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The Development, Affect Regulation, and Style of Pulling of Trichotillomania

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The Development, Affect Regulation, and Style of Pulling of Trichotillomania

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The present study aims to contribute to the growing body of Trichotillomania (TTM) literature by evaluating the role of three important developmental variables – age of onset, current age, and duration of illness. This study also evaluates the utility of an affect regulation model of TTM and the influence of style of pulling. All participants were drawn from users of the StopPulling.com website, an interactive Internet program for TTM. A total population of 1,523 users was recruited. Aggregate data on multiple episodes of hair pulling from 597-609 participants who completed a baseline assessment (pre-intervention) were used in this study. The sample had an average age of 29.7 years, the majority was female (94%), Caucasian (87.2%), and U.S. residents (87%). Pearson's product moment correlation, T-tests, and multiple regression were used to evaluate hypotheses involving relationships between variables and determine key predictors of TTM symptom urge severity. Findings indicate the most important factor in predicting

the urge severity of TTM was the duration of illness. Negative affect before pulling and style of pulling also predicted urge severity. Adults (aged 18 and older) reported more negative affect before pulling than youth (aged 17 and younger). As duration of illness and age increased, participants reported less positive affect during hair pulling. Positive affect after pulling was related to a focused style of pulling while negative affect after pulling was related to an automatic style of pulling. An earlier onset of TTM was related with more focused pulling while later onset was associated with more automatic pulling. Research and treatment implications of these findings are discussed as well as limitations of this study.

This dissertation by Ali M. Mattu fulfills the dissertation requirements for the doctoral degree in philosophy approved by Sandra Barrueco, Ph.D., as Director, and by Brendan Rich, Ph.D., and Charles Mansueto, Ph.D. as Readers.

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CHAPTER 1

Introduction

Trichotillomania (TTM) is a pathological form of hair pulling (Christenson & Mansueto, 1999). While researchers have a basic understanding of TTM's epidemiology and classification, what is currently missing is a thorough understanding of how the developmental course of TTM relates to the conceptualization, presentation, and severity of the disorder (Dell'Osso, Altamura, Allen, Marazziti, & Hollander, 2006; Franklin et al., 2008; Woods et al., 2006). This project aims to contribute to the growing body of TTM literature by evaluating the role of three important developmental variables – age of onset, current age, and duration of illness. Additionally, this project will evaluate the utility of an affect regulation model of TTM and the influence of style of pulling as they relate to the developmental course of the disorder and its urge severity.

Historical Origins & Diagnostic Criteria

Historical accounts of human hair pulling date as far back as ancient Egypt and the early Greeks (Christenson & Mansueto, 1999). However, a pathological form of hair pulling was not identified until 1889 when French physician Francois Henri Hallopeau coined the term Trichotillomania (Greek for "impulse toward pulling hair"). TTM first entered psychiatric classification in 1987 with the revised third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-III-R*; American Psychiatric Association, 1987). Currently, TTM is categorized as a *DSM-IV* Impulse-Control

Disorder (American Psychiatric Association, 1994). *DSM-IV* diagnostic criteria for TTM include the following: A) frequently pulling out of one's hair resulting in noticeable hair loss; B) feelings of tension before pulling out the hair or when resisting the urge to pull hair; C) pleasure or relief when pulling out the hair; D) the symptoms are not better explained by a medical condition; and E) clinically significant distress or impairment results in important areas of functioning.

Controversy currently surrounds TTM's *DSM-IV* classification and diagnostic criteria (Lochner et al., 2011; Stein et al., 2010; Stein et al., 2007). First, TTM shares little in common with other Impulse-Control Disorders (e.g., Intermittent Explosive Disorder, Kleptomania, Pyromania, Pathological Gambling) (Dell'Osso, Altamura, Allen, Marazziti, & Hollander, 2006; Stein et al., 2007). TTM may be better categorized as an anxiety disorder, obsessive-compulsive spectrum disorder, body-focused repetitive behavior disorder, or stereotypic movement disorder (Hollander, Kim, Braun, Simeon, & Zohar, 2009; Stein et al., 2010; Stein et al., 2007). Additionally, *DSM-IV* criteria B and C do not fit many clinical presentations of hair pulling as several studies have found substantive sub-clinical populations that do not experience tension before pulling their hair or relief when pulling their hair (Christenson, Pyle, & Mitchell, 1991; Christenson, Mackenzie, & Mitchell, 1991; Duke, Keeley, Geffken, & Storch, 2010; King et al., 1995; Lochner et al., 2011; Schlosser, Black, Blum, & Goldstein, 1994; Stein et al., 2010; Woods et al., 2006).

A draft of the *DSM-5*'s proposed changes could potentially address the controversy surrounding TTM's classification and criteria (American Psychiatric Association, 2012). The proposed changes include renaming TTM as *Hair-Pulling Disorder (Trichotillomania)*, reclassifying the disorder under the new category of Obsessive-Compulsive and Related Disorders, removing "noticeable" from criterion A (since TTM related hair loss may not always be noticeable), removing *DSM-IV*'s criterion B (tension before pulling) and C (pleasure/relief when pulling), and adding new exclusionary criteria (hair pulling is not restricted to the symptoms of another mental disorder, e.g. hair pulling due to preoccupation with appearance in Body Dysmorphic Disorder). Since a wide variety of affect has been implicated in TTM, and samples meeting *DSM-IV*'s criterion B and C do not vary in regards to severity and impairment when compared to samples that do not meet criterion B and C, removal of *DSM-IV*'s criterion B and C will make diagnostic criteria more consistent with literature on the disorder (Lochner et al., 2011; Shusterman, Feld, Baer, & Keuthen, 2009).

Epidemiology

Prevalence.

Large-scale epidemiological data on trichotillomania, drawn from the general population, is unavailable (Woods et al., 2006). Additionally, what is known is subject to several limitations. First, most prevalence studies have used small samples of convenience (e.g., college students and clinical populations). Second, given the previously mentioned controversy surrounding TTM's diagnostic criteria,

epidemiological studies have used different criteria for TTM, ranging from DSM-IV, modified DSM-IV (ignoring criteria B and C), and sub-clinical TTM (presence of distressing hair pulling symptoms that do not meet DSM-IV criteria). These differences in samples make comparisons across studies difficult.

TTM was once thought to be an extremely rare disorder. Early research suggested a prevalence rate of 0.05% (Schachter, 1961). Current research acknowledges that TTM is more common (Mansueto & Rogers, 2011). Prevalence of TTM meeting DSM-III-R criteria among 2,579 college students was found to be 0.6% (Christenson et al., 1991). Sub-clinical levels of hair pulling in this sample were noted in 3.4% of females and 1.5% of males. In a study of 288 college students, sub-clinical hair pulling was found in 15.3% of the sample (Stanley, Borden, Bell, & Wagner, 1994). Among psychiatric inpatients, 3.4% were diagnosed with TTM with a lifetime prevalence of 4.4% (Grant, Levine, Kim, & Potenza, 2005). More recent data suggests an overall estimated prevalence rate of 0.76% among a sample of 527 college students and a 0.6% prevalence among adults (Duke, Bodzin, Tavares, Geffken, & Storch, 2009; Duke, Keeley, Ricketts, Geffken, & Storch, 2009). Thus, TTM seems to vary from 0.6% to 0.76% in non-clinical populations and has 3.4% point prevalence and 4.4% lifetime prevalence in clinical populations. Further research using large-scale community samples and consistent diagnostic criteria are needed before we fully understand the prevalence of this disorder.

Gender.

Among children, TTM seems to be equally common among males and females (Reeve, 1999). With adults, key differences emerge between community and clinical samples. Community samples have revealed equal distributions among males and females while clinical samples have been primarily female (Duke, Keeley, Geffken, & Storch, 2010). For example, Duke and colleagues (2009) found no differences between males and females in their community sample while Christenson (1995) identified a 92.5% female majority in a clinical sample. Findings from Duke and colleagues (2010) confirm that while prevalence rates are similar across genders in community samples, as hair pulling becomes more severe the gender distribution shifts towards females.

Several explanations for these differences have been proposed (Christenson & Mansueto, 1999; Duke, Keeley, Geffken, & Storch, 2010; Flessner, Woods, Franklin, Keuthen, & Piacentini, 2009; Woods et al., 2006). The effects of TTM may be more public for females, making them more likely to seek treatment (Christenson & Mansueto, 1999). Males, on the other hand, can more easily conceal their hair pulling by shaving their face and scalp, have a wider variety of areas on their body to pull from, and have a greater social acceptability of hair loss (e.g., male-pattern baldness). Such differences in pulling sites have been identified in research such that females are more likely to pull from their scalp and eyelashes while men more commonly pull from their stomach, back, moustache, and beard (Lochner, Seedat, & Stein, 2010). Additionally, females are more

likely to access treatment across a number of psychiatric disorders (Mojtabai, Olfson, & Mechanic, 2002).

Culture.

Unfortunately, cross-cultural TTM research is still in its early stages. Given the current state of the literature, no statements can be made regarding salient cross-cultural differences. What can be noted is that TTM has been identified in African American, Israeli, Polish, and South African samples (King et al., 1995; Lochner, Seedat, & Stein, 2010; Mansueto, Thomas, & Brice, 2007; Szepietowski, Salomon, Pacan, Hrehorów, & Zalewska, 2009). Mansueto, Thomas, and Brice (2007) found 6.3% of an African American sample of 248 undergraduate students engaging in hair pulling behavior. While 15.4% of hair pullers in this sample pulled to the point of noticeable hair loss, many did not meet the present DSM-IV criteria for TTM. A related study noted that TTM impairment and severity were positively correlated with anxiety symptoms for a sample of 41 African American females (Neal-Barnett, Statom, & Stadulis, 2011). This study was also the first to evaluate the influence of cultural messages about hair on TTM; however no significant relationship was noted.

Outside of the United States, hair pulling has been identified in about 1% of Israeli adolescents (King et al., 1995). Szepietowski and colleagues (2009) interviewed 118 Polish dermatologists and identified 68% having seen at least one patient with TTM, with 5% reporting contact with more than 10 patients with TTM. Finally, Lochner, Seedat, and Stein's (2010) South African sample of patients with TTM closely matched

United States samples on several important variables including gender and age. While more research is needed in this area, TTM does appear to be a disorder that affects a wide variety of cultures and populations.

Clinical Presentation

TTM is a complex disorder with a heterogeneous presentation (Duke, Keeley, Geffken, & Storch, 2010). Individuals may pull hair from any part of the body, but usually pull from the scalp, eyebrows, eyelashes, beard, and pubic areas (Woods et al., 2006). Hair is often pulled one at a time with fingers or instruments (e.g., tweezers). While some individuals immediately discard pulled hair, others engage in ritual manipulations (Christenson, Mackenzie, et al., 1991). Post-pulling rituals include collecting and saving hair, using one's hands, mouth, or face to manipulate the hair, chewing the hair, or ingesting the hair.

Impairments.

TTM often leads to several biological, psychological, and social impairments. Beyond hair loss, TTM can result in follicle damage, skin irritation, enamel erosion or gingivitis from chewing hairs, and potentially lethal trichobezoars (hairballs in the stomach) from oral ingestion (Bouwer & Stein, 1998; Christenson & Crow, 1996; Christenson et al., 1991; Schlosser et al., 1994). Individuals with TTM also can suffer from profound social impairment (Diefenbach et al., 2005; Flessner et al., 2009; Stemberger et al., 2000; Wetterneck et al., 2006; Woods et al., 2006). TTM can lead to an

avoidance of many common activities including medical exams, social activities, haircuts, and sexual intimacy. This can lead to feelings of isolation, shame, and embarrassment (Diefenbach et al., 2005; Susan & Rapoport, 1991). TTM sufferers may feel unattractive, have low self-esteem, and be dissatisfied with their bodies (Stemberger et al., 2000). Many with TTM also try to hide evidence of their hair pulling by using wigs, elaborate hairstyles, makeup, hats, and scarves (Diefenbach et al., 2005; Flessner et al., 2009; Stemberger et al., 2000; Wetterneck et al., 2006; Woods et al., 2006). Additionally, individuals suffering from TTM are at an increased risk of developing comorbid mood, anxiety, and substance use disorders (Duke et al., 2009; Duke et al., 2009; Lewin et al., 2009). Further, females may experience fluctuating TTM intensity, particularly during puberty onset, pre-menopause, and post-menopause, suggesting that the female hormonal cycles impact the degree of TTM impairment experienced by women (Flessner et al., 2009).

Additionally, neurocognitive research has identified impulsivity as a prominent impairment in TTM (Singisetti, Chamberlain, & Fineberg, 2010). Impulsivity involves poor decision making, difficulty in delaying rewards, and deficits in response inhibition (i.e., suppressing motor responses). Of these factors, response inhibition has received the most attention in the literature. Researchers have compared response inhibition between those diagnosed with obsessive-compulsive disorder (OCD) and TTM (Bohne, Keuthen, Tuschen-Caffier, & Wilhelm, 2005; Chamberlain et al., 2006). While OCD samples tend not to demonstrate response inhibition deficits, both studies have identified response inhibition deficits in the TTM groups. Furthermore, the relationship between response

inhibition and TTM could be related to age of onset, with an earlier age of onset related to poorer response inhibition. In another study, researchers found deficits on divided attention tasks among TTM patients when compared to controls (Stanley, Hannay, & Breckenridge, 1997).

Style of Pulling.

Several recent studies have aimed to understand how aware individuals are of their hair pulling behavior (Duke, Keeley, Geffken, & Storch, 2010; Flessner, Woods, Franklin, Keuthen, & Piacentini, 2008; Flessner et al., 2009; Lochner, Seedat, & Stein, 2010; Woods et al., 2006). Christenson and colleagues (1991) described two distinct styles of pulling – focused and automatic pulling. Individuals who consciously pull their hair are described as engaging in focused pulling. Focused pulling often consumes one's attention. Focused pulling is more likely to be associated with a greater urge to pull hair and is often precipitated by negative affect (e.g., anger, stress, frustration). Individuals may participate in rituals (e.g., prepare their bathroom in a specific way) or use tools (e.g., tweezers or mirrors) while engaging in focused pulling. Focused pulling can be triggered by finding specific types of hairs (e.g., oily, knotted, or gray hairs) or by thoughts related to hair color, texture, or hairline symmetry (Mansueto & Rogers, 2011). Specific sensations, such as itching, irritation, or pressure, may also lead to focused pulling.

On the other hand, automatic pulling occurs when individuals pull their hair outside of their awareness (Flessner et al., 2008). Individuals who are engaging in

automatic pulling often do not realize they are pulling their hair unless someone else informs them of their behavior or after their hair pulling behavior is complete. A variety of affective states can be associated with automatic pulling. While focused pulling consumes one's attention, automatic pulling usually occurs in addition to another activity (e.g., watching television, reading a book, driving a car, absorbed in thought).

Automatic and focused styles of hair pulling are not distinct and separate TTM subtypes in the DSM. Indeed, less than .01% of individuals with TTM are estimated to engage in only one style of hair pulling (Flessner, Woods, Franklin, Keuthen, & Piacentini, 2008). Rather, individuals vary in the degree to which they engage in both styles of pulling. Some individuals may predominately pull with one style, as evidenced in the nearly 75% of Christenson and colleagues' (1994) sample of TTM patients who predominately engaged in automatic pulling. There is a possibility that those who predominantly engage in focused pulling may experience a more severe form of TTM, are more prone to depression, and endure more functional impairment (Flessner et al., 2008).

Severity

The most widely used measure of the clinical presentation of TTM is the Massachusetts General Hospital Hair Pulling Scale (MGH-HS) (Keuthen et al. 1995 & O'Sullivan et al., 1995). Recent factor analysis utilizing 990 self-reported hair pullers has identified two main factors that comprise the MGH-HS – severity and resistance and control (Keuthen et al., 2007). The severity factor consists of four items: the frequency of

the urge to pull one's hair, the severity of the urge to pull one's hair, the frequency at which an individual pulls their hair, and the distress hair pulling causes an individual. The resistance and control factor includes items that measured the control an individual has over hair pulling, resistance to hair pulling, and control over urges. The severity factor of the MGH-HS captured the majority of variance in this sample (53.2%) while resistance and controls represented a smaller degree of variance (17.9%). While both factors were related to depression and anxiety resulting from TTM, only the severity factor was significantly related to disability scores, time spent hiding hair loss from TTM, and time spent resisting TTM hair pulling behavior. Thus, when assessing the clinical presentation of TTM and the severity of the disorder, the most important aspects to consider include urge frequency, urge severity, hair pulling frequency, and distress associated with hair pulling.

Etiology

It is theorized that several variables interact with each other to produce TTM. Preliminary evidence suggests that an interaction between psychological, biological, and environmental factors influence the etiology of TTM (Diefenbach, Tolin, Meunier, & Worhunsky, 2008; Duke, Keeley, Geffken, & Storch, 2010; Flessner, Woods, Franklin, Keuthen, & Piacentini, 2009; Shusterman, Feld, Baer, & Keuthen, 2009). Specifically, psychological factors can lead individuals to use hair pulling as a way to regulate one's affect, biology can produce a vulnerability to develop TTM, and environmental variables could trigger negative affective states.

Psychological Etiology.

Affect regulation and habit formation have been implicated as key variables in the development and presentation of TTM (Stein, Chamberlain, & Fineberg, 2006). Penzel (2003) hypothesized that the homeostatic mechanisms controlling arousal do not function correctly in individuals with TTM. Research implicating the left amygdalo-hippocampal formation, left putamen, bilateral cingulated cortices, and frontal cortical regions' involvement in TTM (reviewed later), provide preliminary biological evidence supporting this affective model (Chamberlain et al., 2008). In this model, feelings of tension, anxiety, boredom, sadness, anger, frustration, and loneliness often lead to the urge to pull hair for individuals with TTM (Duke et al., 2009). Some learn that hair pulling can serve as a way to regulate their nervous system, stimulating when under-stimulated and relaxing when over-stimulated. Mansueto et al. (1997) suggested that through a combination of classical and operant conditioning, internal affective states become associated with hair pulling while the reduction of the unwanted affective states negatively reinforce the hair pulling behavior. Using this affect regulation model, hair pulling could be conceptualized as a learned habitual behavior beginning with the onset of symptoms (during childhood or adolescence) and strengthening over time (Stein et al., 2006). As generalization and habituation occur, individuals may expand to pull from new sites and develop a more complex form of TTM in adulthood. This model may also explain why some individuals differentially engage in automatic versus focused pulling, depending upon their affective state. Additionally, since females are also more likely to

experience anxiety, females may experience a greater need for affect-regulation (Duke et al., 2009).

Two specific studies have evaluated the role of affect regulation in TTM. First, Shusterman and colleagues' (2009) internet survey of 1162 self-identified hair pullers found that hair pullers experienced more problems regulating their affect than non pullers. Further, difficulty regulating affect was related to severity of hair pulling and problems regulating specific types of affect was potentially related to those affective states triggering hair pulling. In a small sample of 15 children and adolescents diagnosed with TTM, Meunier, Tolin, and Franklin (2009) noted that first episodes of hair pulling (i.e. the very first time the individual remembers pulling their hair) were associated with pleasure and pain while recent pulling was associated only with pleasure. This supports the notion that hair pulling can be a habit that is maintained through positive reinforcement and the habituation of pain during hair pulling.

In addition to affective regulation and habit formation, behavioral addiction has been hypothesized as a maintenance factor in TTM (Grant, Brewer, & Potenza, 2006; Stein et al., 2006). Behavioral addiction, like drug addiction, involves: 1) repeated involvement in a behavior which results in adverse consequences; 2) lack of control over the behavior; 3) a strong desire to engage in the behavior; and 4) pleasurable feelings during the behavior. In animal research, behavioral addictions have produced similar biological effects as drug addictions, specifically the release of dopamine in the nucleus accumbens (Lambert, 1993; Lambert et al., 1998). Unfortunately, researchers have yet to

empirically test the behavioral addiction model in relation to TTM. Additionally, the research that has been conducted on behavioral addictions has focused on other impulse-control disorders. Given the previously discussed controversy over TTM's placement in this diagnostic category, as well as the lack of tension experienced before pulling and relief after pulling, TTM may not fit within the behavioral addiction framework as well as other impulse-control disorders (e.g., pathological gambling).

In summary, it is hypothesized that individuals with TTM have defects in arousal and use hair pulling as a way to regulate their nervous system (Penzel, 2003; Duke et al., 2009). Classical and operant conditioning strengthens the hair pulling behavior while generalization and habituation expands the hair pulling leading to a more complex presentation of the disorder (Mansueto et al., 1997; Stein et al., 2006). Individuals differentially engage in automatic or focused pulling depending upon the needs of their current affective state. While there is limited support for affective models of TTM, it is unknown how affect differentially impacts TTM before, during, and after pulling. Additionally, more research is needed to determine how affective models of TTM vary across developmental cohorts, particularly among children, adolescents, and adults.

Biological Etiology.

Although biological TTM research is still in its early stages, important findings have been discovered from heritability, genetic, animal, neurocognitive, neuroimaging, and neuropharmacological studies (Singisetti, Chamberlain, & Fineberg, 2010). With regard to heritability, there is preliminary evidence of a genetic basis for TTM. Using the

DSM-IV TTM criteria, a twin study found a 38.1% concordance rate for monozygotic twins and 0% for dizygotic twins (Novak, Keuthen, Stewart, & Pauls, 2009). Using sub-clinical DSM-IV criteria, researchers found a similar trend (39.1% for monozygotic and 0% for dizygotic twins). When expanding the criteria to non-cosmetic hair pulling, concordance rates grew to 58.3% for monozygotic and 20% for dizygotic twins. This study indicates that a vulnerability to develop TTM can be inherited.

Researches have attempted to link TTM to polymorphisms, or differences in the genetic code of those who experience TTM symptoms and those who do not (Singisetti, Chamberlain, & Fineberg, 2010). At present, findings from this line of research must be considered preliminary due to small sample sizes. Four polymorphisms have been implicated in TTM – SLITTRK1, 5HT2A, A1438A, and SAPAP3 (Bienvenu et al., 2009; Bienvenu et al., 2000; Hemmings et al., 2006; Nomura et al., 2006; Zuchner et al., 2006). Mutations in SLITTRK1 impact axon and dendrite development in mice and have also been linked to Tourette's syndrome in humans. This suggests a genetic link to the behavioral disinhibition symptoms of TTM (e.g. automatic hair-pulling) and a potential similarity to Tourette's syndrome, which is characterized by disinhibitory problems related to motor and vocal tics (Abelson et al., 2005; Grados & Walkup, 2006). The 5HT2A gene controls serotonin receptor sites (Hemmings et al., 2006). Serotonin has been implicated in a wide variety of psychiatric disorders and is involved in motor behavior, depression, and anxiety (Lucki, 1998). Specifically, the 5HT gene is often the target of antidepressant and antianxiety drugs (Lesch et al., 1996). Additionally, the A1438A polymorphism of the 5HT2A gene controls impulsive behavior (Nomura et al.,

2006). Together, 5HT2A and A1438A suggest the involvement of the serotonin system in the development of emotional and impulsive symptoms of TTM. Finally, SAPAP3 is involved in promoting neuronal communication in the cortex-striatum circuit (Bienvenu et al., 2009). Previous research has linked SAPAP3 defects to OCD behavior in mice (Welch et al., 2007). Specifically, this is due to SAPAP3's role in the production of glutamate, which mediates communication between the striatum (involved in reward processing and movement) and the cortex (involved in decision making). This may help to explain the rewarding nature of hair-pulling in TTM. Collectively, these studies have begun to link TTM affective and behavioral symptoms to genetic variations.

Animal research has further studied the role of genes in the development of TTM. In a study of mice, researchers found that mutations in the HOXB8 gene led to disordered grooming behavior similar to TTM in humans (Greer & Capecchi, 2002). Mice with this mutation excessively groomed and removed hair from themselves as well as other nearby mice. Recent research has found that the immune system of mice interact with HOXB8 to produce hair removal symptoms (Chen et al., 2010). Microglia, a type of cell that guards against infections, are the only cells that produce HOXB8. Mice with HOXB8 mutations have fewer microglia than normal mice. Additionally, when microglia cells were transferred (in the form of bone marrow) from healthy mice to those with HOXB8 mutations, mice with the HOXB8 mutations stopped excessive removing hair. Interestingly, when microglia cells were transferred from mice with HOXB8 mutations to normal mice, the normal mice began engaging in excessive grooming and hair removal. Immune system dysregulation has been linked to several psychiatric disorders in humans

including autism, obsessive-compulsive disorder, schizophrenia, and depression (Ashwood, Wills, & Van de Water, 2006; da Rocha, Correa, & Teixeira, 2008; Leonard & Myint, 2009; Strous & Shoenfeld, 2006). Further research is needed to determine if HOXB8 mutations, microglia cells, and immune system dysregulation are linked to TTM symptoms in humans.

Findings from the neuroimaging literature offer disparate and sometimes conflicting results. First, in regards to activation studies, Swedo et al. (1991) noted increased activity in the right and left cerebellum and right superior parietal lobe. However, Stein and colleagues (2002) noted inferior-posterior and frontal-cortical region activity with TTM patients. The remainder of neuroimaging research has focused on volumetric analysis. Grachev (1997) found reduced left inferior frontal gyrus volume and enlarged right cuneal cortex volume with TTM participants. During this time, O'Sullivan et al. (1997) noted smaller left putamen volume in TTM patients. More recently, Keuthen et al. (2007) identified smaller cerebellar volumes in TTM participants, supporting earlier activation research that implicated the right and left cerebellum in TTM. It is important to note that each of these studies utilized a-priori volumetric analyses that highlighted specific brain regions of interest. A whole-brain analysis conducted by Chamberlain et al. (2008) revealed increased gray matter density in the left amygdalo-hippocampal formation, left putamen, bilateral cingulated cortices, and frontal cortical regions. While these imaging studies provide a lack of consensus regarding the neural activity and brain volume of individuals with TTM, each of the regions identified in this research is implicated in affect regulation, habit formation, and behavioral inhibition. This provides a

basic link between neural research on TTM and psychological models of the disorder (Singisetti, Chamberlain, & Fineberg, 2010).

In addition to neuroimaging research, the previously discussed neurocognitive research on response inhibition has implicated the orbitofrontal cortex, the right inferior frontal gyrus, and the fronto-striatal brain regions (Bohne et al., 2008; Chamberlain & Sahakian, 2007; Eagle et al., 2008; Woolley et al., 2008). This line of research suggests that TTM's neural deficits are similar to Attention-Deficit Hyperactivity Disorder's deficits, a disorder which also implicates affect, motor behavior, impulsivity, and disinhibition (Chamberlain et al., 2007; Singisetti, Chamberlain, & Fineberg, 2010). Additional research is needed to determine the unique neurocognitive markers of TTM.

Similar to neuroimaging research, results from neuropharmacological research are considered preliminary due to small sample sizes (Bloch et al., 2007; Chamberlain et al., 2007; Stein, Bouwer, & Maud, 1997). Currently, there is no Food and Drug Administration approved drug for TTM (Grant, Odlaug, & Kim, 2009). In general, studies have not supported serotonin agents, such as selective serotonin reuptake inhibitors (SSRIs) (Singisetti, Chamberlain, & Fineberg, 2010). This is surprising given the previously reviewed research implicating the serotonin system in TTM. However, medications involving the serotonin system historically have little impact in the treatment of impulsive motor behavior (Chamberlain & Sahakian, 2007). Cools et al. (2005) suggest that SSRIs may be less effective since serotonin is involved in affective impulsivity involving rewards and feedback, not motor impulsivity or response

inhibition. Additionally, given the heterogeneous nature of TTM, there is a possibility that SSRIs may be effective for specific subsamples of TTM patients (Grant & Potenza, 2006). Researchers have noted limited support for clomipramine hydrochloride, which limits norepinephrine and serotonin uptake (Swedo, Lenane, & Leonard, 1993). A new line of research into N-Acetylcysteine, an antioxidant that reduces the synaptic release of glutamate, has potential to be the first effective medical treatment of TTM (Grant et al., 2009). Deficits in the glutamate system have been identified in OCD and the restoration of glutamate in the nucleus accumbens (a region responsible for motivation, reward, affect, and addiction) is hypothesized to reduce compulsive behaviors (Chakrabarty et al., 2005; Kalivas & Volkow, 2005). While N-Acetylcysteine has demonstrated promising results, there is a need for more pharmacological studies of TTM before definitive conclusions can be made.

Environmental Etiology.

Traumatic experiences have been suggested to relate to the development of TTM (Gershuny et al., 2006). In a study of 42 patients seeking treatment for TTM, 76% were found to have one traumatic event that occurred prior to their TTM onset. Type of trauma experienced included accidents (50%), death/injury/family violence (38.5%), childhood sexual abuse (25.8%), adult sexual assault or rape (23.3%), childhood physical abuse (20.6%), natural disaster (20.6%), adult physical assault (18.4%), mugging or robbery (18%), and combat (2.6%). Additionally, 19% of these individuals met criteria for post-traumatic stress disorder (PTSD), which is higher than what is expected among the

general population but lower when compared to other psychiatric disorders. Interestingly, the PTSD group reported less severe TTM symptoms. Individuals with two or more types of trauma reported a greater duration of illness. Individuals with TTM are also more likely to have endured emotional neglect in their past (Lochner et al., 2002). However, this is contrasted with findings from Moore and colleagues (2009), which did not reveal significant family discord or negative parental attitudes towards children and adolescents with TTM. Specifically, scores of familial conflict were similar to that of children with anxiety disorders and eating disorders. Given the limited research in this area, no broad implications can be made at this time regarding the influence of the environment on TTM. More studies are needed to determine how environmental stress, trauma, and family functioning influence the etiology of TTM.

Development

While researchers have begun to develop a body of literature surrounding the epidemiology and etiology of TTM, research focusing on developmental aspects of TTM has been slower to emerge. Much of the research in this area has been completed within the past six years and represents preliminary findings. Given the important developmental differences documented in the presentation and treatment of many psychiatric disorders, there a clear need for new research to fill this gap in the trichotillomania literature (Farrell, Barrett, & Piacentini, 2006; Garber, 2000; Seidman, 2006; Portman, 2009; Rajji, Ismail, & Mulsant, 2009). As described in detail below, current developmental TTM findings suggest three main variables of interest – age of onset, current age, and duration

of illness (Flessner et al., 2009; Lewin et al., 2009; Meunier et al., 2009). It is theorized here that each of these variables impact how TTM changes over time. Specifically, age of onset influences the course of the disorder, the presentation of TTM varies across ages, and the duration of illness influences the affective experience of the disorder.

Age of Onset.

Age of onset may influence the course of the disorder. While the average age of onset is 13 years, TTM has a bimodal onset with most cases beginning in childhood or during adolescence (Christenson, 1995; Cohen et al., 1995, Schlosser et al., 1994, Swedo & Rapport, 1991; Mansueto & Rogers, 2011). Among young children, TTM symptoms are typically limited in their course, though some cases can become chronic (Walsh & McDougle, 2001, Wright & Holmes, 2003). Researchers presently do not know what differentiates early onset TTM with a limited course from early onset TTM with a chronic course. In turn, later onset TTM has been linked to a more severe course of the disorder, often resulting in greater comorbidity, symptom severity, and treatment resistance (Swedo et al., 1992; Winchel, 1992; Keuthen et al., 2001; Lewin et al., 2009). However, these findings must be considered preliminary due to small sample sizes (varying from n=10-44). Studies incorporating both large samples and longitudinal methodology are needed to better understand age of onset and the course of TTM.

Current Age.

Most of what is known about current age-related differences in the presentation of TTM originates from Flessner and colleagues' study of 1,471 women with TTM (Flessner et al., 2009). This study was cross-sectional and based on retrospective reports of women. However, it yielded several important age-related differences insights. First, the degree to which women engage in focused and automatic hair pulling styles varied depending upon age, with the highest levels of automatic and focused pulling evidenced during the adolescent period. Interestingly, focused pulling spiked in frequency during puberty and perimenopause (the 2-8 year period before menopause) and later declined after menopause. This suggests important life events (e.g., hormonal changes, phase of life transitions, or stress) during development and aging may influence focused pulling. However, despite these fluctuations in pulling styles, Flessner and colleagues found a stable percentage of missing hair across all age groups. This demonstrates that while the symptoms of TTM changed throughout the lifespan, these changes did not influence the amount of hair individuals pulled from their bodies. Additionally, older women appeared to pull from more sites on their body than younger women. This could be due to increased body hair resulting from developmental maturation, having less hair remaining on the scalp and facial areas, or an increased ability to pull without being noticed. Older women also experienced more social and interpersonal impairment, though it is unclear what caused this effect. Reports of mental anxiety (a sense of worry or fear that something bad will happen if one does not pull their hair) were rare across all age groups. Finally, affect experienced before pulling varied across age groups. Specifically, girls

reported little physical anxiety (e.g., increased heart rate, sweating) prior to pulling their hair. Reports of physical anxiety increased through adolescence and adulthood. Recalling the previously discussed theories of affect regulation, this finding could be indicative of the changing nature of TTM during adolescence - potentially beginning as an unconscious process and later being used for affect regulation.

Duration of Illness.

Compared to other developmental variables, duration of illness has been the least studied in the literature. Most studies have only exclusively measured age of onset and current age, often ignoring duration of illness. Since duration of illness has been implicated as an important developmental variable in other psychiatric disorders (for example, see Micali et al.'s 2010 study of OCD), what is currently known about this variable is being included in this review.

As duration of illness increases, individuals with TTM experience more social and interpersonal impairment (Flessner et al., 2009), though only less than 1% of the variance in impairment related to illness duration in this study. In turn, a pilot study demonstrated that affect following hair pulling might be related to the duration of the illness (Meunier, Tolin, & Franklin, 2009). Specifically, as described earlier, a mixture of pleasure and pain was reported to follow first hair pulling episodes while later hair pulling was followed only by a pleasurable affect. This suggests that as the duration of illness increases, individuals may habituate to the pain they experience after pulling their hair. Given the small sample size of this study (n=15), this finding must be considered

preliminary until it is replicated using a larger sample. Duration of illness was not related to symptoms of depression and anxiety in a sample of 133 youth with TTM; however, age of onset (specifically, a later onset) was linked to comorbid depression and anxiety (Lewin et al., 2009). Finally, duration of illness has been associated with a greater number of traumas in a sample of participants with TTM (Gershuny et al., 2006). Given these mixed findings, more research is needed to better understand the impact of duration of illness on TTM.

In sum, while these three important developmental variables (age of onset, current age, and duration of their TTM symptoms) are implicated in the presentation of TTM, several questions remain unanswered. Few studies in the literature have differentially measured the age of participants as well as the duration of their TTM symptoms. Given the previously mentioned bimodal TTM age of onset, it is important to measure both variables to determine which effects are results of the cumulative experience of the illness, developmental changes, or environmental variables. Additionally, most studies evaluating these developmental variables have utilized small samples. Further research is needed to understand how these developmental variables influence each other, differentially impact TTM, and relate to theoretical models of TTM. Finally, nearly all studies have utilized retrospective reports of hair pulling. New research is needed that is based upon multiple episodes of hair pulling behavior to yield a more accurate understanding of TTM.

Current Study

While the literature provides a broad overview of TTM, what is currently missing is a thorough analysis of all developmental variables affecting the disorder (age of onset, current age, duration of illness). Additionally, few studies have investigated affect regulation models of TTM, specifically affect preceding, during, and following hair pulling (Duke, Keeley, Geffken, & Storch, 2010). Those that have were often exploratory, utilized small homogeneous samples, and employed retrospective or single incident samples of hair pulling. Furthermore, style of pulling, a variable that has received significant attention in the literature, remains understudied among TTM developmental research. What is needed now is an analysis of developmental variables influencing TTM as they related to affect regulation and style of pulling using large samples based upon multiple episodes of hair pulling.

Thus, the present study aims to understand the developmental course of TTM and investigate unanswered questions in the TTM literature. Specifically, this investigation studied how the clinical presentation of TTM varies as a function of age of onset, current age, and duration of illness. Additionally, it evaluated the utility of an affect regulation model of TTM by examining how emotions experienced before, during, and after hair pulling vary as a function of age of onset, current age, and duration of illness. The relationship between style of pulling, affect regulation, and development was also studied.

The following hypotheses were specifically evaluated in this investigation.

Style of Pulling and Affect Regulation

Hypothesis 1A: A greater degree of focused pulling was hypothesized to be related to more negative affect before hair pulling while a greater degree of automatic pulling was hypothesized to be related to more neutral affect before hair pulling.

Hypothesis 1B: A greater degree of focused pulling was hypothesized to be related to more positive affect during hair pulling while a greater degree of automatic pulling was hypothesized to be related to more neutral affect during hair pulling.

Hypothesis 1C: A greater degree of focused pulling was hypothesized to be related to more positive affect after hair pulling while a greater degree of automatic pulling was hypothesized to be related to more neutral affect after hair pulling.

Age and Urge Severity

Hypothesis 2: Current age was hypothesized to be positively correlated with the urge severity of TTM.

Style of Pulling and Age

Hypothesis 3: A greater degree of focused pulling was hypothesized to be predictive of an older age.

Age and Affect

Hypothesis 4A: Youth (17 and younger) were hypothesized to report less negative affect before pulling than adults (18 and older).

Hypothesis 4B: Youth (17 and younger) were hypothesized to report less negative affect during pulling than adults (18 and older).

Hypothesis 4C: Youth (17 and younger) were hypothesized to report less positive affect after pulling than adults (18 and older).

Age and Urge Severity

Hypothesis 5: Among developmental variables, the urge severity of TTM was hypothesized to be best predicted by current age relative to age of onset and duration of illness of TTM symptoms.

Complete Prediction Model

Hypothesis 6: Among all variables, urge severity of TTM was hypothesized to be best predicted by current age relative to age of onset, duration of illness, style of pulling, affect before, affect during, and affect after hair pulling.

While this study builds upon previous literature, it differs in several ways. First, the present study utilizes a large sample of participants. It investigates the relationship between developmental variables (age of onset, current age, duration of illness), affect regulation, and style of pulling. Lastly, and most notably, this study is the first to be based upon daily reports and on multiple episodes of hair pulling.

CHAPTER 2

Methods

Participants

All participants were drawn from users of the StopPulling.com website, an interactive Internet program for TTM (Mouton-Odum, Keuthen, Wagener, & Stanley, 2006). StopPulling.com is based upon empirically supported cognitive behavioral models of TTM. Individuals using this service monitor their hair-pulling behavior by recording the date, time of day, urge severity, thoughts, feelings, location and activity, body part, and number of hairs pulled for every hair-pulling episode after they have experienced it. Based on this data, the service progresses users through three modules: assessment, intervention, and maintenance (Mouton-Odum, Keuthen, Wagener, & Stanley, 2006). During assessment, which lasts two to five weeks depending upon the frequency of hair pulling the user reports, users are trained to gather information about their hair pulling behavioral patterns. At the end of assessment, users begin the intervention module. This module uses information from assessment to create a customized coping program for the user. This module ends after users accomplish four consequence weeks of meeting their weekly coping goals. During the maintenance period, users continue to monitor their hair-pulling behavior. As new problems emerge, the program offers users with additional coping strategies. If users do not meet their weekly goals for four consecutive weeks, the program considers this a relapse and returns them to the intervention module. StopPulling.com is used both as a self-help treatment program and as an adjunct to

psychotherapy. Pilot testing has demonstrated that StopPulling.com is effective at reducing TTM severity (Mouton-Odum, Keuthen, Wagener, & Stanley, 2006).

The current study used data from 2003 through 2009. The total population of StopPulling.com users for this period was 1,523. All participants passed StopPulling.com's screening tests for TTM diagnosis and those with high comorbidity, substance abuse, or suicidality were discouraged from participating in the website's services and were offered referrals for professional services in their local areas. The majority of the population was female (93%). Given the clinical nature of this web service, such a gender distribution is to be expected based on previous studies (Flessner, et al., 2008; Franklin et al., 2008; Woods et al., 2006). Many of the participants were referred to the StopPulling website through the Trichotillomania Learning Center (51%) or found the service through an Internet search engine (32%). The remainder were referred by a friend (9%), learned about the service through internet chat (3%), magazine (2%), from a professional (1.5%), or through the press (1.5%). All participants agreed to make de-identified data from the website's database available in aggregate form to members of the TTM Learning Center's Scientific Advisory Board for research purposes. For detailed demographics on the population's gender, age, race, and country, see Table 1.

For the present study, a sample was created which focused on assessment phase baseline (pre-intervention) data. This ensured a common baseline of data across all participants that were not influenced by intervention. This resulted in a final sample size

ranging from 598 - 609 participants (depending upon the analysis used). This sample shared much of the same demographics as the larger population. Detailed demographics on this sample, as they compare to the larger population, are provided in Table 1.

Table 1
Population and Sample Demographics

	Group	
Demographic	Population (N=1523)	Sample (N=609)
Gender		
Female	1368 (93.5%)	546 (89.7%)
Male	95 (6.5%)	35 (5.7%)
Not Reported	60 (3.9%)	28 (4.6%)
Age		
Under 12	45 (3%)	12 (2.0%)
12-18	271 (17.8%)	104 (17.1%)
19-24	250 (16.4%)	94 (15.4)
25-30	331 (21.7%)	141 (23.2%)
31-40	364 (23.9%)	145 (23.8%)
41-50	199 (13%)	79 (13%)
51-60	59 (3.9%)	26 (4.3%)
61-70	4 (0.3%)	2 (0.3%)
Not Reported	19 (1.2%)	5 (0.8%)
Race		
African-American	34 (2.2%)	13 (2.1%)
Asian-American	47 (3.1%)	22 (3.6%)

Caucasian	1329 (87.3%)	531 (87.2%)
Hispanic	33 (2.2%)	10 (1.6%)
Other	63 (4.1%)	26 (4.3%)
Not Reported	18 (1.1%)	5 (.8%)
Country		
Australia	25 (1.6%)	13 (2.1%)
Canada	61 (4%)	24 (3.9%)
Ireland	6 (0.4%)	3 (0.5%)
Israel	10 (0.7%)	7 (1.2%)
Italy	5 (0.3%)	3 (0.5%)
New Zealand	4 (0.3%)	2 (0.3%)
South Africa	3 (0.2%)	1 (0.2%)
Switzerland	6 (0.4%)	2 (0.3%)
United Kingdom	23 (1.5%)	10 (1.6%)
United States of America	1355 (88.9%)	529 (86.9%)
Other	25 (1.6%)	15 (2.5%)
Not Reported	0 (0%)	0 (0%)

Notes. Due to rounding, numbers do not add up to 100%. Additionally, due to limitations of the study, international participants were grouped into American racial categories.

Measures

Current Age, TTM Age of Onset, Duration of illness, Youth/Adults.

Participants were asked about their demographic variables during the initial phase of the assessment module. Participants self-reported their Current Age as well as TTM Age of Onset (age at which their TTM symptoms began). Current Age was reported as a categorical variable with the following categories: under 12, 12-18, 19-24, 25-30, 31-40, 41-50, 51-60, and 61-70. For the purposes of this study, Current Age was recoded from a categorical variable to a continuous variable based on the averages of each category (under 12 became 11, 12-18 became 15, 19-24 became 21.5, 25-30 became 27.5, 31-40 became 35.5, 41-50 became 45.5, 51-60 became 55.5, 61-70 became 65.5). In order to calculate Duration of illness, Current Age was subtracted from TTM Age of Onset. The Youth and Adult variable was created by recoding individuals aged 17 and below as Youth and individuals above 17 as Adults.

Affect Before Pulling, Affect During Pulling, Affect After Pulling.

Affect variables were created based on an aggregate of all hair pulling episodes for each participant. Participants were asked to report their affect before, during, and after each hair-pulling episode. Due to the method in which data was collected in this study, negative physical sensations were also grouped into the classification of negative states of affect. Individuals could select from negative (anxious, tired, tense, bored, indifferent, worried, frustrated, overwhelmed, sad, rushed, angry, annoyed, irritated, guilty, disappointment, afraid, itching, pressure, burning, sensitivity, tingling, discomfort), neutral (no affect), positive (relaxed, happy, excited, satisfied), or other affect. Negative affect was coded as -1, neutral affect as 0, and positive affect as 1. Other affect was

excluded from this study. Next, the aggregate averages for all episodes of hair pulling was calculated resulting in an average affect before pulling, average affect during pulling, and average affect after pulling for each participant.

Style of Pulling.

Similar to Affect variables, Style of Pulling was created based on aggregate data. First, a coding system was developed to classify behaviors preceding hair pulling episodes as indicative of automatic or focused hair pulling. Due to the method in which data was collected in this study, physical sensations were also grouped into the classification of style of pulling. The following behaviors were coded as automatic hair pulling: face touching, running hair along face or mouth, scratching an itch, stroking hair before pulling, touching or rubbing scalp, tugging at hair. The following behaviors were coded as focused hair pulling: feeling for a thick or coarse hair, looking at hair before it was pulled, searching for a certain hair, using hair pulling tools (e.g., tweezers). Each episode of automatic pulling was classified as -1 while focused pulling was classified as 1. Since participants could report up to two behaviors for each episode of hair pulling, multiple reported behaviors were averaged with each other. Next, the aggregate average for all episodes of hair pulling was calculated resulting in an average style of pulling. This led to a final Style of Pulling variable that represents the style of pulling each participant most often engages in ranging from -1 (automatic) to 1 (focused).

Urge Severity of TTM.

As with Style of Pulling and Affect variables, the Urge Severity of TTM was created based on aggregate data. Participants were asked to report the severity of the urge to pull their hair for each hair pulling episode. Severity of the urge to pull hair was rated on a Likert scale ranging from 0 (no urge) to 5 (strongest urge). Next, the aggregate averages for all episodes of hair pulling were calculated resulting in an average urge severity of TTM for each participant.

Assessing the urge to pull hair has been demonstrated to be a strong overall proxy of TTM severity (Keuthen et al., 1995; Keuthen et al., 2007). Specifically, Keuthen and colleagues (2007) found that, within a large sample (n=990), a question assessing urge severity has a loading of .81 onto the Severity factor of the Massachusetts General Hospital Hair Pulling Scale (MGH-HS). The only stronger predictor was urge frequency, which was a variable not available for the present study.

An overview of all independent variables is presented in Table 2.

Table 2.
Number of Participants, Range, Means, and Standard Deviations for all Independent and Dependent Variables and Covariates.

	N	Range	Mean	Standard Deviation
Current Age	603	11-65.50	29.70	11.39
TTM Age of Onset	599	1-50	12.23	5.50

Duration of Illness	598	0-55.50	17.38	11.42
Style of Pulling	609	-1-1	-0.18	0.52
Affect Before Pulling	609	-1-0.30	-0.70	0.28
Affect During Pulling	608	-1-0.85	-0.52	0.41
Affect After Pulling	608	-1-0.91	-0.64	0.36
Urge Severity of TTM	609	1.27-4.97	3.33	0.60

CHAPTER 3

Results

SPSS statistical software was used for all analyses.

Style of Pulling and Affect Regulation

Hypothesis 1A: A greater degree of focused pulling was hypothesized to be related to more negative affect before hair pulling while a greater degree of automatic pulling was hypothesized to be related to more neutral affect before hair pulling.

Hypothesis was not supported. As evidenced in Table 3 below, Pearson's product moment correlation revealed no significant relationship between Style of Pulling and Affect Before Hair Pulling.

Hypothesis 1B: A greater degree of focused pulling was hypothesized to be related to more positive affect during hair pulling while a greater degree of automatic pulling was hypothesized to be related to more neutral affect during hair pulling.

Hypothesis was not supported. Pearson's product moment correlation indicated no significant relationship between Style of Pulling and Affect During Hair Pulling (see Table 3).

Hypothesis 1C: A greater degree of focused pulling was hypothesized to be related to more positive affect after hair pulling while a greater degree of automatic

pulling was hypothesized to be related to more neutral affect after hair pulling. Hypothesis was supported. Pearson's product moment correlation revealed a significant relationship between Style of Pulling and Affect After Hair Pulling [r(606) = .09, p = .01].

Table 3
Correlations Between Style of Pulling and Affect Before Hair Pulling

	Affect Before Hair Pulling (N=609)	Affect During Hair Pulling (N=608)	Affect After Hair Pulling (N=608)
Style of Pulling	-.03	.03	.09**

Note. ** Denotes significant result with p = .01.

Age and Urge Severity

Hypothesis 2: Current age was hypothesized to be positively correlated with the urge severity of TTM.

Results support this hypothesis. Pearson's product moment correlation found a significant positive relationship between age and urge severity of TTM [r(601) = .10, p = .02]. Though not a part of the original hypotheses, significant correlations were also noted among age of onset and urge severity [r(597) = -.10, p = .02] and duration of illness and urge severity [r(596) = .15, p < .01].

Table 4
Correlations Between Current Age, Age of Onset, Duration of Illness, and Urge Severity

	Current Age (N=603)	Age of Onset (N=599)	Duration of Illness (N=598)
Urge Severity	.10*	-.10*	.15**

Note. * Denotes significant result with $p < .05$; ** denotes significant result with $p < .01$.

Style of Pulling and Age

Hypothesis 3: A greater degree of focused pulling was hypothesized to be predictive of an older age.

Hypothesis was not supported. Pearson's product moment correlation showed no significant relationship between style of pulling and age. Though not predicted, style of pulling was significantly correlated with age of onset [$r(596) = -.11$, $p = .01$]. Style of pulling was not significantly correlated with duration of illness.

Table 5
Correlations Between Current Age, Age of Onset, Duration of Illness, and Style of Pulling

	Current Age (N=602)	Age of Onset (N=598)	Duration of Illness (N=597)
Style of Pulling	-.06	-.11**	.00

Note. ** Denotes significant result with $p = .01$.

Age and Affect

Hypothesis 4A: Youth (17 and younger) were hypothesized to report less negative affect before pulling than adults (18 and older).

Hypothesis was supported. T-Tests revealed a significant difference between youth and adults in their reporting of affect before pulling. There was a significant effect for age, $t(601) = 2.41$, $p = .02$, with youth (aged 17 and younger) reporting less negative affect before pulling than adults (age 18 and older).

Hypothesis 4B: Youth (17 and younger) were hypothesized to report less negative affect during pulling than adults (18 and older).

Hypothesis was not supported. T-Test indicated no significant difference between youth and adults in their reporting of affect during pulling (see Table 6).

Hypothesis 4C: Youth (17 and younger) were hypothesized to report less positive affect after pulling than adults (18 and older).

Hypothesis was not supported. T-Test demonstrated no significant difference between youth and adults in their reporting of affect after pulling (see Table 6).

Table 6
T-Tests Comparing Affect Before, During, and After Hair Pulling for Youth and Adults

	Means		Standard deviation			
Variable	Youth	Adults	Youth	Adults	*t*	*df*
Affect Before Hair Pulling	-.64	-.71	.32	.27	2.41*	601

Affect During Hair Pulling	-.46	-.53	.45	.40	1.69	600
Affect After Hair Pulling	-.62	-.64	.37	.35	.54	600

Note. * Denotes significant result with $p < .05$.

Age and Urge Severity

Hypothesis 5: Among developmental variables, the urge severity of TTM was hypothesized to be best predicted by current age relative to age of onset and duration of illness of TTM symptoms.

Due to multicollinearity between current age and duration of illness, only age of onset and illness duration were entered into the regression model. The resulting multiple regression model yielded a regression model that accounted for nearly 2.7% of the variance (R^2 = .03) which was significant, $F(2, 595) = 8.390$, p=.000 (see Table 7). It was found that duration of illness significantly predicted urge severity (β = .136, p = .001).

Table 7
Summary of Multiple Regression Analysis for Variables Predicting Urge Severity (N= 598)

	B	*SE B*	β
Age of Onset	-.01	.01	-.07
Duration of Illness	.01	.00	.136***

Note: *** Denotes significant result with p = .001.

Complete Prediction Model

Hypothesis 6: Among all variables, urge severity of TTM was hypothesized to be best predicted by current age relative to age of onset, duration of illness, style of pulling, affect before, affect during, and affect after hair pulling.

As noted above, current age was not included in the regression analysis. Multiple regression analysis with the remaining variables revealed a significant regression model. As evidenced in Table 8, duration of illness, affect before pulling (-1=negative affect, 1=positive affect), and style of pulling (-1=automatic pulling, 1=focused pulling) were significant predictors of urge severity. These predictors yielded a regression model that accounted for 5% of the variance (R^2 = .05) which was significant, $F(6, 591) = 5.519$, p=.000. It was found that duration of illness significantly predicted urge severity (β = .128, p = .002), as did affect before pulling (β = -.089, p = .044) and style of pulling (β = .081, p = .045).

Table 8
Summary of Multiple Regression Analysis for Variables Predicting Urge Severity (N=597)

	B	*SE B*	β
Age of Onset	-.01	.01	-.05
Duration of Illness	.01	.00	.13**
Style of Pulling	.1	.05	.08*
Affect Before Hair Pulling	-.19	.09	-.09*

Affect During Hair Pulling	-.03	.06	-.02
Affect After Hair Pulling	-.12	.07	-.07

Note: * Denotes significant result with $p < .05$; ** denotes significant result with $p < .01$.

Post-hoc Analyses

To determine relationships between developmental and affective variables, post-hoc analyses were completed (see Table 9). Pearson's product moment correlation showed a significant relationship between current age and affect during hair pulling [$r(600) = -.09$, $p = .04$] as well as duration of illness and affect during hair pulling [$r(596) = -.10$, $p = .02$].

Table 9
Correlations Between Developmental and Affective Variables

	Current Age (N=602)	Age of Onset (N=599)	Duration of Illness (N=598)
Affect Before Hair Pulling	-.04	.06	-.06
Affect During Hair Pulling	-.09*	.02	-.10*
Affect After Hair Pulling	-.02	.03	0.03

Note. * Denotes significant result with $p < .05$.

An additional post-hoc analysis determined the relationship between style of pulling and urge severity. Pearson's product moment correlation showed a significant relationship between style of pulling and urge severity [$r(607) = .09$, $p = .02$]

CHAPTER 4

Discussion

The goal of this study was to understand the developmental course of TTM, focusing on how the clinical presentation of TTM varies as a function of age of onset, current age, and duration of illness. This study also aimed to evaluate an affect regulation model of TTM, focusing on affect before, during, and after hair pulling. Finally, the present study aimed to examine the influence of style of pulling on developmental variables and affect regulation.

Duration of Illness

The findings suggest that the cumulative experience of having TTM over time amplifies the urge severity of the disorder. Specifically, multiple regression analysis revealed that the best predictor of urge severity in this study was duration of illness (how long someone has experienced TTM). This is consistent with prior research suggesting that the duration of illness could be a significant variable in understanding the impact of TTM (Flessner et al., 2008). Duration of illness could be an important feature in urge severity for several reasons. First, studies have implicated hair pulling as a mechanism for affect regulation (Keuthen et al., 2011; Meunier et al., 2009; Shusterman et al., 2009). Over time, individuals may not learn other more adaptive forms of affect regulation strategies, thus limiting their ability to respond to negative emotional states. Such a process has been noted among individuals diagnosed with borderline personality

disorders and substance abuse (Thorberg & Lyvers, 2006; Yen, Zlotnick, & Costello, 2002). Second, TTM often results in several physical, psychological, and social impairments (Christenson & Mansueto, 1999; Diefenbach et al., 2005; Franklin et al., 2008; Lewin et al., 2009; Woods et al., 2006). Those with TTM often experience damage to their hair, possess low self-esteem, feel unattractive, and avoid social activities. The impairment experienced as a result of TTM may increase the longer one experiences the illness. Finally, as the duration of illness increases, individuals may be at a greater risk for losing protective factors. Such examples could include loss of relationships and social support due to stress, shame, or conflict resulting from TTM symptoms. Future research on the relationship between duration of illness and TTM urge severity need to carefully examine these potential mechanisms.

Affect Regulation

Another significant predictor of urge severity (after duration of illness) in the complete regression model was affect *before* pulling. Specifically, those who experienced negative affect *before* pulling were more likely to experience greater urge severity of TTM. This provides support for an affect regulation model of TTM. Recall that among affect regulation models, negative affect is theorized to precede the urge to pull hair, leading some to use hair pulling as a way of regulating their affect (Duke et al., 2009). This process is maintained through classical and operant conditioning (Mansueto et al, 1997). In this study, individuals whose hair pulling was preceded with negative affect reported greater urge severity. This suggests that hair pulling could be negatively

reinforced in individuals who use pulling to cope with negative affect. Additionally, greater negative affect *before* pulling may suggest a comorbid disorder (e.g., depression) or a higher baseline of affect. Greater negative affect could also lead individuals to pull more hair. While previous research has noted a relationship between negative affect *before* pulling and focused style of pulling (which is by itself related to greater urge severity) (Christenson et al., 1991), in this sample affect *before* pulling and style of pulling were not correlated.

Related to affect, specifically with regard to developmental sequelae, adults (18 and older) expressed more negative affect *before* pulling than youth (aged 17 and under). This suggests TTM symptoms could start as an automatic process, unaccompanied by specific affective states. Later, hair pulling may develop into a form of coping for negative emotional states. This would support previous theories of TTM, which utilize classical and operant conditioning to explain the development, maintenance, and expansion of hair pulling behavior (Mansueto et al., 1997; Stein et al., 2006). This finding could also be related to increased comorbidity and impairment that is often associated with older TTM cohorts.

Continuing the discussion on the affect regulation model, affect *during* pulling was negatively correlated with duration of illness and current age such that, as individuals increase in duration of illness and age, they are less likely to report positive affect during hair pulling. This supports exploratory findings from Meunier and colleagues (2009) suggesting a habituation to affective states associated with hair pulling. Other factors,

such as increased severity, comorbidities, and impairments could also explain this finding.

The final variable in the affect regulation model, affect *after* pulling, was significantly correlated with style of pulling. Specifically, a greater degree of positive affect *after* pulling was related to a greater degree of focused style of pulling while more negative affect was related to an automatic style of pulling. This finding supports trends documented in the area of style of pulling, though it uniquely links specific affective states with focused and automatic styles of pulling and highlights the reinforcing nature of focused pulling (Christenson et al., 1991; Duke et al., 2009; Flessner et al., 2008; Flessner et al., 2008; Flessner et al., 2009). These findings support the notion that focused pulling may be used to intentionally regulate emotions while automatic pulling occurs with minimal awareness often resulting in negative affect after pulling. Findings from this study also provide a link to biological research on TTM. Specifically, focused pulling is rewarding and may be particularly related to the cortex-striatum circuit (Bienvenu et al., 2009). Additionally, this finding also underlines the difficultly in treating focused pulling, due to its reinforcing nature, and why it could be more resistant to treatment.

Summarizing the affective findings, the present study found support for the following: 1) negative affect *before* pulling was predictive of urge severity; 2) adults report more negative affect before pulling than youth; 3) as duration of illness and age increase individuals report less positive affect *during* hair pulling; and 4) positive affect *after* pulling was related to a focused style of pulling while negative affect *after* pulling

was related to an automatic style of pulling. Together, these findings support previously discussed affect regulations models of TTM, highlight the relationship between developmental variables and affect regulation, link affect regulation with styles of pulling, and demonstrate the prominent role of affect in influencing the presentation and course of TTM. Regarding affect regulation models of TTM, the results indicate associations between negative affect and hair pulling, increasing negative affect *before* hair pulling as individuals age, habituation to positive affect *during* hair pulling as TTM increases in duration and as individuals age, and associations between positive affect *after* hair pulling and a focused style of pulling (a more severe form of hair pulling) as well as negative affect *after* hair pulling and an automatic style of pulling.

Style of Pulling

Regarding the multiple regression predictive model, style of pulling was the third and final predictive variable of urge severity (after duration of illness and affect *before* pulling). Findings indicate a greater degree of focused pulling was predictive of more urge severity. This is consistent with previous research that has linked a focused style of pulling with a more severe form of TTM, intentional hair pulling, a greater urge to pull hair, stronger negative affect preceding hair pulling, and more elaborate forms of hair pulling (Duke, Keeley, Geffken, & Storch, 2010; Flessner, Woods, Franklin, Keuthen, & Piacentini, 2008; Flessner et al., 2009; Lochner, Seedat, & Stein, 2010; Woods et al., 2006).

Style of pulling was also negatively correlated with age of onset. Specifically, an earlier onset of TTM was associated with a greater degree of focused pulling while later onset was associated with a greater degree of automatic pulling. Given this finding, as well style of pulling's relationship with urge severity, individuals with an earlier age of onset may be at risk for a more severe course of the disorder. This conflicts with earlier research that linked a later onset of TTM with a more severe course of the disorder (Swedo et al., 1992; Winchel, 1992; Keuthen et al., 2001; Lewin et al., 2009). Differences between findings discussed here and in previous studies may be due to sample sizes (previous samples varied from n=10-44, present study's samples ranged from n=597-609). However, several studies have linked a focused style of pulling with a poorer course of the disorder (Duke, Keeley, Geffken, & Storch, 2010; Flessner, Woods, Franklin, Keuthen, & Piacentini, 2008; Flessner et al., 2009; Lochner, Seedat, & Stein, 2010; Woods et al., 2006). Though the relationship between an earlier onset of TTM and focused pulling has not been documented explicitly in the past, focused pulling has been identified as increasing in frequency during puberty (Flessner et al., 2009). Unfortunately, due to the limited longitudinal research in the literature, it is unclear what differentiates earlier onset TTM from a later onset of the disorder. Yet, this study highlights the importance of understanding the developmental context of individuals suffering from TTM. It would be advisable for researchers and clinicians working with TTM to conduct thorough assessments of the developmental course of the disorder to fully understand the impact of TTM on each individual and customize treatments for specific developmental cohorts.

Implications

Additionally, the important role of affect in influencing TTM symptoms is clear. Further research into TTM should continue to assess affect before, during, and after hair pulling differentially rather than measuring affect globally, particularly since this study revealed different results for each stage of affect. Clinicians treating TTM may need to incorporate affective components into their treatment while researchers developing empirically supported treatments should examine whether inclusion of affect regulation strategies improve efficacy. Recent treatment consensus reports from TTM experts have yet to highlight the prominent role of affect regulation in the maintenance of hair pulling behavior outside of focused pulling (Flessner, Penzel, & Keuthen, 2010; Franklin, Zagrabbe, & Benavides, 2011). Findings from this study imply that treatments of TTM could be overly limited to motor behaviors alone (e.g., awareness training, self-monitoring, competing response training, habit reversal training, and stimulus control). The finding that negative affect before hair pulling is related to urge severity, across styles of pulling, highlights this. Effective treatment of TTM may need to both incorporate motor *and* affective components regardless of style of pulling, as first described by Mansueto, Stemberger, and Golomb (1997) and recently supported by clinical trials of Acceptance and Commitment Therapy for TTM (Woods, Wetterneck, & Flessner, 2006) and Dialectical Behavior Therapy for TTM (Keuthen et al., 2010, 2011). Finally, style of pulling should also be assessed along with affect, given its relationship in influencing the presentation of the disorder. This is particularly true of focused pulling, which was identified in this study, as in past research, to be rewarding.

These findings also speak to the heterogeneity of the disorder. Individuals in this study experienced a wide variety of affect, differed in their degree of style of pulling, and presented differently depending upon their age and the duration of their illness. Professionals working with TTM will benefit from remembering that few TTM patients are alike. Rather, while each individual with TTM shares a common constellation of symptoms, the way in which symptoms manifest will vary depending upon age and duration of the illness, the specific conditioning of affect and hair pulling, and styles of pulling.

Strengths and Weaknesses of Present Study

The present study was unique in several ways. First, data was collected on multiple episodes of hair pulling. As a result, data on affect, style of pulling, and urge severity was calculated based on aggregate totals rather than single episodes of hair pulling. Given the heterogeneity of the disorder, this aggregate approach resulted in a more comprehensive and realistic overview of each participant. Additionally, this study incorporated a functional analysis approach to measuring affect. Rather than simply measuring affect globally, affect was differentially measured before, during, and after hair pulling. Since results varied for each affective variable, future studies would benefit from continuing this approach.

There are several limitations to the findings presented here. First, all findings are based on participants' self-report. This sample was also a self-referred population. Most of the total population for the StopPulling.com website was referred to by the

Trichotillomania Learning Center (50.62%) or found the website through a search engine (31.99%). As a result, actual diagnosis, comorbidities, and the breath of potential impairments are unknown. For the purposes of this study, individuals who did not complete the assessment phase of the website were excluded. There is a possibility that individuals who did not complete assessment had a more severe form of the disorder, thus resulting in a biased sample. Also, the website charges a $29.95 monthly fee for its services, thus limiting participation from those who were financially struggling. Moreover, the use of this service requires a computer with an Internet connection, thus additionally limiting specific socio-economic, cultural, and ethnic groups from accessing StopPulling.com. Further, all data was reported in retrospect rather than in vivo during actual episodes of hair pulling. Finally, this study incorporated cross-sectional analyses and made comparisons across developmental cohorts. Thus, implications are limited to cohort differences and causal explanations cannot be made.

Given the findings and limitations of this study, there is a clear and important need to engage in longitudinal research following TTM diagnosed individuals across developmental milestones to better understand causal relationships. Efforts should be made to record hair pulling data in vivo to better evaluate affect regulation models. Ecological momentary assessment may prove to an effective way of collecting aggregate data during in vivo settings (Shiffman, Stone, & Hufford, 2008).

In conclusion, the present study identified three key predictors of TTM symptom urge severity: 1) duration of illness; 2) affect *before* pulling; and 3) style of pulling.

Additionally, several important relationships between developmental variables, affect regulation, and style of pulling were found. This study was the first to base its findings on multiple episodes of hair pulling in aggregate form. Taken together, these results speak to the common constellation of symptoms in TTM as well as the heterogeneity of the disorder.

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