

PI BIOGRAPHICAL SKETCH

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| NAME: Tiffany Woynaroski, PhD, CCC-SLP |
| eRA COMMONS USER NAME (credential, e.g., agency login): WOYNARTG |
| POSITION TITLE: Assistant Professor, Vanderbilt University Medical Center |

EDUCATION/TRAINING

| INSTITUTION AND LOCATION | DEGREE | YEAR(s) | FIELD OF STUDY |
|---------------------------------------|--------|---------|-----------------------------|
| Valparaiso University, Valparaiso, IN | B.S. | 2002 | Psychology |
| Vanderbilt University, Nashville, TN | M.S. | 2009 | Speech-Language Pathology |
| Vanderbilt University, Nashville, TN | Ph.D. | 2014 | Hearing and Speech Sciences |

A. Personal Statement

I have extensive clinical experience working with young children with autism spectrum disorder (ASD) and other intellectual and developmental disabilities (IDD) as an early interventionist/parent educator, speech language pathologist, and autism consultant. These clinical experiences led me to pursue an academic career. My interdisciplinary research identifies brain and behavioral factors that (a) explain heterogeneity in symptomatology, (b) predict growth and response to treatment, and (c) evaluate how/why treatment works in young children with ASD and other IDD. To date, I have 15 publications on these topics. One line of my research has focused on sensory function, and its relation to other core and related ASD symptoms in children diagnosed with or at risk for ASD. I have 5 publications on this topic (2 additional manuscripts under review), and am presently the PI of a Clinical and Translational Career Development Award (KL2) that is using EEG/ERPs to examine the role of sensory function in spoken language of young children with ASD; PI on related work, supported by an intramural pilot grant (pending extramural support), that extends this work to examine the association between early sensory function and later social communication and language of infants at high risk for ASD; and key personnel on Vanderbilt's u54 research project examining the neural basis of sensory and multisensory function in children and adolescents with ASD. Under an IDRC Exchange Award, I have trained to reliability in administration and coding of several assessments of sensory responsivity with Grace Baranek, PhD, OTR/L, FAOTA, an expert in this area and developer of assessments that are proposed for use in this RCT. I will oversee all aspects of the proposed project in close collaboration with Dr. Yoder, with whom I have a positive and extremely productive history in working to test the efficacy of interventions geared towards children with ASD and IDD. Dr. Newsom has been integrally involved in much of our past and ongoing work involving children diagnosed with or at risk for ASD. The proposed project brings together this exceptional team in an independent and rigorous test of the efficacy of Environmental Enrichment in preschoolers with ASD. If our hypotheses are born out, this project will have identified a novel approach to the remediation of core and related deficits in children who are diagnosed with ASD.

- **Woynaroski, T.**, Kwakye, L. D., Foss-Feig, J. H., Stevenson, R. A., Stone, W. L., & Wallace, M. T. (2013). Multisensory speech perception in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 43(12), 2891-2902. doi: 10.1007/s10803-013-1836-5. [PMID: 23624833; PMCID: PMC3998667]
- Cascio, C., **Woynaroski, T.**, Baranek, G., & Wallace, M. T. (2016). Toward an interdisciplinary approach to understanding sensory function in autism spectrum disorder. *Autism Research*.
- **Woynaroski, T.**, Watson, L., Gardner, E., **Newsom, C.**, Keceli-Kaysili, B., **Yoder, P.** (2015). Early predictors of growth in diversity of key consonants used in communication in initially preverbal children with autism spectrum disorder. *Journal of Autism and Developmental Disabilities*.
- **Woynaroski, T.**, **Yoder, P.**, Fey, M., Warren, S. (2014). A transactional model of spoken vocabulary variation in toddlers with intellectual disabilities. *Journal of Speech, Language, and Hearing Research*, 57, 1754-1763. [NIHMSID 586204; PMID: 24802090; PMCID: PMC4192117]

B. Select Academic and Professional Honors

Trainee, Clinical Specialty Preparation to Serve Infants, Toddlers, and Children With Feeding and Swallowing Disabilities, Vanderbilt University, US Department of Education Personnel Preparation Grant, 2007-2009

Vanderbilt University Graduate School Harold Stirling Vanderbilt Scholarship, 2010-present
 Trainee, US Department of Education Training Grant, Preparing Teachers/Scholars in Language and Literacy (H325D080075; PI: Schuele), 2010-2014
 Student Research Travel Grant, Vanderbilt University Graduate School, 2012, 2013, 2014
 Vanderbilt Kennedy Center Trainee Student Travel Grant, 2013
 David Zeaman Travel Award for the Gatlinburg Conference on Intellectual Disabilities, 2014
 Vanderbilt University Faculty Research Scholars Award, 2015
 Vanderbilt Clinical and Translational Research Scholar, 2015-present
 Newman Scholar, 2015-present
 Burroughs-Wellcome Translational Scholar Award 2016
 IDDRRC Exchange Award, 2016
 Professional Affiliations:
 American Speech-Language-Hearing Association
 Vanderbilt Kennedy Center - Member

C. Contributions to Science

1. Demonstrated that a new, automated method of measuring children's vocal development is highly stable and valid for predicting word use of minimally verbal preschoolers with ASD.

This line of research has focused on how measurement of vocalizations (i.e., the sounds that children make before they are using words to communicate) can be used to predict language outcomes of children with ASD. Theory and evidence from a fairly large literature had previously demonstrated that children follow a predictable path through "universal stages of vocal development" as they progress towards language use. Previous work had also shown that conventional indices of vocalizations, derived by collecting and coding fairly limited vocal samples, predicted language outcomes in many populations, including children with ASD. However, the large amount of time and high cost involved in the collection and coding of these conventional samples precluded measurement of vocal development in clinical practice. My dissertation and subsequent work, carried out in collaboration with leading experts in prelinguistic vocal development and automated vocal analysis, showed that we can use automated indices of vocal development, derived by collecting day-long samples of vocalizations with a small digital recorder worn in the pocket of a special T-shirt, to predict the later language of children with ASD in the early stages of language development. One automated score that we have developed predicts later word use of minimally verbal preschoolers with ASD "as good as" indices derived via the conventional approach. The more time-effective and cost-efficient automated method may ultimately make it possible for clinicians to measure vocal development in everyday practice. I am the first author on this body of work. To date, I have published my doctoral dissertation on this topic, disseminated findings from this work at many scientific meetings, and published a manuscript on the psychometrics of automated vocal analysis in minimally verbal preschoolers with ASD to *Autism Research*.

- **Woynaroski, T.** (2014). *The stability and validity of automated vocal analysis in preschoolers with autism spectrum disorder in early stages of language development* (Doctoral dissertation). Retrieved from <http://etd.library.vanderbilt.edu/>. (URN: 11252014-15182).
- **Woynaroski, T.**, Oller, D.K., Keceli-Kaysili, B., Xu, D., Richards, J.A., Gilkerson, J., & Gray, S., Yoder, P.J. (2016). The stability and validity of automated vocal analysis in minimally verbal preschoolers with autism spectrum disorder. *Autism Research*. [PMID: 27459107]

2. Identified predictors of vocal development and mechanisms by which vocal development influences later language of children with ASD and other developmental disabilities.

Children's prelinguistic and linguistic development does not occur in a vacuum. Transactional theory suggests that models that consider parent and child factors, and the dynamic way in which they interact with one another, should best explain individual differences in early language development. This account of language development had seemingly been widely accepted, but surprisingly not previously tested in children with autism and other developmental disabilities. My work in this area, carried out in collaboration with Paul Yoder and others, has provided empirical support for the transactional model of language learning in both children with intellectual disabilities (published), as well as children with ASD (submitted for presentation at upcoming scientific meetings and in preparation for submission to *Child Language*). These longitudinal correlational investigations have shown that early child vocalizations used in

communication elicit parent linguistic responses, which in turn support language learning. We have further demonstrated that early intervention may boost vocal development to jumpstart this dynamic language learning mechanism in children with developmental disabilities. Another one of our recent studies has shown that children's motivation to communicate and parent's linguistic input also influence children's vocal development. I am first author on these studies, which are important because a) they increase our understanding of factors and mechanisms that influence early vocal development and language learning and b) they suggest how we might best intervene to support language acquisition in children with developmental disabilities.

- **Woynaroski, T.**, Yoder, P., Fey, M., Warren, S. (2014). A transactional model of spoken vocabulary variation in toddlers with intellectual disabilities. *Journal of Speech, Language, and Hearing Research*, 57, 1754-1763. [NIHMSID 586204; PMID: 24802090; PMCID: PMC4192117]
- **Woynaroski, T.**, Watson, L., Gardner, E., Newsom, C., Keceli-Kaysili, B., Yoder, P. (2015). Early predictors of growth in diversity of key consonants used in communication in initially preverbal children with autism spectrum disorder. *Journal of Autism and Developmental Disabilities*, 46(3), 1013-1024. [PMID: 26603885]

3. Demonstrated that more intense treatment yields better language outcomes for some children with developmental disabilities, in part by boosting children's prelinguistic vocal development.

In my predoctoral work and ongoing collaborations with Paul Yoder, I have additionally contributed to our collective knowledge re: the effects of treatment intensity (i.e., the amount of treatment provided) on language outcomes of children with developmental disabilities. Prior to this work, there had been no systematic research into the effects of treatment intensity on language and communication outcomes of children with developmental disabilities. This research revealed that some children with developmental disabilities, such as children with Down syndrome, achieve more optimal language outcomes when they receive 5 hours of intervention per week versus only 1 hour of intervention per week. Subsequent analyses revealed that the effect of more intense treatment on language outcomes of children with Down syndrome was preceded and mediated by earlier effects on children's vocal communication and receptive vocabulary. Thus, changes in children's vocalizations and language understanding may serve as early indicators that increased treatment intensity is "working" to improve language outcomes. I am first author on an in-press chapter summarizing the findings from this seminal study of treatment intensity in developmental disabilities and co-author on the peer-reviewed articles stemming from this work. I have further worked to disseminate these results, which point to the need for personalized treatment planning for this population, at scientific meetings reaching the broad range of disciplines with an interest in developmental disabilities, in regional meetings reaching parents and service providers, and via partnership on a unique project called "Kindred Stories" that is intended to convey the findings of this research to policy makers and the public at large. Thus, my work in this area highlights my commitment to translation of findings from research to practice.

- **Woynaroski, T.**, Fey, M., Warren, S., & Yoder, P. (2016). Prelinguistic communication intervention research: a focus on treatment intensity. In M. Ronski & R. Sevcik (Eds.), *Examining the science and practice of communication interventions for individuals with severe disabilities*. Baltimore, MD: Brookes Publishing.
- Yoder, P., **Woynaroski, T.**, Fey, M., & Warren, S. (2014). Effects of dose frequency of early communication intervention in young children with and without Down syndrome. *American Journal of Intellectual and Developmental Disabilities*, 119, 17 – 32. doi: 10.1352/1944-7558-119.1.17. [NIHMSID: 586088. PMID: 24450319]
- Yoder, P., **Woynaroski, T.**, Fey, M., Warren, S., Gardner, E. (2015). Why dose frequency affects spoken vocabulary in preschoolers with Down syndrome. *American Journal of Intellectual and Developmental Disabilities*, 120(4), 302-314. [PMID: 26161468]
- Yoder, P., & **Woynaroski, T.** (2014). How to study the influence of intensity of treatment on generalized skill and knowledge acquisition in students with disabilities. *Journal of Behavioral Education*, 24(1), 152-166. [PMID: 25914513; PMCID: PMC4405899]

4. Showed that the effects of treatment that we observe for young children with autism will depend on the manner in which we measure outcomes (i.e., the type of dependent variable that we use).

During my doctoral training, I additionally had the opportunity to collaborate on a project that reviewed and synthesized the literature on treatment of social communication impairments in preschoolers with ASD.

This meta-analysis provided support for the notion that currently available treatments can improve social communication abilities of young children with ASD, a result that is significant because difficulties in social communication represent the “core” deficit in ASD. More importantly, though, our work showed that the probability of finding treatment effects on social communication varied greatly depending on (a) whether the dependent variable used in a given study was directly targeted or not (i.e., whether the outcome was proximal versus distal) and (b) whether the dependent variable was measured in contexts very similar to treatment sessions or in contexts that differed from treatment in setting, materials, and communication partner (i.e., whether the effect observed was likely highly generalized versus potentially context-bound). The latter set of findings provide the field with a new framework for interpretation of reported treatment effects and new methodological issues for consideration in design of future treatment research with this population of children, who often appear to be proficient on precisely what we have taught when tested in a context similar to how we taught them, but who have difficulty with generalization. I am a co-author on the publications resulting from this review.

- Yoder, P., Bottema-Beutel, K., **Woynaroski, T.**, Chandrasekhar, R., & Sandbank, M. (2014). Social communication intervention effects vary by dependent variable type in preschoolers with autism spectrum disorders. *Evidence-Based Communication Assessment and Intervention*, 7(4), 150-174.
- Bottema-Beutel, K., Yoder, P., & **Woynaroski, T.**, & Sandbank, M. (2014). Targeted interventions for social communication symptoms in preschoolers with autism spectrum disorders. In F.R. Volkmar, R. Paul, A. Klin (Editor), & D.J. Cohen (Eds.) *Handbook of autism and pervasive developmental disorders* (4th ed.). New York: John Wiley & Sons, Inc.

5. Detailed the nature of sensory disturbances, and related these sensory differences to deficits in communication, in children and adults with autism.

Even when we account for all of the previously identified predictors of language in individuals with ASD, we are unable to explain the majority of the variance in this population. This has led me to consider whether other factors, such as sensory differences, might account for some of the variability that remains unaccounted for. Differences in responding to sensory stimuli were noted even in the earliest accounts of autism and have been commonly observed in, or reported by, individuals with ASD since that time. It has been proposed that “foundational” sensory could underlie deficits in higher-order cognitive, linguistic, and social deficits in ASD. However, there has been surprisingly little empirical work focused on identifying the nature of sensory differences in ASD, or on understanding how they may contribute to the well-established deficits in higher-order abilities in individuals with ASD. In a predoctoral rotation with Mark Wallace, Ph.D., I found that integration and perception of audiovisual speech were associated with broader behavioral characteristics of ASD, such as communication skill and sensory profile, in children with ASD. This study and related work from continued collaborations with Dr. Wallace and colleagues has yielded numerous peer-reviewed presentations at scientific meetings and publications in journals such as *Journal of Autism and Developmental Disabilities* and *Journal of Neuroscience*. My ongoing research in this area seeks to a) extend our prior work to younger and lower-functioning children with ASD, b) evaluate whether early differences in sensory function produce cascading effects on later social communication and language abilities, c) determine whether sensory differences improve our understanding of variability in language after we have controlled for factors, such as vocal development and parent linguistic input, that have been identified as value-added predictors of useful speech, and d) test whether targeting sensory differences may translate to improved social communication and language outcomes for children with ASD.

- **Woynaroski, T.**, Kwakye, L. D., Foss-Feig, J. H., Stevenson, R. A., Stone, W. L., & Wallace, M. T. (2013). Multisensory speech perception in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 43(12), 2891-2902. doi: 10.1007/s10803-013-1836-5. [PMID: 23624833; PMCID: PMC3998667]
- Cascio, C., **Woynaroski, T.**, Baranek, G., & Wallace, M. T. (2016). Toward an interdisciplinary approach to understanding sensory function in autism spectrum disorder. *Autism Research*.
- Stevenson, R., Siemann, J. K., , **Woynaroski, T.**, Schneider, B. C., Eberly, H. E., Camarata, S. M., & Wallace, M. T. (2014). Multisensory temporal integration in autism spectrum disorders. *Journal of Neuroscience*, 34(3), 691-697. doi: 10.1523/JNEUROSCI.3615-13.201434/3/691 [pii]. [PMID: 24431427; PMCID: PMC3891950]
- Stevenson, R., Siemann, J. K., **Woynaroski, T.**, Schneider, B. C., Eberly, H. E., Camarata, S. M., & Wallace, M. T. (2013). Brief report: Arrested development of audiovisual speech perception in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 44(6):1470-1477. doi: 10.1007/s10803-013-1992-7. [PMCID: PMC4018423]

Total Number of Peer-Reviewed Publications: 15 published, 6 under review, 3 in preparation

Total Number of Chapters: 2

Total Peer Reviewed Presentations at Scientific Meetings: 38

Citations: 250

h-index: 6

i10-index: 6

For further information, see: <http://scholar.google.com/citations?user=6e8jeJoAAAAJ&hl=en&oi=ao>

D. Research Support

CTSA Clinical Research Mentored KL2 [PI: Woynaroski] 10/01/15 – 9/30/18
Vanderbilt University Medical Center Faculty Research Scholars [PI; Woynaroski] 09/01/15 – 9/30/15
NIH/CTSA
Temporal Facilitation of Audiovisual Speech Processing & Language in Kindergartners with ASD (TALK ASD)

Children with ASD are highly heterogeneous, especially in terms of their ability to use language to communicate. This federally-funded KL2 award is intended to promote Dr. Woynaroski's development of an independent, translational line of research (a) identifying brain and behavior factors that explain individual differences in language ability and (b) testing whether such factors are plastic and thus potentially treatable in young children with ASD. The TALK ASD project specifically aims to examine whether EEG/ERP metrics of multisensory processing map onto spoken language ability in kindergarten-aged children with ASD.

U54 HD83211-02 [PI: Dykens] 5/01/16-5/01/21
NIH/NICHD
Sensory and Multisensory Contributions to Autism

Recent changes to diagnostic criteria recognize sensory differences as "core characteristics" of ASD. This research project aims to a) characterize alterations in sensory and multisensory function and the associated brain networks that contribute to the social communication deficits in ASD; b) explore associations between (multi)sensory function and social and communication abilities; c) describe the differences in the neural processes and networks subserving sensory and multisensory function in ASD, with a focus on a key multisensory 'hub' in temporal cortex, and d) develop novel remediation tools in children and young adults with ASD ages 5-21.

Role: Key Personnel

1R01DC01376-01 (PI: Yoder) 9/01/14-8/31/19
NIH/NIDCD
Efficacy of Parent-Implemented Treatment in Infant Siblings of Children with ASD

This project is examining the efficacy of an inexpensive home-based early intervention for children at risk for autism spectrum disorders (ASD) focused on early communicative development; this early cost-effective program is part of an Incremental Treatment Approach that proposes to identify which at-risk children would versus would not need more intensive treatment.

Role: Key Personnel

Vanderbilt Institute for Clinical and Translational Research Pilot Award [PI: Cascio] 12/10/15 – 5/31/17
Sensory Project in Infant/Toddler Siblings of Children with Autism

Infant siblings of children who are diagnosed with autism spectrum disorder (Sibs-ASD) are at heightened risk for ASD and other language and communication impairments. This pilot project, presently funded via an internal clinical and translational research pilot award and precluding support as an R21, examines the extent to which early sensory responsivity (a) differs in Sibs-ASD relative to infant siblings of typically developing children (Sibs-TD), and (b) predicts later language and social communication ability in high versus relatively lower-risk groups.

Role: Co-I