

# WOUTER KOOL

[wkool@fas.harvard.edu](mailto:wkool@fas.harvard.edu)  
[wouterkool.com](http://wouterkool.com)

## EMPLOYMENT

- 2019-present Assistant Professor, Department of Psychological and Brain Sciences, Washington University in St. Louis
- 2015-2019 Postdoctoral fellow, Department of Psychology, Harvard University  
*Advisors:* Samuel J. Gershman, Ph.D. & Fiery A. Cushman, Ph.D.
- 2009-2010 Research specialist, Botvinick Lab, Princeton Neuroscience Institute
- 2007-2009 Lab manager, Dopamine Lab, Leiden University

## EDUCATION

- 2015 Ph.D. in Psychology and Neuroscience, Princeton University  
*Advisor:* M. M. Botvinick, M.D., Ph.D.  
*Secondary advisor:* N. B. Turk-Browne, Ph.D.
- 2011 M.A. in Psychology, Princeton University  
*Advisor:* M. M. Botvinick, M.D., Ph.D.  
*Secondary advisor:* N. B. Turk-Browne, Ph.D.
- 2008-2009 Visiting student research collaborator, Princeton University
- 2009 M.Sc. in Cognitive Neuroscience, Universiteit Leiden  
*Supervisors:* M. M. Botvinick, M.D., Ph.D., and Prof. Dr. B. Hommel
- 2007 B.S. in Psychology, Universiteit Leiden  
*Supervisors:* Dr. L. S. Colzato, and Prof. Dr. B. Hommel
- 2004 [Propaedeutic diploma](#) in Mathematics, Universiteit Leiden

## PUBLICATIONS

See [wouterkool.com/publications](http://wouterkool.com/publications) for reprints.

1. Bolenz, F., **Kool, W.**, Reiter, A. M. F., Kiebel, S. J., & Eppinger, B. (2019). Metacontrol of decision-making strategies in human aging. *eLife*, 8, e49154.
2. Liu, S., Cushman, F. A., Gershman, S. J., **Kool, W.**, Spelke L. (2019). Hard choices: Children's understanding of the cost of action selection. *Proceedings of the Cognitive Science Society*.
3. Patzelt, E. H., **Kool, W.**, Millner, A. J., & Gershman, S. J. (2019). The transdiagnostic structure of mental effort avoidance. *Scientific Reports*, 9, 1689.
4. Patzelt, E. H., **Kool, W.**, Millner, A. J., & Gershman, S. J. (2019). Incentives boost model-based control across a range of severity on several psychiatric constructs. *Biological Psychiatry*, 85, 425-433.
5. **Kool, W.**, & Botvinick, M. M. (2018). Mental labour. *Nature Human Behaviour*, 2, 899-908.

6. **Kool, W.**, Gershman, S. J.\*, & Cushman, F. A.\* (2018). Planning complexity registers as a cost in metacontrol. *Journal of Cognitive Neuroscience*, *30*, 1391-1404.
7. **Kool, W.**, Cushman, F. A.\*, Gershman, S. J.\* (2018). Competition and cooperation between multiple reinforcement learning strategies. In R. W. Morris, A. M. Bornstein, & A. Shenhav (Eds.), *Understanding Goal-Directed Decision Making: Computations and Circuits* (pp 153-178). New York: Elsevier.
8. **Kool, W.**, Gershman, S. J.\*, & Cushman, F. A.\* (2017). Cost-benefit arbitration between multiple reinforcement learning systems. *Psychological Science*, *28*, 1321-1333.
9. Shenhav, A., Musslick, S., Lieder, F., **Kool, W.**, Griffiths, T. L., Cohen, J. D., & Botvinick, M. M. (2017). Towards a rational and mechanistic account of mental effort. *Annual Reviews of Neuroscience*, *40*, 99-124.
10. **Kool, W.\***, Shenhav, A. S.\*, & Botvinick, M. M. (2017). Cognitive control as cost-benefit decision making. In T. Egner (Ed.), *The Wiley Handbook of Cognitive Control* (pp. 167-189). Chichester, West Sussex, UK: John Wiley & Sons.
11. **Kool, W.**, Cushman, F. A.\*, & Gershman, S. J.\* (2016). When does model-based control pay off? *PLOS Computational Biology*, *12*, e1005090.
12. Gold, J. M., **Kool, W.**, Botvinick, M., Hubzin, L., August, S., & Waltz, J. (2015). Cognitive effort avoidance and detection in people with schizophrenia. *Cognitive, Affective, & Behavioral Neuroscience*, *15*, 145-154.
13. **Kool, W.**, Conway, A. R. A., & Turk-Browne, N. B. (2014). The sequential dynamics of visual short-term memory. *Attention, Perception, & Psychophysics*, *76*, 1885-1901.
14. Braver, T. S., Krug, M. K., Chiew, K. S., **Kool, W.**, Westbrook, J. A., Clement, N. J., ... Somerville, L. H. (2014). Mechanisms of motivation-cognition interactions: challenges and opportunities. *Cognitive, Affective, & Behavioral Neuroscience*, *14*, 443-472.
15. **Kool, W.**, & Botvinick, M. M. (2014). A labor/leisure trade-off in cognitive control. *Journal of Experimental Psychology: General*, *143*, 131-141.
16. **Kool, W.**, & Botvinick, M. M. (2013). The intrinsic cost of cognitive control. *Behavioral and Brain Sciences*, *36*, 697-698. Comment on Kurzban, R., Duckworth, A., Kable, J. W., & Myers, J. (2013). An opportunity cost model of subjective effort and task performance.
17. **Kool, W.**, McGuire, J. T., Wang, G. J., & Botvinick, M. M. (2013). A role for effort costs in self-control and intertemporal choice. *PLOS ONE*, *8*, e72626.
18. **Kool, W.**, Getz., S., & Botvinick, M. M. (2013). Neural representations of reward probability: Evidence from the Illusion of Control. *Journal of Cognitive Neuroscience*, *25*, 852-861.
19. **Kool, W.\***, McGuire, J. T.\*, Rosen, Z., & Botvinick, M. M. (2010). Decision making and the avoidance of cognitive demand. *Journal of Experimental Psychology: General*, *139*, 665-682.
20. Colzato, L. S., **Kool, W.**, & Hommel, B. (2008). Stress modulation of visuomotor binding. *Neuropsychologia*, *46*, 1542-1548.

## submitted or in preparation

**Kool, W.**, & Botvinick, M. M. (submitted). A utility map for mental effort.

Patzelt, E. H., **Kool, W.**, & Gershman, S. J. (submitted). Boosting model-based control in older adults.

Patil\*, I., Zucchelli\*, M. M., **Kool, W.**, Fornasier, F., Calò, Silani, G., Cikara, M., & Cushman, S. J. (submitted). Reasoning supports utilitarian resolutions to moral dilemmas across diverse measures.

**Kool, W.**, & Cushman, F. A., & Gershman, S. J. (in preparation). Metacontrol in reinforcement learning.

## CONFERENCE PRESENTATIONS

1. Patil, I., **Kool, W.**, Campbell, S., Cikara, M., & Cushman, F. A. (2018). *Moral learning privileges model-free update*. Talk presented at the meeting of the European Society for Cognitive and Affective Neuroscience, Leiden, July 2018.
2. Bolenz, F., **Kool, W.**, Reiter, F. A., Kiebel, S. J., & Eppinger, B. (2018). *Meta-control of learning strategies in human aging*. Poster presented at the meeting of the Federation for European Neuroscience Societies, Berlin, July 2018.
3. **Kool, W.**, Cushman, F. A., & Gershman, S. J. (2017). *Neural and behavioral signatures of metacontrol in reinforcement learning*. Talk presented at the meeting of the Society for Neuroscience, Washington, DC, November 2017.
4. **Kool, W.**, Gershman, S. J., & Cushman, F. A. (2017). *Neural and behavioral signatures of metacontrol in reinforcement learning*. Talk presented at the meeting of the Society for Neuroeconomics, Toronto, Canada, October 2017.
5. **Kool, W.**, Cushman, F. A., & Gershman, S. J. (2017). *Metacontrol in reinforcement learning*. Talk presented at the International Conference for Cognitive Neuroscience, Amsterdam, the Netherlands, August 2017.
6. **Kool, W.**, Cushman, F. A., & Gershman, S. J. (2017). *Metacontrol in reinforcement learning*. Poster presented at the Multi-Disciplinary Conference on Reinforcement Learning and Decision Making, Ann Arbor, MI, June 2017.
7. **Kool, W.**, Gershman, S. J., & Cushman, F. A. (2017). *Thinking fast or slow? A reinforcement-learning approach*. Poster presented at the meeting of the Society for Personality and Social Psychology, San Antonio, TX, January 2017.
8. **Kool, W.** (2017). *Decision making and the intrinsic cost of cognitive control*. Talk presented at the Society for Personality and Social Psychology Self-Regulation Preconference, San Antonio, TX, January 2017.
9. **Kool, W.**, Cushman, F. A., & Gershman, S. J. (2016). *A cost-benefit analysis between multiple reinforcement-learning mechanisms*. Talk presented at the meeting of the Society for Judgment and Decision Making, Boston, MA, November 2016.
10. **Kool, W.**, Cushman, F. A., Gershman, S. J., & Botvinick, M. M. (2016). *Cost-benefit analyses in cognitive control*. Talk presented at the meeting of the Association for Psychological Science, Chicago, IL, May 2016.
11. **Kool, W.**, Cushman, F. A., & Gershman, S. J. (2016). *Cost-benefit analyses in reinforcement learning*. Poster presented at the meeting of the Social & Affective Neuroscience Society, New York, NY, April 2016.
12. **Kool, W.**, & Botvinick, M. M. (2015). *Dopaminergic genes predict the cost of cognitive control and reliance on habit*. Poster presented at the meeting of the Society for Neuroeconomics, Miami, FL, September 2015.

13. **Kool, W.**, & Botvinick, M. M. (2013). *The intrinsic cost of cognitive control*. Talk presented at the meeting of the Society for Psychophysiological Research, Florence, October 2013.
14. **Kool, W.**, McGuire, J. T., Wang, G. J., & Botvinick, M. M. (2012). *Aversion to cognitive effort predicts poor self-control and reliance on habit*. Poster presented at the MoMCAI conference, Washington DC, May 2013.
15. **Kool, W.**, Wang, G. J., & Botvinick, M. M. (2012). *A role for effort costs in self-control and intertemporal choice*. Poster presented at the meeting of the Society for Neuroscience, New Orleans, LA, October 2012.
16. **Kool, W.**, Getz, S., & Botvinick, M. M. (2011). *Ventral striatum is immune to the Illusion of Control*. Poster presented at the meeting of the Society for Neuroscience, Washington, DC, November 2011.
17. **Kool, W.**, Conway, A. R. A., & Turk-Browne, N. B. (2011). *The sequential dynamics of visual short-term memory*. Poster presented at the meeting of the Society for Psychonomics, Seattle, WA, November 2011.
18. Hommel, B., Colzato, L., van Wouwe, N., & **Kool, W.** (2008). *Affect, stress, and visuomotor binding: Evidence for a role of dopamine in integrating perception and action*. Poster presented at the meeting of the Cognitive Neuroscience Society, New York, NY, May 2008.

## INVITED PRESENTATIONS

1. **Kool, W.** (2019). *Decision making and the intrinsic cost of cognitive control*. Talk presented at the Department of Psychology at The University of Chicago, Chicago, IL, January 2019.
2. **Kool, W.** (2018). *Decision making and the intrinsic cost of cognitive control*. Talk presented at the Department of Psychological & Brain Science at Washington University in St. Louis, MO, December 2018.
3. **Kool, W.** (2018). *Metacontrol in reinforcement learning*. Talk presented at the 2018 TU Dresden Symposium “Volition and Self-Control: From Metaphors to Mechanisms”, Dresden, Germany, August 2018.
4. **Kool, W.** (2016). *Decision making and the intrinsic cost of cognitive control*. Talk presented at the Department of Psychology at Columbia University, New York City, NY, December 2016.
5. **Kool, W.** (2016). *Decision making and the avoidance of cognitive effort*. Talk presented at the Center for Social Brain Science at Dartmouth University, Hanover, NH, March 2016.
6. **Kool, W.** (2013). *The intrinsic cost of cognitive control*. Talk presented at the Donders Institute for Brain, Cognition and Behavior at the Radboud University Nijmegen, the Netherlands, October 2013.
7. **Kool, W.** (2013). *A role for mental effort avoidance in self-control*. Talk presented at the Princeton Research Symposium (PRS), Princeton, October 2013.

## SERVICE

- 2012-2014 Princeton Neuroscience Institute, Neuroscience of Social Decision Making colloquium series co-organizer
- 2012-2013 Princeton Department of Psychology, Graduate Student Committee member
- 2011 Princeton Department of Psychology, Graduate Student Orientation coordinator

2011 Princeton Department of Psychology, Colloquium Host

*Ad-hoc reviewer for:*

Attention, Perception, & Psychophysics, Cerebral Cortex, Cognition, Cognitive, Affective, & Behavioral Neuroscience, Current Directions in Psychological Science, eLife, European Neuropsychopharmacology, Journal of Cognitive Neuroscience, Journal of Experimental Psychology: General, Journal of Experimental Psychology: Human Perception and Performance, Journal of Experimental Psychology: Learning, Memory, and Cognition, Journal of Experimental Social Psychology, Journal of Neuroscience, Journal of Personality and Social Psychology: Attitudes and Social Cognition, Motivation Science, Nature Human Behaviour, NeuroImage, Neuropsychologia, PLOS Computational Biology, PLOS ONE, Psychonomic Bulletin & Review, Psychological Research, Psychological Review, Psychological Science, Psychophysiology, Scientific Reports, Visual Cognition

## AWARDS & HONORS

- 2017 Best talk award, Meeting of the Society for Neuroeconomics 2017
- 2013-2014 *Harold W. Dodds* Honorific Fellowship, Princeton University
- 2012 Travel award MoMCAI Meeting 2013, Scientific Research Network on Decision Neuroscience & Aging
- 2009 Graduated *cum laude* (highest honors) M.Sc., Universiteit Leiden
- 2009 *Van de Geer award* for best Master's thesis in Psychology, Universiteit Leiden
- 2008 Best research poster, CSCA Conference, Amsterdam, the Netherlands
- 2008 Fellowship *Dr. Hendrik Muller Vaderlandsch Fonds*, The Hague, the Netherlands
- 2008 Fellowship *LUF Internationaal Studie Fonds*, Universiteit Leiden
- 2008 Fellowship *Schuurman Schimmel-van Outerer Stichting*, Haarlem, the Netherlands
- 2008 Fellowship *Curatorenfonds*, Universiteit Leiden
- 2008 Fellowship *LUSTRA Fonds*, Leiden, the Netherlands
- 2007 Graduated *cum laude* (highest honors) B.Sc., Universiteit Leiden

## TEACHING

- 2015 Lab materials developer (cognitive control and connectionism), Introduction to Psychology, Princeton University.
- 2012 Introduction to Cognitive Neuroscience, Professor Matthew M. Botvinick, Princeton University.