

APAN Advances and Perspectives in Auditory Neuroscience

Sponsored by TDT and NIDCD
Wyndham San Diego Bayside Hotel, San Diego, CA
Friday, November 2nd, 2018

8:00 – 9:00 **Registration and Poster set-up**
9:00 – 9:05 **Opening Remarks** (Chris Petkov, covering for chair Jennifer Bizley)

Keynote Lecture Chair: Chris Petkov

9:05 – 10:00 Prof. **Andrew King, University of Oxford**
Adaptive coding in the central auditory system

Poster Teaser Session I (Chairs: Michael Brosch and Molly Henry)

10:00 – 10:15 **Four 3-minute Teasers**

- Neuromodulation and plasticity for a rodent model of cochlear implant use. *Glennon E, Multani J, Carcea I, Svirsky M, Froemke RC.*
- Fronto-temporal cortical interactions during vocal production in marmoset monkeys. *Tsunada J, Eliades S*
- Behavioral and electrophysiological evidence of incidental learning across continuous speech. *Wu Y, Liu R, Lim SJ, Holt L.*
- Distinct contributions of auditory cortical inhibitory neuron types to spectral surround suppression. *Lakunina A, Ahmadian Y, Jaramillo S*

10:20 – 11.45 **Morning Poster Session (Presentations by EVEN # Posters)** and Coffee Break

Slide Session I (Chairs: Stephen David and Liberty Hamilton)

- 11.45 – 12.00 A temporal landmark for syllabic representation of continuous speech in human superior temporal gyrus. *Oganian Y, Chang EF*
- 12:00 – 12.15 Tracking stimulus statistics from sensory cortices to frontal cortex. *Lawlor J, Bimbard C, Shamma S, Boubenec Y.*
- 12:15 – 12:30 Illusory sound texture reveals statistical completion in auditory scene analysis. *McWalter R, McDermott JH.*
- 12:30 – 2:00 **Lunch** on your own (posters remain up through entire meeting)

2.00-2.05 NIDCD Announcements

Young Investigator Spotlight I (Chair: Liz Romanski)

2.05-2.35 **Nima Mesgarani, Columbia University, *Discerning the nonlinear properties of speech processing in the human auditory cortex***

Side Session II (Chairs: Tobias Overath and David Schneider)

- 2:35 – 2:50 Amygdala-TRN projections amplify tone-evoked activity in auditory thalamus and cortex. *Rolon-Martinez S, Aizenberg M, Geffen MN.*
- 2:50 – 3:05 Dissociation of task engagement and arousal effects in auditory midbrain and cortex. *Saderi D, Heller CR, Schwartz ZP, David SV.*
- 3:05 – 3:20 Amodal neural representations. *Muers RS, Perrodin C, Kayser C, Chandrasekaran C, Kocsis Z, Kikuchi Y, Wilson B & Petkov CI.*

Young Investigator Spotlight II (Chair: Liz Romanski)

3.25 – 3.50 - **Sarah Verhulst, Univ. Oldenburg, *Supra-threshold psychoacoustics and envelope-following response relations: Disentangling the contributions from outer-hair-cell loss and synaptopathy***

Poster Teaser Session II (Chair: Santiago Jaramillo and Kexin Yuan)

3:50 – 4:05 **Four 3-minute Teasers**

- Investigation of pitch encoding neurons in the ferret auditory cortex. *Gaucher Q, Ivanov Z, Panniello M, Dahmen J, Willmore B, King AJ, Walker KMM.*
- Affective whispered voices in the human limbic system: differences in single-cell firing and LFP recordings from the amygdala and hippocampus. *Bobin, M. Staib, T. Fedele, J. Sarnthein, S. Frühholz.*
- Multiplexed encoding of sensory and reinforcement cues in the cholinergic basal forebrain supports associative learning and cortical plasticity. *Robert B, Guo W, Polley DB.*

- Modulation of parietal alpha power reflects contributions of pitch cues to auditory spatial selective attention.
Bonacci L, Shinn-Cunningham B.

4:05 – 6:15 **Afternoon Poster Session (Presentations by ODD # Posters until 5:20 PM)** and Open Bar

6.15 - 6.20 **Travel Awards and Other Announcements** (Santiago Jaramillo and Kexin Yuan)

6:20 – 6:40 **Business Meeting** (ad-hoc chair Chris Petkov plus Programming, Event and Organizing Committee members)

APAN 2018 Poster Presentations:

- 1. Recalibration of excitatory and inhibitory local cortical networks supports neural and perceptual recovery of simple – but not complex – sound processing following a long-lasting reduction in auditory input strength**
Jenifer Resnik, Daniel B. Polley
- 2. Cross-modal gain control in sensory thalamus**
Michael Lohse, Johannes C. Dahmen, Victoria M. Bajo, Andrew J. King
- 3. Neural Selectivity for Music, Speech, and Song in Human Auditory Cortex**
Sam V Norman-Haignere, Jenelle Feather, Peter Brunner, Anthony L Ritaccio, Josh H McDermott, Gerwin Schalk, Nancy Kanwisher
- 4. Processing of reverberant sound in the auditory system**
Aleksandar Z. Ivanov, Benjamin D. B. Willmore, Kerry M. M. Walker, Andrew J. King, Nicol S. Harper
- 5. Distinct codes as a substrate for causal inference in primate superior colliculus neurons**
Jeff Mohl, Surya Tokdar, Jennifer Groh
- 6. Behavior state-dependence of correlated neural population activity in ferret primary auditory cortex**
Charles Heller, Daniela Sadari, Zachary Schwartz, Stephen David
- 7. Evaluating the generality of deep neural networks as a model of human hearing: Comparison with a large set of psychophysical and neural experiments**
Alexander J.E. Kell, Erica N. Shook, Josh H. McDermott
- 8. Enhanced ability of detecting rat vocalization-in-noise by sound exposure during a critical period**
Natsumi Homma, Christoph Schreiner
- 9. Auditory cortex dependent reprogramming of an innate maternal behaviour**
Alex Dunlap, Robert Liu
- 10. Increased cortical gain facilitates the detection of targets in noise.**
Chris Angeloni, Maria Geffen
- 11. Modulation of parietal alpha power reflects contributions of pitch cues to auditory spatial selective attention**
Lia Bonacci, Barbara Shinn-Cunningham
- 12. Competing Sounds reveal Spatial Configuration Sensitive Neurons in Mouse Primary Auditory Cortex**
Howard Gritton, Kevin Lou, Jun Ma, Xue Han and Kamal Sen
- 13. Predictive auditory sequence learning modulates inter-regional oscillatory coupling in human intracranial recordings**
Yukiko Kikuchi, Christopher K. Kovach, Ryan Calmus, Phillip E. Gander, Ariane E. Rhone, Kirill V. Nourski, Hiroto Kawasaki, Timothy D. Griffiths, Matthew A. Howard III & Christopher I. Petkov
- 14. The eardrums report both eye position and eye movement: the full EMREO map**
David LK Murphy, Rachel Landrum, Cole D. Jenson, Stephanie Schlebusch, David W. Smith, Christopher A. Shera, Cynthia D. King, Jennifer M. Groh
- 15. Reproducibility of eardrum movements accompanying saccades: implications for clinical testing**

Stephanie Schlebusch, David L.K. Murphy, Cynthia King, David M. Kaylie, Jennifer M. Groh

16. Auditory Attention Decoding: What Anatomical Locations and Neural Frequency Bands Contribute?

James O'Sullivan, Jose Herrero, Elliot Smith, Sameer A. Sheth, Guy M. McKhann, Ashesh D. Mehta, Nima Mesgarani

17. Integration of cross-modal information enhances auditory gap detection performance

Anna-Katharina R. Bauer, Martin G. Bleichner, Sylvain Baillet, Stefan Debener

18. Multiscale Calcium Imaging of Auditory Cortex in Awake Marmoset Monkeys

Xindong Song, Yueqi Guo, Xiaoqin Wang

19. Decoding sound texture identity via statistics of neuron ensembles

Xiu Zhai, Mina Sadeghi, Fatemeh Khatami, Heather L Read, Ian Stevenson, Monty A Escabi

20. Functional organization of human perisylvian cortex in response to speech

Bahar Khalighinejad, Sam Norman-Haignere, Jose Herrero, Ashesh Mehta, Nima Mesgarani

21. Multiplexed encoding of sensory and reinforcement cues in the cholinergic basal forebrain supports associative learning and cortical plasticity

Blaise Robert, Wei Guo, Daniel B. Polley

22. Mechanisms of information processing by coordinated neuronal ensembles in the primary auditory cortex

Jermyn Z See, Craig A Atencio, Natsumi Y Homma, Vikaas S Sohal, Christoph E Schreiner

23. Investigate what makes it “new” in the old-plus-new strategy of auditory scene analysis in the auditory cortex of marmoset monkeys

Yi Zhou, Jonas Braasch

24. Mechanisms to Communicate in a marmoset ‘Cocktail Party’

Vladimir Jovanovic, Cory T. Miller

25. Cross-Modal Representation of Individual Identity in Marmoset Hippocampal Neurons

Hristos Courellis, Cory Miller

26. Contribution of correlated cortical activity to identity-preserving changes in sounds.

Francisco A. Rodriguez Campos, Matthew Schaff, Brianna Karpowicz, Yale E. Cohen

27. A modular high-density 294 channels μ ECoG system on macaque vIPFC for auditory cognitive decoding

Chia-Han Chiang, Jaejin Lee, Charles Wang, Ashley J. Williams, Yale Cohen, and Jonathan Viveri

28. Modulation of auditory cortical information processing by movement and VIP interneuron activation

James Bigelow, Jefferson DeKloe, Ryan Morrill, Andrea Hasenstaub

29. Reorganization of cortical population neuronal activity following auditory fear conditioning

Katherine C. Wood, Richard Betzel, Danielle Bassett, Maria N. Geffen

30. Connectional modularity within the lateral cortex of the mouse inferior colliculus gives rise to partially segregated processing streams for auditory and multisensory information

Alexandria Lesicko, Daniel Llano

31. How do neurons overcome developmental hearing loss-induced cellular deficits during auditory learning?

Todd Mowery, Nihaad Parouty

32. Neural activities in marmoset premotor cortex for vocal production during social communication

Lingyun Zhao, Xiaoqin Wang

33. Predicting the neural responses to speech in human auditory cortex using deep neural network models

Menoua Keshishian, Hassan Akbari, Bahar Khalighinejad, Jose Herrero, Ashesh D Mehta, Nima Mesgarani

34. Population responses underlying statistical inference in a map of auditory space in the barn owl's midbrain

Roland Ferger, Michael V. Beckert, Keanu Shadron, Daniel Sanculi, William M. DeBello, Brian J. Fischer, Jose L. Pena

35. Neural competition in auditory decoding of own- and other-vocalizations

Joris Dietziker, Matthias Staib, Sascha Frühholz

36. A neural ensemble correlation code for sound category identification

Monty Escabi, Mina Sadeghi, Xiu Zhai, Ian Stevenson

37. Electrocorticographic Responses to Vowel Sequences in Awake and Anesthetized States

Kirill Nourski, Mitchell Steinschneider, Ariane E. Rhone, Hiroto Kawasaki, Matthew A. Howard, Matthew I. Banks

38. Understanding speech in background noise relies on similar processes to figure-ground segregation

Emma Holmes, Timothy D. Griffiths

39. Investigation of pitch encoding neurons in the ferret auditory cortex

Quentin Gaucher, Aleksandar Z. Ivanov, Mariangela Panniello, Johannes C. Dahmen, Benjamin Willmore, Andrew J. King, Kerry M. M. Walker

40. Mapping the human subcortical auditory system: Validation across histology, ex vivo MRI, and in vivo MRI

Kevin R. Sitek*, Omer Faruk Gulban*, Evan Calabrese, G. Allan Johnson, Satrajit S. Ghosh†, Federico De Martinot

41. Neurons in auditory cortex are sensitive to frequency pattern violation

Linda Garami, Chris Angeloni, Kathrine C. Wood, Maria N. Geffen

42. Effects of peristimulus vagal nerve stimulation on responses in ferret auditory cortex

Jonathan B. Fritz, Ali Mohammed, Jaya Viswanathan, Pingbo Yin, Diego Elgueda, Erin Causey, Jeslyn Lai, Stephen V. David, Shihab Shamma

43. A computational model of the underlying mechanisms of temporal coding in auditory cortex

Jong Hoon LEE, Xiaoqin Wang, Daniel Bendor

44. Attentional modulation of neural speech tracking and alpha power independently support speech comprehension in middle-aged adults

Sarah Tune, Mohsen Alavash, Lorenz Fiedler, Jonas Obleser

45. Interactions between intra- and inter-areal connections of human insula in processing emotional sounds

Yang Zhang, Wenjing Zhou, Juan Huang, Bo Hong, Xiaoqin Wang

46. Alpha oscillations index the temporal dynamics of exerted cognitive effort during listening

Björn Herrmann, Burkhard Maess, Ingrid S. Johnsrude

47. Non-reciprocal open-loop interactions in thalamo-thalamic reticular network

Kush Paul, Jeffrey W. Brown, Aynaz Taheri, Robert V. Kenyon, Tanya Y. Berger-Wolf, Daniel A. Llano

48. A Cortical Time-Frequency Mask for Auditory Scene Analysis

Kenny F Chou, H Steven Colburn, Kamal Sen

49. Detecting tinnitus in nonhuman primates by using a non-acoustic startle paradigm

Lars Rogenmoser, Pawel Kusmieriek, Denis Archakov, Josef P. Rauschecker,

50. Inhibitory inputs to medial geniculate body modulate nonlinear population auditory cortical responses after midbrain stimulation

Baher A. Ibrahim, Aynaz Taheri, Robert V. Kenyon, Tanya Berger-Wolf and Daniel A. Llano

51. Correlations improve accuracy in predicting population codes in macaque auditory cortex

M. B. Schaff, S. Subramanian, C. Lo, O. Contreras, E. Piasini, V. Balasubramanian, Y. E. Cohen

52. Active tracking of sound textures: a human intracranial study

Alexander J. Billig, Phillip E. Gander, William Sedley, Maria Chait, Hiroto Kawasaki, Christopher K. Kovach, Matthew A. Howard, Timothy D. Griffiths

- 53. A potential role of non-lemniscal auditory thalamic inputs to lateral amygdala in diverse sound-induced defensive behaviors**
Miaomiao Liu, Yiwei Wang, Hanqing Wang, Dongqin Cai, Ling You, Fenghua Xie, Yin Yue, Kexin Yuan
- 54. Variant-Independent Sound Representation and Neural Discriminability in the Zebra Finch Auditory Forebrain**
Mingwen Dong, Mimi Phan, David Vicario
- 55. Affective whispered voices in the human limbic system: differences in single-cell firing and LFP recordings from the amygdala and hippocampus**
M. Bobin, M. Staib, T. Fedele, J. Sarnthein, S. Frühholz
- 56. The frequency-band specific information flows in speech network**
Yuxiang Yan, Hao Han, Dan Zhang, Wenjing Zhou, *Bo Hong
- 57. Loss of interaural time difference sensitivity in rabbit inferior colliculus neurons following noise-induced hearing loss**
Hariprakash Haragopal, Ryan Dorkoski, Gareth Whaley, Lukas Palmer, Mitchell Day
- 58. Closed-loop stimulation reveals the brain state-dependence of auditory perceptual sensitivity**
Leonhard Waschke, Jonas Obleser
- 59. Auditory texture synthesis from task-optimized convolutional neural networks**
Jenelle Feather, Josh H. McDermott
- 60. The neural processing of phonemes is shaped by linguistic analysis**
Jackson C Lee, Tobias Overath
- 61. Decoding trajectories of multiple moving sound sources from EEG in cocktail party environment**
Adam Bednar, Edmund C. Lalor
- 62. Neural voice decoding in the primate auditory cortex is task-dependent**
Sascha Frühholz, Plamina Dimanova
- 63. Human Sound Localization Depends on Sound Intensity: Implications for Sensory Coding**
Antje Ihlefeld, Nima Alamatsaz, Robert Shapley
- 64. Two-Talker Attention Decoding from EEG with Nonlinear Neural Networks and Linear Methods**
Gregory Ciccarelli, Michael Nolan, Joey Perricone, Paul Calamia, James O'Sullivan, Nima Mesgarani, Thomas Quatieri, Christopher Smalt
- 65. Response to own name in noise differs in autistic adolescents with severe language impairments**
Sophie Schwartz, Le Wang, Barbara Shinn-Cunningham, Helen Tager-Flusberg
- 66. Supra-threshold psychoacoustics and envelope-following response relations: Disentangling the contributions from outer-hair-cell loss and synaptopathy**
Sarah Verhulst, Viacheslav Vasilkov, Markus Garrett, Frauke Ernst
- 67. Neural oscillatory mechanisms for interpersonal entrainment in music ensembles**
Andrew Chang, Philip Chrapka, Dan J. Bosnyak, Laurel J. Trainor
- 68. Temporal Tracking of Speech Periodicity in Human Auditory Cortex**
Ning Guo, Xiaopeng Si, Wenjing Zhou, Bo Hong
- 69. Descending projections from the auditory cortex and inferior colliculus contact GABAergic cells in the ventral nucleus of the trapezoid body**
Nichole L. Beebe, William A. Noftz, Brett R. Schofield
- 70. Distinct contributions of auditory cortical inhibitory neuron types to spectral surround suppression**

Anna Lakunina, Yashar Ahmadian, Santiago Jaramillo

71. Classifying the neural code of concurrently presented vowels

Samuel Smith, Ananthakrishna Chintanpalli, Mark Wallace, Adam Hockley, Michael Heinz, Christian Sumner

72. A potential pathway mediating sound-induced anxiety-like behaviour

Yiwei Wang, Miaomiao Liu, Jingshan Zhou, Dongqin Cai, Limei Ke, Ling You, Fenghua Xie, Yin Yue, Kexin Yuan

73. Cortical excitatory and inhibitory neurons differentially affect collicular responses to sound

Jennifer M. Blackwell, Winnie Rao, Dashiell Ridolfi-Starr, Maria N. Geffen

74. Front-Temporal Cortical Interactions during Vocal Production in Marmoset Monkeys

Joji Tsunada, Steven Eliades

75. Characterization of auditory neurons in the mouse superior colliculus detected using virtual auditory space stimulation

Shinya Ito, David A. Feldheim, Alan M. Litke

76. O-15 Water PET study of speech in noise processing in cochlear implant patients

"Laurie Ponto, Inyong Choi, Bruce Gantz, Bob McMurray, Tim Griffiths"

77. Neural computational principles of auditory processing revealed by magnetoencephalography and deep neural networks

Xiangbin. Teng, David Poeppel

78. Investigating auditory conscious perception with a threshold task and intracranial EEG

Kate L. Christison-Lagay, Christopher Micek, Sharif I. Kronemer, Sarit Forman, Mark Aksen, Ahmad Abdel-Aty, Frederick van Duyne, Melanie Boly, Elsa Juan, Tom Bugnon, Erin Yeagle, Jose Herrero, Stephan Bickel, Ashesh Mehta, Lawrence J. Hirsch, Jason L. Gerrard, Dennis D. Spencer, Hal Blumenfeld

79. Removable cranial window for chronic multi-scale and multi-modal optical imaging in marmosets

Yueqi Guo, Xindong Song, Xiaoqin Wang

80. Hearing loss, auditory sensorimotor gating deficits, and cortical interneuron abnormalities in a mouse model of 22q11.2 Deletion Syndrome

Jennifer F. Linden, Fhatarah A. Zinnamon, Freya G. Harrison, Sandra S. Wenas, Arne F. Meyer, Qing Liu and Kuan H. Wang

81. Receptive field characterization using pure tones and broadband stimuli in the mouse primary auditory cortex

Kyunghee X. Kim, Craig A. Atencio, Christoph E. Schreiner

82. Opposite abnormalities in gap-in-noise sensitivity in the auditory midbrain and thalamus of a mouse model of developmental disorder

J. Mattley, L.A. Anderson, J. F. Linden

83. Co-variability across the neural population in the map of auditory space of the barn owl

Michael V. Beckert, Roland Feger, Keanu Shadron, Brian J. Fischer, Jose L. Pena

84. The primate voice-sensitive cortex is a general acoustic pattern analyser

Matthias Staib, Sascha Frühholz

85. Cortical Asymmetry for Sound Energy (CASE) in Mustached Bat Primary Auditory Cortex

Stuart D. Washington, Georgios A. Keliris, Jagmeet S. Kanwal

86. Neuromodulation and Plasticity for a Rodent Model of Cochlear Implant Use

Erin Glennon, Jasmin Multani, Ioana Carcea, Mario Svirsky, Robert C. Froemke

87. Frequency dependent interaction of dual sound representations in monkey inferior colliculus

Shawn M. Willett, Valeria C. Caruso, Surya T. Tokdar, Jennifer M. Groh

88. Voice activity detection in the brain: Understanding the spatio-temporal characteristics of voice detection in the auditory cortex during fMRI.

Huw Swanborough, Matthias Staib, Sascha Fruehholz

- 89. Neural substrates of auditory rhythm processing and language skill in early-to-mid adolescence.**
Manon Grube, Faye Smith, Sukbinder Kumar, Heather Slater, Timothy D. Griffiths
- 90. Adaptation to simple sounds in the auditory field of insular cortex in anesthetized rats** Maciej Jankowski
- 91. Directed effective connectivity in the human and monkey brain: Auditory cortex impact on inferior frontal gyrus, hippocampus and anterior cingulate cortex**
Francesca Rocchi*, Hiroyuki Oya*, Fabien Balezeau, Zsuzsanna Kocsis, Jeremy Greenlee, Timothy D. Griffiths, Matthew Howard III & Christopher I. Petkov
- 92. Mating but not restraint vocalizations have different valence for male and female mice**
Zahra Ghasemahmad, Rishitha Panditi, Krish Nair, Bhavya Sharma, Jeff Wenstrup
- 93. Nonlinear coding of naturalistic sound streams in marmoset auditory cortex**
Luke A Shaheen, Stephen V David
- 94. Auditory language localizer: An fMRI/ECoG study with epilepsy patients**
B. F. Sneed, P. E. Gander, C. K. Kovach, K. V. Nourski, H. Kawasaki, E. Fedorenko, M. A. Howard III
- 95. Top-down and bottom-up predictions in auditory decision-making**
Lalitta Suriya-Arunroj, Yale E. Cohen, Joshua I. Gold
- 96. The effect of anticipated cue reliability on behavioral and neural adaptation in barn owls**
Michael V Beckert, Roland Ferger, Jose L Pena
- 97. Decoding of phonemes in continuous speech from fMRI response patterns**
Julia Erb, Dino Düwel, Giancarlo Valente, Federico De Martino, Elia Formisano
- 98. The Role of Auditory Experience in the Neural Systems for Effortful Listening**
"Bradley E. White, Clifton Langdon"
- 99. Cortical network topology across awareness states during sleep and anesthesia: An intracranial electrophysiology study**
Matthew I. Banks*, Kirill V. Nourski*, Hiroto Kawasaki, Matthew A. Howard III
- 100. Triadic forebrain structures that directly control the auditory midbrain of echolocating bats**
T. Ito, R. Yamamoto, T. Furuyama, K. Hase, K. I. Kobayashi, S. Hiryu
- 101. Electrocorticographic (ECoG) analysis of dialog-based paradigms for assessing speech, language and cognitive functions: a case report**
Mitchell Steinschneider, Kirill V Nourski
- 102. Memory and integration of faces and vocalizations in neuronal populations in the primate prefrontal cortex**
Shraddha Shah, Theodore Lincoln, Katryna Kevelson, Lizabeth M. Romanski
- 103. Are human hippocampal sharp wave ripples involved in auditory sequence encoding?**
Araceli Ramirez-Cardenas, Juan Felipe Ramirez-Villegas, Matthew Howard, Jeremy Greenlee
- 104. Behavioral and electrophysiological evidence of incidental learning across continuous speech**
Yunan "Charles" Wu, Ran Liu, Sung-Joo Lim, Lori Holt
- 105. Quadratic discriminant analysis reveals representational dissimilarities between different types of auditory selective attention**
Winko W. An, Alexander Pei, Barbara G. Shinn-Cunningham
- 106. Investigating audiovisual integration in the inferior colliculus**
Katherine Wood, Melanie Tobin, Maria Geffen
- 107. Indexing multisensory integration of natural speech using canonical correlation**

Aisling E. O'Sullivan, Michael J. Crosse, Giovanni M. Di Liberto, Joe Majeski, Alain de Cheveigné and Edmund C. Lalor

108. MRI monitoring of macaque monkeys for neuroscience: Two case studies

Fabien Balezeau*, Jennifer Nacef*, Kathy Murphy, Yukiko Kikuchi, Felix Schneider, Francesca Rocchi, Ross S. Muers, Rocio Fernandez-Palacios O'Connor, Christoph Blau, Richard Saunders, Matthew Howard III, Alexander Thiele, Timothy D. Griffiths & Christopher I. Petkov