

Research Statement

My primary area of research is focused on better understanding and treating obsessive-compulsive spectrum disorders with an emphasis on chronic tic disorders (CTDs). CTDs are a class of complex neurodevelopmental disorders characterized by involuntary motor and vocal tics. Once thought to be exceptionally rare, several converging lines of research suggest that tics are quite common (occurring in up to 20% of school-aged children), fall along a continuum from transient/benign to persistent/problematic, and (for some children) are a clinical indicator of risk for a broad range of internalizing and externalizing psychopathology. Although the exact cause of TS is unknown, tics have historically been conceptualized as purely biological and resulting from structural and functional abnormalities within cortico-striato-thalamo-cortical brain circuitry. However recent research, including my own, has demonstrated that a broad range of cognitive, behavioral, and psychosocial (i.e., contextual) factors influence the frequency, intensity, and complexity of tics and play an important role in the overall progression and course of both tics (i.e., motor) and comorbid psychological/behavioral symptoms. For the past several years, I have been developing and employing a cognitive-behavioral framework that appreciates biological, developmental, and contextual influences to better understand transdiagnostic factors that underlie both tics and the internalizing and externalizing problems that co-occur in CTD. I argue that reconceptualizing CTDs from a transdiagnostic perspective will lead to an accelerated and more thorough understanding of the broad range of symptoms that characterize CTD, a better understanding and appreciation for individual differences in the clinical course of symptoms (developmental, contextual, cultural, and family-systems level variables), and more efficacious nonpharmacological interventions. The specific areas I have been researching over the past several years are described below.

1. **Understanding CTD and comorbidity from a transdiagnostic perspective.** Although motor and vocal tics may be the defining characteristic of CTD, they frequently occur within a broader presentation of comorbidity and neuropsychiatric phenomena. In fact, most children with CTD meet criteria for >1 one comorbid psychiatric diagnosis (referred to as CTD+) with OCD, anxiety, and ADHD being the most common. An even larger percentage display internalizing and externalizing symptoms that do not meet full diagnostic criteria but are nonetheless problematic and numerous studies have shown that comorbid symptoms are a stronger predictor of functional impairment, family problems, and decreased quality of life than the tics themselves. However, current best practice guidelines for psychosocial management of the complex pattern of comorbidity observed in CTD (and other disorders of childhood) are based on empirically supported intervention (ESI) protocols developed and tested in isolation for single diagnoses (e.g., exposure and response prevention for OCD, parent training interventions for ADHD). For children with multiple comorbidities (as is the case in CTD+), sequential administration of ESIs based on specific diagnoses has several limitations. First, it is difficult to determine which symptoms to prioritize, resulting in delaying intervention for impairing problems. Relatedly, sequential treatment is not an efficient approach when treating multiple comorbidities. Second, internalizing and externalizing symptoms interact to influence each other and symptoms of one problem (e.g., defiance) can interfere with treatment of another (e.g., OCD). Sequentially administering ESIs fails to adequately address these additive and interactive elements. Rather, there seems a need for a transdiagnostic approach to treatment. The transdiagnostic approach draws from a unifying theoretical model that explains disparate conditions via shared mechanisms. Rather than splitting disorders based on taxonomy (e.g., DSM or ICD criteria), this approach targets shared cognitive, behavioral, emotional, and interpersonal processes that unify or explain varied

clinical phenomenon. Furthermore, it assumes that these factors are causally interrelated such that altering one aspect of the system will have effects on the other features. Extrapolating from the diverse literatures on processes underlying internalizing and externalizing conditions, I have proposed that five interrelated and interactive transdiagnostic processes are particularly relevant for conceptualizing and treating internalizing and externalizing symptoms in CTD+: impulsivity, emotional dysregulation, information processing deficits, cognitive and behavioral avoidance, and interpersonal and family factors. To this end, I was recently awarded funding from the Tourette Association of America to develop and examine a transdiagnostic treatment protocol for CTD+ (data collection for that project is currently underway). I am particularly excited about that project because I believe it has significant implications for understanding and treating other complex psychological/behavioral problems in children (e.g., externalized expressions of anxiety, the relation between mood and anger, etc.) and is a culmination and logical extension of my research to date. Below I describe my research program as it has unfolded over the past 10 years, organized around 3 themes: (1) understanding internal (e.g., cognitive) and external (e.g., contextual) factors that influence symptom course and expression, (2) understanding the behavioral mechanism(s) underlying evidence-based interventions for TD, and (3) understanding and addressing barriers to treatment utilization and dissemination.

- 2. The influence of contextual factors on tics and comorbid symptoms:** There is increasing data showing that although motor and vocal tics are involuntary, they are impacted by a variety of environmental variables. Historically, research in this area has focused on variables that were thought to have a direct biological influence (stress, anxiety). However research from my lab and others has shown that environmental influences are much more dynamic and are often socially mediated. My research focuses on understanding how operant and respondent-conditioning principles can be applied to explain how/why contextual stimuli and social consequences shape and facilitate tic suppression, even though the symptoms are involuntary. Much of my early work used carefully controlled small-N methods to demonstrate that tic suppression/expression can be facilitated by operant reinforcement and tics (i.e., frequency) can be brought under contextual control (see Woods & Himle, 2004; Himle et al., 2007b, Woods et al., 2008). Several research laboratories across the country are now using my operant tic-suppression paradigm to better understand the role of reinforcement on response inhibition in TD (a transdiagnostic factor also related to ADHD in some children), including the underlying brain mechanisms. Although I continue to pursue this line of experimental research, I am also interested in its clinical application. For example, using a function-based assessment protocol I examined common antecedent and consequence variables associated with tic exacerbation in a large sample of children with TS and found that that specific functional patterns were common (especially attention and escape functions) and predicted tic severity. The next logical steps in this line of research, which are currently ongoing in my lab, are to (1) validate the functional assessment protocol (i.e., using functional analysis and experimental reinforced suppression paradigms), (2) examine whether functional variables (e.g., social reactions in families) predict the immediate and long-term course of tic expression and (3) to formally test whether function-based intervention strategies can help reduce tics. For example, we recently completed a project in which we were able to demonstrate that, for some children, symptom expression was altered when tics (or periods of tic absence) were followed by reward even when children were not aware of the contingency (Hayes, Himle, et al., in prep). I believe such findings have important

implications for understanding the course of CTD and ultimately lead to advances in non-pharmacological treatment.

- 3. Learning Mechanisms Underlying Tic Control:** Another major focus of my research is on understanding the mechanisms by which nonpharmacological treatments are effective for reducing tics and comorbid symptoms. Although current treatments (e.g., habit reversal training, HRT, and suppression treatments) have shown to be effective for reducing tics, there is considerable variability in treatment response both within and between individuals. In addition, little is known about how these treatments work or whether they share common mechanisms or even target shared mechanistic factors. The hypothesis with the most empirical support is the urge-reduction model (preventing the tic results in habituation to premonitory urges thereby extinguishing the negative reinforcement cycle; Himle et al., 2007a, Himle et al., 2008). While this hypothesis may explain why seemingly different psychosocial treatments show similar levels of efficacy, group studies have cast doubt on whether pre-tic urges indeed habituate during suppression (Conelea, Himle, et al., in press). However we recently examined the effects of awareness training and competing response training on pre-tic urges using a more systematic and sensitive test of urge habituation (Ramanjam & Himle, in prep) and have found that (a) urges indeed do not habituate during suppression, (b) urges ratings do show a pattern consistent with habituation during HRT (suggesting HRT operates differently from suppression), and (c) it appears that different tics serve different functions and the function changes over time, possibly as a result of the aforementioned social contingencies. This is consistent with some of my previous research showing that pre-tic sensations are described differently (and are likely not functional) early in the course of the disorder (Chang et al., 2009) but the stimulus function of the “urge” changes over time. This suggests that future research may need to examine treatment based on mechanisms of change (i.e., targeting the specific function of specific tics).
- 4. Implementation and Dissemination:** My final primary area of research involves systematically identifying and addressing barriers to implementation and dissemination of effective childhood interventions, again using TD as a model. Both Chronic Tic Disorders and OCD have been shown to be responsive to psychosocial treatments (HRT for TS, see Himle et al., 2006; Exposure and Response Prevention for OCD, see Freeman et al., 2008). Despite data supporting their efficacy, these treatments are not widely available (Woods, Conelea, & Himle, 2010a). Developing and evaluating effective dissemination strategies for psychosocial treatments has become a primary focus of mental health research. In my view, dissemination needs to follow two data-driven steps. First, barriers must be systematically identified, and second, barriers must be systematically addressed. My past research (see Woods, Conelea, & Himle, 2010) has identified that practical barriers (travel, time, lack of providers) are the most commonly cited barriers inhibiting the use of psychosocial interventions for TS. One way to address these dissemination barriers is the use of technology. For example, I completed the first pilot investigation examining the efficacy, acceptability, and feasibility of HRT delivered via videoconference (see Himle et al., 2010b), completed a multi-site randomized pilot trial comparing video-conference delivered HRT to face-to-face delivery (Himle et al., 2012), and examined the delivery of behavior therapy using a voice over internet (VoIP) protocol (Ricketts et al., 2016), and most recently collaborated with a colleague to examine the acceptability and efficacy of a telehealth dissemination model for CTD (ongoing). Results of each of these studies has shown telehealth to be effective for delivering HRT. Another way to utilize technology to address practical barriers is to deliver the intervention online. Along these lines, I have partnered with the company

Psych Tech, Ltd. to develop and test an individualized, adaptive online program for delivering behavior therapy to individuals with tics (called TicHelper). Together with PsycTech, we were awarded and completed an NIMH Phase I R43 (SBIR) project in which we developed and tested a prototype of the tic helper program (with positive results) and were awarded a Phase II (R44) to finalize development and test TicHelper in a randomized controlled trial (Himle et al., in prep). We are now developing a companion online program to train therapists to administer evidence-based treatment that we are calling CBIT-Trainer that utilizes research-informed instructional design methods and technologies. Similar to the TicHelper project, we were awarded an NIMH R43 to develop and test a prototype of this program and found it to be effective for training therapists to administer CBIT with fidelity. Based on our Phase I results, we are now applying for a follow-up R44 to conduct a non-inferiority trial comparing CBIT-Trainer to an intensive in-person training (the Tourette Association of America's Behavior Therapy Training Institute, which is the current gold standard for training therapist in CBIT). A few of the most exciting aspects of the TicHelper and CBIT-Trainer programs are that they are designed to be adaptive and have built in program evaluation tools. These features will allow us to continually update and evaluate each program as new research emerges. I also view these programs as models for increasing dissemination and implementation of evidence-based treatments more generally and plan to extend them to, among other things, a broader range of habit behaviors.

As a secondary area of research emphasis that has emerged for me more recently is understanding and promoting healthy sexual development, sexuality, relationships, and quality of life for individuals with Autism Spectrum Disorders (ASD) and other neurodevelopmental conditions. My interest in this work began several years ago when one of my doctoral students, Laura Graham-Holmes, expressed an interest in understanding relationships and sexuality. Although this was not an area I had been interested in, she and I found a way to combine her interests with my long standing interest in improving services for individuals with ASD. While she was still in our program, Laura and I successfully launched a systematic line of research to better understand the experiences of individuals with ASD (and their families), as they relate to all facets of relationships and sexuality, and how these experiences affect health and quality of life. We have continued to collaborate on this work and I have been particularly interested in understanding how individual, family, and community (attitudes, policy, etc.) factors interact to influence the development and maintenance of intimate relationships, sexual development, physical and sexual health, and quality of life for individuals on the spectrum. Recent research has emphasized the importance of promoting independence and optimizing quality of life for adolescents and young adults with ASD, yet the areas of sexual development, romantic relationships, and sexual health have been almost completely neglected, in part due to misconceptions that individuals with ASD are disinterested in such relationships. On the contrary, our work has shown that most individuals with ASD are interested in relationships (including romantic/sexual relationships) yet existing support systems (the educational system, medical professionals, and parents) report being under-prepared to help individuals with ASD navigate this important topic. As a result, most individuals with ASD are less successful than their neurotypical peers at successfully securing meaningful relationships, which we have shown has significant implications for their quality of life as well as their mental and physical health. As a follow-up to our initial work, we recently completed a large survey of young adults with ASD and their parents with the aim of better understanding the experiences and needs of families regarding relationship and sexuality, with the ultimate goal of providing guidance on how to better support individuals with ASD as they navigate this important aspect of their lives.