

# Thomas S. A. Wallis, PhD

Position	Vertretungsprofessor (W3) / Acting Professor Wilhelm-Schickard Institute for Computer Science (Cognitive Science) & Project Leader Collaborative Research Centre (SFB) 1233 “Robust Vision”
Address	Computational Vision and Neuroscience Lab (AG Bethge) Centre for Integrative Neuroscience Otfried-Müller-Str. 25 72076 Tübingen Germany
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Website	<a href="http://www.tomwallis.info">www.tomwallis.info</a>
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## Summary

How does the visual system represent and transform information, giving rise to conscious perception? I explore these questions using human behavioural experiments and computational modelling. The focus of my current work is on understanding what we can learn about how humans make visual inferences from the recent successes of deep neural networks. Deep neural networks trained on object recognition have learned abstract representations of information in natural scenes, and these abstractions in some ways resemble the representations that humans use. I explore this relationship in the context of scene appearance, eye movements and material properties. I have previously worked on crowding, motion-induced blindness, binocular rivalry, contrast perception, macular degeneration, hazard perception in driving, and employing Bayesian statistical methods. I do my best to make my research reproducible and encourage open science.

## Education & Employment

Oct 2017 - Present	Vertretungsprofessor (W3) / Acting Professor <i>Wilhelm-Schickard Institute for Computer Science, University of Tübingen</i>
Jan 2017 - Present	Project Leader Collaborative Research Centre (SFB) 1233 “Robust Vision” <i>Centre for Integrative Neuroscience, University of Tübingen</i>
Aug 2016 - Dec 2016	Postdoctoral Fellow / Akademischer Mitarbeiter <i>AG Bethge, Centre for Integrative Neuroscience, University of Tübingen</i>
2013 - 2016	Humboldt Postdoctoral Fellow (€104,400 over three years) Bethge & Wichmann laboratories <i>University of Tübingen</i>
2011 - 2013	NHMRC Training Fellow National Health and Medical Research Council of Australia (NHMRC) fellowship, \$394,559 support over four years (relinquished after two, to move to Germany). <i>Bex lab, Schepens Eye Research Institute, Harvard Medical School</i>
2010 - 2011	Postdoctoral Fellow (NIH grant EY019281) <i>Bex lab, Schepens Eye Research Institute, Harvard Medical School</i>
2007 - 2010	PhD, Psychology Pencils and erasers: Interactions between motion and spatial coding in human vision Supervisor: Derek Arnold. Associates: Jason Mattingley and Ottmar Lipp <i>School of Psychology, The University of Queensland (Australia)</i>
2001 - 2004	Bachelor of Psychological Science (Hons I) Undergraduate thesis title: Hazard perception in driving Undergraduate thesis supervisor: Mark Horswill <i>School of Psychology, The University of Queensland (Australia)</i>

## Awards & Funding

2017 - 2020	Project leader, Collaborative Research Centre (Sonderforschungsbereich) 1233 “Robust Vision” (approx. 8 mil. Euro for 14 projects over four years)
2013 - 2016	Humboldt Research Fellowship for Postdoctoral Researchers (extended to three years due to parental responsibilities)
2013	Marie Curie International Incoming Fellowship, declined in favour of Humboldt fellowship
2011	Schepens Eye Research Institute Paper of the Year Award (dry labs section for Wallis & Bex (2011))
2010	NHMRC Postgraduate Training Award
2008	Winner, Postgraduate Student Research Excellence Award, School of Psychology, The University of Queensland
2008	Australasian Experimental Psychology Conference Student Award
2008	Selected to attend the European Visual Neuroscience Summer School, Rauscholzhausen, Germany
2004	University Medal for undergraduate degree (awarded to the top 1% of UQ graduates annually). Equivalent to <i>Summa Cum Laude</i> .

## Publications

### Unreviewed Preprints

Gatys, L. A., Kümmerer, M., Wallis, T.S.A. & Bethge, M. (2017).  
Guiding human gaze with convolutional neural networks.  
*arXiv:1712.06492* ([link](#))

Kümmerer, M., Wallis, T.S.A. & Bethge, M. (2016).  
Saliency Benchmarking: Separating Models, Maps and Metrics.  
*arXiv:1704.08615*. ([link](#))

### Peer-reviewed journal articles and conference papers

Wallis, T.S.A., Funke, C.M., Ecker, A.S., Gatys, L.A., Wichmann, F.A., & Bethge, M. (2017).  
A parametric texture model based on deep convolutional features closely matches texture appearance for humans.  
*Journal of Vision*, 17(12):5. ([link](#), [preprint](#), [code and raw data](#), [stimuli](#))

Kümmerer, M., Wallis, T.S.A., Gatys, L.A., & Bethge, M. (2017).  
Understanding Low- and High-Level Contributions to Fixation Prediction.  
*The IEEE International Conference on Computer Vision (ICCV), 2017*. ([pdf](#))

Wallis, T.S.A., Tobias, S., Bethge, M. & Wichmann, F.A. (2017).  
Detecting distortions of peripherally-presented letter stimuli under crowded conditions.  
*Attention, Perception and Psychophysics*. ([publisher link](#), [open pdf](#), [code and data](#))

Wallis, T.S.A., Bethge, M. & Wichmann, F. A. (2016).  
Testing models of peripheral encoding using metamerism in an oddity paradigm.

*Journal of Vision*, 16(2), 4. ([link](#), [code](#), [data and materials](#))

Kümmerer, M., Wallis, T.S.A. & Bethge, M. (2015).

Information-theoretic model comparison unifies saliency metrics.

*Proceedings of the National Academy of Sciences* 112(52), 16054–16059. ([link](#), [code](#))

Wallis, T.S.A., Dorr, M.A.C. & Bex, P.J. (2015).

Sensitivity to gaze-contingent contrast increments in naturalistic movies: An exploratory report and model comparison.

*Journal of Vision*, 15(8), 3. ([link](#), [code and data](#))

Wallis, T.S.A., Taylor, C.P., Wallis, J., Jackson, M.L. & Bex, P.J. (2014).

Characterisation of field loss based on microperimetry is predictive of face recognition difficulties.

*Investigative Ophthalmology & Visual Science*, 55(1), 142–153. ([pdf](#), [supp](#), [code and data](#))

Wallis, T.S.A. & Bex, P.J. (2012).

Image correlates of crowding in natural scenes.

*Journal of Vision*, 12(7): 6, 1–19. ([link](#))

Wallis, T.S.A. & Bex, P.J. (2011).

Visual crowding is correlated with awareness.

*Current Biology*, 21(3): 254–258. ([pdf](#), [Supp](#))

Arnold, D.H., Erskine, H., Roseboom, W. & Wallis, T.S.A. (2010).

Spatio-Temporal Rivalry: A perceptual conflict involving illusory moving and static forms.

*Psychological Science*, 21(5): 692–9. ([pdf](#))

Wallis, T.S.A., Williams, M.A. & Arnold, D.H. (2009).

Pre-exposure to moving form enhances static form sensitivity.

*PLoS ONE*, 4(12): e8324. ([link](#))

Wallis, T.S.A. & Arnold, D.H. (2009).

Motion-induced blindness and motion streak suppression.

*Current Biology*, 19(4): 325–329. ([pdf](#))

Wallis, T.S.A. & Arnold, D.H. (2008).

Motion-induced blindness is not tuned to retinal speed.

*Journal of Vision*, 8(2): 11, 1–7. ([pdf](#))

Arnold, D.H., Birt, A., & Wallis, T.S.A. (2008).

Perceived Size and Spatial Coding.

*Journal of Neuroscience*, 28(23): 5954–5958. ([pdf](#))

Arnold, D.H., Law, P. & Wallis, T.S.A. (2008).

Binocular Switch Suppression: A new method for persistently rendering the visible ‘invisible’.

*Vision Research*, 48(8): 994–1001. ([pdf](#))

Wallis, T.S.A. & Horswill, M.S. (2007).

Using fuzzy signal detection theory to determine why experienced and trained drivers respond faster than novices in a hazard perception test.

*Accident Analysis & Prevention*, 39(6), 1177–1185. ([pdf](#))

Arnold, D.H., Grove, P.M. & Wallis, T.S.A. (2007).

Staying focussed: A functional account of perceptual suppression during binocular rivalry.

*Journal of Vision*, 7(7):7, 1–8. ([link](#))

## Peer-reviewed conference abstracts

- Wallis, T. S. A., Funke, C. M., Ecker, A. S., Gatys, L. A. Wichmann, F. A. & Bethge, M. (2017)  
Matching peripheral scene appearance using deep features: Investigating image-specific variance and contributions of spatial attention.  
*European Conference on Visual Perception (ECVP)*, Berlin.
- Funke, C. M., Wallis, T. S. A., Ecker, A. S., Gatys, L. A. & Bethge, M. (2017)  
Human sensitivity to distortions of image structure induced by a deep neural network texture model.  
*European Conference on Visual Perception (ECVP)*, Berlin.
- Kümmerer, M., Wallis, T.S.A., Gatys, L.A. & Bethge, M. (2017).  
Separating Fixations From Deep and Low-Level Features  
*European Conference on Visual Perception (ECVP)*, Berlin.
- Kümmerer, M., Wallis, T.S.A., Gatys, L.A. & Bethge, M. (2017).  
Predicting Fixations From Deep and Low-Level Features  
*Computational and Mathematical Models in Vision (MODVIS)*, Florida. ([link](#))
- Wallis, T.S.A., Funke, C.M., Ecker, A.S., Gatys, L.A., Wichmann, F.A. & Bethge, M. (2016).  
Towards matching the peripheral visual appearance of arbitrary scenes using deep convolutional neural networks.  
*European Conference on Visual Perception (ECVP) Meeting*, Barcelona.
- Wallis, T.S.A., Ecker, A.S., Gatys, L.A., Funke, C.M., Wichmann, F.A. & Bethge, M. (2016).  
Seeking summary statistics that match peripheral visual appearance using naturalistic textures generated by deep neural networks.  
*Vision Sciences Society (VSS) Meeting*, Florida.
- Lewke, B., Wallis, T.S.A. & Wichmann, F.A. (2016).  
The influence of semantic information on early visual processing in natural scenes.  
*Tagung experimentell arbeitender Psychologen (TeaP)*, Heidelberg.
- Wallis, T.S.A., Bethge, M. & Wichmann, F.A. (2016).  
Testing models of peripheral encoding using metamerism in an oddity paradigm.  
*Tagung experimentell arbeitender Psychologen (TeaP)*, Heidelberg.
- Wallis, T.S.A., Bethge, M. & Wichmann, F.A. (2015).  
Metamers of the ventral stream revisited.  
*Vision Sciences Society (VSS) Meeting*, Florida. Published in *Journal of Vision*, 15(12), 554.
- Kümmerer, M., Wallis, T.S.A., Theis, L., Bethge, M. (2015).  
Deep Gaze I: Boosting saliency prediction with feature maps trained on ImageNet.  
*Computational and Systems Neuroscience (COSYNE)*, Salt Lake City, USA.
- Tobias, S., Wallis, T.S.A., Bethge, M. & Wichmann, F.A. (2014).  
Human sensitivity to spatial distortions in the periphery.  
*Bernstein Conference for Computational Neuroscience*, Göttingen, Germany.
- Kümmerer, M., Wallis, T.S.A. & Bethge, M. (2014).  
How close are we to understanding saliency?  
*Bernstein Conference for Computational Neuroscience*, Göttingen, Germany.
- Wallis, T.S.A., Dorr, M.A.C. & Bex, P.J. (2014).

- A Bayesian multilevel modelling approach to characterising contrast sensitivity in naturalistic movies.  
*European Mathematical Psychology Group Meeting*, July 2014, Tübingen, Germany.
- Wallis, T.S.A., Dorr, M.A.C. & Bex, P.J. (2013).  
The psychophysical contrast response of the human visual system to freely-viewed naturalistic movies.  
*Bernstein Conference for Computational Neuroscience*, September 2013, Tübingen, Germany.
- Wallis, T.S.A., Dorr, M.A.C. & Bex, P.J. (2013).  
The psychophysical contrast response of the human visual system to freely-viewed naturalistic movies.  
*European Conference on Visual Perception (ECVP)*, August 2013, Bremen, Germany. To be published in *Perception*.
- Chen, X., Lesmes, L. A., Wallis, J., Wallis, T.S.A., Jackson, M.L. & Bex, P.J. (2013).  
Analysis of contrast sensitivity assessments over time: A pilot study.  
*Association for Research in Vision and Ophthalmology (ARVO)*, 2013. To be published in *Investigative Ophthalmology and Visual Science*.
- Wallis, T.S.A., Dorr, M.A.C & Bex, P.J. (2012).  
Sensitivity to gaze-contingent spatial distortions in freely-viewed movies.  
*European Conference on Visual Perception (ECVP)*, September 2012, Alghero, Italy. To be published in *Perception*.
- Wallis, J., Bex, P. J., Lesmes, L. A., Wallis, T.S.A., Jackson, M.L. (2012).  
Contrast Sensitivity As A Predictor Of Central Field Loss.  
*Association for Research in Vision and Ophthalmology (ARVO)*. Published in *Investigative Ophthalmology and Visual Science*, 53:E-Abstract 6519.
- Wallis, T.S.A. & Bex, P.J. (2011).  
Image Correlates of Peripheral Contour Discrimination in Natural Scenes.  
*Fall Vision Meeting of the Optical Society of America*, Seattle, Washington. Published in *Journal of Vision*, 11(15), 62.
- Wallis, T.S.A. & Bex, P.J. (2011).  
Image correlates of crowding in natural scenes.  
*Vision Sciences Society (VSS) Meeting*, Naples, Florida. Published in *Journal of Vision*, 11(11), 1192.
- Lesmes, L. A., Wallis, T.S.A. & Bex, P.J. (2011).  
Response bias contributes to visual field anisotropies for crowding in natural scenes.  
*Vision Sciences Society Meeting (VSS)*, Naples, Florida. Published in *Journal of Vision*, 11(11), 1156.
- Wallis, T.S.A. & Bex, P.J. (2010).  
Crowding is reduced when flankers are suppressed from awareness.  
*European Conference on Visual Perception (ECVP) 2010*. Lausanne, Switzerland. 22-26 August, 2010. Published in *Perception*, 39.
- Wallis, T.S.A., Williams, M.A. & Arnold, D.H. (2009).  
Pre-exposure to moving forms improves sensitivity to static forms.  
*European Conference on Visual Perception (ECVP) 2009*. Regensburg, Germany. 24-28 August, 2009. Published in *Perception*, 38.
- Wallis, T.S.A. & Arnold, D.H. (2008).  
Motion-induced blindness may be a consequence of motion deblurring.  
*European Conference on Visual Perception (ECVP) 2008*. Utrecht, Netherlands. 24-28 August, 2008. Published in *Perception*, 37.

- Wallis, T.S.A. & Arnold, D.H. (2008).  
Melting Form: A gradual perceptual dispersion of motion-induced form segregation.  
*Asia Pacific Conference on Vision (APCV)*, 2008. Brisbane, Australia. 18-21 July, 2008.
- Arnold, D.H., Birt, A. & Wallis, T.S.A. (2008).  
Illusory size changes influence the tuning of spatial coding interactions.  
*European Conference on Visual Perception (ECVP)* 2008. Utrecht, Netherlands. 24-28 August, 2008. Published in *Perception*, 37.
- Wallis, T.S.A. & Arnold, D.H. (2008).  
I could see but now I'm blind: Motion-induced blindness may be a case of overzealous motion deblurring.  
*Australasian Experimental Psychology Conference (EPC)*, 2008. Perth, Australia. March, 2008. Published in the *Australian Journal of Psychology*, 60 (Supp 1).
- Arnold, D.H., Birt, A. & Wallis, T.S.A. (2008).  
Perceived size and spatial coding.  
*Australasian Experimental Psychology Conference (EPC)*, 2008. Perth, Australia. March, 2008. Published in the *Australian Journal of Psychology*, 60 (Supp 1).
- Arnold, D.H., Law, P. & Wallis, T.S.A. (2008).  
Binocular switch suppression: A new method for persistently rendering the visible "invisible".  
*Australasian Experimental Psychology Conference (EPC)*, 2008. Perth, Australia. March, 2008. Published in the *Australian Journal of Psychology*, 60 (Supp 1).
- Wallis, T.S.A. & Arnold, D.H. (2007).  
Staying focused: The function of suppression during binocular rivalry?  
*Vision Sciences Society (VSS) Meeting*, Florida, USA. May, 2007. Published in *Journal of Vision*, 7(9):62, 62a.
- Wallis, T.S.A. & Arnold, D.H. (2007).  
Putting the "motion" back into motion-induced blindness.  
*Australasian Experimental Psychology Conference (EPC)*, 2007. Canberra, Australia. April, 2007. Published in the *Australian Journal of Psychology*, 59 (Supp 1).
- Arnold, D.H., Grove, P. & Wallis, T.S.A. (2007).  
Do eyes or stimuli dominate perception during binocular rivalry? The answer is clear!  
*Vision Sciences Society (VSS) Meeting*, Florida, USA. May, 2007. Published in *Journal of Vision*, 7(9):370, 370a.
- Arnold, D.H., Grove, P. & Wallis, T.S.A. (2007).  
Staying focussed: A functional account of perceptual suppression during binocular rivalry.  
*Australasian Experimental Psychology Conference (EPC)*, 2007. Canberra, Australia. April, 2007. Published in the *Australian Journal of Psychology*, 59 (Supp 1).
- Wallis, T.S.A. & Horswill, M.S. (2006).  
Using fuzzy signal detection theory to determine why experienced and trained drivers respond faster than novices in a hazard perception test.  
*Australasian Experimental Psychology Conference (EPC)*, 2006. Brisbane, Australia. April, 2006. Published in the *Australian Journal of Psychology*, 57 (Supp 1).

## Teaching & supervision

2017	Lecturer; “Visuelle Wahrnehmung für Informatiker” (4 SWS) Supervisor of Bachelor student projects Anna Giron and Wiebke Ringels. Co-supervisor (with Matthias Bethge) of PhD student Christina Funke. Co-supervisor (with Matthias Bethge) of PhD student Judy Borowski.
2016	Co-supervisor (with Matthias Bethge) of M.Sc. student Christina Funke.
2015	Lecturer, with Philipp Berens: “Advanced Statistics for Graduate Students”, Graduate School, The University of Tübingen. <a href="#">Course materials available here.</a> Co-supervisor (with Felix Wichmann) of Bachelor thesis student Britta Lewke. Co-supervisor (with Matthias Bethge) of undergraduate intern Cordula Markert.
2014	Co-supervisor (with Felix Wichmann) of M.Sc. student Saskia Tobias. Co-supervisor (with Matthias Bethge) of undergraduate intern Annelie Mühler.
2009	Guest lecturer, “Sensory Neuroscience” <i>School of Psychology, The University of Queensland</i>
7/2007 - 11/2007	Lead Tutor, “Research Methodology and Statistics I” <i>School of Psychology, The University of Queensland</i>
3/2007 - 6/2007	Tutor, “Research Methodology and Statistics I” <i>School of Psychology, The University of Queensland</i>

## Invited talks

Medical Research Council Cognition and Brain Sciences Unit, Cambridge UK. “Deep features capture natural image statistics important for human perception”. October 19, 2016.

Twitter Cortex (Twitter Inc.), London UK. “Deep features capture natural image statistics important for human perception”. October 18, 2016.

Department of Psychology, Ludwig-Maximilians-Universität München. “Probing peripheral visual representations”. November 19, 2014.

Centre for Perception and Cognitive Neuroscience, The University of Queensland. “Sensitivity to gaze-contingent modifications of image structure in freely-viewed naturalistic movies: contrast and spatial distortions”. April 2013.

Radcliffe Symposium, Harvard University. “Reading: Clinical Rehabilitation and Neuro-Plasticity”, September 17–18, 2012.

Dean’s Scholars’ Seminar, The University of Queensland. “Moving objects can alter your consciousness”. 2008.



## Professional activities & outreach

Board membership	Psychology in Open Access ( <a href="http://psyoa.org">http://psyoa.org</a> )
Society memberships	Vision Sciences Society Bernstein Association for Computational Neuroscience
Ad hoc reviewing	Biology Letters, Cognitive Computational Neuroscience (CCN) Conference 2017, Current Biology, Frontiers in Perception Science, Investigative Ophthalmology and Visual Science, Journal of Vision, Neural Information Processing Systems (NIPS) 2013 & 2014, Perception, Psychological Review, Vision Research. “Exceptional Reviewer” for Journal of Vision in 2013, 2014, 2015 & 2016 “Exceptional Reviewer” for Investigative Ophthalmology and Visual Science (IOVS) 2015. Member of the Board of Reviewers, Journal of European Psychology Students ( <a href="#">JEPS</a> )
Workshop and committee service	Co-organiser of a workshop for early career vision scientists “What have vision scientists learned in the past five years?”, Cambridge, UK. October 20–21, 2016.
Consulting	Statistical and data mining consultant for <a href="#">Goodfilms</a> , a social film rating website.
Blog	I blog at <a href="http://www.tomwallis.info">www.tomwallis.info</a> about open science, reproducibility, and data analysis.

## Software competencies

Primary tools	R, Python, MATLAB, $\LaTeX$
Familiar tools	git, Office-like packages, SPSS, JASP
Github	<a href="http://github.com/tomwallis">http://github.com/tomwallis</a>

## Referees

- Derek Arnold      Associate Professor  
School of Psychology  
The University of Queensland  
[darnold@psy.uq.edu.au](mailto:darnold@psy.uq.edu.au)  
*Prof. Arnold was my PhD supervisor*
- Peter Bex      Professor  
School of Psychology  
Northeastern University  
[p.bex@neu.edu](mailto:p.bex@neu.edu)  
*Prof. Bex was my postdoctoral advisor*
- Felix Wichmann      Professor  
Department of Computer Science  
The University of Tübingen  
[felix.wichmann@uni-tuebingen.de](mailto:felix.wichmann@uni-tuebingen.de)  
*Prof. Wichmann was my postdoctoral advisor*
- Matthias Bethge      Professor  
Centre for Integrative Neuroscience  
The University of Tübingen  
[matthias@bethgelab.org](mailto:matthias@bethgelab.org)  
*Prof. Bethge is my co-project leader and the speaker of SFB 1233*
- Karl Gegenfurtner      Professor  
Department of Psychology  
Giessen University  
[gegenfurtner@uni-giessen.de](mailto:gegenfurtner@uni-giessen.de)  
*Prof. Gegenfurtner is familiar with my work, and me personally, but we have never worked together.*