Research Statement

My research focus has been on (1) improving conceptual and clinical understanding of what triggers lapses in executive functioning (EF) in daily life, and (2) improving methods for assessment of subtle EF weaknesses. This work is important because the prevailing conceptualizations of EF continue to define this construct (and EF assessment instruments) by their association with the integrity of the prefrontal cortex. This conceptualization is less and less relevant with the advances in neuroimaging, and is inadequate for identification of patterns of EF strengths and weaknesses as they relate to successful and independent daily functioning. Furthermore, the importance of EF is increasingly recognized by allied specialties, such as health psychology, developmental psychology, and psychology of personality, for its role in mediating mental illness and maladaptive behaviors ranging from criminal offending to the inability to maintain a healthy lifestyle. Consequently, clinical neuropsychology is increasingly being called upon to aid with identification of patterns of subtle EF strengths and weaknesses as they relate to individual differences in personality and temperament (Suchy, 2009; Williams, Suchy, & Rau, 2009). In response to these calls, I define EF broadly as the ability to identify relevant and adaptive goals, and to successfully take steps toward accomplishing those goals.

(1) What triggers lapses in executive functioning (EF) in daily life. My work in this area has drawn upon the notion that EF failures in daily life generally cannot be validly detected by a single measure or a single observation of EF, as subtle EF weaknesses most often present as lapses that emerge only under certain circumstances. In other words, subtle weaknesses in EF may best be conceptualized as limitations in the available EF reserves, and lapses emerge only when situational demands exceed those reserves. In fact, it appears that EF lapses can occur even in the absence of objective EF limitations, simply due to a mismatch between objective demands and available resources. This notion is supported by our recent work with adolescents suffering from Type 1 Diabetes: Our data show that successful management of the highly complex diabetes regimen requires superior EF abilities; in other words, not deficits, but rather normal/average EF, place adolescents at risk for mismanaging their illness (manuscript in preparation).

However, situational demands are defined not only by the complexity of a given task, but also by individual differences in temperament, personality, and intellectual capacity, as well as the interaction of such individual differences with situational demands. For example, one individual may be temperamentally prone to anxiety in certain situations and thus use up a portion of his/her EF reserve on anxiety regulation, while another individual may be temperamentally prone to seeking and pursuing pleasure and in some situations use up a portion of his/her EF reserve on suppressing hedonistic needs. Thus, while neither individual may evidence an executive “deficit” per traditional clinical definitions, both are at risk for exhibiting lapses in EF in certain situations in their daily lives. Within this conceptual framework, optimal daily functioning requires that an individual possess both an adequate EF reserve and personality/temperamental/intellectual traits that are less likely to deplete those reserves. My long-term research goal is to advance our understanding of what triggers lapses in EF in different individuals and different situations, as well as to advance methods for identifying individuals who are at risk for such lapses.
My past work supports the notion that success in daily life relies on an interaction between EF and other individual and situational factors. For example, we have shown that simply just having “a bad day” depletes EF reserves by increasing emotion regulation demands, leading to clinically significant declines in EF by as much as 2/3 SD, or 2 Scaled Score points, especially for individuals who are not accustomed to high regulation burden (Franchow & Suchy, in press). Similarly, populations that are known to be pathologically driven by rewards (e.g., criminal psychopaths) exhibit dynamic emergence of executive dysfunction (Suchy & Kosson, 2005, 2006) in situations when the reward system is activated. Along the same lines, pedophilic child molesters are characterized by greater rates of re-offense against children than non-pedophilic child molesters, despite their greater EF capacity (Eastvold, Suchy, & Strassberg, 2011). Additionally, daily EF lapses appear to be a function of a combination of EF and intellectual capacity, both in adolescents with type 1 diabetes (Suchy et al., in prep), and in community-dwelling older adults (Suchy, Kraybill, & Franchow, 2010). Lastly, insight about one’s limitations, which is typically thought to be an integral aspect of EF that is inherently related to daily functionality, appears to be affected by both intellectual capacity and personality traits, rather than performance on EF tests (William, Suchy, & Kraybill, 2010; Suchy, Williams, Kraybill, Franchow, & Butner, 2010).

Together, this work shows that EF difficulties emerge dynamically in different situations for different populations. We are currently further building on these findings. Specifically, we are in the process of collecting data on older adults with and without cognitive concerns, testing the hypothesis that older adults who experience subjective concerns but are indistinguishable per typical neuropsychological assessment will exhibit greater than typical EF depletion when required to engage in emotion regulation. Preliminary examination of the data collected thus far supports this hypothesis. Similarly, we are in the process of examining the degree to which tic suppression depletes EF reserves among children with Tourette’s Syndrome, and the degree to which sexual suppression depletes EF among healthy adults vs. pedophilic child molesters.

(2) Assessment of subtle EF weaknesses. My work in this area has focused on identifying cognitive “biomarkers” for decreases in the integrity of the EF substrates. The hope is that such biomarkers would be able to detect limitations in the EF reserve at a pre-clinical or sub-clinical level, that is, prior to the onset of overt cognitive decline, thereby identifying individuals who are at risk for EF lapses in daily life during periods of increased situational demands.

Consistent with the notion that a single observation cannot adequately identify EF weaknesses, I have developed a measure that allows assessment of multiple subtle deviations in performance as the task demands change. This approach is in contrast to typical clinical measures that tend to subsume all aspects of performance into a single comprehensive score (e.g., the Trail-Making Test and the Stroop test confound speed and accuracy by including erroneous responses in the total completion time, and do not provide information about the preparation time, the execution time, or performance changes over the course of the task). The Push-Turn-Tap task (PTT, developed in my laboratory; Suchy, Derbidge, & Cope, 2005; Suchy & Kraybill, 2007) is an electronic analogue to Luria’s Fist-Edge-Palm task, and was originally inspired by the Behavioral Dyscontrol Scale (developed by Jim Grigsby and colleagues). Due to its theoretically-based design and electronic administration, the PTT task takes only five minutes to administer yet generates indices for a variety of discrete neurocognitive processes, including (a) motor/action planning, (b) motor/action control (i.e., the smoothness and accuracy of a double-tap movement), (c) motor learning, (d) hyperkinetic...
perseveration, (e) the effects of task novelty and task complexity on performance, (f) motor speed, and (g) insight. The task has proven to have excellent psychometric properties and its construct validity has been demonstrated by both behavioral and neuroimaging studies (e.g., Kraybill & Suchy, 2008; Marchand et al., 2012; Marchand et al., 2013; Suchy & Kraybill, 2007; Suchy, Euler, & Eastvold, 2014; Suchy et al., 2010; Suchy, Lee, & Marchand, 2013).

For example, using the PTT task, we have demonstrated that an exaggerated reaction to novelty (evidenced by performance deviations during early/novel PTT trials) identifies older adults who are “on the brink” of exhibiting cognitive decline (Suchy, Kraybill, & Franchow, 2011). Because adequate EF reserve is needed for compensation for the emotional and cognitive demands associated with novel contexts, the exaggerated reaction to novelty in older adults likely reflects subtle limitations in EF reserves that are present just prior to the onset of overt cognitive decline. Incidentally, this finding was also replicated when assessing reaction to novelty in older adults via self-report (using the NEO-PI; Williams, Suchy, & Kraybill, 2013), as well as when assessing reaction to novelty behaviorally (again using the PTT task) among individuals who have a distant history of traumatic brain injury (Suchy, Euler, & Eastvold, 2014).

Additionally, the work with the PTT task has demonstrated that certain discrete aspects of motor output (e.g., motor/action planning and motor/action control) are strongly related to executive functioning and are, in fact, key to performing certain traditional neuropsychological tasks (e.g., Kraybill & Suchy, 2008; Larson & Suchy, 2014; Suchy & Kraybill, 2007; Suchy, Kraybill, & Larson, 2010). Additionally, a simple lack of smoothness on the double tap movement is associated with EF lapses as task complexity increases (Suchy, Lee, & Marchand, 2013), suggesting that it is sensitive to limitations in the EF reserve. Incidentally, the apparently healthy older adults who exhibit the subtle lapses on the PTT task also exhibit anomalous functional connectivity (via fMRI) (Suchy, Lee, & Marchand, 2013), supporting the assertion that the PTT task detects actual neurobiologic changes.

The PTT’s potential clinical utility is also beginning to be demonstrated: The task has proven superior to traditional measures of executive functioning in predicting (a) both concurrent and future functional independence in older adults (Kraybill & Suchy, 2011; Kraybill, Thorgusen, & Suchy, 2013), (b) incipient cognitive and functional decline in older adults (Suchy, Kraybill, & Franchow, 2011), and (c) subtle sequelae of traumatic brain injury (Suchy, Eastvold, Whittaker, & Strassberg, 2007; Suchy, Euler, & Eastvold, 2014).

Together, this work offers a paradigm shift of sorts in the assessment of EF, demonstrating that multiple observations within a single task may offer a highly cost-effective alternative to the comprehensive single score yielded by typical EF tests. Additionally, this research demonstrates that subtle deviations during task performance represent an important index of the integrity of the EF system. In my future research, I am interested in further pursuing the notion that reaction to novel contexts and the smoothness of the double tap movement represent pre-clinical markers of incipient decline. I also aim to further delineate which task variables are most sensitive to subclinical EF changes, and identifying task properties that will further accentuate the sensitivity of these variables. My long-term research goal is to implement these findings toward the development of an instrument that would prove to have both clinical and research utility for detection of subtle preclinical/subclinical weaknesses in EF.