- Brázdil, M., Roman, R., Daniel, P. & Rektor, I. (2003). Intracerebral somatosensory event-related potentials: Effect of response type (button pressing versus mental counting) on P3-like potentials within the human brain. *Clinical Neurophysiology*, *114*, 1489–1496.
- Britten, K. H., Shadlen, M. N., Newsome, W. T. & Movshon, A. J. (1992). The analysis of visual motion: A comparison of neuronal and psychophysical performance. *Journal of Neuroscience*, *12*(12), 4745–4765.
- Britten, K. H., Shadlen, M. N., Newsome, W. T. & Movshon, A. J. (1993). Responses of neurons in macaque MT to stochastic motion signals. *Visual Neuroscience*, *10*, 1157–1169.
- Brooks, S. P. & Gelman, A. (1998). General methods for monitoring convergence of iterative simulations. *Journal of Computational and Graphical Statistics*, *7*, 434–455.
- Brown, K. S. & Sethna, J. P. (2003). Statistical mechanical approaches to models with many poorly known parameters. *Physical Review E*, *68*(2), 021904. doi: 10.1103/PhysRevE.68.021904
- Brown, S., Steyvers, M. & Wagenmakers, E. J. (2009). Observing evidence accumulation during multi-alternative decisions. *Journal of Mathematical Psychology*, *53*(6), 453–462.
- Brown, S. D. & Heathcote, A. (2008). The simplest complete model of choice response time: linear ballistic accumulation. *Cognitive Psychology*, *57*(3), 153–178. doi: 10.1016/j.cogpsych.2007.12.002
- Buckner, R. L. (1998). Event-related fMRI and the hemodynamic response. *Human Brain Mapping*, *6*(5-6), 373–377.

- Buelow, M. T. & Suhr, J. A. (2009). Construct validity of the Iowa gambling task. *Neuropsychology Review*, *19*, 102–114. doi: 10.1007/s11065-009-9083-4
- Busemeyer, J. R. & Rapoport, A. (1988). Psychological models of deferred decision making. *Journal of Mathematical Psychology*, *32*(2), 91–134.
- Busemeyer, J. R. & Stout, J. C. (2002). A contribution of cognitive decision models to clinical assessment: Decomposing performance on the Bechara gambling task. *Psychological Assessment*, *14*, 253–262. doi: 10.1037/1040-3590.14.3.253
- Busemeyer, J. R. & Townsend, J. T. (1993). Decision field theory: A dynamic-cognitive approach to decision making in an uncertain environment. *Psychological Review*, *100*(3), 432–459.
- Cain, N. & Shea-Brown, E. (2012). Computational models of decision making: integration, stability, and noise. *Current Opinion in Neurobiology*, *22*(6), 1047–1053.
- Canessa, N., Crespi, C., Motterlini, M., Baud-Bovy, G., Chierchia, G., Pantaleo, G., ... Cappa, S. F. (2013). The Functional and Structural Neural Basis of Individual Differences in Loss Aversion. *Journal of Neuroscience*, *33*(36), 14307–14317.
- Carpenter, B., Gelman, A., Hoffman, M., Lee, D., Goodrich, B., Betancourt, M., ... Riddell, A. (2017). Stan: A Probabilistic Programming Language. *Journal of Statistical Software*, *76*(1). doi: 10.18637/jss.v076.i01
- Carpenter, B., Gelman, A., Hoffman, M., Lee, D., Goodrich, B., Betancourt, M., ... Riddell, A. (in press). Stan: A Probabilistic Programming Language. *Journal of Statistical Software*.
- Cavanagh, J. F., Wiecki, T. V., Cohen, M. X., Figueroa, C. M., Samanta, J., Sherman, S. J. & Frank, M. J. (2011). Subthalamic nucleus stimulation reverses mediofrontal influence over decision threshold. *Nature Neuroscience*, *14*(11), 1462–1467.
- Chan, T. W. S., Ahn, W.-Y., Bates, J. E., Busemeyer, J. R., Guillaume, S., Redgrave, G. W., ... Courtet, P. (2013). Differential impairments underlying decision making in anorexia nervosa and bulimia nervosa: A cognitive modeling analysis. *The International Journal of Eating Disorders*, *47*(2), 157–167. doi: 10.1002/eat.22223
- Chevalier, N., Chatham, C. H. & Munakata, Y. (2014). The practice of going helps children to stop: The importance of context monitoring in inhibitory control. *Journal of Experimental Psychology: General*, *143*(3), 959–965. doi: 10.1037/a0035868
- Chung, Y., Rabe-Hesketh, S., Dorie, V., Gelman, A. & Liu, J. (2013). A non-degenerate estimator for hierarchical variance parameters via penalized likelihood estimation. *Psychometrika*, *78*(4), 685–709. doi: 10.1007/s11336-013-9328-2
- Churchland, A. K., Kiani, R., Chaudhuri, R., Wang, X. J., Pouget, A. & Shadlen, M. N. (2011). Variance as a signature of neural computations during decision making. *Neuron*, *69*(4), 818–831.
- Churchland, A. K., Kiani, R. & Shadlen, M. N. (2008). Decision-making with multiple alternatives. *Nature Neuroscience*, *11*(6), 693–702.

- Cisek, P., Puskas, G. A. & El-Murr, S. (2009). Decisions in changing conditions: The urgency-gating model. *Journal of Neuroscience*, *29*(37), 11560–11571.
- Cohen, J. (1983). The cost of dichotomization. *Applied Psychological Measurement*, *7*, 249–253.
- Coles, M. G. H. (1989). Modern mind-reading: Psychophysiology, physiology, and cognition. *Psychophysiology*, *26*(3), 251–269.
- Coolin, A., Erdfelder, E., Bernstein, D. M., Thornton, A. E. & Thornton, W. L. (2015). Explaining individual differences in cognitive processes underlying hindsight bias. *Psychonomic Bulletin & Review*, *22*, 328–348. doi: 10.3758/s13423-014-0691-5
- Cooper, J. A., Worthy, D. A. & Maddox, W. T. (2015). Chronic motivational state interacts with task reward structure in dynamic decision-making. *Cognitive Psychology*, *83*, 40–53. doi: 10.1016/j.cogpsych.2015.09.001.
- Cui, R. Q., Egkher, A., Huter, D., Lang, W., Lindinger, G. & Deecke, L. (2000). High resolution spatiotemporal analysis of the contingent negative variation in simple or complex motor tasks and a non-motor task. *Clinical Neurophysiology*, *111*(10), 1847–1859.
- De Jong, R., Wierda, M., Mulder, G. & Mulder, L. J. (1988). Use of partial stimulus information in response processing. *Journal of Experimental Psychology: Human Perception and Performance*, *14*(4), 682–692.
- Deco, G., Rolls, E. T. & Romo, R. (2009). Stochastic dynamics as a principle of brain function. *Progress in Neurobiology*, *88*(1), 1–16.
- DeGroot, M. H. (1969). *Optimal statistical decisions*. New York: McGraw-Hill.
- Deneve, S. (2012). Making decisions with unknown sensory reliability. *Frontiers in Neuroscience*, *6*. doi: 10.3389/fnins.2012.00075
- Dickey, J. M. & Lientz, B. P. (1970). The weighted likelihood ratio, sharp hypotheses about chances, the order of a Markov chain. *The Annals of Mathematical Statistics*, *41*(1), 214–226. doi: 10.1214/aoms/1177697203
- Ditterich, J. (2006a). Evidence for time-variant decision making. *The European Journal of Neuroscience*, *24*(12), 3628–3641.
- Ditterich, J. (2006b). Stochastic models of decisions about motion direction: Behavior and physiology. *Neural Networks*, *19*(8), 981–1012.
- Ditterich, J. (2010). A comparison between mechanisms of multi-alternative perceptual decision making: Ability to explain human behavior, predictions for neurophysiology, and relationship with decision theory. *Frontiers in Neuroscience*, *4*. doi: 10.3389/fnins.2010.00184
- Donkin, C., Brown, S. & Heathcote, A. (2011). Drawing conclusions from choice response time models: A tutorial using the linear ballistic accumulator. *Journal of Mathematical Psychology*, *55*(2), 140–151. doi: 10.1016/j.jmp.2010.10.001
- Donkin, C., Brown, S., Heathcote, A. & Wagenmakers, E.-J. (2011). Diffusion versus linear ballistic accumulation: Different models but the same conclusions about psychological processes? *Psychonomic Bulletin & Review*, *18*, 61–69.
- Donner, T. H., Siegel, M., Fries, P. & Engel, A. K. (2009). Buildup of choice-predictive activity in human motor cortex during perceptual decision making. *Current Biology*, *19*(18), 1581–1585.

- Drugowitsch, J., Moreno-Bote, R., Churchland, A. K., Shadlen, M. N. & Pouget, A. (2012). The cost of accumulating evidence in perceptual decision making. *Journal of Neuroscience*, *32*(11), 3612–3628.
- Dutilh, G., Forstmann, B. U., Vandekerckhove, J. & Wagenmakers, E.-J. (2013). A diffusion model account of age differences in posterror slowing. *Psychology and Aging*, *28*(1), 64–76.
- Edwards, W. (1954). The theory of decision making. *Psychological Bulletin*, *51*(4), 380–417.
- Edwards, W. (1965). Optimal strategies for seeking information: Models for statistics, choice reaction time, and human information processing. *Journal of Mathematical Psychology*, *2*, 312–329.
- Edwards, W., Lindman, H. & Savage, L. J. (1963). Bayesian statistical inference for psychological research. *Psychological Review*, *70*(3), 193–242. doi: 10.1037/h0044139
- Efron, B. & Morris, C. (1977). Stein’s paradox in statistics. *Scientific American*, *236*(5), 119–127.
- Efron, B. & Tibshirani, R. (1994). *An introduction to the bootstrap*. New York: Chapman & Hall.
- Elbert, T. (1990). Slow cortical potentials reflect the regulation of cortical excitability. In W. C. McCallum (Ed.), *Proceedings of a NATO Advanced Research Workshop on Slow Potential Changes in the Human Brain* (Vol. 65390, pp. 235–251). Il Ciocco, Italy.
- Epstein, J. N., Conners, C. K., Hervey, A. S., Tonev, S. T., Arnold, L. E., Abikoff, H. B., ... Wigal, T. (2006). Assessing medication effects in the MTA study using neuropsychological outcomes. *Journal of Child Psychology and Psychiatry*, *47*(5), 446–456. doi: 10.1111/j.1469-7610.2005.01469.x
- Eriksen, B. A. & Eriksen, C. W. (1974). Effects of noise letters upon identification of a target letter in a non- search task. *Perception and Psychophysics*, *16*, 143–149. doi: 10.3758/BF03203267
- Ernst, M., Grant, S. J., London, E. D., Contoreggi, C. S., Kimes, A. S. & Spurgeon, L. (2003). Decision making in adolescents with behavior disorders and adults with substance abuse. *The American Journal of Psychiatry*, *160*, 33–40. doi: 10.1176/appi.ajp.160.1.33
- Evans, N. J. & Brown, S. D. (2017). People adopt optimal policies in simple decision-making, after practice and guidance. *Psychonomic Bulletin & Review*, *24*(2), 597–606.
- Evans, N. J., Hawkins, G. E., Boehm, U., Wagenmakers, E.-J. & Brown, S. D. (2017). The computations that support simple decision-making: A comparison between the diffusion and urgency-gating models . *Submitted for Publication*.
- Farrell, S. & Ludwig, C. J. H. (2008). Bayesian and maximum likelihood estimation of hierarchical response time models. *Psychonomic Bulletin & Review*, *15*(6), 1209–1217. doi: 10.3758/PBR.15.6.1209
- Feller, W. (1968). *An Introduction to probability theory and its applications* (3rd ed., Vol. 1 ed.). New York: Wiley.
- Festinger, L. (1943). Studies in decision. II. An empirical test of a quantitative theory of decision. *Journal of Experimental Psychology*, *32*(5), 411–423.

- Forstmann, B. U., Anwander, A., Schäfer, A., Neumann, J., Brown, S., Wagenmakers, E.-J., ... Turner, R. (2010). Cortico-striatal connections predict control over speed and accuracy in perceptual decision making. *Proceedings of the National Academy of Sciences*, *107*(36), 15916–15920. doi: 10.1073/pnas.1004932107
- Forstmann, B. U., Dutilh, G., Brown, S., Neumann, J., von Cramon, D. Y., Ridderinkhof, K. R. & Wagenmakers, E.-J. (2008). Striatum and pre-SMA facilitate decision-making under time pressure. *Proceedings of the National Academy of Sciences*, *105*(45), 17538–17542. doi: 10.1073/pnas.0805903105
- Forstmann, B. U., Ratcliff, R. & Wagenmakers, E. (2016). Sequential sampling models in cognitive neuroscience: Advantages, applications, and extensions. *Annual Review of Psychology*, *67*, 641–666. doi: 10.1146/annurev-psych-122414-033645
- Forstmann, B. U., Wagenmakers, E.-J., Eichele, T., Brown, S. & Serences, J. T. (2011). Reciprocal relations between cognitive neuroscience and formal cognitive models: opposites attract? *Trends in Cognitive Sciences*, *15*(6), 272–279. doi: 10.1016/j.tics.2011.04.002
- Frank, M. J., Gagne, C., Nyhus, E., Masters, S., Wiecki, T. V., Cavanagh, J. F. & Badre, D. (2015). fMRI and EEG predictors of dynamic decision parameters during human reinforcement learning. *Journal of Neuroscience*, *35*(2), 485–494. doi: <https://doi.org/10.1523/JNEUROSCI.2036-14.2015>
- Frazier, P. I. & Yu, A. J. (2008). Sequential hypothesis testing under stochastic deadlines. In J. Platt, D. Koller, Y. Singer & S. Roweis (Eds.), *Advances in neural information processing systems 20* (pp. 465–472). Cambridge, MA: MIT Press.
- Fridberg, D. J., Queller, S., Ahn, W.-Y., Kim, W., Bishara, A. J., Busemeyer, J. R., ... Stout, J. C. (2010). Cognitive mechanisms underlying risky decision-making in chronic cannabis users. *Journal of Mathematical Psychology*, *54*(1), 28–38. doi: 10.1016/j.jmp.2009.10.002
- Frühwirth-Schnatter, S. (2004). Estimating marginal likelihoods for mixture and markov switching models using bridge sampling techniques. *Econometrics Journal*, *7*, 143–167.
- Gaillard, A. W. & Näätänen, R. (1973). Slow potential changes and choice reaction time as a function of interstimulus interval. *Acta Psychologica*, *37*, 173–186.
- Gelman, A. (2006). Prior distribution for variance parameters in hierarchical models. *Bayesian Analysis*, *1*(3), 515–533. doi: 10.1214/06-BA117A
- Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A. & Rubin, D. B. (2013). *Bayesian Data Analysis* (3rd ed.). London: Chapman and Hall/ CRC.
- Gelman, A. & Hill, J. (2007). *Data analysis using regression and multi-level/hierarchical models*. Cambridge: Cambridge University Press.
- Gelman, A. & Rubin, D. B. (1992). Inference from iterative simulation using multiple sequences. *Statistical Science*, *7*(4), 457–511. doi: 10.1214/ss/1177011136
- Geweke, J. (1992). Evaluating the accuracy of sampling-based approaches to calculating posterior moments. In J. M. Bernardo, J. O. Berger, A. P. Dawid



- & A. F. M. Smith (Eds.), *Bayesian statistics 4* (pp. 169–193). Oxford, UK.: Clarendon Press.
- Gigerenzer, G., Krauss, S. & Vitouch, O. (2004). The Null ritual: What you always wanted to know about significance testing but were afraid to ask. In D. Kaplan (Ed.), *The sage handbook of quantitative methodology for the social sciences* (pp. 391–408). Thousand Oaks, CA: Sage.
- Gigerenzer, G. & Todd, P. M. (1999). *Fast and frugal heuristics: The adaptive toolbox*. Oxford University Press.
- Gluth, S., Rieskamp, J. & Büchel, C. (2012). Deciding when to decide: Time-variant sequential sampling models explain the emergence of value-based decisions in the human brain. *Journal of Neuroscience*, *32*(31), 10686–10698.
- Gluth, S., Rieskamp, J. & Büchel, C. (2013a). Classic EEG motor potentials track the emergence of value-based decisions. *NeuroImage*, *79*, 394–403.
- Gluth, S., Rieskamp, J. & Büchel, C. (2013b). Deciding not to decide: Computational and neural evidence for hidden behavior in sequential choice. *PLoS Computational Biology*, *9*(10), e1003309.
- Gold, J. I. & Shadlen, M. N. (2007). The neural basis of decision making. *Annual Review of Neuroscience*, *30*, 535–574.
- Gold, J. I., Shadlen, M. N. & Sales, T. (2002). Banburismus and the brain: Decoding the relationship between sensory stimuli, decisions, and reward. *Neuron*, *36*, 299–308.
- Gronau, Q. F., Sarafoglou, A., Matzke, D., Ly, A., Boehm, U., Marsman, M., . . . Steingroever, H. (2017). A Tutorial on Bridge Sampling. *Manuscript submitted for publication*. Retrieved from <http://arxiv.org/abs/1703.05984>
- Grünewald, G., Grünewald-Zuberbier, E., Netz, J., Homberg, V. & Sander, G. (1979). Relationships between the late component of the contingent negative variation and the Bereitschaftspotential. *Electroencephalography and clinical Neurophysiology*, *46*(5), 538–545.
- Haider, M., Spong, P. & Lindsley, D. B. (1964). Attention, vigilance, and cortical evoked-potentials in humans. *Science*, *145*(3628), 180–182.
- Hanes, D. P. & Schall, J. D. (1996). Neural control of voluntary movement initiation. *Science*, *274*(5286), 427–430.
- Hanks, T. D., Kiani, R. & Shadlen, M. N. (2014). A neural mechanism of speed-accuracy tradeoff in macaque area LIP. *eLife*, *3*, e02260. doi: 10.7554/eLife.02260
- Hanks, T. D., Mazurek, M. E., Kiani, R., Hopp, E. & Shadlen, M. N. (2011). Elapsed decision time affects the weighting of prior probability in a perceptual decision task. *Journal of Neuroscience*, *31*(17), 6339–63352.
- Hawkins, G. E., Brown, S. D., Steyvers, M. & Wagenmakers, E.-J. (2012a). Context effects in multi-alternative decision making: Empirical data and a Bayesian model. *Cognitive Science*, *36*(3), 498–516.
- Hawkins, G. E., Brown, S. D., Steyvers, M. & Wagenmakers, E.-J. (2012b). Decision speed induces context effects in choice. *Experimental Psychology*, *59*, 206–215.
- Hawkins, G. E., Brown, S. D., Steyvers, M. & Wagenmakers, E.-J. (2012c). An optimal adjustment procedure to minimize experiment time in decisions with

- multiple alternatives. *Psychonomic Bulletin & Review*, 19(2), 339–348.
- Hawkins, G. E., Forstmann, B. U., Wagenmakers, E.-J., Ratcliff, R. & Brown, S. D. (2015). Revisiting the evidence for collapsing boundaries and urgency signals in perceptual decision-making. *Journal of Neuroscience*, 35(6), 2476–2484.
- Hawkins, G. E., Wagenmakers, E.-J., Ratcliff, R. & Brown, S. D. (2015). Discriminating evidence accumulation from urgency signals in speeded decision making. *Journal of Neurophysiology*, 114(1), 40–47. doi: 10.1152/jn.00088.2015
- Heath, R. A. (1981). A tandem random-walk model for psychological discrimination. *British Journal of Mathematical and Statistical Psychology*, 34, 76–92.
- Heath, R. A. (1992). A general nonstationary diffusion model for two-choice decision-making. *Mathematical Social Sciences*, 23, 283–309.
- Heathcote, A. & Hayes, B. (2012). Diffusion versus linear ballistic accumulation: Different models for response time with different conclusions about psychological mechanisms? *Canadian Journal of Experimental Psychology*, 66, 125–136.
- Heathcote, A., Lin, Y. & Gretton, M. B. (2016). *DMC: Dynamic Models of Choice [Computer software]*. Retrieved from [osf.io/5yeh4](https://osf.io/5yeh4)
- Heathcote, A. & Love, J. (2012). Linear deterministic accumulator models of simple choice. *Frontiers in Psychology*, 3. doi: <http://doi.org/10.3389/fpsyg.2012.00292>
- Heck, D. W., Arnold, N. R. & Arnold, D. (in press). TreeBUGS: An R Package for Hierarchical Multinomial-Processing-Tree Modeling. *Behavior Research Methods*.
- Heekeren, H. R., Marrett, S. & Ungerleider, L. G. (2008). The neural systems that mediate human perceptual decision making. *Nature Reviews Neuroscience*, 9(6), 467–479.
- Heitz, R. P. & Schall, J. D. (2012). Neural mechanisms of speed-accuracy tradeoff. *Neuron*, 76(3), 616–628.
- Higgins, E. T., Friedman, R. S., Harlow, R. E., Idson, L. C., Ayduk, O. N. & Taylor, A. (2001). Achievement orientations from subjective histories of success: Promotion pride versus prevention pride. *European Journal of Social Psychology*, 31, 3–23. doi: 10.1002/ejsp.27
- Hillyard, S. A. (1969). Relationships between the contingent negative variation (CNV) and reaction time. *Physiology and Behavior*, 4, 351–357.
- Hillyard, S. A. & Münte, T. F. (1984). Selective attention to color and location: an analysis with event-related brain potentials. *Perception & Psychophysics*, 36(2), 185–198.
- Ho, T., Brown, S., Van Maanen, L., Forstmann, B. U., Wagenmakers, E.-J. & Serences, J. T. (2012). The optimality of sensory processing during the speed-accuracy tradeoff. *Journal of Neuroscience*, 32(23), 7992–8003. doi: 10.1523/JNEUROSCI.0340-12.2012
- Huang, Y. & Rao, R. P. N. (2013). Reward optimization in the primate brain: A probabilistic model of decision making under uncertainty. *PLoS One*, 8(1), e53344. doi: 10.1371/journal.pone.0053344

- Huk, A. C. & Shadlen, M. N. (2005). Neural activity in macaque parietal cortex reflects temporal integration of visual motion signals during perceptual decision making. *Journal of Neuroscience*, *25*(45), 10420–10436.
- Irwin, F. W., Smith, W. A. S. & Mayfield, J. F. (1956). Tests of two theories of decision in an “expanded judgment” situation. *Journal of Experimental Psychology*, *51*(4), 261–268.
- Ivanoff, J., Branning, P. & Marois, R. (2008). fMRI Evidence for a Dual Process Account of the Speed-Accuracy Tradeoff in Decision-Making. *PLoS ONE*, *3*(7), e2635. doi: 10.1371/journal.pone.0002635
- Janssen, P. & Shadlen, M. N. (2005). A representation of the hazard rate of elapsed time in macaque area LIP. *Nature Neuroscience*, *8*(2), 234–41.
- Jeffreys, H. (1961). *Theory of Probability* (3rd ed. ed.). Oxford: Oxford University Press.
- Jentzsch, I. & Sommer, W. (2001). Sequence-sensitive subcomponents of P300: Topographical analyses and dipole source localization. *Psychophysiology*, *38*, 607–621.
- Johnson, V. E. (2010). On the use of non-local prior densities in Bayesian hypothesis tests. *Journal of the Royal Statistical Society Series B (Methodological)*, *72*, 143–170. doi: 10.1111/j.1467-9868.2009.00730.x
- Jones, M. & Dhafarav, E. N. (2014). Unfalsifiability and mutual translatability of major modeling schemes for choice reaction time. *Psychological Review*, *121*(1), 1–32.
- Jung, T.-P., Makeig, S., Humphries, C. & Lee, T.-w. (2000). Removing electroencephalographic artifacts by blind source separation. *Psychophysiology*, *37*, 163–178.
- Kahneman, D. & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263–292.
- Kahneman, D. & Tversky, A. (1984). Choices, values, and frames. *American Psychologist*, *39*(4), 341–350.
- Kass, R. & Raftery, A. (1995). Bayes factors. *Journal of the American Statistical Association*, *90*, 773 – 795.
- Kaufman, L. & Gay, D. (2003). *The PORT library - optimization*. Murray Hill, NJ: AT&T Bell Laboratories.
- Kelly, S. P. & O’Connell, R. G. (2013). Internal and external influences on the rate of sensory evidence accumulation in the human brain. *Journal of Neuroscience*, *33*(50), 19434–19441.
- Khodadadi, A., Fakhariand, P. & Busemeyer, J. R. (2014). Learning to maximize reward rate: A model based on semi-markov decision processes. *Frontiers in Neuroscience*, *8*, Article 101.
- Kiani, R., Hanks, T. D. & Shadlen, M. N. (2008). Bounded integration in parietal cortex underlies decisions even when viewing duration is dictated by the environment. *The Journal of Neuroscience*, *28*(12), 3017–3029.
- Kieffaber, P. D., Kappenman, E. S., Bodkins, M., Shekhar, A., O’Donnell, B. F. & Hetrick, W. P. (2006). Switch and maintenance of task set in schizophrenia. *Schizophrenia Research*, *84*(2-3), 345–358. doi: 10.1016/j.schres.2006.01.022

- King, A. R. & Jackson, D. A. (2009). Personality disorder scale predictors of depression stability over time as a partial function of mental health history. *Personality and Mental Health*, *3*, 263–274. doi: 10.1002/pmh.84
- Kononowicz, T. W. & Van Rijn, H. (2011). Slow potentials in time estimation: The role of temporal accumulation and habituation. *Frontiers in Integrative Neuroscience*, *5*(48). doi: 10.3389/fnint.2011.00048
- Kononowicz, T. W. & Van Rijn, H. (2014). Decoupling Interval Timing and Climbing Neural Activity: A Dissociation between CNV and N1P2 Amplitudes. *Journal of Neuroscience*, *34*(8), 2931–2939.
- Kruschke, J. K. (2011). *Doing Bayesian data analysis*. Burlington, MA: Academic Press.
- Kryptos, A.-M., Beckers, T., Kindt, M. & Wagenmakers, E.-J. (2015). A Bayesian hierarchical diffusion model decomposition of performance in approach-avoidance tasks. *Cognition & Emotion*, *29*(8), 1424–1444. doi: 10.1080/02699931.2014.985635
- Kühn, S., Schmiedek, F., Schott, B., Ratcliff, R., Heinze, H.-J., Düzel, E., ... Lövdén, M. (2011). Brain areas consistently linked to individual differences in perceptual decision-making in younger as well as older adults before and after training. *Journal of Cognitive Neuroscience*, *23*(9), 2147–58. doi: 10.1162/jocn.2010.21564
- Kutas, M. & Donchin, E. (1980). Preparation to respond as manifested by motor-related brain potentials. *Brain Research*, *202*, 95–115.
- Kwak, Y., Pearson, J. & Huettel, S. A. (2014). Differential reward learning for self and others predicts self-reported altruism. *PLoS ONE*, *9*(9), e107621. doi: 10.1371/journal.pone.0107621
- Laming, D. R. J. (1968). *Information theory of choice reaction time*. New York: Wiley.
- Lang, W., Cheyne, D., Kristeva, R., Beisteiner, R., Lindinger, G. & Deecke, L. (1991). Three-dimensional localization of SMA activity preceding voluntary movement. A study of electric and magnetic fields in a patient with infarction of the right supplementary motor area. *Experimental Brain Research*, *87*, 688–695.
- Lee, M. D. (2011). Special issue on hierarchical Bayesian models. *Journal of Mathematical Psychology*, *50*, 1–118.
- Lee, M. D. & Wagenmakers, E.-J. (2014). *Bayesian Cognitive Modeling: A Practical Course*. Cambridge: Cambridge University Press.
- Lejuez, C. W., Aklin, W. M., Jones, H. A., Richards, J. B., Strong, D. R., Kahler, C. W. & Read, J. P. (2003). The balloon analogue risk task (BART) differentiates smokers and nonsmokers. *Experimental and Clinical Psychopharmacology*, *11*, 26–33. doi: 10.1037/1064-1297.11.1.26
- Leon, M. I. & Shadlen, M. N. (2003). Representation of time by neurons in the posterior parietal cortex of the macaque. *Neuron*, *38*, 317–327.
- Lerche, V. & Voss, A. (2016). Model complexity in diffusion modeling: Benefits of making the model more parsimonious. *Frontiers in Psychology*. doi: 10.3389/fpsyg.2016.01324
- Lerche, V. & Voss, A. (in press). Retest reliability of the parameters of the Ratcliff diffusion model. *Psychological Research*. doi: 10.1007/s00426-016-0770-5

- Leth-Steensen, C., Elbaz, K. Z. & Douglas, V. I. (2000). Mean response times, variability, and skew in the responding of ADHD children: A response time distributional approach. *Acta Psychologica*, *104*(2), 167–190. doi: 10.1016/S0001-6918(00)00019-6
- Leuthold, H. & Jentzsch, I. (2002). Distinguishing neural sources of movement preparation and execution: An electrophysiological analysis. *Biological Psychology*, *60*, 173–198.
- Leuthold, H., Sommer, W. & Ulrich, R. (1996). Partial advance information and response preparation: Inferences from the lateralized readiness potential. *Journal of experimental psychology: General*, *125*(3), 307–323.
- Leuthold, H., Sommer, W. & Ulrich, R. (2004). Preparing for Action: Inferences from CNV and LRP. *Journal of Psychophysiology*, *18*(2-3), 77–88. doi: 10.1027/0269-8803.18.2
- Lewis, S. M. & Raftery, A. E. (1997). Estimating Bayes factors via posterior simulation with the Laplace-Metropolis estimator. *Journal of the American Statistical Association*, *92*(468), 648–655. doi: 10.1080/01621459.1997.10474016
- Liang, F., Rui, P., German, M., Clyde, M. A. & Berger, J. O. (2008). Mixture of g priors for Bayesian variable selection. *Journal of the American Statistical Association*, *103*, 410–423.
- Lindley, D. V. & Smith, A. F. M. (1972). Bayes estimates for the linear model. *Journal of the Royal Statistical Society Series B (Methodological)*, *34*, 1–41.
- Lo, C.-C., Boucher, L., Paré, M., Schall, J. D. & Wang, X.-J. (2009). Proactive inhibitory control and attractor dynamics in countermanding action: A spiking neural circuit model. *Journal of Neuroscience*, *29*(28), 9059–9071.
- Loftus, G. R. & Masson, M. E. J. (1994). Using confidence intervals in within-subject designs. *Psychonomic Bulletin & Review*, *1*(4), 476–490.
- Lorist, M. M. & Snel, J. (1997). Caffeine effects on perceptual and motor processes. *Electroencephalography and Clinical Neurophysiology*, *102*(5), 401–413. doi: 10.1016/S0921-884X(97)95729-5
- Loveless, N. E. & Sanford, A. J. (1973). The contingent negative variation related to preparatory set in a reaction time situation with variable foreperiod. *Electroencephalography and Clinical Neurophysiology*, *35*(4), 369–374.
- Loveless, N. E. & Sanford, A. J. (1974). Slow potential correlates of preparatory set. *Biological Psychology*, *1*(4), 303–314.
- Luce, R. D. (1959). *Individual choice behavior: A theoretical analysis*. New York, NY: Wiley.
- Luck, S. J. (2005). *An introduction to the event-related potential technique*. Cambridge: MIT Press.
- Ly, A., Boehm, U., Heathcote, A., Turner, B. M., Forstmann, B., Marsman, M. & Matzke, D. (in press). A flexible and efficient hierarchical Bayesian approach to the exploration of individual differences in cognitive-model-based neuroscience. In *Computational models of brain and behavior*. Wiley.
- Ly, A., Verhagen, A. J. & Wagenmakers, E.-J. (2016). Harold Jeffreys’s default Bayes factor hypothesis tests: Explanation, extension, and application in psychology. *Journal of Mathematical Psychology*, *72*, 19–32.

- MacCallum, R. C., Zhang, S., Preacher, K. J. & Rucker, D. D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods*, 7, 19–40. doi: 10.1037//1082-989X.7.1.19
- MacKay, W. A. & Bonnet, M. (1990). CNV, stretch reflex and reaction time correlates of preparation for movement direction and force. *Electroencephalography and clinical Neurophysiology*, 76(1), 47–62.
- Maddox, W. T. & Bohil, C. J. (1998). Base-rate and payoff effects in multidimensional perceptual categorization. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24(6), 1459–1482.
- Malhotra, G., Leslie, D. S., Ludwig, C. J. H. & Bogacz, R. (2017). Overcoming indecision by changing the decision boundary. *Journal of Experimental Psychology: General*, 146(6), 776–805.
- Malhotra, G., Leslie, D. S., Ludwig, C. J. H. & Bogacz, R. (in press). Time-varying decision boundaries: Insights from optimality analysis. *Psychonomic Bulletin & Review*.
- Mantini, D., Hasson, U., Betti, V., Perrucci, M. G., Romani, G. L., Corbetta, M., ... Vanduffel, W. (2012). Interspecies activity correlations reveal functional correspondence between monkey and human brain areas. *Nature Methods*, 9(3), 277–282.
- Marsman, M., Maris, G., Bechger, T. & Glas, C. (2016). What can we learn from Plausible Values? *Psychometrika*, 81(2), 274–289.
- Martin, T., Huxlin, K. R. & Kavcic, V. (2010). Motion-onset visual evoked potentials predict performance during a global direction discrimination task. *Neuropsychologia*, 48(12), 3563–3572.
- Matzke, D., Dolan, C. V., Batchelder, W. H. & Wagenmakers, E.-J. (2015). Bayesian estimation of multinomial processing tree models with heterogeneity in participants and items. *Psychometrika*, 80, 205–235. doi: 10.1017/CBO9781107415324.004
- Matzke, D., Dolan, C. V., Logan, G. D., Brown, S. D. & Wagenmakers, E.-J. (2013). Bayesian parametric estimation of stop-signal reaction time distributions. *Journal of Experimental Psychology: General*, 142, 1047–1073. doi: 10.1037/a0030543
- Matzke, D., Hughes, M., Badcock, J. C., Michie, P. & Heathcote, A. (in press). Failures of cognitive control or attention? The case of stop-signal deficits in schizophrenia. *Attention, Perception, & Psychophysics*.
- Matzke, D., Love, J. & Heathcote, A. (2017). A Bayesian approach for estimating the probability of trigger failures in the stop-signal paradigm. *Behavior Research Methods*, 49(1), 267–281. doi: 10.3758/s13428-015-0695-8
- Matzke, D. & Wagenmakers, E.-J. (2009). Psychological interpretation of the ex-Gaussian and shifted Wald parameters: A diffusion model analysis. *Psychonomic Bulletin & Review*, 16(5), 798–817. doi: 10.3758/PBR.16.5.798
- Maxwell, S. E. & Delaney, H. D. (1993). Bivariate median splits and spurious statistical significance. *Psychological Bulletin*, 113, 181–190. doi: 10.1037/0033-2909.113.1.181
- McAdam, D. W., Knott, J. R. & Rebert, C. S. (1969). Cortical slow potential changes in man related to interstimulus interval and to pre-trial prediction of interstimulus interval. *Psychophysiology*, 5, 349–358.

- McKoon, G. & Ratcliff, R. (1996). Separating implicit from explicit retrieval processes in perceptual identification. *Consciousness and Cognition*, 5(4), 500–511. doi: 10.1006/ccog.1996.0029
- Meng, X.-L. & Wong, W. H. (1996). Simulating ratios of normalizing constants via a simple identity: a theoretical exploration. *Statistica Sinica*, 6, 831–860.
- Michalkiewicz, M. & Erdfelder, E. (2016). Individual differences in use of the recognition heuristic are stable across time, choice objects, domains, and presentation formats. *Memory & Cognition*, 44(3), 454–468. doi: 10.3758/s13421-015-0567-6
- Miller, J., Patterson, T. & Ulrich, R. (1998). Jackknife-based method for measuring LRP onset latency differences. *Psychophysiology*, 35, 99–115.
- Miller, P. & Katz, D. B. (2013). Accuracy and response-time distributions for decision-making: Linear perfect integrators versus nonlinear attractor-based neural circuits. *Journal of Computational Neuroscience*, 35(3), 261–294.
- Milosavljevic, M., Malmaud, J. & Huth, A. (2010). The Drift Diffusion Model can account for the accuracy and reaction time of value-based choices under high and low time pressure. *Judgment and Decision Making*, 5(6), 437–449.
- Mislevy, R. (1991). Randomization-based inference about latent variables from complex samples. *Psychometrika*, 56, 177–196. doi: 10.1007/BF02294457
- Mislevy, R., Johnson, E. & Muraki, E. (1992). Scaling procedures in NAEP. *Journal of Educational Statistics*, 17, 131–154. doi: 10.3102/10769986017002131
- Moran, R. (2015). Optimal decision making in heterogeneous and biased environments. *Psychonomic Bulletin & Review*, 22(1), 38–53.
- Morey, R. D. & Rouder, J. N. (2015). *BayesFactor: Computation of Bayes factors for common designs*.
- Mulckhuyse, M. & Theeuwes, J. (2010). Unconscious attentional orienting to exogenous cues: A review of the literature. *Acta Psychologica*, 134(3), 299–309. doi: 10.1016/j.actpsy.2010.03.002
- Mulder, M. J., Keuken, M. C., Van Maanen, L., Boekel, W., Forstmann, B. U. & Wagenmakers, E.-J. (2013). The speed and accuracy of perceptual decisions in a random-tone pitch task. *Attention, Perception, & Psychophysics*, 75, 1048–1058.
- Mulder, M. J., Wagenmakers, E.-J., Ratcliff, R., Boekel, W. & Forstmann, B. U. (2012). Bias in the brain: A diffusion model analysis of prior probability and potential payoff. *Journal of Neuroscience*, 32, 2335–2343.
- Müller-Gethmann, H., Ulrich, R. & Rinkenauer, G. (2003). Locus of the effect of temporal preparation: evidence from the lateralized readiness potential. *Psychophysiology*, 40(4), 597–611.
- Myung, I. J. (2003). Tutorial on maximum likelihood estimation. *Journal of Mathematical Psychology*, 47(1), 90–100. doi: 10.1016/S0022-2496(02)00028-7
- Näätänen, R. (1970). Evoked potential, EEG, and slow potential correlates of selective attention. *Acta Psychologica*, 33, 178–192.
- Nash, J. C. & Varadhan, R. (2011). Unifying optimization algorithms to aid software system users: optimx for r. *Journal of Statistical Software*, 43(9).

- Nelder, B. J. A. & Mead, R. (1965). A simplex method for function minimization. *The Computer Journal*, 7(4), 308–313. doi: <https://doi.org/10.1093/comjnl/7.4.308>
- Niyogi, R. K. & Wong-Lin, K. (2013). Dynamic excitatory and inhibitory gain modulation can produce flexible, robust and optimal decision-making. *PLoS Computational Biology*, 9(6), e1003099. doi: [10.1371/journal.pcbi.1003099](https://doi.org/10.1371/journal.pcbi.1003099)
- Novemsky, N. & Kahneman, D. (2005). The Boundaries of Loss Aversion. *Journal of Marketing Research*, 42(2), 119–128.
- Nuijten, M. B., Wetzels, R., Matzke, D., Dolan, C. V. & Wagenmakers, E.-J. (2015). A default Bayesian hypothesis test for mediation. *Behavior Research Methods*, 47, 85–97. doi: [10.3758/s13423-012-0295-x](https://doi.org/10.3758/s13423-012-0295-x)
- O’Connell, R. G., Dockree, P. M. & Kelly, S. P. (2012). A supramodal accumulation-to-bound signal that determines perceptual decisions in humans. *Nature Neuroscience*, 15(12), 1729–1735.
- Oostenveld, R., Fries, P., Maris, E. & Schoffelen, J.-m. (2011). FieldTrip: Open source software for advanced analysis of MEG, EEG, and invasive electrophysiological data. *Computational Intelligence and Neuroscience*, Volume 201. doi: [10.1155/2011/156869](https://doi.org/10.1155/2011/156869)
- Orban, G. A., Van Essen, D. & Vanduffel, W. (2004). Comparative mapping of higher visual areas in monkeys and humans. *Trends in Cognitive Sciences*, 8(7), 315–324.
- Osman, A., Moore, C. M. & Ulrich, R. (1995). Bisecting RT with lateralized readiness potentials: Precue effects after LRP onset. *Acta Psychologica*, 90, 111–127.
- Ossmy, O., Moran, R., Pfeffer, T., Tsetsos, K., Usher, M. & Donner, T. H. (2013). The timescale of perceptual evidence integration can be adapted to the environment. *Current Biology*, 23(11), 981–986.
- Osth, A., Bora, B., Dennis, S. & Heathcote, A. (2017). Diffusion vs. linear ballistic accumulation: Different models, different conclusions about the slope of the zroc in recognition memory. *Journal of Memory and Language*, 96, 36–61.
- Palmer, J., Huk, A. C. & Shadlen, M. N. (2005). The effect of stimulus strength on the speed and accuracy of a perceptual decision. *Journal of Vision*, 5, 376–404. doi: [10.1167/5.5.1](https://doi.org/10.1167/5.5.1)
- Peirce, J. W. (2007). PsychoPy - Psychophysics software in Python. *Journal of Neuroscience Methods*, 162(1-2), 8–13.
- Peirce, J. W. (2009). Generating stimuli for neuroscience using PsychoPy. *Frontiers in Neuroinformatics*, 2.
- Penner-Wilger, M., Leth-Steensen, C. & LeFevre, J.-A. (2002). Decomposing the problem-size effect: A comparison of response time distributions across cultures. *Memory & Cognition*, 30(7), 1160–1167. doi: [10.3758/BF03194333](https://doi.org/10.3758/BF03194333)
- Petrides, M., Tomaiuolo, F., Yeterian, E. H. & Pandya, D. N. (2012). The prefrontal cortex: Comparative architectonic organization in the human and the macaque monkey brains. *Cortex*, 48(1), 46–57.
- Philiastides, M. G. (2006). Neural representation of task difficulty and decision making during perceptual categorization: A timing diagram. *Journal of Neuroscience*, 26(35), 8965–8975. doi: [10.1523/JNEUROSCI.1655-06.2006](https://doi.org/10.1523/JNEUROSCI.1655-06.2006)



- Philiastides, M. G. & Sajda, P. (2006). Temporal characterization of the neural correlates of perceptual decision making in the human brain. *Cerebral Cortex*, *16*, 509–518.
- Pike, A. R. (1968). Latency and relative frequency of response in psychophysical discrimination. *British Journal of Mathematical and Statistical Psychology*, *21*(2), 161–182.
- Pinheiro, C. J. & Bates, D. M. (2000). *Mixed-effects models in S and S-Plus*. New York: Springer.
- Pitt, M. A., Kim, W., Navarro, D. J. & Myung, J. I. (2006). Psychological review. *Psychological Review*, *113*, 57–83.
- Pitt, M. A., Myung, J. I., Montenegro, M. & Pooley, J. (2008). Measuring model flexibility with parameter space partitioning: An introduction and application example. *Cognitive Science*, *32*, 1285–1303.
- Pitz, G. F. (1968). Information seeking when available information is limited. *Journal of Experimental Psychology*, *76*(1), 25–34.
- Pitz, G. F., Reinhold, H. & Geller, E. S. (1969). Strategies of information seeking in deferred decision making. *Organizational Behavior and Human Performance*, *4*, 1–19.
- Plichta, M. M., Wolf, I., Hohmann, S., Baumeister, S., Boecker, R., Schwarz, A. J., ... Brandeis, D. (2013). Simultaneous EEG and fMRI reveals a causally connected subcortical-cortical network during reward anticipation. *Journal of Neuroscience*, *33*(36), 14526–14533. doi: 10.1523/JNEUROSCI.0631-13.2013
- Plummer, M. (2003). JAGS: A Program for Analysis of Bayesian Graphical Models Using Gibbs Sampling JAGS. In K. Hornik, F. Leisch & A. Zeileis (Eds.), *Proceedings of the 3rd international workshop on distributed statistical computing (dsc 2003)*. Vienna, Austria. Retrieved from <http://www.ci.tuwien.ac.at/Conferences/DSC-2003/>
- Plummer, M., Best, N., Cowles, K., Vines, K., Sarkar, D., Bates, D., ... Magnusson, A. (2016). *coda: Output Analysis and Diagnostics for MCMC [Computer software]*. Retrieved from <https://cran.r-project.org/package=coda>
- Polich, J. (2007). Updating P300: An integrative theory of P3a and P3b. *Clinical Neurophysiology*, *118*, 2128–2148.
- Praamstra, P. (2006). Prior information of stimulus location: Effects on ERP measures of visual selection and response selection. *Brain Research*, *1072*(1), 153–160.
- Purcell, B. A., Heitz, R. P., Cohen, J. Y., Schall, J. D., Logan, G. D. & Palmeri, T. J. (2010). Neurally constrained modeling of perceptual decision making. *Psychological Review*, *117*(4), 1113–1143.
- Purcell, B. A., Schall, J. D., Logan, G. D. & Palmeri, T. J. (2012). From salience to saccades: Multiple-alternative gated stochastic accumulator model of visual search. *Journal of Neuroscience*, *32*(10), 3433–3446.
- R Core Team. (2015). *R: A language and environment for statistical computing [Computer software]*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from <https://www.r-project.org/>
- Radford, N. M. (2003). Slice Sampling. *Annals of Statistics*, *31*, 705–767.

- Raftery, A. (1996). Approximate Bayes factors and accounting for model uncertainty in generalised linear models. *Biometrika*, *83*(2), 251–266. doi: 10.1093/biomet/83.2.251
- Rao, R. P. N. (2010). Decision making under uncertainty: A neural model based on partially observable markov decision processes. *Frontiers in Computational Neuroscience*, *4*. doi: 10.3389/fncom.2010.00146
- Rapoport, A. & Burkheimer, G. J. (1971). Models for deferred decision making. *Journal of Mathematical Psychology*, *8*, 508–538.
- Ratcliff, R. (1978). A theory of memory retrieval. *Psychological Review*, *85*(2), 59–108.
- Ratcliff, R. (2002). A diffusion model account of response time and accuracy in a brightness discrimination task: Fitting real data and failing to fit fake but plausible data. *Psychonomic Bulletin & Review*, *9*(2), 278–291. doi: 10.3758/BF03196283
- Ratcliff, R. & Childers, R. (2015). Individual differences and fitting methods for the two-choice diffusion model. *Decision*, *2*(4). doi: 10.1037/dec0000030
- Ratcliff, R., Gomez, P. & McKoon, G. (2004). A diffusion model account of the lexical decision task. *Psychological Review*, *111*(1), 159–182. doi: 10.1038/nature13314.A
- Ratcliff, R., Hasegawa, Y. T., Hasegawa, R. P., Childers, R., Smith, P. L. & Segraves, M. a. (2011). Inhibition in superior colliculus neurons in a brightness discrimination task? *Neural Computation*, *23*, 1790–1820.
- Ratcliff, R., Hasegawa, Y. T., Hasegawa, R. P., Smith, P. L. & Segraves, M. A. (2007). Dual diffusion model for single-cell recording data from the superior colliculus in a brightness-discrimination task. *Journal of Neurophysiology*, *97*, 1756–1774.
- Ratcliff, R., Huang-Pollock, C. & McKoon, G. (in press). Modeling Individual Differences in the Go/No-Go Task With a Diffusion Model. *Decision*. doi: 10.1037/dec0000065
- Ratcliff, R. & McKoon, G. (2008). The diffusion decision model: Theory and data for two-choice decision tasks. *Neural Computation*, *20*, 873–922.
- Ratcliff, R., McKoon, G. & van Zandt, T. (1999). Connectionist and diffusion models of reaction time. *Psychological Review*, *106*, 261–300. doi: 10.1037/0033-295X.106.2.261
- Ratcliff, R. & Murdock, B. B. (1976). Retrieval processes in recognition memory. *Psychological Review*, *83*(3), 190–214. doi: 10.3758/BF03198129
- Ratcliff, R., Philiastides, M. G. & Sajda, P. (2009). Quality of evidence for perceptual decision making is indexed by trial-to-trial variability of the EEG. *Proceedings of the National Academy of Sciences*, *106*, 6539–6544.
- Ratcliff, R. & Rouder, J. N. (1998). Modeling response times for two-choice decisions. *Psychological Science*, *9*(5), 347–356. doi: 10.1111/1467-9280.00067
- Ratcliff, R. & Smith, P. L. (2004). A comparison of sequential sampling models for two-choice reaction time. *Psychological Review*, *111*(2), 333–367.
- Ratcliff, R. & Smith, P. L. (2010). Perceptual discrimination in static and dynamic noise: the temporal relation between perceptual encoding and decision making. *Journal of Experimental Psychology: General*, *139*(1), 70–94.

- Ratcliff, R., Smith, P. L., Brown, S. D. & McKoon, G. (2016). Diffusion Decision Model: Current issues and history. *Trends in Cognitive Sciences*, 20(4), 260–281. doi: 10.1016/j.tics.2016.01.007
- Ratcliff, R., Thapar, A., Gomez, P. & McKoon, G. (2004). A diffusion model analysis of the effects of aging in the Lexical Decision Task. *Psychology and Aging*, 19(2), 278–289. doi: 10.1037/0882-7974.19.2.278
- Ratcliff, R., Thapar, A. & McKoon, G. (2001). The effects of aging on reaction time in a signal detection task. *Psychology and Aging*, 16(2), 323–341.
- Ratcliff, R. & Tuerlinckx, F. (2002). Estimating parameters of the diffusion model: Approaches to dealing with contaminant reaction and parameter variability. *Psychonomic Bulletin & Review*, 9(3), 438–481. doi: 10.3758/BF03196302
- Redner, S. (2007). *A Guide to First-Passage Processes*. Cambridge: Cambridge University Press.
- Rescorla, R. A. & Wagner, A. R. (1972). A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and nonreinforcement. In A. H. Black & W. F. Prokasy (Eds.), *Classical conditioning II: Current research and theory* (pp. 64–99). New York: Appleton-Century-Crofts.
- Resulaj, A., Kiani, R., Wolpert, D. M. & Shadlen, M. N. (2009). Changes of mind in decision-making. *Nature*, 461(7261), 263–266.
- Riefer, D. M. & Batchelder, W. H. (1988). Multinomial modeling and the measurement of cognitive processes. *Psychological Review*, 95, 318–339.
- Rohrbaugh, J. W. & Gaillard, A. W. K. (1983). Sensory and motor aspects of the contingent negative variation. In A. W. K. Gaillard & W. Ritter (Eds.), *Tutorials in event-related potential research: Endogenous components* (pp. 269–310). Amsterdam: Elsevier.
- Roitman, J. D. & Shadlen, M. N. (2002). Response of neurons in the lateral intraparietal area during a combined visual discrimination reaction time task. *Journal of Neuroscience*, 22(21), 9475–9989.
- Rouder, J. N. (2014). Optional stopping: no problem for Bayesians. *Psychonomic Bulletin & Review*, 21, 301–308. doi: 10.3758/s13423-014-0595-4
- Rouder, J. N. & Lu, J. (2005). An introduction to Bayesian hierarchical models with an application in the theory of signal detection. *Psychonomic Bulletin & Review*, 12(4), 573–604. doi: 10.3758/BF03196750
- Rouder, J. N. & Morey, R. D. (2012). Default Bayes factors for model selection in regression. *Multivariate Behavioral Research*, 47, 877–903. doi: 10.1080/00273171.2012.734737
- Rouder, J. N., Morey, R. D., Speckman, P. L. & Province, J. M. (2012). Default Bayes factors for ANOVA designs. *Journal of Mathematical Psychology*, 56(5), 356–374. doi: 10.1016/j.jmp.2012.08.001
- Rouder, J. N., Speckman, P. L., Sun, D., Morey, R. D. & Iverson, G. (2009). Bayesian t tests for accepting and rejecting the null hypothesis. *Psychonomic Bulletin & Review*, 16(2), 225–237. doi: 10.3758/PBR.16.2.225
- Rouder, J. N., Sun, D., Speckman, P. L., Lu, J. & Zhou, D. (2003). A hierarchical Bayesian statistical framework for response time distributions. *Psychometrika*, 68(4), 589–606. doi: 10.1007/BF02295614
- Royston, P., Altman, D. G. & Sauerbrei, W. (2006). Dichotomizing continuous predictors in multiple regression: A bad idea. *Statistics in Medicine*, 25(1),

- 127–141. doi: 10.1002/sim.2331
- Sanders, A. F. & Ter Linden, W. (1967). Decision making during paced arrival of probabilistic information. *Acta Psychologica*, 27, 170–177.
- Savage, L. J. (1954). *The Foundations of Statistics*. New York: Wiley.
- Shadlen, M. N. & Kiani, R. (2013). Decision making as a window on cognition. *Neuron*, 80(3), 791–806.
- Shadlen, M. N. & Newsome, W. T. (2001). Neural basis of a perceptual decision in the parietal cortex (area LIP) of the rhesus monkey. *Journal of Neurophysiology*, 86(4), 1916–1936.
- Shankle, W. R., Hara, J., Mangrola, T., Hendrix, S., Alva, G. & Lee, M. D. (2013). Hierarchical Bayesian cognitive processing models to analyze clinical trial data. *Alzheimer's and Dementia*, 9(4), 422–428. doi: 10.1016/j.jalz.2012.01.016
- Shiffrin, R. M., Lee, M. d., Kim, W. & Wagenmakers, E.-J. (2008). A survey of model evaluation approaches with a tutorial on hierarchical Bayesian methods. *Cognitive Science*, 32(8), 1248–1284. doi: 10.1080/03640210802414826
- Siegel, M., Engel, A. K. & Donner, T. H. (2011). Cortical network dynamics of perceptual decision-making in the human brain. *Frontiers in Human Neuroscience*, 5. doi: 10.3389/fnhum.2011.00021
- Simen, P., Contreras, D., Buck, C., Hu, P., Holmes, P. & Cohen, J. D. (2009). Reward rate optimization in two-alternative decision making: Empirical tests of theoretical predictions. *Journal of Experimental Psychology: Human Perception and Performance*, 35(6), 1865–1897.
- Singmann, H. & Kellen, D. (2013). MPTinR: analysis of multinomial processing tree models in r. *Behavior Research Methods*, 45(2), 560–575. doi: 10.3758/s13428-012-0259-0
- Singmann, H., Scott, B., Gretton, M., Heathcote, A., Voss, A., Voss, J. & Terry, A. (2016). *rtdists: Response time distributions (R package version 0.6-6) [Computer software]*. Retrieved from <https://cran.r-project.org/web/packages/rtdists/index.html>
- Smith, P. L. (1995). Psychophysically principled models of visual simple reaction time. *Psychological Review*, 102(3), 567–593.
- Smith, P. L. (2010). From Poisson shot noise to the integrated Ornstein-Uhlenbeck process: Neurally principled models of information accumulation in decision-making and response time. *Journal of Mathematical Psychology*, 54(2), 464–465.
- Smith, P. L. & Ratcliff, R. (2009). An integrated theory of attention and decision making in visual signal detection. *Psychological Review*, 116(2), 283–317. doi: 10.1037/a0015156
- Smith, P. L., Ratcliff, R. & Sewell, D. K. (2014). Modeling perceptual discrimination in dynamic noise: Time-changed diffusion and release from inhibition. *Journal of Mathematical Psychology*, 59(1), 95–113. doi: 10.1016/j.jmp.2013.05.007
- Smith, P. L., Ratcliff, R. & Wolfgang, B. J. (2004). Attention orienting and the time course of perceptual decisions: Response time distributions with masked and unmasked displays. *Vision Research*, 44(12), 1297–1320. doi: 10.1016/j.visres.2004.01.002

- Smith, P. L. & Vickers, D. (1988). The accumulator model of two-choice discrimination. *Journal of Mathematical Psychology*, *32*(2), 135–168. doi: 10.1016/0022-2496(88)90043-0
- Stan Development Team. (2016a). *RStan: The R interface to Stan (Version 2.9.0)* [Computer software].
- Stan Development Team. (2016b). *Stan (Version 2.9.0)* [Computer software].
- Standage, D., You, H., Wang, D.-H. & Dorris, M. C. (2011). Gain modulation by an urgency signal controls the speed-accuracy trade-off in a network model of a cortical decision circuit. *Frontiers in Computational Neuroscience*, *5*. doi: 10.3389/fncom.2011.00007
- Starns, J. J. (2014). Using response time modeling to distinguish memory and decision processes in recognition and source tasks. *Memory and Cognition*, *42*(8), 1357–1372. doi: 10.3758/s13421-014-0432-z
- Starns, J. J. & Ratcliff, R. (2010). The effects of aging on the speed-accuracy compromise: Boundary optimality in the diffusion model. *Psychology and Aging*, *25*(2), 377–390.
- Starns, J. J. & Ratcliff, R. (2012). Age-related differences in diffusion model boundary optimality with both trial-limited and time-limited tasks. *Psychonomic Bulletin & Review*, *19*, 139–145.
- Starns, J. J. & Ratcliff, R. (2014). Validating the unequal-variance assumption in recognition memory using response time distributions instead of ROC functions: A diffusion model analysis. *Journal of Memory and Language*, *70*(1), 36–52. doi: 10.1016/j.jml.2013.09.005
- Statisticat LLC. (2016). *LaplacesDemon: Complete environment for Bayesian inference*. Retrieved from <https://web.archive.org/web/20150206004624/http://www.bayesian-inference.com/software>
- Steingroever, H., Pachur, T., Smíra, M. & Lee, M. (in press). Bayesian techniques for analyzing group differences in the Iowa gambling task: A case study of intuitive and deliberate decision makers. *Psychonomic Bulletin & Review*.
- Steingroever, H., Wetzels, R. & Wagenmakers, E.-J. (2013). Validating the PVL-Delta model for the Iowa gambling task. *Frontiers in Psychology*, *4*, 1–17. doi: 10.3389/fpsyg.2013.00898
- Steingroever, H., Wetzels, R. & Wagenmakers, E.-J. (2014). Absolute performance of reinforcement-learning models for the Iowa Gambling Task. *Decision*, *1*(3), 161–183. doi: 10.1037/dec0000005
- Stone, C. J., Hansen, M., Kooperberg, C. & Truong, Y. K. (1997). Polynomial splines and their tensor products in extended linear modeling. *Annals of Statistics*, *25*(4), 1371–1425.
- Stone, M. (1960). Models for choice-reaction time. *Psychometrika*, *25*, 251–260.
- Summerfield, C. & Tsetsos, K. (2012). Building bridges between perceptual and economic decision-making: Neural and computational mechanisms. *Frontiers in Neuroscience*, *6*. doi: 10.3389/fnins.2012.00070
- Sutton, R. S. & Barton, A. G. (1998). *Reinforcement learning: An introduction*. Cambridge: MIT Press.
- Sutton, S., Braren, M., Zubin, J. & John, E. (1965). Evoked potential correlates of stimulus uncertainty. *Science*, *150*, 1187–1188.

- Swensson, R. G. & Thomas, R. E. (1974). Fixed and optional stopping models for two-choice discrimination times. *Journal of Mathematical Psychology*, *11*, 213–236.
- Tanner, W. P. & Swets, J. A. (1954). A decision-making theory of visual detection. *Psychological Review*, *61*(6), 401–409.
- ter Braak, C. J. F. (2006). A Markov chain Monte Carlo version of the genetic algorithm differential evolution: Easy Bayesian computing for real parameter spaces. *Statistics and Computing*, *16*, 239–249.
- Thomas, N. W. D. & Paré, M. (2007). Temporal processing of saccade targets in parietal cortex area LIP during visual search. *Journal of Neurophysiology*, *97*(1), 942–947.
- Thura, D., Beauregard-Racine, J., Fradet, C.-W. & Cisek, P. (2012). Decision making by urgency gating: Theory and experimental support. *Journal of Neurophysiology*, *108*(11), 2912–2930.
- Thura, D. & Cisek, P. (2014). Deliberation and commitment in the premotor and primary motor cortex during dynamic decision making. *Neuron*, *81*(6), 1401–1416.
- Thura, D., Cos, I., Trung, J. & Cisek, P. (2014). Context-dependent urgency influences speed-accuracy trade-offs in decision-making and movement execution. *Journal of Neuroscience*, *34*(49), 16442–16454.
- Tom, S. M., Fox, C. R., Trepel, C. & Poldrack, R. A. (2007). The neural basis of loss aversion in decision-making under risk. *Science*, *315*(5811), 515–518.
- Turner, B. M., Sederberg, P. B., Brown, S. D. & Steyvers, M. (2013a). A method for efficiently sampling from distributions with correlated dimensions. *Psychological Methods*, *18*(3), 368–384. doi: 10.1037/a0032222
- Turner, B. M., Sederberg, P. B., Brown, S. D. & Steyvers, M. (2013b). A method for efficiently sampling from distributions with correlated dimensions. *Psychological Methods*, *18*(3), 368–384. doi: 10.1037/a0032222
- Turner, B. M., Van Maanen, L. & Forstmann, B. U. (2015). Informing cognitive abstractions through neuroimaging: The neural drift diffusion model. *Psychological Review*, *122*(2), 312–336.
- Tversky, A. & Kahneman, D. (1992). Advances in prospect-theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, *5*(4), 297–323. doi: Doi10.1007/Bf00122574
- Ulrich, R., Leuthold, H. & Sommer, W. (1998). Motor programming of response force and movement direction. *Psychophysiology*, *35*(6), 721–728.
- Ulrich, R. & Miller, J. (2001). Using the jackknife-based scoring method for measuring LRP onset effects in factorial designs. *Psychophysiology*, *38*, 816–827.
- Usher, M. & McClelland, J. L. (2001). The time course of perceptual choice: The leaky, competing accumulator model. *Psychological Review*, *108*(3), 550–592.
- Van Boxtel, G. J. M. & Böcker, K. B. E. (2004). Cortical Measures of Anticipation. *Journal of Psychophysiology*, *18*(2-3), 61–76. doi: 10.1027/0269-8803.18.2
- Van Kampen, N. G. (2007). *Stochastic Processes in Physics and Chemistry* (3rd ed.). Amsterdam: Elsevier.

- Van Maanen, L., Brown, S. D., Eichele, T., Wagenmakers, E.-J., Ho, T., Serences, J. & Forstmann, B. U. (2011). Neural correlates of trial-to-trial fluctuations in response caution. *The Journal of Neuroscience*, *31*(48), 17488–17495. doi: 10.1523/JNEUROSCI.2924-11.2011
- Van Rijn, H., Kononowicz, T. W., Meck, W. H., Ng, K. K. & Penney, T. B. (2011). Contingent negative variation and its relation to time estimation: a theoretical evaluation. *Frontiers in Integrative Neuroscience*, *5*(91). doi: 10.3389/fnint.2011.00091
- Van Veen, V., Krug, M. K. & Carter, C. S. (2008). The neural and computational basis of controlled speed-accuracy tradeoff during task performance. *Journal of Cognitive Neuroscience*, *20*(11), 1952–1965. doi: 10.1162/jocn.2008.20146
- Van Zandt, T. & Ratcliff, R. (1995). Statistical mimicking of reaction time data: Single-process models, parameter variability, and mixtures. *Psychonomic Bulletin & Review*, *2*(1), 20–54. doi: 10.3758/BF03214411
- Vandekerckhove, J. (2014). A cognitive latent variable model for the simultaneous analysis of behavioral and personality data. *Journal of Mathematical Psychology*, *60*, 58–71. doi: 10.1016/j.jmp.2014.06.004
- Vandekerckhove, J., Matzke, D. & Wagenmakers, E.-J. (2015). Model comparison and the principle of parsimony. In J. Busemeyer, J. Townsend, Z. J. Wang & A. Eidels (Eds.), *Oxford handbook of computational and mathematical psychology*. Oxford: Oxford University Press.
- Vandekerckhove, J. & Tuerlinckx, F. (2007). Fitting the Ratcliff diffusion model to experimental data. *Psychonomic Bulletin & Review*, *14*(6), 1011–26. doi: 10.3758/BF03193087
- Vandekerckhove, J., Tuerlinckx, F. & Lee, M. D. (2011). Hierarchical diffusion models for two-choice response times. *Psychological Methods*, *16*(1), 44–62. doi: 10.1037/a0021765
- van Driel, J., Knapen, T., van Es, D. M. & Cohen, M. X. (2014). Interregional alpha-band synchrony supports temporal cross-modal integration. *NeuroImage*, *101*, 404–415. doi: 10.1016/j.neuroimage.2014.07.022
- van Maanen, L., Fontanesi, L., Hawkins, G. E. & Forstmann, B. U. (2016). Striatal activation reflects urgency in perceptual decision making. *NeuroImage*, *139*, 294–303.
- van Ravenzwaaij, D., Boekel, W., Forstmann, B. U., Ratcliff, R. & Wagenmakers, E.-J. (2014). Action video games do not improve the speed of information processing in simple perceptual tasks. *Journal of Experimental Psychology*, *143*(5), 1–21.
- van Ravenzwaaij, D., Donkin, C. & Vandekerckhove, J. (2017). The EZ diffusion model provides a powerful test of simple empirical effects. *Psychonomic Bulletin & Review*, *24*(2), 547–556. doi: 10.3758/s13423-016-1081-y
- van Ravenzwaaij, D. & Oberauer, K. (2009). How to use the diffusion model: Parameter recovery of three methods: EZ, fast-dm, and DMAT. *Journal of Mathematical Psychology*, *53*, 463–473. doi: 10.1016/j.jmp.2009.09.004
- van Ravenzwaaij, D., Provost, A. & Brown, S. D. (in press). A confirmatory approach for integrating neural and behavioral data into a single model. *Journal of Mathematical Psychology*. doi: 10.1016/j.jmp.2016.04.005

- Van Vugt, M. K., Simen, P., Nystrom, L. E., Holmes, P. & Cohen, J. D. (2012). EEG oscillations reveal neural correlates of evidence accumulation. *Frontiers in Neuroscience*, *6*. doi: 10.3389/fnins.2012.00106
- Vassileva, J., Ahn, W.-Y., Weber, K. M., Busemeyer, J. R., Stout, J. C., Gonzalez, R. & Cohen, M. H. (2013). Computational modeling reveals distinct effects of HIV and history of drug use on decision-making processes in women. *PloS one*, *8*(8). doi: 10.1371/journal.pone.0068962
- Verdejo-García, A. & Pérez-García, M. (2007). Profile of executive deficits in cocaine and heroin polysubstance users: Common and differential effects on separate executive components. *Psychopharmacology*, *190*, 517–530. doi: 10.1007/s00213-006-0632-8
- Vickers, D. (1979). *Decision Processes in Visual Perception*. London: Academic Press.
- Vickers, D., Smith, P., Burt, J. & Brown, M. (1985). Experimental paradigms emphasising state or process limitations: II effects on confidence. *Acta Psychologica*, *59*(2), 163–193.
- Voskuilen, C., Ratcliff, R. & Smith, P. L. (2016). Comparing fixed and collapsing boundary versions of the diffusion model. *Journal of Mathematical Psychology*, *73*, 59–79.
- Voss, A., Rothermund, K. & Voss, J. (2004). Interpreting the parameters of the diffusion model: An empirical validation. *Memory and Cognition*, *32*(7), 1206–1220.
- Voss, A. & Voss, J. (2007). Fast-dm: A free program for efficient diffusion model analysis. *Behavior Research Methods*, *39*(4), 767–775.
- Voss, A. & Voss, J. (2008). A fast numerical algorithm for the estimation of Diffusion-Model parameters. *Journal of Mathematical Psychology*, *52*(1), 1–9.
- Voss, A., Voss, J. & Klauer, K. C. (2010). Separating response-execution bias from decision bias: Arguments for an additional parameter in Ratcliff’s diffusion model. *British Journal of Mathematical and Statistical Psychology*, *63*, 539–555. doi: 10.1348/000711009X477581
- Voss, A., Voss, J. & Lerche, V. (2015). Assessing cognitive processes with diffusion model analyses: A tutorial based on fast-dm-30. *Frontiers in Psychology*, *6*: 336. doi: 10.3389/fpsyg.2015.00336
- Wabersich, D. & Vanderkerckhove, J. (2014). Extending JAGS: A tutorial on adding custom distributions to JAGS (with a diffusion model example). *Behavior Research Methods*, *46*, 15–28. doi: 10.1016/j.cognition.2008.05.007
- Wagenmakers, E.-J., Grasman, R. P. & Molenaar, P. C. (2005). On the relation between the mean and the variance of a diffusion model response time distribution. *Journal of Mathematical Psychology*, *49*(3), 195–204. doi: 10.1016/j.jmp.2005.02.003
- Wagenmakers, E.-J., Lodewyckx, T., Kuriyal, H. & Grasman, R. (2010). Bayesian hypothesis testing for psychologists: A tutorial on the Savage-Dickey method. *Cognitive Psychology*, *60*(3), 158–189. doi: 10.1016/j.cogpsych.2009.12.001
- Wagenmakers, E.-J., Ratcliff, R., Gomez, P. & McKoon, G. (2008). A diffusion model account of criterion shifts in the lexical decision task. *Journal of*



- Memory and Language*, 58, 140–159. doi: 10.1016/j.jml.2007.04.006
- Wald, A. (1945). Sequential tests of statistical hypotheses. *The Annals of Mathematical Statistics*, 16(2), 117–186.
- Wald, A. & Wolfowitz, J. (1948). Optimum character of the sequential probability ratio test. *The Annals of Mathematical Statistics*, 19(3), 326–339.
- Wallsten, T. S. (1968). Failure of predictions from subjectively expected utility theory in a Bayesian decision task. *Organizational Behavior and Human Performance*, 3, 239–252.
- Walter, C. N. V. (1964). Contingent negative variation: An electric sign of sensorimotor association and expectancy in the human brain. *Nature*, 203(4943), 380–384.
- Wang, X.-J. (2002). Probabilistic decision making by slow reverberation in cortical circuits. *Neuron*, 36(5), 955–968.
- Watson, A. B. & Ahumada, A. J. (1985). Model of human visual-motion sensing. *Journal of the Optical Society of America. A, Optics and Image Science*, 2(2), 322–342.
- Wells, E. F., Bernstein, G. M., Scott, B. W., Bennett, P. J. & Mendelson, J. R. (2001). Critical flicker frequency responses in visual cortex. *Experimental Brain Research*, 139(1), 106–110.
- Wetzels, R., Grasman, R. P. P. P. & Wagenmakers, E.-J. (2012). A default Bayesian hypothesis test for ANOVA designs. *The American Statistician*, 66, 104–111. doi: 10.1080/00031305.2012.695956
- Wetzels, R., Vandekerckhove, J., Tuerlinckx, F. & Wagenmakers, E. J. (2010). Bayesian parameter estimation in the Expectancy Valence model of the Iowa gambling task. *Journal of Mathematical Psychology*, 54, 14–27. doi: 10.1016/j.jmp.2008.12.001
- White, C. N., Kapucu, A., Bruno, D., Rotello, C. M. & Ratcliff, R. (2014). Memory bias for negative emotional words in recognition memory is driven by effects of category membership. *Cognition & Emotion*, 28(5), 867–80. doi: 10.1080/02699931.2013.858028
- White, C. N., Ratcliff, R. & Starns, J. S. (2011). Diffusion models of the flanker task: Discrete versus gradual attentional selection. *Cognitive Psychology*, 63(4), 210–238. doi: 10.1016/j.cogpsych.2011.08.001.Diffusion
- White, C. N., Servant, M. & Logan, G. D. (2017). Practical considerations for using conflict-based diffusion models to interpret choice RT data. *Psychonomic Bulletin & Review*.
- Wickelgren, W. A. (1977). Speed-accuracy tradeoff and information processing dynamics. *Acta Psychologica*, 41, 67–85.
- Wiecki, T. V., Sofer, I. & Frank, M. J. (2013). HDDM: Hierarchical Bayesian estimation of the Drift-Diffusion Model in Python. *Frontiers in Neuroinformatics*, 7. doi: 10.3389/fninf.2013.00014
- Wiecki, T. V., Sofer, I. & Frank, M. J. (2016). *HDDM 0.6.0 documentation*. Retrieved from <http://ski.cllps.brown.edu/hddm{ }docs/index.html>
- Winkel, J., Keuken, M. C., Van Maanen, L., Wagenmakers, E.-J. & Forstmann, B. U. (2014). Early evidence affects later decisions: Why evidence accumulation is required to explain response time data. *Psychonomic Bulletin & Review*, 21(3), 777–784.

- Winkel, J., Van Maanen, L., Ratcliff, R., Van der Schaaf, M. E., Van Schouwenburg, M. R., Cools, R. & Forstmann, B. U. (2012). Bromocriptine does not alter speed-accuracy tradeoff. *Frontiers in Neuroscience*, *6*(126). doi: 10.3389/fnins.2012.00126
- Wood, S. (2013). *Mixed GAM Computation Vehicle with GCV/AIC/REML smoothness estimation (Version 1.7-26)* [Computer software].
- Wood, S. N. (2006). *Generalized Additive Models: An introduction with R*. London: Chapman & Hall.
- Worthy, D. A., Gorlick, M. A., Pacheco, J. L., Schnyer, D. M. & Maddox, W. T. (2011). With age comes wisdom: Decision-making in younger and older adults. *Psychological Science*, *22*(11), 1375–1380. doi: 10.1177/0956797611420301. With
- Wühr, P. & Kunde, W. (2008). Precueing spatial S-R correspondence: is there regulation of expected response conflict? *Journal of Experimental Psychology: Human Perception and Performance*, *34*(4), 872–883. doi: 10.1037/0096-1523.34.4.872
- Wyart, V., de Gardelle, V., Scholl, J. & Summerfield, C. (2012). Rhythmic fluctuations in evidence accumulation during decision making in the human brain. *Neuron*, *76*(4), 847–858.
- Yap, M. J., Balota, D. A., Sibley, D. E. & Ratcliff, R. (2012). Individual differences in visual word recognition: Insights from the English lexicon project. *Journal of Experimental Psychology: Human Perception and Performance*, *38*(1), 53–79. doi: 10.1037/a0024177
- Yap, M. J., Sibley, D. E., Balota, D. a., Ratcliff, R. & Rueckl, J. (2015). Responding to nonwords in the lexical decision task: Insights from the English Lexicon Project. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(3), 597–613. doi: 10.1037/xlm0000064
- Zandbelt, B., Purcell, B. A., Palmeri, T. J., Logan, G. D. & Schall, J. D. (2014). Response times from ensembles of accumulators. *Proceedings of the National Academy of Sciences*, *111*(7), 2848–2853.
- Zellner, A. (1986). On assessing prior distributions and Bayesian regression analysis with g-prior distributions. In P. K. Goel & A. Zellner (Eds.), *Bayesian inference and decision techniques: Essays in honor of Bruno de Finetti* (pp. 233–243).
- Zellner, A. & Siow, A. (1980). Posterior odds ratios for selected regression hypotheses. In J. M. Bernardo, M. H. DeGroot, D. V. Lindley & A. F. M. Smith (Eds.), *Bayesian statistics: Proceedings of the first international meeting held in Valencia (Spain)* (pp. 585–603). Valencia, Spain: University of Valencia.
- Zhang, J., Rittman, T., Nombela, C., Fois, A., Coyle-Gilchrist, I., Barker, R. A., ... Rowe, J. B. (2016). Different decision deficits impair response inhibition in progressive supranuclear palsy and Parkinson’s disease. *Brain*, *139*(1), 161–173. doi: 10.1093/brain/awv331
- Zhang, J. & Rowe, J. B. (2014). Dissociable mechanisms of speed-accuracy tradeoff during visual perceptual learning are revealed by a hierarchical drift-diffusion model. *Frontiers in Neuroscience*, *8*. doi: 10.3389/fnins.2014.00069

- Zhang, S., Lee, M. D., Vandekerckhove, J., Maris, G. & Wagenmakers, E.-J. (2014). Time-varying boundaries for diffusion models of decision making and response time. *Frontiers in Psychology*, 5. doi: 10.3389/fpsyg.2014.01364