Stanford

Daniel Arthur Abrams

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Curriculum Vitae available Online

Bio

BIO

Speech is a critical communication signal for the development of social skills and language function. Autism spectrum disorders affect 1 in 88 school-age children and are characterized by deficits in social communication and language skills, and many of these individuals also experience speech perception difficulties. My primary research goals are to understand the brain bases of social communication and language impairments in children with ASD, and to describe neural changes associated with remediation of these behavioral deficits. The theoretical framework that motivates my work is that impaired perception and neural decoding of speech impact social skill and language development in many children with ASD. Moreover, I believe that a grasp of these relationships is central to understanding the etiology of these disorders and will provide insight into their remediation.

I have initiated a program of research to further our understanding of auditory brain function serving key elements of speech perception in children with ASD. The first study produced by this program of research was recently published in the Proceedings of the National Academy of Sciences and shows that children with ASD have weak brain connectivity between voice-selective regions of cortex and the distributed reward circuit and amygdala. Moreover, the strength of these speech-reward brain connections predicts social communication abilities in these children. These results provide novel support for the hypothesis that deficits in representing the reward value of social stimuli, including speech, impede children with ASD from actively engaging with these stimuli and consequently impair social skill development.
My future research will leverage this finding by probing this aberrant brain circuit in detailed explorations of speech perception in children with ASD. An important component of my future research is to explore neural plasticity associated with training programs designed to ameliorate social communication deficits in children with ASD, with a focus on the speech-reward brain circuit identified in my recent publication. In addition to my interest in studying social communication and language impairments in children with ASD, my research program also includes investigating the relationship between speech perception impairments and phonological and reading difficulties in children with reading disorders (RD). This work is a continuation of my dissertation work, which examined neural decoding of temporal features in speech in children with RD.

ACADEMIC APPOINTMENTS

- Clinical Assistant Professor, Psychiatry and Behavioral Sciences

HONORS AND AWARDS

- CHRI Pilot Early Career Award, Lucile Packard Foundation for Children’s Health (2017)
- K01 Research Scientist Development Award, NIMH, NIH/NIMH (2014-2017)
- Postdoctoral National Research Service Award, NIH/NIDCD (2010-2012)
- Independence Blue Cross Grant in Auditory Science Award, National Organization for Hearing Research Foundation (2006)
- Research Training in Neuroscience, NIH/NIDCD (2002-2003)

- Graduate Fellowship, Northwestern University (2000-2001)

PROFESSIONAL EDUCATION

- Ph.D., Northwestern University , Auditory Cognitive Neuroscience (2008)
- B.F.A., University of Arizona (1994)

LINKS

- Stanford Cognitive and Systems Neuroscience Laboratory: http://stanford.edu/group/scsnl/cgi-bin/drupal_scsnl/
- Center for Computer Research in Music and Acoustics (CCRMA): https://ccrma.stanford.edu/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Language impairments affect up to 19% of school age children and these deficits are predictive of long-term problems affecting learning, academic achievement, and behavior. My primary research goal is to understand the neurobiological foundations of language impairments. Specifically, I am interested in how the perception and neural coding of speech impact language and other behavioral deficits in children, with a focus on children with reading disabilities (RD) and autism spectrum disorders (ASD). The theoretical framework that motivates my work is that impaired perception and neural decoding of speech are causally related to language deficits in many affected children. Moreover, I believe that a grasp of these relationships is central to understanding the etiology of these disorders and will provide insight into their remediation.

Temporal Features of Speech in the Reading-Impaired Auditory System: Speech contains a number of temporal features that are important for perception. Some of these temporal features are relatively slow, such patterns of syllables in speech, and some features are much faster and enable us to discriminate the word “gab” from “dab.” My dissertation work was the first to show that cortical processing of syllable patterns is related to phonological and reading impairments in children with reading disorders. Additionally, this work identified a relationship between brainstem and leftward cortical asymmetry for processing rapid elements of speech in both normal and reading-impaired children. A fundamental question raised by my dissertation work is why does the auditory system preferentially route slow speech features to right-hemisphere auditory cortex and rapid features to left-hemisphere? A plausible explanation is that lateralized brain structures beyond auditory cortex may facilitate the discrimination of these temporal features. As part of my postdoctoral research at Stanford, I am examining this question with research funded by a postdoctoral NRSA from NIH/NIDCD. I am collecting fMRI data while unimpaired adults attend to both slow and rapid speech features as a means of identifying brain structures that accurately discriminate temporal information within these two time ranges. Results will provide new information regarding extended brain networks that facilitate the discrimination of slow and fast temporal features of speech, and may provide clues as to why it is advantageous for the auditory system to route this temporal information in an asymmetric manner. Importantly, I plan to use this novel experimental design for examining individuals with RD to gain a deeper understanding of the brain networks underlying impaired temporal processing in the RD auditory system.

The Neural Basis of Phonological Processing and Speaker Identity in the Autistic Brain: Impaired phonological processing and abnormal perception of human voice are two critical, yet understudied, aspects of language and social impairments in children with ASD. Despite the prevalence and adverse impact of these deficits, the brain mechanisms underlying these phenomena have received surprisingly little experimental investigation, particularly in children with ASD. I have initiated a study to further our understanding of basic auditory function underlying decoding of phonological content (“what” is being said) and speaker identity (“who” is saying it) in children with ASD, compared to typically developing children matched on age and language ability. This study is funded with an R21 from NIH/NIDCD that I co-wrote with my postdoctoral mentor, Dr. Vinod Menon.

Publications

PUBLICATIONS

- **Neural circuits underlying mother's voice perception predict social communication abilities in children** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Abrams, D. A., Chen, T., Odriozola, P., Cheng, K. M., Baker, A. E., Padmanabhan, A., Ryali, S., Kochalka, J., Feinstein, C., Menon, V.
  2016; 113 (22): 6295-6300

- **Underconnectivity between voice-selective cortex and reward circuitry in children with autism** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Abrams, D. A., Lynch, C. J., Cheng, K. M., Phillips, J., Supekar, K., Ryali, S., Uddin, L. Q., Menon, V.
  2013; 110 (29): 12060-12065

- **Brain State Differentiation and Behavioral Inflexibility in Autism†.** *Cerebral cortex*
  Uddin, L. Q., Supekar, K., Lynch, C. J., Cheng, K. M., Odriozola, P., Barth, M. E., Phillips, J., Feinstein, C., Abrams, D. A., Menon, V.
  2015; 25 (12): 4740-4747

- **Neurobiological Underpinnings of Math and Reading Learning Disabilities** *JOURNAL OF LEARNING DISABILITIES*
  Ashkenazi, S., Black, J. M., Abrams, D. A., Hoeft, F., Menon, V.
  2013; 46 (6): 549-569

- **Reply to Brock: Renewed focus on the voice and social reward in children with autism.** *Proceedings of the National Academy of Sciences of the United States of America*
  Abrams, D. A., Uddin, L. Q., Menon, V.
  2013; 110 (42): E3974-?

- **Multivariate Activation and Connectivity Patterns Discriminate Speech Intelligibility in Wernicke's, Broca's, and Geschwind's Areas** *CEREBRAL CORTEX*
  Abrams, D. A., Ryali, S., Chen, T., Balaban, E., Levitin, D. J., Menon, V.
  2013; 23 (7): 1703-1714

- **Inter-subject synchronization of brain responses during natural music listening.** *European journal of neuroscience*
  Abrams, D. A., Ryali, S., Chen, T., Chordia, P., Khouzam, A., Levitin, D. J., Menon, V.
  2013; 37 (9): 1458-1469

- **Inferior colliculus contributions to phase encoding of stop consonants in an animal model** *HEARING RESEARCH*
  Warrier, C. M., Abrams, D. A., Nicol, T. G., Kraus, N.
  2011; 282 (1-2): 108-118

- **Decoding Temporal Structure in Music and Speech Relies on Shared Brain Resources but Elicits Different Fine-Scale Spatial Patterns** *CEREBRAL CORTEX*
  Abrams, D. A., Bhatara, A., Ryali, S., Balaban, E., Levitin, D. J., Menon, V.
  2011; 21 (7): 1507-1518

- **A possible role for a paralemniscal auditory pathway in the coding of slow temporal information** *HEARING RESEARCH*
  Abrams, D. A., Nicol, T., Zecker, S., Kraus, N.
  2011; 272 (1-2): 125-134

- **Sparse logistic regression for whole-brain classification of fMRI data** *NEUROIMAGE*
  Ryali, S., Supekar, K., Abrams, D. A., Menon, V.
  2010; 51 (2): 752-764

- **Rapid acoustic processing in the auditory brainstem is not related to cortical asymmetry for the syllable rate of speech** *Clinical Neurophysiology*
  Abrams DA, Nicol T, Zecker S, Kraus N
  2010; 121: 1343-1350

- **Abnormal Cortical Processing of the Syllable Rate of Speech in Poor Readers** *JOURNAL OF NEUROSCIENCE*
  Abrams, D. A., Nicol, T., Zecker, S., Kraus, N.
  2009; 29 (24): 7686-7693

- **Relating Structure to Function: Heschl's Gyrus and Acoustic Processing** *JOURNAL OF NEUROSCIENCE*
  Warrier, C., Wong, P., Penhune, V., Zatorre, R., Parrish, T., Abrams, D., Kraus, N.
  2009; 29 (1): 61-69
- **Right-hemisphere auditory cortex is dominant for coding syllable patterns in speech** *JOURNAL OF NEUROSCIENCE*
  Abrams, D. A., Nicol, T., Zecker, S., Kraus, N.
  2008; 28 (15): 3958-3965
- **Sensory-based learning disability: Insights from brainstem processing of speech sounds** *INTERNATIONAL JOURNAL OF AUDIOLOGY*
  Banai, K., Abrams, D., Kraus, N.
  2007; 46 (9): 524-532
- **Auditory brainstem timing predicts cerebral asymmetry for speech** *JOURNAL OF NEUROSCIENCE*
  Abrams, D. A., Nicol, T., Zecker, S. G., Kraus, N.
  2006; 26 (43): 11131-11137