Lore Thaler, PhD, FHEA
Associate Professor, Department of Psychology
Durham University, South Road
Durham, DH1 3LE, United Kingdom
Phone: +44 (0)191 334 3290
E-mail: lore.thaler@durham.ac.uk

Education

2008 PhD, The Ohio State University, USA
2004 MSc, Bonn University, Germany

Professional and Research Experience

2017 – present	Associate Professor, Durham University, UK
2011-2017	Assistant Professor, Durham University, UK
2008-2011	Post-Doctoral Fellow, The University of Western Ontario, Canada

Research Funding

- **ESRC- Impact Acceleration Grant** (2018-2019) 'Echolocation: Training and Resources' (£25,000)
- **ESRC (Co-I; PI: M Nardini;)** (2016-2019) 'Using Echolocation To Study The Development Of Cue Combination' (£450k)
- **BBSRC (PI)** (2015-2018) 'Human echolocation: Basic mechanisms and neuroplasticity' (£410k)
- **British Council GII** (2014-2016) 'Seeing with Sound: Developing an Echolocation Device based on sensing principles derived from Human Users' (total: £147,064; sub-award LT: £35,800)
- **Durham University Seedcorn Impact Award:** 2,200 £
- **IAS Workshop funding;** Workshop Title: Seeing the World through Echoes (2,000 £)
- **Biophysical Sciences Institute Durham University (2012)**; Project: Teaching and Evaluating the Use of Palatal Clicks for Human Echolocation (6,000 £)
- **Wolfson Research Institute Durham University (2011);** Project: Mathematical Modelling of Echolocation in People (4,000 £)
- **Ontario Ministry of Research and Innovation Postdoctoral Fellowship (2008-2010),** Project: Investigation of Neural Correlates of Visual-Spatial Representations (50,000 CA $)

Papers (authors with * are students/PDRs supervised by me)

1. Negen*, J., Wen, L., **Thaler, L.** & Nardini, M. (2018). Bayes-Like Integration of a New Sensory Skill with Vision. Scientific Reports, 8: 16880.
2. *Norman, L., **Thaler, L.** (2018). Human echolocation for target detection is more accurate with emissions containing higher spectral frequencies, and this is explained by echo intensity. Perception, 9(3). doi: 10.1177/2041669518776984.
3. Yu, X.L., **Thaler, L.**, Baker, C.J., Smith, G.E., Zhao, L.S. (2018). Human echolocation: 2-D shape discrimination using features extracted from acoustic echoes. Electronics Letters. DOI: 10.1049/el.2018.0680
4. Arcaro, M., **Thaler, L.**, Quinlan, D.J., Monaco, S., Khan, S., Valyear, K., Goebel, R., Dutton, G.N., Goodale, M.A., Kastner, S., Culham, J.C. (2018). Psychophysical and neuroimaging responses to moving stimuli in a patient with the Riddoch phenomenon due to bilateral visual cortex lesions, Neuropsychologia. doi: 10.1016/j.neuropsychologia.2018.05.008
5. **Thaler, L.**, De Vos, R., Kish, D., Antoniou, M., Baker, C., Hornikx, M. (2018). Human Echolocators adjust loudness and number of clicks for detection of reflectors at various

azimuth angles. Proceedings of the Royal Society: Series B Biological Sciences. 285: 20172735.
6. Norman*, L.**, Thaler, L.** (2017). Human Echolocation – Spatial Resolution and Signal Properties. In 'Biologically Inspired Radar and Sonar: Lessons from Nature'. pp 209-227. Eds.: Balleri, A., Griffiths, H., Baker, C.
7. **Thaler, L.,** Foresteire*, D. (2017). Visual sensory stimulation interferes with people's ability to echolocate object size. Nature Scientific Reports. doi: 10.1038/s41598-017-12967-3
8. **Thaler, L.,** Reich, G.M., Zhang, X., Wang, D., Smith, G.E., Tao, Z., Abdullah, R., Cherniakov, M., Baker, C.J., Kish, D. & Antoniou, M. (2017). Mouth-Clicks used by Blind Human Echolocators – Signal Description and Model Based Signal Synthesis. PLoS Computational Biology, 13(8): e1005670. doi: 10.1371/journal.pcbi.1005670.
9. Zhang, X., Reich, G., Antoniou, M., Cherniakov, M., Baker, C.J., **Thaler, L.**, Kish, D., Smith, G.E. (2017). Human echolocation: Waveform Analysis of Tongue Clicks. Electronics Letters. doi: 10.1049/el.2017.0454
10. **Thaler, L.** , Goodale, M.A. (2016). Echolocation in People: An Overview**.** WIREs Cogn Sci, doi: 10.1002/wcs.1408
11. **Thaler, L.,** Castillo-Serrano*, J.G. (2016). People's ability to detect objects using click-based echolocation: A direct comparison between mouth-clicks and clicks made by a loudspeaker**.** PLoS One, 11(5): e0154868. doi:10.1371/journal.pone.0154868
12. **Thaler, L.** (2015). Using Sound to Get Around - Discoveries in Human Echolocation. Observer, 28 (10).
13. **Thaler, L**., Paciocco, J., Daley, M., Lesniak, G.D., Purcell, D.W., Fraser, J.A. Dutton, G.N., Rossit, S., Goodale, M.A. & Culham, J.C. (2015). A selective impairment of perception of sound motion direction in peripheral space: A case study. Neuropsychologia, 80, 79-89.
14. Fiehler, K., Schütz, I., Meller, T. & **Thaler, L**. (2015). Neural correlates of human echolocation of path direction during walking. Multisensory Research, 28, 195-226.
15. Milne*, J.L., Goodale, M.A., Arnott S.R., Kish, D. & **Thaler, L**. (2015). Parahippocampal cortex is involved in material processing through echolocation in blind echolocation experts. Vision Research, 109, 139-148.
16. Milne*, J.L., Anello, M., Goodale, M.A., & **Thaler, L**. (2014). A blind human expert echolocator shows size constancy for objects perceived by echoes. Neurocase, 21(4):465-70.
17. Milne*, J.L., Goodale, M.A., & **Thaler, L**. (2014). The role of head movements in the discrimination of 2-D shape by blind echolocation experts. Attention, Perception, & Psychophysics, 76, 1828-1837.
18. **Thaler, L.,** Wilson*, R. & Gee*, B. (2014). Correlation between Vividness of Visual Imagery and Echolocation Ability in Sighted, Echo-Naïve People. Exp Brain Res, 232 (6), 1915-1925. doi: 10.1007/s00221-014-3883-3
19. **Thaler, L.,** Milne*, J.L., Arnott,S., Kish,D. & Goodale, M.A. (2014). Neural Correlates of Motion Processing through Echolocation, Source Hearing and Vision in Blind Echolocation Experts and Sighted Echolocation Novices. J Neurophys, 111:112-127.
20. Arnott,S.R., **Thaler, L**., Milne*,J.L., Kish,D. & Goodale, M.A.(2013). Shape-specific activation of occipital cortex in an early blind echolocation expert. Neuropsychologia, 51, 938-949
21. **Thaler, L.** (2013) Echolocation may have real-life advantages for blind people: An Analysis of Survey Data. Frontiers in Physiology, 4:98. doi: 10.3389/fphys.2013.00098
22. Schlicht, T., Vetter, P., **Thaler, L**. & Moss, C. (2013). Wahrnehmung. In Handbuch Kognitionswissenschaft. Stephan, Achim & Walter, Sven Stuttgart: Metzler.
23. **Thaler, L.**, Schütz, A.C., Goodale, M.A. & Gegenfurtner K.R (2013). What is the best fixation target? The effect of target shape on stability of fixational eye movements. Vis Res 76: 31-42.

24. **Thaler, L.** & Goodale, M. A. (2011) Neural substrates of visual spatial coding and visual feedback control for hand movements in allocentric and target-directed tasks. Frontiers in Human Neuroscience, 5:92. doi: 10.3389/fnhum.2011.00092
25. Gordon*, G., Kaplan*, D.M., Lankow*, B., Little*, D.Y., Sherwin*, J. Suter*, B.A & **Thaler*, L**. (2011). Towards an integrated Framework for Perception and Action: Conference Report and Future Directions. Frontiers in Systems Neuroscience, 5:20. doi: 10.3389/fnsys.2011.00020 *all authors contributed equally to this work.
26. **Thaler, L.** & Goodale, M.A. (2011). Reaction times for allocentric movements are 35 ms slower than reaction times for target-directed movements. Exp Brain Res, 211 (2), 313-328.
27. **Thaler, L**., Arnott, S.A. & Goodale, M.A. (2011). Neural correlates of natural human echolocation in early and late blind echolocation experts. *PLoS* ONE, 6(5): e20162. doi:10.1371/journal.pone.0020162
28. **Thaler, L**. & Goodale, M.A. (2011). The role of online visual feedback for the control of target-directed and allocentric hand movements. J Neurophys, 105, 846-859.
29. Todd, J.T. & **Thaler, L**. (2010). The perception of 3D shape from texture based on directional width gradients. J Vis, 10(5), 1-13.
30. **Thaler, L**. & Goodale, M.A. (2010). Beyond Distance and Direction: The CNS represents Target Locations non-metrically. J Vis, 10(3), 1-27.
31. **Thaler, L**. & Todd, J.T. (2010). Evidence from Visuo-Motor Adaptation for two partially independent Visuo-motor systems. J Exp Psych: Human Percept Perform, *36(4),* 924-935.
32. **Thaler, L**. & Todd, J.T. (2009). The Control Parameters used by the CNS to Guide the Hand Depend on the Visuo-Motor Task: Evidence from Visually Guided Pointing. Neuroscience, 159, 578–598.
33. **Thaler, L**. & Todd, J.T. (2009). The Use of Head/Eye-Centered, Hand-Centered and Allocentric Representations for Visually Guided Hand Movements and Perceptual Judgments. Neuropsychologia, 47, 1227–1244.
34. Todd, J.T., **Thaler, L**., Dijkstra, T.M.H, Koenderink, J.J. & Kappers, A.M.L. (2007). The Effects of Viewing Angle, Camera Angle and Sign of Surface Curvature on the Perception of 3D Shape from Texture. J Vis, 7(12), 1-16.
35. **Thaler, L.,** Todd, J. J., Spering, M., & Gegenfurtner, K. R. (2007). Illusory Bending of a rigidly moving Line Segment: Effects of Image Motion and smooth pursuit Eye Movements. J Vis, 7(6), 1-13.
36. **Thaler, L.,** Todd, J.T. & Dijkstra, T.M.H. (2007). The Effects of Phase on the Perception of 3D Shape from Texture: Psychophysics and Modeling. Vis Res, 47, 411-427.
37. Todd, J.T., **Thaler, L**. & Dijkstra, T.M.H (2005). The Effects of Field of View on the Perception of 3D Slant from Texture. Vis Res, 45, 1501-1517.

Peer Reviewed Abstracts (authors with * are students supervised by me)

1. Culham, J. C., Arcaro, M. J., Thaler, L., McLean, D. A., Quinlan, D. J., Dutton, G. N., Goodale, M. A. & Kastner, S. (January 2016). Cortical and subcortical responses to moving stimuli in a patient with Riddoch phenomenon arising from bilateral visual cortex lesions. *European Workshop on Cognitive Neuropsychology*. Bressanone, Italy.
2. **Thaler, L.** & Cutts*, M. (2015). Luminance signals interfere with echolocation in sighted people, *European Conference for Visual Perception*.
3. Fiehler, K., Schütz, I., Meller, T. & **Thaler, L**. (2015). Neural correlates of processing of path direction during walking using echolocation, *IMRF*.
4. **Thaler, L.,** Wilson*, R. & Gee*, B. (2014). Correlation between Vividness of Visual Imagery and Echolocation Ability in Sighted, Echo-Naïve People. *J Vis,* in Press
5. Milne*, J.L., Goodale, M.A. & **Thaler, L.** (2013). Is there a 'retinotopic' representation of echo locations in the calcarine cortex of the blind brain? *J Vis*, 13(9): 1334.

6. **Thaler, L**., Milne*, J.L., Arnott, S.R. & Goodale, M.A. (2012). Brain areas involved in Echolocation Motion Processing in Blind Echolocation Experts. *Seeing and Perceiving*, 25, 140.
7. Milne*, J.L., Goodale, M.A., Arnott S.R., Kish, D. & **Thaler, L.** (2012). Parahippocampal cortex is involved in material processing through echolocation in blind echolocation experts. *J Vis,* 12(9): 581.
8. Arnott, S.R., **Thaler, L.,** Milne*, J.L., Kish, D. & Goodale, M.A. (2012). Functional imaging of shape processing in a blind echolocation expert. *J Vis,* 12(9): 580.
9. **Thaler, L.,** Paciocco, J., Daley, M., Lesniak, G.D., Purcell, D.W., Goodale, M.A. & Culham, J.C. (2011). A selective impairment of auditory perception of motion direction in peripheral space: A case study. To appear in *The Journal of Neuroscience*.
10. **Thaler, L**. & Goodale, M.A. (2011). The Allocentric Brain in Action. *J Vis,* 11(11): 939.
11. **Thaler, L**., Arnott, S.A. & Goodale, M.A. (2010). Echolocation I. *J Vis,* 10(7), 1050.
12. Arnott, S.A., **Thaler, L.** & Goodale, M.A. (2010). Echolocation II. *J Vis,* 10(7), 1055.
13. **Thaler, L**., Goodale, M. & Todd, J.T. (2009). Visual Feedback is used to guide the Hand towards Endpoints not along Trajectories. *J Vis,* 9(8), 1152.
14. **Thaler, L**. & Todd, J.T. (2008). Evidence from Visuo-Motor Adaptation for two partially independent Visuo-motor systems. *J Vis,* 8(6), 376.
15. **Thaler, L**. & Todd, J.T. (2007). Reaching to a Point or over a Distance: What is the Difference? *J Vis,* 7(9), 166.
16. **Thaler, L**. & Todd, J.T. (2006). The Rubber Pencil Illusion. Journal of Vision, 6(6), 634.
17. **Thaler, L.,** Todd, J.T. & Lindsey, D.T.L. (2005). Investigation of Image Structures important in Shape Perception from Texture. Perception (Supplement), 34, 174.
18. **Thaler, L**., Todd, J.T. & Lindsey, D.T.L. (2005). Phase dependent Local Energy Mediates Effects of Phase Scrambling on Shape Perception from Texture**.** Journal of Vision, 5(8), 994.
19. Todd, J.T. & **Thaler, L**. (2005). A Gradient based Heuristic for the Perception of 3D Shape from Texture. *J Vis,* 5(8), 995.
20. Todd, J. T., **Thaler, L**. & Dijkstra, T., Koenderink, J. J. & Kappers, A.M.L. (2004). The Effects of Camera and Viewing Angles on the Perception of 3D Shape from Texture**.** Journal of Vision, 4(8), 75.
21. **Thaler, L.**, Dijkstra, T. & Todd J. T. (2004). The Role of Phase Information in the Perception of 3D Shape from Texture. *J Vis,* 4(8), 76.
22. Todd, J. T., **Thaler, L**. & Dijkstra, T. (2003). The Effects of Visual Angle on the Perception of 3D Curvature from Texture**.** *J Vis,* 3(9), 611.

Selected Invited Talks

1. Human echolocation for walking and navigation in real and virtual spaces. Matariki Spring School, Tuebingen, Germany, April 10 & 11, 2017.
2. Echolocation in People. Institute for Advanced Study (Wissenschaftskolleg), Berlin, Germany, March 2 & 3, 2017.
3. Echolocation in People – Definitions and Applications. Rehabilitation Worker National Seminar, UK; Birmingham City University, UK, July 7, 2016.
4. Human Echolocation – Acoustic Signals and Sampling Behaviour. Gordon Research Conference on the Auditory System, Bates College, Lewiston, Maine, USA. July 10-15, 2016.
5. Human Echolocation – Acoustic Signals and Sampling Behaviour - NIHR Nottingham Hearing Biomedical Research Unit, Nottingham University, UK, March 7, 2016.
6. Echolocation, Vision and Assistive Technology; Italian Institute of Technology, Genova, Italy, February 15, 2016.
7. Echolocation and other sensory Modalities. Behavioural Science Institute, Radboud University Nijmegen, Nijmegen, The Netherlands, February 5, 2016

8. Echolocation in People- What it is and what we can learn from it. University of East Anglia, UK, January 20, 2016
9. Perception of Size and Shape through Echoes in Humans – Department of Psychological and Brain Sciences, John's Hopkins University, Baltimore, Maryland, USA. May 23, 2014.
10. Echolocation in People - What recent Evidence tells us about Human Sensory Processing. Department of Psychology, Swansea University, UK, November 2013.
11. Echolocation in People. British Society for Hearing Aid Audiologists, Nottingham, UK, May 2012.
12. Echolocation in People . Centre for Consciousness Studies, Tuscon, Arizona, USA, April 2012.
13. Echolocation in Blind People: Brain Activity and Behaviour. Department of Psychology, Giessen University, Germany, January 2012.

Teaching

Lecturing: Applied Statistics (PG), Classic Papers (UG), Advanced Neuropsychology (PG), Advanced Developmental Psychopathology Review (PG), Current Issues in Cognitive Neuroscience (PG)
Student supervision: PhD (J. Milne; J Castillo-Serrano); MSc; BSc

Administration / Service

• Programme Director MSc Cognitive Neuroscience • Durham University Neuroimaging Centre Managt. Board

Reviewing

Journals: • Journal of Motor Behavior • Journal of Experimental Psychology: Human Perception and Performance • Consciousness and Cognition • Neuron • Journal of Neuroscience Methods • Human Brain Mapping • Cognition • Journal of the Royal Society 'Interface' • Proceedings of the Royal Society (Series B) • Visual Cognition • Frontiers in Integrative Physiology • PLoS One • Current Biology • Journal of Neurophysiology • Behavioral Brain Research • Investigative Ophthalmology and Vision Science • European Journal of Neuroscience • Current Directions in Psychological Science • Acta Psychologica • Frontiers in Cognitive Science • IEEE TBME • Neuroscience and Biobehavioural Reviews • Nature Communications

Grants: MRC, ESRC, NSF, NWO, National Science Center Poland, Fight for Sight

Impact & Public Engagement:

Radio/Podcasts: "Seeing with Sound" (National Public Radio), with support from the Alfred P. Sloan Foundation, published on PRX July 15, 2013 • "No End in Sight" (30 Minutes West), featured at the Oregon Museum of Science and Industry, March 26, 2014 • "How to become Batman" (part of the Invisibilia series; National Public Radio), published January 23, 2015 • "Batman" (This American Life), published January 9, 2015 • "What is it like to be a bat?" (Nature Podcast), January 12, 2015 • Feature on echolocation (BBC Tees; Mike Parr/Lisa McCormick), May 20, 2015 • "The Listeners" (BBC4), published 29 & 30 Dec, 2015 • "Spectrum" (Deutsche Welle), published March 2016 • "Quirks & Quarks" (Canadian Broadcasting Company, CBC), 23 September 2017 • "Can we see with our ears?" (1.program Radio Slovenija), 15th February 2018 • World Update (38mins in) (BBC World Service), 28 Feb 2018 • Human Echolocators Use Tricks Similar to Bats (Scientific American), 6 March 2018 • A world of silhouettes: Seeing with sound (BBC Radio Cambridgeshire, BBC 5 Live, The Naked Scientists), 3 April 2018 • A world of silhouettes: Seeing with sound (ABC Australia), 6 April 2018 • New Research Into Echolocation (BBC 4 In Touch), 5 June 2018.

TV: “Superhuman” (ABC Australian TV), April 2016 • “Catalyst Science” (ABC Australian TV), 12 April 2016 • “Decouverte - Echolocation” (ICI Tele, Canadian TV), 14 January 2018 • P.M. Wissen (Servus TV, Austrian TV broadcasting) 15 Nov 2018.

Events: “Can Computers help Blind people to see?” Event Host, Royal Society London Café Scientifique, March 24, 2014 • “Could bat-inspired technology help blind people cycle?” Feature Comment accompanying the “Ultrabike” Exhibit, Science Museum London, 09/ 2013 – 01/2014 • “Seeing the World through Echoes” Organizer and Speaker, Public Engagement Event, Durham University, June 19 & 20, 2014 • “Echolocation in People – Definitions and Applications”, UK Rehabilitation Worker National Seminar, Birmingham, July 7, 2016 • “Sensing Nature - Echolocation Lecture & Workshop” Speaker and Workshop leader, Waveney & Blyth Arts Council, 5 & 6 November, 2016 • “Human Echolocation” Café Scientifique, Stockton on Tees, 21 February, 2017 • “Echolocation Training for Rehab workers and people with vision impairments” Organizer, Public Engagement Event, Durham University, March 9, 2017 • “Echolocation Training for Rehab workers” Public Engagement Event, Durham University, June 26 & July 20, 2017 • “Exploring your Senses – Sight and Sound” (Durham Celebrate Science Festival), 24-26 October, 2017 • “Echolocation Training for Mobility Professionals, people with vision impairments and relatives” Public Engagement Event, Durham University, March 13 & 15, 2018.

News Coverage (Selection): “The brain on sonar - how blind people find their way around with echoes” (Discover Magazine), May 25, 2011 • “Hirnforschung: Wie sich Blinde per Echoortung orientieren” (Der Spiegel), May 26, 2011 • “Klickblitze im Dunkeln“ (Spektrum der Wissenschaft), December 5, 2011 • “Human brain's 'bat sight' found” (BBC), May 26, 2011 • “Human echolocation: Using tongue-clicks to navigate the world” (BBC World News), 12 September 2012 • “Humans Can Learn to Echolocate” (Life Science), August 27, 2013 • Bat-Inspired Tech Could Help Blind People See with Sound (PBS, Nova), October 23, 2013 • “Ultrasonic helmet lets anyone see like a bat” (Popular Science), February 9, 2015 • “Human bat uses echoes and sounds to see the world” (New Scientist), May 9, 2015 • “Echolocation” (AsK – Kid’s Science Magazine), September, 2016 • “Learning Echolocation” (Scientific American “Mind Matters” Guest Blog), April, 2017 • “How Blind People use Echolocation” (Science Magazine), 1 September 2017 • “What it takes to be an expert echolocator” (Wired), 31 August 2017 • “This is how some people are able to echolocate like bats” (New Scientist), 31 August 2017 • “Mouth clicks used in human echolocation captured in unprecedented detail” (Science Daily), 31 August 2017 • “'Seeing with sound': study explores how the blind use echolocation (CTV News), 31 August 2017 • “Human echolocators ‘see’ with sound. Here’s what that actually looks like.” (PBS News), 8 September 2017 • made it to top on Reddit 31.5k votes; 1000 comments • “Mouth Clicks Used in Human Echolocation Captured in Unprecedented Detail” (EurekAlert), 31 August 2017 • ‘We Finally Know How Humans Are Able to Echolocate, Just Like Bats And Whales: And it's not that hard to learn’ (Science Alert) 31 August 2017 • ‘The stunning acoustic power of human echolocators’ (Washington Post), 1 September 2017 • ‘Teaching Humans to Echolocate’ (The Scientist) 1st October 2017 • ‘How does human echolocation work?’ (Smithsonian Magazine) 2 October 2017 • “Echolocation: helping the blind see with sound” (The Mathworks Blog), 18 October, 2017 • “Blind people able to use array of bat-like clicks as 'sonar' to sense their surroundings” (The Independent), 28 February 2018 • “Just Like Bats, Humans Are Able to Echolocate” (Seeker), 28 February 2018 • “How humans echolocate 'like bats” (BBC News), 28 February 2018 • “Echolocation could help blind people learn to navigate like bats” (The Guardian), 28 February 2018 • “Human Echolocation” (Bat Conservation Trust: Bat News, Issue 115), Spring 2018.