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Emotion regulation and other psychological models for body-focused repetitive behaviors

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HIGHLIGHTS

- The ER model for BFRBs proposes that body-focused habits serve an ER function.
- Comorbidity, and naturalistic, experimental, and treatment studies are reviewed.
- The ER model represents a viable framework for conceptualizing and treating BFRBs.

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ABSTRACT

The term body-focused repetitive behaviors (BFRBs) refers to a group of recurrent, problematic, destructive behaviors directed toward the body, including hair-pulling, skin-picking, and nail-biting. Individuals with BFRBs report diminished control over the behavior and a range of physical and psychological sequelae. Recent research on psychological models for BRFBs has investigated the role of emotion regulation (ER), and many authors in this area have conceptualized problematic body-focused behavior as a maladaptive ER mechanism. This article organizes and reviews the empirical research on the ER model for BRFBs. First, the three most common BFRBs are described, as are the conceptualization, phenomenological similarities and covariation, and psychological and physical impact of BFRBs. Next, psychodynamic models and several cognitive-behavioral (CB) models are described. The article focuses on the ER model, including a review of studies of comorbidity in BFRBs, naturalistic and experimental studies, studies of subtypes of BFRBs, and treatment trials. The implications of the findings are discussed and the authors make recommendations for future research. The article concludes with a discussion of the limitations of psychological models for BFRBs and the limitations of the review.

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1. Introduction

The term body-focused repetitive behaviors (BFRBs) refers to a group of problematic, destructive, and apparently non-functional behaviors directed toward the body, including hair-pulling (trichotillomania; TTM), skin-picking, and nail-biting (Hansen, Tishelman, Hawkins, & Doepke, 1990; O'Connor, Lavoie, Robert, Stip, & Borgeat, 2005; Snorrason, Belleau, & Woods, 2012). BFRBs are recurrent, undesired, and often designed to remove part of the body (e.g., a hair, scab, or nail; Snorrason et al., 2012). Although many individuals engage in harmless "nervous habits" that do not cause them distress, individuals with BFRBs report diminished control over the behavior (Schreiber, Odlaug, & Grant, 2011) and a range of physical and psychological sequelae (Diefenbach, Tolin, Hannan, Crocetto, & Worhunsky, 2005).

Research into BFRBs has been limited in comparison to research into other psychiatric conditions. Between 1975 and 2000, *PsychLit* database contained 32,471 articles about schizophrenia and 2489 about bipolar disorder, in comparison to 309 about TTM and fourteen about other BFRBs or about stereotypic movement disorders (Woods & Miltenberger, 2001). However, the past two decades have witnessed a significant increase in research on BFRBs; in particular, there has been increased interest in exploring psychological models for these problems. To date, hair-pulling and skin-picking are the BFRBs that have received the most research attention.

The objective of this article is to provide an up-to-date synthesis of the research on psychological models for BFRBs in developmentally normal adults. The current explosion of interest in acceptance-based treatments for psychological disorders has prompted clinicians and researchers to look more closely at the role of emotion expression, avoidance, and regulation in maladaptive behaviors. Researchers who study BFRBs have pursued this area, and a number of authors have conceptualized problematic body-focused behavior as a maladaptive emotion regulation (ER) mechanism (e.g., Diefenbach, Tolin, Meunier, & Worhunsky, 2008; Shusterman, Feld, Baer, & Keuthen, 2009; Snorrason, Smári, & Ólafsson, 2010; Woods, Wetterneck, & Flessner, 2006), generating a body of work that has yet to be summarized and concisely presented. The present review constitutes the first effort to compile and review the empirical research on the ER model for BFRBs. First, the three most common BFRBs are described, as are subtypes, similarities and covariation between BFRBs, and the psychological and physical impact of BFRBs. Next, to introduce psychological models for these disorders, the psychodynamic model and several cognitive-behavioral (CB) models are described. The article focuses on the ER model, with an in-depth review of studies of BFRBs and comorbid psychological symptoms and disorders, naturalistic studies, experimental studies, studies of particularly relevant emotions, studies of BFRB subtypes, and treatment trials. The implications of findings based on the ER model and recommendations for future research are made. Finally, the article discusses the limitations of psychological models for BFRBs, as well as the limitations of this review.

Databases PsychInfo and MedLine were searched for articles about BFRBs published between 1980 and 2012, using the following search keywords: *emotion regulation* or *affect regulation* or *affective regulation* or *emotion* or *affect* and *trichotillomania* or *TTM* or *hair-pulling* or *skin-picking* or *neurotic excoriation* or *nail-biting* or *onychophagy* or *body-focused repetitive behavior* or *BFRB*. The search was limited to articles about hair-pulling, skin-picking, and nail-biting because they have received the most research attention and are therefore better defined and documented than are other body-focused behaviors. This search was conducted several times over the course of 1.5 years and over one hundred studies were retrieved. All abstracts were reviewed, and articles deemed to be relevant to the scope and objective of the paper were retained, including articles that provided background or statistical information about BFRBs. The references of retained articles were reviewed for further relevant articles. Dissertations and non-English-language papers were not retained; papers that did not focus on BFRBs as a primary or comorbid diagnosis were also excluded.

2. Body-focused repetitive behaviors

2.1. Trichotillomania

TTM is characterized by chronic hair-pulling (HP), often leading to alopecia (i.e., hair loss or baldness). Hair may be pulled out from any area of the body, including the scalp, eyebrows, arms, legs, and pubic

area (American Psychiatric Association [APA], 2000). TTM is the only BFRB listed in the current edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR). The DSM diagnostic criteria for TTM are the following: recurrent pulling out of one's own hair, resulting in noticeable hair loss; feeling of tension immediately prior to pulling out or attempting to pull out hair; sense of pleasure, gratification, or relief when pulling out hair; HP is not better explained by another diagnosis; and HP causes significant distress or dysfunction (APA, 2000). TTM can involve a variety of behaviors not included in the DSM criteria for this disorder; common behaviors include playing with the hair, stroking the hair against the face or mouth, pulling or biting off the bulb at the end of the hair, and swallowing the hair (trichophagia) (Christenson, Pyle, & Mitchell, 1991).

Not every individual who reports HP endorses the criterion of tension prior to pulling and it is not clear whether this criterion refers to tension generated by external factors or to tension generated by efforts to resist the urge to pull. In 1991, Christenson, Pyle, and Mitchell explored the prevalence of TTM in 2579 college students. The authors reported that 0.6% of participants ($n = 15$) met the DSM diagnostic criteria for current or lifetime TTM; however, when the criteria of tension prior to pulling and gratification or relief from tension after pulling were removed, 1.5% of males ($n = 17$) and 3.4% of females ($n = 47$) met the diagnostic criteria. A 1994 survey of 288 college students (Stanley, Borden, Bell, & Wagner, 1994) found that 15.3% reported HP; a more recent study of 830 adults also reported that 0.6% of the sample met the full criteria for TTM, although 6.51% of the sample acknowledged HP unrelated to grooming (Duke, Bodzin, Tavares, Geffken, & Storch, 2009). Discrepancies in the data on TTM prevalence can be attributed to small sample sizes and to differences in diagnostic criteria between studies. It seems prudent to conclude that the prevalence rate of TTM as described by the DSM criteria is approximately 0.6%, but that a considerably greater proportion of the population reports subclinical HP. To reflect a more inclusive definition of TTM, an American Psychiatric Association (APA) work group for DSM-5 recommended the removal of the criteria of arousal or tension prior to pulling and relief or gratification following pulling (Stein et al., 2010).

Many studies have reported a higher incidence of TTM in females, but this finding may reflect a treatment-seeking bias or the social acceptability of hair loss in men (Christenson & Mansueto, 1999). TTM often develops in early adolescence (Christenson, Mackenzie, & Mitchell, 1991; Cohen et al., 1995). Some research has supported a bimodal distribution of onset, with a peak at the beginning of puberty and an earlier peak between ages two and six years; however, HP in young children tends to remit spontaneously, whereas adolescent HP tends to persist if left untreated (Wilhelm & Margraf, 1993). TTM is considered to be a chronic disorder that fluctuates over time (Flessner, Woods, Franklin, Keuthen, & Piacentini, 2009) and varies from individual to individual (Keuthen, O'Sullivan, & Sprich-Buckminster, 1998).

2.2. Skin-picking

Pathological skin-picking (SP) refers to repetitive picking of skin or scabs, causing tissue damage and distress or impairment, in the absence of a dermatological condition (Grant & Odlaug, 2009; Keuthen, Koran, Aboujaoude, Large, & Serpe, 2010; Stein et al., 2010). Common sites for picking include easily accessible areas such as the face, upper body, cuticles, and extremities (Arnold, Auchenbach, & McElroy, 2001; Calikuşu, Yücel, Polat, & Baykal, 2003). SP may begin as a grooming routine in which small blemishes or skin irregularities are removed; however, in severe cases, individuals create visible damage by using tweezers, pins, or other small instruments to dig into their skin (Keuthen et al., 2000; Penzel, 1995; Wilhelm et al., 1999). SP can be time-consuming, with studies reporting that individuals spend from one hour (Neziroglu, Rabinowitz, Breytman, & Jacofsky, 2008) to nearly three hours (Flessner & Woods, 2006) to over eight hours per day (Arnold et al., 1998) picking skin.

SP is not included as an official diagnosis in DSM-IV. Various diagnostic criteria have been proposed, all of which include recurrent or repetitive SP that causes tissue damage or skin lesions, and creates significant distress or impairment (e.g., Arnold et al., 2001; Stein et al., 2010). It was recently confirmed that SP will be included as an independent diagnosis in DSM-5, listed as Excoriation Disorder (Skin-Picking Disorder) in the category of Obsessive–Compulsive Spectrum Disorders (APA, 2013).

SP prevalence rates of 1.4% to 5.4% have been reported in various populations, including community samples, college students, dermatology clinic patients, and a large US population sample (Bohne, Wilhelm, Keuthen, Baer, & Jenike, 2002; Hayes, Storch, & Berlanga, 2009; Keuthen, Koran, et al., 2010; Keuthen et al., 2000). However, reports of the prevalence of SP must be interpreted with caution due to the absence of established diagnostic criteria. SP appears to have a trimodal age of onset, with SP appearing before age 10, during adolescence or early adulthood (15–21 years), or between ages 30 and 45 years; onset in childhood and adolescence appears to be most common (Odlaug & Grant, 2012). SP appears to be more common among females (Teng, Woods, Twohig, & Marcks, 2002), although this finding may reflect a treatment-seeking bias.

2.3. Nail-biting

Nail-biting (NB) refers to an insertion of the fingers into the mouth, with contact between the nails and teeth. Many individuals occasionally use the teeth to replace nail clippers in grooming, however, severe or clinical NB involves biting past the nail bed and cuticles, drawing blood and resulting in chronic scarring, or in red, sore, and infected fingers (Penzel, 1995; Wells, Haines, & Williams, 1998). NB is widely accepted as a simple habit when it does not have negative or distressing consequences, but falls into the category of BFRBs when it leads to social problems or to significant tissue or nail damage (Snyder & Friman, 2012).

The data about the prevalence of NB are inconsistent. Snyder and Friman (2012) reviewed the literature on NB and concluded that the prevalence increases in four- to six-year-olds and peaks during puberty, with a reported prevalence rate varying between 25% and 60%. Between late adolescence and age 35 years, prevalence rates range from 10% to 30%, falling below 10% after age 35. However, much of the literature on this topic is out of date; operational definitions of NB are not clear and the studies may have included NB that did not cause distress or injury. In a survey of 286 college students about "repeated actions that appear to serve no useful purpose but that you continue to engage in anyway" (p. 69), Hansen, Tishelman, Hawkins, and Doepke (1990) reported that NB was the second most common behavior; 63.6% of students endorsed this behavior, and 14.8% rated it as severe.

2.4. Conceptualization

BFRBs have been variably conceptualized as obsessive–compulsive spectrum disorders (e.g., Bienvenu et al., 2000) and impulse control disorders (APA, 2000). The designation of obsessive–compulsive spectrum disorders is not implausible. Repetitive motor symptoms in BFRBs share features with the repetitive compulsive rituals observed in individuals with obsessive–compulsive disorder (OCD); further, like individuals with OCD, individuals who suffer from HP, SP, or NB perceive the behavior as difficult to resist, despite aversive consequences (Bohne, Keuthen, & Wilhelm, 2005). However, differences between BFRBs and OCD have been reported in terms of phenomenological experiences and situational triggers for the behavior. For example, obsessive thoughts are a prominent feature of OCD, but are less commonly associated with TTM (Keuthen et al., 1998). Individuals with BFRBs report that episodes of body-focused behavior are likely to occur during sedentary activity (O'Connor, Gareau, & Blowers, 1993; O'Connor, Brisebois, Brault, Robillard, & Loiselle, 2003) or in the presence of specific emotions (e.g., Duke, Keeley, Ricketts, Geffken, & Storch, 2010). In contrast,

individuals with OCD report that their repetitive or ritualistic behavior is often precipitated by 'danger cues' such as dirt or germs (Keuthen et al., 1998); the cues may or may not be accompanied by negative emotion. BFRBs are conceptualized as impulse control disorders because individuals with these problems report diminished control over the behavior and an urge or craving prior to engaging in the behavior. Some individuals also report pleasure during BFRB (Schreiber et al., 2011).

2.5. Phenomenological similarities and covariation

There is considerable overlap in phenomenology between HP, SP, and NB. All three behaviors can be triggered by tactile or visual cues (e.g., a kinky hair, a scab, or a hangnail) and certain postures (e.g., leaning on a table with head or face in hand). All three behaviors are performed primarily when individuals are alone or are not engaged interpersonally, and when the hands are idle (Christenson, Mackenzie, et al., 1991; Wilhelm & Margraf, 1993; Wilhelm et al., 1999). Episodes of BFRB may occur daily or fluctuate over the course of weeks and months, with periods of limited BFRB, followed by relapse. Individuals may perform the behavior unconsciously or may follow a ritual of tactile stimulation wherein picked or pulled pieces of hair, skin, and nail are manipulated (e.g., rolled between the fingers, stroked across the lips) or swallowed (Arnold et al., 1998; Snorrason et al., 2012; Wilhelm & Margraf, 1993). Individuals with HP often seek certain types of hairs to pull, and those with SP often focus on certain types of skin imperfections. In both groups, the sight or feel of the preferred type of hair or imperfection triggers BFRB episodes (Arnold et al., 1998; Odlaug & Grant, 2008b).

There is frequent covariation between BFRBs (i.e., multiple BFRBs reported by the same individual). Individuals with TTM have been demonstrated to have an elevated incidence of SP and other BFRBs (Christenson & Mansueto, 1999; Simeon et al., 1997), and individuals with SP have an elevated incidence of TTM, among other disorders (Arnold et al., 1998; Odlaug & Grant, 2008b). Stein et al. (2008) investigated body-focused behaviors in individuals who endorsed clinical or non-clinical HP. Seventy percent of their sample reported a second body-focused behavior; the most common were SP (51%) and NB (30%). Participants also reported lip-biting or cheek-biting (26%), nose-picking (12%), and other behaviors involving the mouth, eyes, skin, and skeleton (e.g., knuckle-cracking, head-banging). In 34 individuals reporting chronic SP, Arnold et al. (1998) found that three subjects also reported HP and two subjects reported problem NB. Odlaug and Grant (2008a) found that 25% of skin-pickers and 21.2% of hair-pullers reported problem NB; in a separate sample, 38.3% of adults with pathological SP also reported a lifetime diagnosis of TTM (Odlaug & Grant, 2008b). Du Toit and colleagues (du Toit, van Kradenburg, Niehaus, & Stein, 2001) reported that 63.8% of their sample of clinical and non-clinical hair-pullers reported other self-injurious behaviors such as SP, NB, and lip-biting. Most recently, Snorrason et al. (2012) investigated rates of various BFRBs in a large online sample of individuals reporting SP, in comparison with a sample of college students who did not report SP. The authors found that the prevalence rate of each BFRB measured (HP, NB; nose-picking, cheek-biting) was higher in the SP group than in the comparison group; 29.7% of the SP group reported symptoms consistent with a DSM diagnosis of TTM, and 83.4% of the SP sample reported a lifetime history of at least one additional BFRB.

Some of the studies described in this section suffered from methodological considerations such as failure to include a control group or failure to carefully define HP or SP. However, Snorrason et al. (2012) carefully evaluated studies that reported the prevalence of SP in HP samples, as well as studies that reported the prevalence of HP in SP samples, and tentatively concluded that the rate of covariation is greater than what could be expected by chance.

The topographical similarities and frequent covariation across BFRBs supports the conceptualization of BFRBs as a group of related problematic body-focused behaviors that share phenomenology, and highlights the relevance of research into etiological models that apply to BFRBs as a cohesive group.

2.6. Impact

The disparity in the quantity of research about BFRBs and research about other psychiatric disorders may reflect the perception that BFRBs are less severe than are other conditions, a perception that may account for delays and deficits in research and treatment (Duke, Keeley, Geffken, & Storch, 2010). However, BFRBs are prevalent and their physical and psychological consequences can be serious (Diefenbach, Mouton-Odum, & Stanley, 2002; Diefenbach et al., 2005; Woods, 2002; Woods, Friman, & Teng, 2001). Physically, chronic HP can result in hair loss, follicle damage, scalp irritation, changes in the structure and appearance of regrown hair, enamel erosion and gingivitis (from hair mouthing; Christenson & Mansueto, 1999), and repetitive strain injuries such as carpal tunnel syndrome (O'Sullivan, Keuthen, Jenike, & Gumley, 1996). Chronic SP can create scarring, sores, and infections (Woods et al., 2001). In an online study of SP impact, nearly 75% of participants reported that SP had resulted in "moderate" skin damage (Tucker, Woods, Flessner, Franklin, & Franklin, 2011). In addition to damaging the nails, NB can damage fingers (Salmon-Ehr, Mohn, & Bernard, 1999), gums (Krejci, 2000), and teeth (Johansson, Fareed, & Omar, 1991).

Although the physical sequelae of BFRBs are significant, the social and psychological consequences are also of concern. Individuals with TTM often feel unattractive and ashamed of their hair, and may go to significant lengths to camouflage cosmetic damage with hairstyles, make-up, and headscarves or wigs. They may avoid swimming, visiting the hairdresser, sexual intimacy, and exposure to windy weather and well-lit areas (Townsley-Stemberger, Thomas, Mansueto, & Carter, 2000). A 2006 internet survey of 1697 individuals with self-reported symptoms consistent with TTM found that HP interfered mildly to moderately with work and academic functioning, household tasks, and interpersonal relationships (Woods, Flessner, et al., 2006; Woods, Wetterneck, & Flessner, 2006). In addition to guilt, shame, and embarrassment about appearance (Bohne et al., 2002), individuals who pick skin report significant social and occupational difficulties as a function of SP (Arnold et al., 2001; Swedo & Rappoport, 1991). In a 2011 online survey of 760 individuals reporting pathological SP, 62.5% reported avoiding social events and 57.7% reported some avoidance of going out in public (Tucker et al., 2011). For their part, individuals who bite their nails may have red, infected, and scarred fingertips (Penzel, 1995), and may be self-conscious and reluctant to show their hands (Williams, Rose, & Chisholm, 2006). Finally, individuals with BFRBs may avoid seeing doctors or dentists out of shame or fear of discovery, resulting in an exacerbation of medical problems associated with BFRBs (Bohne, Keuthen, et al., 2005). Given these findings, it is intuitive that individuals with BFRBs report elevated rates of affective distress and symptoms of psychological disorders (e.g., Arnold et al., 1998; Calikuşu et al., 2003; Duke et al., 2009; Hajcak, Franklin, Simons, & Keuthen, 2006; Teng, Woods, Marcks, & Twohig, 2004).

3. Etiology and psychological models

To observers, BFRBs are difficult to rationalize: HP, SP, and NB appear to be painful; they produce physical consequences that result in shame and distress; and they seem to be a distraction and a waste of time. However, although BFRBs and their sequelae create considerable distress (Bohne et al., 2002; Diefenbach et al., 2002; Diefenbach et al., 2005; Woods, 2002; Woods et al., 2001), they also seem to satisfy an urge and deliver pleasure or gratification (APA, 2000; Penzel, 1995), and do not necessarily cause physical pain. Psychological models for BFRBs have sought to include each of these elements in the explanation of the development and maintenance of the behavior.

Psychodynamic and cognitive-behavioral (CB) models are presented here, followed by an in-depth discussion of one CB model: the ER model. Although much of the literature focuses on HP and SP, the discussion here applies to all BFRBs.

3.1. Psychodynamic model

Etiological models based on the psychoanalytic perspective conceptualize TTM and other BFRBs as a symbolic representation of unresolved unconscious conflicts (e.g., Greenberg & Sarner, 1965; Tattersall, 1992), or as the result of disrupted psychosexual development (e.g., Friman, Finney, & Christophersen, 1984). Psychodynamic models based on object relations propose that BFRBs represent an effort to cope with real or threatened object loss (e.g., Krishnan, Davidson, & Guajardo, 1985). In these models, BFRB symbolizes hatred, self-castration, or the replacement of a love object (Friman et al., 1984). Some researchers (e.g., Singh & Maguire, 1989) have proposed a relationship between TTM and childhood trauma such as physical or sexual abuse, but this hypothesis has not been substantiated (e.g., Christenson, MacKenzie, & Mitchell, 1992). A 2006 study of the relationship between trauma, PTSD, and TTM found that the rate of trauma (76%) in the sample of individuals with TTM ($N = 42$) was similar to that observed in the general population, and that the rate of PTSD (19%) was similar to that observed in general psychiatric populations (Gershuny et al., 2006). A negative relationship between TTM symptoms and PTSD symptoms was observed, and the authors hypothesized that TTM may constitute a form of self-soothing, effectively reducing PTSD symptoms. Overall, there is little empirical data to support the psychodynamic model for BFRBs.

3.2. Behavioral and cognitive-behavioral models

Behavioral models for BFRBs explain how seemingly self-defeating and self-punishing behavior is maintained by learning, practice, and repetition. Cognitive-behavioral (CB) models add that maladaptive behaviors are often triggered by distorted or unhelpful thoughts; the thoughts are generated in certain situations, and subsequently trigger negative emotions and/or maladaptive behavior. Behavioral and CB models for psychopathology further assume that maladaptive behavior is maintained by positive or negative reinforcement.

The three models discussed here are the Comprehensive Behavioral (ComB) model, the Emotion Regulation (ER) model, and the Stimulus Regulation (SR) model. The ComB model is an inclusive model that proposes that the urge to engage in BFRB is triggered by internal and external cognitive, affective, and environmental cues; facilitated or inhibited by the internal or external environment; and positively and negatively reinforced via positive emotion and relief from negative emotion. The ER model similarly acknowledges that BFRBs may provide positive reinforcement via tactile stimulation. However, this model focuses on negative reinforcement of BFRB through relief from painful or unpleasant affect, and further proposes that individuals with BFRBs suffer from global deficits in ER. The SR model also proposes a key role for reinforcement, but suggests that rather than alleviating negative emotions, BFRB provides distraction and relief from overstimulation, and provides stimulation for individuals who are understimulated. In both cases, the behavior is reinforced by the reward it produces. The behavioral/CB models described here are not mutually exclusive.

3.2.1. ComB model

The ComB model (Mansueto, Stemberger, Thomas, & Golomb, 1997; Stemberger, Stein, & Mansueto, 2003) was developed by Mansueto and colleagues to explain TTM. The model does not attempt to explain why an individual initially begins to pull hair, pick skin, or bite nails; rather, it incorporates internal and external triggers for episodes of BFRB, factors that facilitate or inhibit the behavior, and positive and negative reinforcement of the behavior once it has been initiated.

Individuals with TTM, SP, and NB report that the urge to pick, pull, or bite occurs more frequently under certain conditions, and that various external or internal cues trigger the urge (Diefenbach et al., 2002; Duke, Keeley, Geffken, et al., 2010; Mansueto et al., 1997; Williams et al., 2006). External triggers for episodes of BFRB include implements (e.g., hairbrush, tweezers) and settings (e.g., the bedroom). Internal triggers may be sensory, motor, cognitive, or affective. Sensory triggers include physical sensations such as the feeling of a coarse hair between the fingers, the texture of a hard scab, or the rough edge of a hangnail. Motor triggers refer to behaviors like driving or talking on the telephone. Cognitive and meta-cognitive triggers are thoughts or beliefs that provoke the urge to pull, bite, or pick (e.g., "Why are my eyebrows so bushy?" and "I'll never be able to stop biting my nails, so why try" (Mansueto et al., 1997). Affective triggers include such states as frustration, depression, boredom, anxiety, or tension. These emotions may be generated by an external event or by cognitions such as those described above. The emotions may directly trigger an episode of BFRB; alternatively, the urge to engage in the behavior may be triggered by an external or environmental cue, and the effort to control the urge (i.e., to not pick, bite, or pull) may provoke further difficult emotions, creating a vicious cycle of emotions and BFRB.

Facilitators and inhibitors are objects, places, people, thoughts, and emotions that respectively encourage or discourage an episode of BFRB. For example, the presence of a mirror can facilitate HP and SP, whereas the presence of another person may inhibit the behavior. A thought (e.g., "No one's watching; I can pull all I want") can be a cognitive facilitator, whereas an emotion such as shame about physical appearance can inhibit an episode of BFRB.

Once an individual engages in an episode of BFRB, positive and negative reinforcement increase the likelihood of continued pulling, biting, or picking. Pleasure or relief immediately afterward provides sensory positive reinforcement, and satisfaction and the feeling of achievement gained from the removal of a certain type of hair (e.g., kinky, split, wrong color), skin (e.g., rough or scabbed), or nail (e.g., broken, rough, too long) provides affective and cognitive reinforcement. The pleasure or satisfaction that follows a pulled hair, or a picked scab or nail may also create relief from negative emotions; relief is a powerful negative reinforcer, and BFRBs may be consistently used to keep negative emotions at bay (Mansueto et al., 1997).

Episodes of BFRB are often idiosyncratic and follow an observable sequence. For example, one case study described a female TTM patient who pulled out her hair when she was waiting or felt like she was wasting time. She was able to identify frustration and impatience as the dominant emotions present during HP and to identify trigger thoughts such as "I'm not fast enough" and "I'm not performing well." These thoughts increased her tension level and provoked HP (Pélissier & O'Connor, 2004).

3.2.2. Emotion regulation model

ER refers to the ways in which individuals identify (i.e., attend to, label, evaluate) and respond to (i.e., express, try to modify) emotional experiences (Diefenbach et al., 2008). ER can be further understood as the process through which individuals influence the presence and timing of certain emotions, and how emotion is experienced and expressed (Gross, 1998).

Some conceptualizations of ER emphasize the ability to decrease and control negative emotions and reduce arousal, whereas others suggest that ER is defined by the ability to experience, differentiate between, and respond spontaneously to the full range of emotional experiences (Gratz & Roemer, 2004). The latter definitions imply that awareness and understanding of emotions in turn improves ability to monitor, experience, accept, and modify both positive and negative affect (Gratz & Roemer, 2004). The distinction between ER as emotional control/suppression and ER as awareness and understanding is critical because some literature suggests that efforts to control emotional experience and efforts to avoid, or reject uncomfortable emotions may

underlie psychological symptoms. Adaptive ER may therefore require acceptance of both pleasant and unpleasant emotional responses (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996; Linehan, 1993).

Finally, some research suggests that ER can only be understood within the context and demands of a given situation. Adaptive ER therefore requires context-dependent flexibility, and strategic modulation of arousal in order to maintain goal-directed activity and inhibit impulsive behavior when negative emotions develop (Gratz & Roemer, 2004). Modulation implies altering the intensity or duration of arousal, rather than changing or eliminating the emotion that is experienced.

The ER model for BFRBs focuses on negative reinforcement: the function of BFRBs is presumed to be alleviation or relief from negative emotions, and the relief reinforces and perpetuates the behavior. This model combines the role of uncomfortable emotional experiences in triggering an episode of BFRB, the role of the body-focused behavior in modulating emotional arousal, and the role of relief from negative emotional arousal in maintaining and reinforcing the behavior. Adapted from research on ER in TTM, the ER model for BFRBs proposes that individuals with BFRBs have difficulty controlling certain emotions and engage in body-focused behavior to avoid, decrease, or attenuate aversive affect; HP, SP, and NB persist despite negative consequences because they are negatively reinforced by distraction or escape from undesired emotions or difficult events. In this, the ER model is consistent with the broader ComB model described above wherein affective cues, among others, trigger episodes of BFRB and reinforce the behavior. However, the ER model further suggests that individuals with BFRBs are characterized by a general deficit in ER that promotes the adoption of maladaptive coping methods (Snorrason et al., 2010). Episodes of BFRB result from a drive to stop experiencing a given affective state, and a lack of alternative methods for coping with the state (Shusterman et al., 2009). Deficits in ER may stem from many factors, including problems with impulse control, and difficulty identifying, understanding, or accepting emotions (Gratz & Roemer, 2004). Snorrason et al. (2010) further hypothesized that individuals with SP may experience greater emotion reactivity, that is, they tend to frequently experience intense and persistent emotions (Nock, Wedig, Holmberg, & Hooley, 2008).

Applied to all problematic body-focused behaviors, Snorrason and colleagues' model implies that, in individuals with BFRBs, chronically high levels of emotional arousal are coupled with a fundamental deficit in ER, prompting the adoption of maladaptive ER strategies such as HP, SP, and NB. It is unclear whether the anxiety, tension, or other negative affect that can precede episodes of BFRB are produced by external stressors, or whether increase in tension is produced by efforts to avoid engaging in BFRB.

It has been demonstrated that individuals who pull out hair and pick skin have elevated rates of comorbid psychiatric disorders (57% for TTM; 55% for SP; Flessner, 2012), often anxiety and depression. Such findings suggest that stress is generated by external causes and subsequently maladaptively regulated through BFRBs. This possibility is reinforced by Teng and colleagues' report that individuals with BFRBs demonstrate greater trait anxiety (Teng et al., 2004). However, it seems likely that, in some individuals, efforts to avoid engaging in an episode of BFRB may create further emotional arousal, compounding the problem and creating a cycle of elevated tension or emotional arousal, difficulty regulating emotion, and BFRBs.

3.2.3. Stimulus regulation model

The ER model fails to explain the initial development of the use of BFRBs as a means of regulation. Penzel (2002) proposed a stimulus regulation (SR) model based on his clinical work with individuals with TTM. The SR model is based on Penzel's observations in his clinical practice that individuals with TTM pull out hair both when they are overstimulated (due to stress or to positive or negative excitement) and understimulated (due to inactivity or boredom), Penzel hypothesized that individuals with BFRBs experience malfunctions in nervous system mechanisms that balance internal levels of stress. According to the SR model, BFRBs represent an effort to externally regulate an internal state of sensory imbalance. Although individuals with BFRBs are exposed to the same levels of environmental stimulation as are individuals without BFRBs, the former group's nervous systems have a different threshold for physiological stimulation (Penzel, 2002). The model proposes that individuals with BFRBs experience pleasure from behavior that others experience as painful. In individuals who are understimulated, the intensity of the physiological sensation of pulling, picking, or biting provides relief; in individuals who are overstimulated, the sensations provide distraction from the source of overstimulation.

The SR model adds to the ER model by explaining why individuals resort to this particular behavior to regulate levels of stimulation. According to Penzel (2002), BFRBs develop because: (a) hair, skin, and nails are plentiful and are within reach at all times; (b) the areas on the body where HP (and to a lesser extent, SP and NB) occur are rich sites of nerve endings, providing good sources of stimulation; (c) hair, skin, and nails are very interesting and stimulating to touch; (d) genetic predispositions to BFRBs may be present in the brain as part of an old grooming program and BFRBs can therefore be performed nearly automatically and without much attention; (e) BFRBs can be extremely rewarding and pleasurable; and (f) BFRBs can be performed both alone and in the company of others.

4. Empirical research

To date, studies on BFRBs have explored the ER model both directly and indirectly. Research in this area has explored the rate of comorbid psychopathology and psychological symptoms in individuals with BFRBs, correlations between BFRB severity and severity of other psychological symptoms, and capacity for ER in individuals with BFRBs. Naturalistic studies have identified the emotional experiences of individuals prior to, during, and after engaging in HP, SP, and NB, and evaluated change in emotion over the course of an episode of BFRB. Experimental research on the ER model for BFRBs has explored the frequency of the behavior in diverse experimentally induced affective states, and measured the presence and intensity of various emotions during experimentally elicited BFRB. Further studies in this area have attempted to identify situations in which individuals with BFRBs are at elevated risk of engaging in the behavior, and still others have focused on BFRB subtypes. Finally, several research teams have published treatment trials of psychotherapies for BFRBs designed to target ER.

4.1. Psychopathology and psychological symptoms

A number of studies have endeavored to establish the rates of various psychological symptoms and disorders in individuals with BFRBs, and the relationship between BFRB severity and psychological symptom severity. Studies in this area explored the relationships in HP, SP, and NB in both clinical and non-clinical samples.

4.1.1. Hair-pulling

Woods, Wetterneck, et al. (2006) found that 28.6% and 10.7% of a sample of treatment-seeking adults with TTM suffered from major depression and OCD, respectively. Diefenbach et al. (2002) reported that 55% of their sample of 44 individuals with TTM had a co-existent mood or anxiety disorder; the most common diagnoses were generalized anxiety disorder (GAD), social phobia, and specific phobia. Christenson, Mackenzie, et al. (1991) reported that 82% of a sample of 60 adult hair pullers (50 of whom met the DSM-III criteria for TTM) met the diagnostic criteria for another past or current DSM Axis I disorder.

Thirty-four percent of respondents in a large Internet survey of individuals reporting symptoms consistent with a TTM diagnosis also reported having sought help for a comorbid psychological problem, primarily mood and anxiety disorders (Woods, Flessner, et al., 2006). In

a study of HP phenomenology in a community sample, Duke et al. (2009) compared depression and anxiety symptoms in 54 self-reported hair-pullers with symptoms in 776 individuals who did not report HP, and found that the HP group had significantly greater symptoms. In a similar study of a college student sample, Duke and colleagues (Duke, Kelley, Ricketts, et al., 2010) found significantly greater symptoms of depression in self-reported hair-pullers than in non-hair-pullers. No between-group differences in anxiety were reported.

4.1.2. Skin-picking

Where SP is concerned, similar findings have been reported. Arnold et al. (1998) found that each of their 34 participants with pathological SP met DSM criteria for at least one current or lifetime comorbid psychiatric disorder, primarily mood and anxiety disorders. Major depression (24%) was the most common; a minority of participants reported SP in the context of OCD (6%) or body dysmorphic disorder (BDD) (9%). Calikuşu et al. (2003) found that a sample of skin-pickers ($N = 31$) recruited from a dermatology clinic had significantly higher rates of depression and OCD diagnoses than did controls with another dermatological condition. The elevated rate of depression (58%) in the SP group led the authors to conclude that depression is not only a common comorbid psychiatric condition with SP, but may be the primary clinical condition in individuals with SP. Wilhelm et al. (1999) reported that every participant in a sample of 31 individuals with self-injurious SP met criteria for a comorbid disorder; the most common comorbidities were OCD, alcohol abuse/dependence, and BDD.

Several authors have investigated the relationship between psychopathology and BFRBs by exploring correlations between SP severity and psychopathology severity. Hayes et al. (2009) found significant correlations between SP severity and depressive, impulsive, anxious, and obsessive–compulsive symptom severity in 222 skin-pickers in a non-clinical community sample. In a sample of students reporting SP, Bohne et al. (2002) reported a correlation between SP frequency and OCD symptom severity, but no correlation between SP and depression. Neziroglu et al. (2008) found no significant relationship between SP severity and anxiety or SP severity and depression. However, the Neziroglu et al. sample was composed of individuals who reported some degree of SP but were seeking treatment for other psychiatric disorders; as such, anxiety and depression may have been more closely related to participants' other diagnoses. Snorrason et al. (2010) also did not observe a relationship between SP symptoms and severity of depression or anxiety symptoms.

4.1.3. Nail-biting

It is commonly assumed that NB is related to anxiety or is a sign of emotional tension, but this assumption has been the subject of insufficient research (Wells et al., 1998). Joubert (1993a) measured NB and other habits including HP, SP, nose-picking, and teeth-grinding in 139 men and women, and reported that individuals with NB tended to have elevated scores on measures of manifest anxiety and OC symptoms. Klatte and Deardorff (1981) measured anxiety in 10 individuals with NB and 10 controls, and found that individuals with NB reported greater anxiety. Joubert (1993b) reported no relationship between NB and level of happiness (i.e., NB was not associated with unhappiness), but Hansen et al. (1990) reported a relationship between NB and negative appraisals of health and appearance. The research on NB is confounded by the difficulty of distinguishing non-distressing NB from problematic and distressing NB. Much of the literature may focus on mild NB that does not cause distress, creating a limited understanding of the relationship between NB and psychological symptoms or psychopathology.

4.1.4. Multiple BFRBs

Several studies focused on the relationships between psychological symptoms and more than one different BFRB. Hajcak et al. (2006) investigated the prevalence of HP and SP in a large college sample, and the relationship between the frequency of pulling or picking and anxiety or other negative emotions. The authors found that skin-pickers and hair-pullers had significantly higher scores on measures of affective distress than did controls. More specifically, individuals with TTM reported elevated anxiety, stress reactivity, and OC symptoms, whereas individuals with SP reported more pathological worry. Lochner, Simeon, Nichaus, and Stein (2002) reported that 51.8% of a sample of 68 individuals with TTM had a current or lifetime comorbid diagnosis; the most common diagnoses were major depressive disorder, OCD, and GAD. The authors further reported that 47.6% of a sample of 21 patients with pathological SP had a comorbid diagnosis; the most common diagnoses were major depression and dysthymia. Finally, Teng et al. (2004) explored BFRBs in undergraduate students and found that students with problematic body-focused behaviors were more anxious and more depressed than were controls. Further, participants reported that their negative affective states were directly related to self-reported impairment from BFRB.

Although the relationship between psychological symptoms and psychopathology in BFRBs does not allow us to draw conclusions about BFRBs and ER, the elevated rate of psychological symptomatology indicates that this population experiences greater than average negative affect and may experience poorly regulated affect. However, further support for the ER model can be drawn from studies that directly measure for capacity for ER in individuals with BFRBs.

4.2. Emotion regulation

Several studies have explored the ER model for BFRBs using questionnaire measures of ER. Shusterman et al. (2009) conducted a large ($N = 1162$) Internet survey of affective experiences associated with TTM; this study was the first to use measures of ER to explore differences between hair-pullers and controls. The results revealed that hair-pullers reported more difficulty "snapping out of" emotions than did controls on every emotion measured; the biggest differences between groups were observed for anxiety, tension, shame, and boredom. Individuals who reported difficulty regulating certain emotions often reported experiencing those same emotions before and during pulling episodes. Although the correlation between overall difficulty regulating emotions (as measured by the Affective Regulation Scale [ARS]; Shusterman et al., 2009) and HP severity was small to moderate, and ER made only a small independent contribution to HP severity, the authors concluded that hair-pullers may be less capable of regulating emotions than are controls, and that ER may therefore be a factor in TTM.

Snorrason et al. (2010) conducted a study designed to directly investigate the relationships between SP, ER, and emotion reactivity, i.e., the tendency to experience frequent, intense, and persistent emotions (Nock et al., 2008). The authors found that individuals in the SP group reported greater problems with ER and higher scores on measures of emotion reactivity than did controls. They further found that ER and emotion reactivity both predicted SP diagnosis, although the two variables were not related to SP severity.

The results of this non-exhaustive sample of studies on the relationship between BFRBs and psychological symptoms or disorders and BFRBs and ER are presented in Table 1. The studies discussed in this section demonstrate associations between global psychopathology and BFRBs; researchers in this area have pursued the question of emotion and ER in BFRBs by exploring the emotions that are present during an episode of BFRB, and change in emotion over the course of an episode.

4.3. Naturalistic studies

Naturalistic studies of ER and BFRBs have used questionnaires to measure the presence and intensity of participants' emotions before, during, and after an episode of BFRB.

4.3.1. Hair-pulling

Neal-Barnett and Stadulis (2006) explored the emotional states of 43 African-American women with TTM prior to, during, and after an

Table 1
Studies of BFRBs and psychopathology listed by BFRB, population, and method.

Authors	BFRB	Sample[a]	Measure	Results
Comorbidity Hair-pulling				
Diefenbach et al. (2002)	HP	Selected; clinical ($N = 44$)	ADIS	55% were diagnosed with a comorbid anxiety or depressive disorder (30% GAD; 11% social phobia; 11% specific phobia)
Christenson, Mackenzie, et al. (1991)	HP	Selected; clinical ($N = 60$)		82% met diagnostic criteria for a comorbid current or past DSM Axis-I diagnosis
Woods, Wetterneck, et al. (2006)	HP	Selected; clinical ($n = 12$); comparison group ($n = 13$)	PAI (anxiety and depression subscales)	57.1% of participants had at least one comorbid Axis I diagnosis (28.6% depression; 10.7% OCD)
Duke et al. (2009)	HP	Unselected; non-clinical ($n = 54$); comparison group ($n = 759$)	BDI; BAI	HP group had significantly greater anxiety and depression symptoms than comparison group
Duke, Keeley, Ricketts, et al. (2010)	HP	Unselected; non-clinical ($n = 527$); comparison group ($n = 476$)	BDI; STAI	Significantly greater depression in HP group than controls; no between-group differences in anxiety
Woods, Flessner, et al. (2006)	HP	Unselected: non-clinical ($N = 1697$)	DASS-21	34% had sought help for a comorbid problem, primarily mood and anxiety disorders
Comorbidity: Skin-picking				
Arnold et al. (1998)	SP	Selected; clinical ($N = 34$)	SCID, Y-BOCS	All 34 participants met criteria for comorbid disorder (mood = 68%; anxiety = 41%)
Calikuşu et al. (2003)	SP	Selected; clinical ($n = 31$); comparison group ($n = 31$)	SCID, BDI, Y-BOCS, HARS	SP group had significantly higher incidence of depression and OCD than controls
Wilhelm et al. (1999)	SP	Selected; non-clinical ($N = 31$)	SCID-I and II, BDI, BAI	All 31 participants met criteria for a comorbid disorder; most common were OCD, alcohol abuse/dependence, and BDD
Comorbidity: Nail-biting				
Klatte and Deardorff (1981)	NB	Unclear if selected or unselected; non-clinical ($n = 10$); comparison group ($n = 10$)	Taylor Manifest Anxiety Scale	NB group reported significantly greater anxiety
Comorbidity: Several BRFBs				
Lochner et al. (2002)	HP and SP	Selected; clinical; HP ($n = 68$); SP ($n = 21$)		51.8% of TTM sample had current or lifetime comorbid diagnosis; 47.6% of SP sample; most common were major depressive disorder, OCD, and GAD
Hajcak et al. (2006)	SP and HP	Unselected; non-clinical ($n = 72$); comparison group ($n = 221$)	DASS-21, PSWQ, OCI-R, PSWQ	BFRB group had significantly greater anxiety, stress reactivity, and obsessive–compulsive symptoms; no between-group differences in depressive symptoms
Teng et al. (2004)	(NB; SP; skin-biting; teeth-grinding; tongue-thrusting; mouth-chewing; body-scratching)	Unselected; non-clinical ($n = 60$); comparison group ($n = 54$)	STAI, BDI; Habit questionnaire	BFRB group demonstrated greater anxiety and depression than controls
Correlations				
Neziroglu et al. (2008)	SP	Selected; non-clinical SP ($N = 40$)	BAI; BDI; clinician DSM diagnosis	No significant correlation between SP severity and anxious or depressive symptoms
Bohne et al. (2002)	SP	Unselected; non-clinical ($N = 133$; $n = 122$ who reported SP)		Significant correlation between SP frequency and OCD symptom severity; no correlation between SP and depression
Hayes et al. (2009)	SP	Unselected; non-clinical ($n = 354$); comparison group ($n = 132$)	OCI-R, BIS-15, BDI-II; BAI; SPIS	Significant correlations between SP severity and depressive, impulsive, anxious, and obsessive–compulsive symptom severity
Snorrason et al. (2010)	SP	Unselected; non-clinical ($n = 55$); comparison group($n = 55$)		No significant relationship between SP symptoms and severity of depression or anxiety
Joubert (1993a)	NB, HP, picking scabs (and others)	Unselected; non-clinical ($N = 139$)	CSEI; MOCÌ, MAS	
Joubert (1993b)	NB	Unselected; non-clinical ($N = 310$)	Self-report happiness scale	No relationship between happiness and NB
Emotion regulation				
Shusterman et al. (2009)	HP	Selected; non-clinical ($n = 1162$); comparison group ($n = 175$)	MGH-HPS, ARS/HTS, PSWQ, PSS	HP group demonstrated significantly greater difficulty regulating emotion
Snorrason et al. (2010)	SP	Unselected; non-clinical ($n = 55$); comparison group ($n = 55$)		SP group reported significantly greater problems with ER and greater emotion reactivity than did controls

ARS/HTS = Affective Regulation Scale/Hair-pulling Trigger Scale; BAI = Beck Anxiety Inventory; BDD = Body Dysmorphic Disorder; BDDQ = Body Dysmorphic Disorder Questionnaire; BDI = Beck Depression Inventory; BIS-15 = Barratt Impulsiveness Scale—Short Form; CSEI = Coopersmith Self-Esteem Inventory; DASS-21 = Depression Anxiety Stress Scales 21-item version; ED = Eating disorder; GAD = Generalized Anxiety Disorder; HARS = Hamilton Anxiety Rating Scale; MAS = Manifest Anxiety Scale; MD = mood disorder; MOCI = Maudsley Obsessive-Compulsive Inventory; OCI-R = Obsessive–Compulsive Inventory—Revised; PSS = Perceived Stress Scale; PSWQ = Penn State Worry Questionnaire; SCID = Structured Clinical Interview for DSM-IV; SPI = Skin-Picking Inventory; SPIS = Skin-picking Impact Scale; SPS = Skin-Picking Scale; STAI = State-Trait Anxiety Inventory; and YBOCS = Yale–Brown Obsessive–Compulsive Scale.

[a] Selected = direct recruitment of individuals with problem HP, SP, or NB. Unselected = drawn from a large sample of individuals with and without HP, SP, or NB. Clinical = individuals receiving clinical treatment for HP, SP, or NB, or clinician-diagnosed (i.e., not self-report only). Non-clinical = individuals not receiving clinical treatment for HP, SP, or NB and not clinician-diagnosed (i.e., self-report only).

episode of HP. The participants reported significant decreases in boredom, happiness, and anxiety over the course of pulling episodes, and significant increases in guilt and relief. Diefenbach et al. (2002) measured affective states in 44 clinical participants with TTM over the course of an episode of HP; participants reported that boredom, anxiety, and tension decreased after pulling, and guilt, relief, sadness, and anger increased after pulling. Diefenbach et al. (2008) compared a clinical TTM group with a control group on affective states over the course of an HP episode; in comparison to the control group, the clinical group experienced greater decreases in boredom, sadness, anger, and tension over the course of pulling, and greater increases in calm, relief, and pleasure.

Duke and colleagues (Duke, Keeley, Ricketts, et al., 2010) explored affective states associated with focused HP (consciously initiated behavior triggered by urges or negative affect) and automatic HP (habitual or non-consciously initiated behavior, often occurring outside of awareness during sedentary activities) in a college student sample. For the sample as a whole, the most common states experienced prior to pulling were boredom, anxiety, tension, frustration, and indifference; with the exception of indifference, each of these states decreased over the course of the pulling episode. Rates of pre-pulling anxiety, tension, boredom, and frustration were significantly greater in the focused group than in the automatic group. Duke et al. (2009) measured affective states before, during, and after a pulling episode in a community sample of individuals reporting HP, and reported consistent results: boredom, anxiety, tension, and frustration were the most common pre-pulling emotions; frustration and anxiety increased during pulling, but every emotion decreased after the pulling episode.

Finally, Stanley and colleagues (Stanley, Borden, Mouton, & Breckenridge, 1995) and Mansueto, Thomas, and Brice (2007) also explored emotional experiences associated with non-clinical HP. Stanley et al. reported that boredom, anxiety, tension, and indifference were common pre-pulling emotions; common post-pulling emotions included indifference, calm, and relief. Further, significant decreases in boredom, sadness, anger, and tension over the course of the pulling cycle were reported. Mansueto et al. (2007) reported that the most common pre-pulling emotions were anxiety, tension, boredom, and indifference; the strongest post-pulling emotions reported were relief, indifference, and happiness. Relief increased after pulling, and boredom, anxiety, tension, and relief decreased to zero. Calm increased during the pulling episode, only to disappear following pulling. With some exceptions, these results suggest that calm replaces and provides relief from negative emotions.

4.3.2. Skin-picking

Wilhelm et al. (1999) measured various emotions and experiences (e.g., physical pain) from before to during SP and from during to after SP in a sample of 31 clinical participants. The authors observed significant increases in shame and guilt, and a significant decrease in tension from pre- to post-picking. A similar study compared individuals with clinical and non-clinical SP and found that the clinical group reported higher levels of tension before picking, greater satisfaction during picking, and more shame and pain after picking (Keuthen et al., 2000).

Bohne et al. (2002) investigated the presence and intensity of various emotions before, during, and after SP in 122 students; 47.4% of participants reported increased tension or nervousness prior to picking and 60.2% reported pleasure or relief during or after picking. Among other emotions, significant increases in satisfaction from pre- to post-picking were reported. Bohne et al. further asked students why they pick skin; in addition to habit and to avoiding a displeasing appearance, participants attributed SP to negative emotional states such as discomfort (27.1%), tension (22.6%), nervousness (16.5%), and boredom (13.5%); 13.5% of participants reported that they engaged in SP because it was pleasurable.

Snorrason et al. (2010) also explored retrospective reports of emotional experiences before, during, and after SP in a non-clinical sample. Participants reported decreases in a number of negative emotions over the course of SP. In particular, the intensity of boredom decreased from before to during SP and from during to after SP; anxiety and tension diminished from before to after picking. Gratification and relief increased from before to during picking and guilt and shame increased after picking.

Finally, Neziroglu et al. (2008) collected data from 40 individuals reporting a range of SP severity. Participants reported tension, loss of control, and general negative feelings (e.g., guilt, shame) prior to SP, as well as a feeling of being "mesmerized" (p. 310). A small but significant decrease in tension over the course of picking was reported, as well as increases in satisfaction, guilt, shame, and general negative feelings. The finding that tension decreases but that guilt and shame increase over the course of SP episodes is consistent with findings from Keuthen et al. (2000), Snorrason et al. (2010), and Wilhelm et al. (1999).

Together, the findings of naturalistic studies on emotion and BFRBs suggest that negative emotions such as frustration, tension, and anxiety decrease over the course of an episode of BFRB, but that BFRB may subsequently increase negative emotions such as guilt or shame; these results imply that specific emotions may be differentially implicated in ER and BFRBs. No studies of this type are available for NB. The results of naturalistic studies are summarized in Table 2.

The naturalistic studies discussed here evaluated retrospective reports of affect during BFRB, and demonstrated fluctuations in various emotions across the BFRB cycle. Confirming the role of emotion as a BFRB trigger or mediator requires experimental protocols that directly manipulate emotions designed to elicit body-focused behavior.

4.4. Experimental studies

A smaller group of studies on BFRBs and ER used experimental manipulations to induce emotion and to elicit and measure problematic body-focused behavior.

4.4.1. Hair-pulling

Drysdale, Johoda, and Campbell (2009) conducted a case study of a 16-year-old participant with TTM, using four experimental conditions: one neutral condition, two distraction conditions, and one emotional arousal condition. The participant's reported urge to pull was greatest during the emotional arousal condition. Although this result supports the ER model for BFRBs, the findings were not specific to particular emotions and the single-case design of the research limits the generalizability of the results.

4.4.2. Multiple BFRBs

Woods and Miltenberger (1996) measured five classes of body-focused movements or behaviors—hair manipulation, face manipulation, object manipulation, object mouthing, and repetitive limb movements—in a non-clinical sample of university students in three conditions: bored, anxious, and neutral. The authors observed more face and hair manipulation in the anxiety condition than in the bored or neutral conditions.

Teng et al. (2004) recruited students with one of the following BFRBs: NB, SP, mouth-chewing, skin-biting, and skin-scratching. Video segments were used to induce boredom, depression, and anxiety, and a neutral control condition was used. The primary finding was that individuals with BFRBs demonstrated significantly more BFRB in the boredom condition than in the control condition. No differences were found in the comparison of the anxiety condition to the control condition or of the depression condition to the control condition. From these findings, the authors hypothesized that boredom may be more relevant in BFRBs than are other affective states (Teng et al., 2004).

4.4.3. Nail-biting

Williams et al. (2006) explored the function of BFRBs in 39 undergraduate students reporting NB. The participants were exposed to four experimental conditions: being left alone (boredom), solving math

Table 2
Naturalistic studies on ER and BFRBs.

Authors	BFRB	Sample[a]	Design	Emotions or states measured	Key results
Hair-pulling					
Diefenbach et al. (2002)	HP	Selected; clinical ($N = 44$)	Questionnaire measure of affective states before, during, and after pulling	Boredom, happiness, sadness, anger, calm, anxiety, guilt, tension, relief, indifference	Decreased boredom, anxiety, and tension after pulling; increased guilt, relief, sadness, and anger after pulling
Diefenbach et al. (2008)	HP	Selected; clinical ($n = 34$); control ($n = 32$)	Comparison of clinical and control groups on questionnaire measure of affective states before, during, and after pulling	Boredom, happiness, sadness, anger, calm, anxiety, guilt, tension, relief, indifference	Larger decrease in boredom, sadness, anger, and tension across pulling; greater increase in calm, relief, and pleasure across pulling in clinical group than in controls
Neal-Barnett and Stadulis (2006)	HP	Selected; clinical ($N = 43$)	Questionnaire measure of affective states across pulling episode	Boredom, happiness, sadness, anger, calm, anxiety, guilt, tension, relief, indifference	Decreased boredom, happiness, and anxiety after hair-pulling; increased guilt after pulling; increased relief during pulling
Duke et al. (2009)		Unselected; non-clinical ($N = 830$, $n = 54$ who endorsed HP)	Questionnaire measure of affective states before, during, and after picking	Tension, anxiety, depression, boredom, happiness, sadness, anger, calm, relief, indifference, embarrassment, frustration, loneliness	Most common pre-pulling emotions: boredom, anxiety, tension, frustration, all of which decreased after pulling, although frustration and anxiety increased during pulling
Duke, Keeley, Ricketts, et al. (2010)	HP	Unselected; non-clinical ($N = 527$ college students; $n = 51$ who endorsed HP)	Comparison of automatic and focused hair-pullers using questionnaire measure of affective states across pulling episode	Tension, anxiety, depression, boredom, happiness, sadness, anger, calm, relief, indifference, embarrassment, frustration, loneliness	Decreased tension, anxiety, depression, boredom, sadness, anger, and frustration after pulling; increased embarrassment and relief after pulling; most emotions reported more frequently by focused than automatic pullers
Mansueto et al. (2007)	HP	Unselected; non-clinical ($N = 248$; $n = 15$ who endorsed HP)	Questionnaire measure of emotions present before and after pulling	Boredom, happiness, sadness, anger, calm, anxiety, guilt, tension, relief, indifference	Most common pre-pulling emotions: anxiety, tension, boredom, and indifference; most common post-pulling emotions: relief, indifference, happiness
Stanley et al. (1995)	HP	Unselected; non-clinical ($N = 22$)	Questionnaire measure of affective states before, during, and after pulling	Boredom, happiness, sadness, anger, calm, anxiety, guilt, tension, relief, indifference	Decreased tension, boredom, anger, and sadness after pulling
Skin-picking					
Keuthen et al. (2000)	SP	Selected; clinical ($n = 31$) unselected; non-clinical ($n = 82$)	Comparison of clinical and control groups on questionnaire measure of affective states before, during, and after picking	Tension, satisfaction, shame	Greater tension before picking, satisfaction during picking, and shame after picking in clinical group than in controls
Neziroglu et al. (2008)	SP	Selected; non-clinical SP ($N = 40$)	Questionnaire measure of affective states before, during, and after picking	Guilt, shame, general negative feelings, tension, satisfaction	Increase in guilt, shame, and general negative feelings after picking; increase in satisfaction after picking; decrease in tension after picking
Wilhelm et al. (1999)	SP	Selected; non-clinical ($N = 31$)	Questionnaire measure of affective states before, during, and after picking	Satisfaction, feeling mesmerized, loss of control, tension, guilt, shame	Increased satisfaction during picking; decreased satisfaction after picking; increased shame and guilt and decreased tension after picking
Bohne et al. (2002)	SP	Unselected; non-clinical ($n = 122$ SP; $n = 10$ no SP)	Questionnaire measure of affective states before, during, and after picking	Satisfaction, guilt, tension,	Increased guilt and satisfaction after picking; decreased tension after picking; presence of pleasure or relief during or after picking
Snorrason et al. (2010)	SP	Unselected; non-clinical ($n = 55$); comparison group ($n = 55$)	Questionnaire measure of emotion regulation and affective states before, during, and after picking	Tension, anxiety, sadness, boredom, relief, gratification, trance, shame, guilt	Decreased boredom, anxiety, and tension after picking; increased gratification and relief during picking; increased guilt after picking; emotion regulation problems and high emotion reactivity predicted skin-picking; similar pattern in controls, but less intense emotion

[a] Selected = direct recruitment of individuals with problem HP, SP, or NB. Unselected = drawn from a large sample of individuals with and without HP, SP, or NB. Clinical = individuals receiving clinical treatment for HP, SP, or NB, or clinician-diagnosed (i.e., not self-report only). Non-clinical = individuals not receiving clinical treatment for HP, SP, or NB and not clinician-diagnosed (i.e., self-report only).

problems (frustration), being reprimanded for NB (contingent attention), and continuous conversation (non-contingent attention). Thirty-seven participants bit their nails during the experiment and NB was most frequent in the boredom and frustration conditions. The participants also completed a questionnaire indicating how often they bit their nails in identifiable situations or for specific purposes. The most frequently-reported situations and purposes for NB were "when you are bored," "to get something," "to get something you want (e.g., games, food, or drinks)," "because you are uncomfortable," and "when you are not feeling well;" no information was provided as to how NB allowed participants to get something they wanted. The authors concluded that NB occurs primarily in states of boredom or in the context of work on difficult problems (reflecting emotional states such as frustration).

Wells, Haines, Williams, and Brain (1999) devised an experiment to measure the psychophysiological response of individuals reporting severe NB, mild NB, and no NB to exposure to an imagery script describing an episode of NB and to a neutral script. The authors hypothesized that NB serves a tension reduction function and that participants with more severe NB would demonstrate a greater arousal response, and a pattern of tension reduction in response to NB imagery. Levels of arousal as measured by muscle tension, heart rate, and skin conductance did not differ significantly between the severe and mild groups, although the NB groups demonstrated greater arousal than controls. However, the authors observed a difference between the severe and mild NB groups in their pattern of response across different stages of the NB sequence. The mild NB group demonstrated increased arousal/tension at the moment (in the script) of engaging in NB and a decrease following NB, whereas the severe NB group demonstrated an increase in arousal/tension prior to NB and a decrease during NB. The severe NB group's response mirrors the pattern observed in response to self-cutting. A second experiment demonstrated that, in individuals reporting self-cutting, the psychophysiological response to imagery of an episode of NB is one of tension increase followed by reduction; the response of participants who reported severe NB was a pattern of tension management. Wells and colleagues concluded that severe NB is a self-mutilative behavior similar to cutting, but that the chronic and habitual nature of NB is such that NB is less effective in neutralizing tension. The findings of experimental studies on ER and BFRBs are summarized in Table 3.

Results of experimental studies on BFRBs and ER demonstrate that certain emotions or affective states may be more likely than others to elicit body-focused behavior. Studies of "high-risk" emotions have focused directly on the task of identifying the specific emotions involved in BFRBs.

4.5. Studies identifying high-risk emotions

The literature on emotions and ER in BFRBs has focused on a wide variety of affective states, including but not limited to depression, anxiety, anger, sadness, guilt, shame, tension, frustration, and boredom. However, as the research in this area grows, certain types of emotion have emerged as more relevant than others. In a review of the literature on TTM, Duke and colleagues reported that, across studies, the affective states reported as most intense before HP were frustration, anxiety, tension, boredom, and guilt (Duke, Keeley, Geffken, et al., 2010). Results from the few studies that experimentally manipulated emotion suggest that boredom, tension, anxiety, and frustration may be the most relevant emotions; that is, these emotions may be more likely than others to trigger an episode of BFRB, and may be the most likely to be modulated by BFRB (e.g., Teng et al., 2004; Williams et al., 2006).

This hypothesis is supported by reports from individuals with BFRBs that they are at the highest risk of engaging in the behavior during sedentary activities (e.g., reading, studying, sitting in class) or frustrating activities (Bohne et al., 2002; Diefenbach et al., 2002; du Toit et al., 2001; Duke, Keeley, Ricketts, et al., 2010; O'Connor et al., 2003). O'Connor and colleagues (O'Connor et al., 2001; O'Connor et al., 2003; O'Connor et al., 1993) asked participants with various BFRBs to list the activities during which they were the most and least likely to engage in the behavior. The highest-risk activities for BFRB episodes were passive attendance (e.g., watching TV), study activity (e.g., attending class), transit (e.g., coming home from work), and waiting (e.g., in line). The lowest-risk activities were physical exercise, socializing, eating, and manual work. Participants were further asked to appraise the activities or situations that tended to precipitate BFRB. Individuals with TTM appraised high-risk activities as boring; individuals with NB appraised high-risk activities as inactive; and individuals who reported teeth-grinding appraised high-risk activities as unsatisfying (O'Connor et al., 2003). Individuals with tics and BFRBs have been demonstrated to have a perfectionist or overactive style of planning (Pélissier & O'Connor, 2004), and may self-impose unrealistic expectations or standards that are difficult to meet. Failure to meet standards elicits emotions such as boredom, frustration, impatience, and dissatisfaction. These emotions build, creating tension, and the tension and negative emotions are subsequently released or diminished through BFRB or tics (O'Connor, 2002; O'Connor, Aardema, & Pélissier, 2005).

Studies of high-risk emotions have demonstrated that certain emotions (e.g., boredom, frustration) frequently provoke BFRB. Research on subtypes investigates whether these emotions are present and relevant in all episodes of HP, SP, or NB, or whether some BFRB occurs outside of awareness and is unrelated to emotion regulation.

4.6. Studies of BFRB subtypes

Research examining the phenomenology of HP and SP suggests that individuals are not always aware when they engage in BFRBs, and that BFRB occurs on a spectrum from complete awareness to nearly complete unawareness (Flessner, Woods, Franklin, Cashin, & Keuthen, 2008). Christenson and colleagues (Christenson, Mackenzie, et al., 1991; Christenson, Ristvedt, & MacKenzie, 1993) first reported that individuals with TTM engage in two types of HP, and subsequent studies (e.g., Walther, Flessner, Conelea, & Woods, 2009) have evaluated subtypes of SP. Automatic pulling or picking refers to body-focused behavior that occurs outside of awareness; it often occurs during sedentary activities such as reading or watching television, and individuals may not realize that they are pulling or picking until after the fact. In contrast, focused BFRB refers to a consciously-initiated behavior with an almost compulsive quality. Focused pulling or picking may be preceded by conscious negative emotional states and triggered by mounting tension and a powerful urge to pull or pick (Arnold et al., 2001; du Toit et al., 2001; Flessner, Conelea, et al., 2008).

4.6.1. Hair-pulling

Automatic and focused dimensions have been supported in studies of TTM. Although many individuals with TTM engage in both types of pulling (Duke, Keeley, Geffken, et al., 2010), most can identify a dominant style (Flessner, Conelea, et al., 2008; Flessner, Woods, et al., 2008). Christenson and MacKenzie (1994) suggested that 25% of pulling episodes are primarily focused, with automatic as the dominant style for the remaining 75%. A measure of adult TTM subtypes, the Milwaukee Inventory for Subtypes of Trichotillomania—Adult Version (MIST-A), has been developed to further explore these dimensions (Flessner, Woods, et al., 2008), and has provided support for separable dimensions (i.e., distinct pulling styles) in TTM.

4.6.2. Skin-picking

Automatic and focused dimensions have also been supported in research on SP. Grant, Odlaug, and Kim (2007) reported that 66.7% of participants (N = 24) in an SP treatment study were aware of their SP at least half of the time, whereas 33.3% picked skin primarily automatically. Neziroglu et al. (2008) reported similar percentages (73.9% aware at least 50% of the time), but Arnold et al. (1998) reported that 76% of participants with SP (N = 34) reported a more automatic form of SP (i.e., they "found themselves" picking). The

Table 3
Experimental studies of ER and BFRBs.

Authors	BFRB	Sample[a]	Design	Emotions or states	Key results
Diefenbach et al. (2008)	HP	Selected; clinical ($n = 34$); control ($n = 32$)	Comparison of clinical and control groups on HP task	Boredom, happiness, sadness, anger, calm, anxiety, guilt, tension, relief, indifference	Greater decrease in anxiety during pulling from non-typical site in clinical group than in control group
Drysdale et al. (2009)	HP	Selected; clinical ($N = 1$)	Case study; comparison of BFRB across conditions	Neutral, distraction, emotional arousal	Reported urge to pull greatest in arousal condition
Wells et al. (1999)	NB	Selected; non-clinical $n = 15$ severe; $n = 15$ mild; $n = 15$ control	Exposure to scripted imagery of an episode of NB and a neutral script	Respiration, muscle tension, heart rate, skin conductance	NB groups had greater arousal in response to NB scripts than controls; few differences in arousal between mild and severe groups; mild NB group increased arousal/tension during NB and decreased after; severe group increased arousal/tension prior to NB and decreased during
Wells et al. (1999)	NB	Selected; non-clinical[a] $n = 15$ severe; $n = 15$ mild; $n = 67$ self-cutting	Exposure to scripted imagery of an NB episode and a self-cutting episode	Respiration, muscle tension, heart rate, skin conductance	Self-cutting reduces arousal/tension in individuals who cut more effectively than does NB in individuals with NB
Williams et al. (2006)	NB	Selected; non-clinical ($N = 40$)	Comparison of BFRB across conditions	Boredom, frustration, contingent attention, non-contingent attention	NB most frequent in boredom and frustration conditions
Teng et al. (2004)	NB, SP, skin-biting, teeth-grinding, tongue-thrusting, mouth-chewing, body-scratching	Unselected; non-clinical ($n = 18$); controls ($n = 14$)	Comparison of BFRB across conditions	Boredom, anxiety, neutral	BFRB most frequent in boredom condition
Woods and Miltenberger (1996)	Hair, face, and object manipulation; object mouthing; repetitive limb movement	Selected; non-clinical ($N = 44$)	Comparison of BFRB across conditions	Anxiety, boredom, neutral	Hair and face manipulation most frequent in anxiety condition; object manipulation most frequent in boredom condition

[a] Selected = direct recruitment of individuals with problem HP, SP, or NB. Unselected = drawn from a large sample of individuals with and without HP, SP, or NB. Clinical = individuals receiving clinical treatment for HP, SP, or NB, or clinician-diagnosed (i.e., not self-report only). Non-clinical = individuals not receiving clinical treatment for HP, SP, or NB and not clinician-diagnosed (i.e., self-report only).

Milwaukee Inventory for the Dimensions of Adult Skin-Picking (MIDAS; Walther et al., 2009) has been developed to assess automatic versus focused SP and has provided evidence for separable dimensions. These dimensions have not been explored in NB.

The distinction between automatic and focused BFRB has significant implications for the ER model. Some researchers (e.g., Twohig & Woods, 2004) have proposed that ER is a greater factor in focused BFRB than in automatic BFRB and that focused pulling, picking, or biting is designed to address negative emotional experience. If that proves to be the case, treatment for individuals with BFRBs can be tailored to address the predominant type of HP, SP, or NB. That is, individuals whose BFRB is predominantly "automatic" may benefit from treatments designed to increase awareness of the behavior and interrupt the HP, SP, or NB routine; in contrast, individuals whose BFRB is predominantly "focused" may be best treated via interventions that address negative emotions that trigger or exacerbate episodes of BFRB (Flessner, Conelea, et al., 2008; Flessner, Woods, et al., 2008; Walther et al., 2009). One way to explore this question is by evaluating the efficacy of treatments that include components designed to directly target ER.

4.7. Treatment trials

The majority of treatment trials for BFRBs have focused on behavioral or CB treatments as the treatment of choice. Behavioral and CB interventions for HP and SP usually involve habit reversal training (HRT; Azrin & Nunn, 1973), a technique that focuses on awareness and self-monitoring, stimulus control, and the development of a competing response (Bloch et al., 2007). Self-monitoring and increased awareness allow individuals to interrupt BFRB, whereas competing responses (e.g., putting hands in pockets or squeezing a rubber ball) physically prevent the problem behavior. Stimulus control involves identification and modification of environments and activities that trigger BFRB, and HRT often also involves a relaxation training component. CB interventions (e.g., Schuck, Keijsers, & Rinck, 2011) also use strategies such as restructuring of distorted cognitions related to BFRBs.

4.7.1. Hair-pulling

Trials of CBT/HRT for TTM and SP often report significant symptom reduction (e.g., Diefenbach, Tolin, Hannan, Maltby, & Crocette, 2006; Ninan, Rothbaum, Martsteller, Knight, & Eccard, 2000; Teng, Woods, & Twohig, 2006; Twohig & Woods, 2001; van Minnen, Hoogduin, Keijsers, Hellenbrand, & Hendriks, 2003), but do not always result in maintenance of gains over time (Keuthen, Fraim, et al., 2001; Lerner, Franklin, Meadows, Hembree, & Foa, 1998; Twohig & Woods, 2001).

Behavioral or CB interventions for TTM have been demonstrated to be effective in comparison to control conditions (e.g., van Minnen et al., 2003) and in comparison to pharmacotherapy with clomipramine (Ninan et al., 2000). A systematic review demonstrated that HRT had the largest effect size ([ES] = −1.14, [CI] = −1.89, −.38) for TTM when compared to clomipramine and selective serotonin reuptake inhibitors (SSRI) (Bloch et al., 2007). A 2011 meta-analysis of 18 studies using HRT to treat BFRBs including HP and NB, tics, temporomandibular disorder, and other oral–digital behaviors found that HRT was an overall effective intervention for these disorders, with a large combined effect size (ES = −1.14, 95% CI −1.89 to 0.38) for pre-treatment to post-treatment change (Bate, Malouff, Thorsteinsson, & Bhullar, 2011).

In an uncontrolled study of CBT for TTM by Lerner and colleagues, 12 of 14 participants demonstrated significant improvement at post-treatment, but only 31% had maintained the gains at long-term follow-up (on average, 3.9 years later). Van Minnen and colleagues effectively treated 14 TTM patients with behavior therapy/HRT, reporting an effect size of 3.80; however, gains were reduced by 49%

at 3-month follow-up, and by 70% two years post-treatment (Keijsers et al., 2006).

4.7.2. Skin-picking

Two trials of CBT/HRT for SP produced significantly decreased symptoms, and gains were maintained over time. Teng et al. (2006) conducted a pilot investigation comparing brief HRT to a wait-list control condition for individuals reporting chronic SP that resulted in either social impairment or physical injury. HRT was significantly superior to the wait-list condition in decreasing self-reported picking and decreasing skin damage (as assessed by photograph ratings). Between-group differences in improvement were maintained at 3-month follow-up. Schuck et al. (2011) conducted a randomized controlled trial comparing four sessions of CBT for pathological SP to a wait-list control condition. Unlike Teng et al. (2006), Schuck and colleagues included direct interventions for dysfunctional cognitions related to SP. The authors found that CBT was superior to the wait-list condition in reducing SP severity, SP impact, dysfunctional cognitions related to SP, and skin damage as assessed via photographs; gains were maintained at 3-month follow-up.

4.7.3. Nail-biting

The majority of treatment studies for NB were conducted in the 1970s, 80s, and 90s, and results are mixed. Silber and Haynes (1992) and Horne and Wilkinson (1980) found the competing response component of HRT to be effective in reducing NB, and Maletsky (1974) reported that self-monitoring alone was effective. However, Allen (1996) failed to replicate the findings.

For TTM, symptom duration, age at onset, and general neuroticism do not appear to be relevant, and the impact of pre-treatment TTM severity and change in depressive symptoms are not consistent (Woods, Snorrason, & Epsil, 2012). Given the inconsistent maintenance of gains across treatment studies and across BFRBs, researchers who study TTM have endeavored to identify variables that impact long-term outcome. Some authors view CBT/HRT as incomplete treatments that fail to address internal experiences such as emotion and ER (Bate et al., 2011). In an effort to improve upon long-term outcomes from CBT/HRT trials, two research groups have published trials of treatments that include components designed to supplement CBT and directly target ER.

4.7.4. Acceptance and commitment therapy

Acceptance and commitment therapy (ACT; Hayes, Strosahl, & Wilson, 1999) is a treatment approach that discourages emotional control strategies and promotes acceptance of private events, including thoughts, emotions, and urges. ACT teaches clients to observe thoughts and feelings as objective external events, in order to gain awareness of the process of thinking and develop the ability to disengage from thoughts (Twohig, Hayes, & Masuda, 2006). Where BFRBs are concerned, the ACT model suggests that maladaptive body-focused behaviors may be used to avoid or alter unpleasant psychological experiences such as painful thoughts, emotions, or urges. The use of maladaptive behavior to avoid difficult private events is a core ACT concept known as experiential avoidance (Hayes et al., 1996). Previous research (e.g., Begotka, Woods, & Wetterneck, 2004; Norberg, Wetterneck, Woods, & Conelea, 2007) has provided evidence for the relationship between experiential avoidance and TTM and SP severity.

Four studies investigated the use of ACT or ACT-enhanced behavior therapy (AEBT) for BFRBs. Twohig and Woods (2004) evaluated a 7-week combined HRT and ACT protocol with six adults with TTM. The ACT portion of the treatment (four sessions) included (a) abandonment of strategies designed to control the urges to pull hair; (b) acceptance of urges to pull; (c) deconstruction of language (experiencing words as sound without meaning in order to help participants become less "fused" with their thoughts); and (d) review of personal values. In particular, sessions three and four focused on acceptance of difficult private emotional experiences. The HRT component (three sessions) included awareness training, competing response training, and social support, HP severity (as measured by the Massachusetts General Hospital Hair-Pulling Scale [MGH-HPS]; Keuthen et al., 1995) and experiential avoidance (as measured by the Acceptance and Action Questionnaire [AAQ]; Hayes et al., 2004) were evaluated pre- and post-treatment.

The results revealed a significant decrease in HP from pre- to post-treatment in four participants, with results maintained at follow-up for three of the four treatment responders. At post-treatment, the average decrease in HP severity was 63%; at follow-up, the decrease was 52%. Moderate improvements in the expected direction were observed for experiential avoidance scores, but the small sample size precluded statistically significant results.

Woods, Wetterneck, et al. (2006) conducted a randomized controlled trial comparing combined HRT and ACT for TTM to a wait-list control. The 10-session combined treatment was a slightly elaborated version of Twohig and Woods (2004); the objective of combining ACT and HRT was to test the possibility that decreasing experiential avoidance would produce decreases in HP severity. HP severity (MGH-HPS), experiential avoidance (AAQ), hair-pulling impact (National Institute of Mental Health Trichotillomania Impairment Scale [NIMH-TIS]; Swedo et al., 1989), and anxiety and depression (Personality Assessment Inventory [PAI]; Morey, 1991) were measured pre- and post-treatment. The results revealed a statistically significant reduction (45%) in overall MGH-HPS scores from pre- to post-treatment and an average 58% reduction in number of hairs pulled per day (as compared to a 28% increase in the wait-list group). A 13% reduction in experiential avoidance was observed, as were significant decreases in HP impact, anxiety, and depression. The decrease in MGH-HPS scores was not entirely maintained at 3-month follow-up, but the average number of hairs pulled per day remained stable from post-treatment to follow-up, indicating that some pulling reductions were maintained. Decreases in experiential avoidance, HP impact, anxiety, and depression were maintained. Once treated, the wait-list control group demonstrated similar decreases in experiential avoidance, HP, and NIMH-TIS ratings, although reductions in anxiety and depression were not observed. To evaluate the role of reduced experiential avoidance in reducing HP, the authors calculated change scores for both variables and conducted correlation analyses. The results revealed a moderate correlation between decreased experiential avoidance and decreases on the MGH-HPS scale, supporting the authors' hypothesis.

Flessner and colleagues (Flessner, Busch, Heideman, & Woods, 2008) explored the impact of ACT and HRT component sequencing in an AEBT protocol with five individuals with HP and SP using a 10-session intervention that incorporated the ACT and HR components described above. Component sequencing involves testing the impact of the order of treatment components; in this case, three participants received HRT followed by ACT and two others received ACT followed by HRT. HP and SP were measured with the MGH-HPS; experiential avoidance was not measured. The results demonstrated that AEBT reduced HP and SP in all five participants. Mean symptom reduction from pre- to post-treatment was 49.5% for SP and 65.3% for HP. Participants' response patterns varied somewhat according to treatment component sequence, and the authors concluded that it may be valuable to predetermine participants' primary HP or SP style (automatic versus focused) and tailor treatment sequence accordingly.

Finally, Twohig et al. (2006) implemented a preliminary trial of ACT for SP with five participants. The eight-session treatment included (a) data collection, treatment contract, and evaluation of urges; (b) work on decreasing urges to pick and efforts to control urges; (c) cognitive defusion and contact with the present moment; and (d) identification of personal values, review, and relapse prevention. SP severity was evaluated pre- and post-treatment using objective skin-damage ratings and the Skin Picking Impact Scale (SPIS; Keuthen, Deckersbach, et al., 2001). Experiential avoidance was measured using the AAQ.

The results revealed that four of the five participants decreased SP frequency over the course of treatment. Four participants reached near-zero levels of SP; one returned to near baseline level at follow-up,

and two showed increases in SP from post-treatment to follow-up, without reaching baseline levels. Only one participant maintained gains entirely. Three of five participants demonstrated large reductions in experiential avoidance from pre- to post-treatment, with continued or maintained gains at three-month follow-up. No information was provided about correlations between decreases in SP and decreases in experiential avoidance. The authors of the study concluded that ACT has the potential to effectively treat SP, but that additions or modifications to the protocol are required to enhance maintenance of gains.

Despite some limitations and some inconsistent results, data on the use of ACT to treat BFRBs indicate that experiential avoidance may be a variable of interest in the ER model for BFRBs; further tests of the ACT approach to treating BFRBs are warranted.

4.7.5. Dialectical behavior therapy

Dialectical behavior therapy (DBT; Linehan, 1993) is a CB approach based on the dialectic between validation/acceptance of client experience and helping clients change. DBT combines mindfulness and acceptance of uncomfortable or negative internal experiences with concrete, step-by-step skills and strategies for tolerating distress and regulating emotions (Linehan, 1993). Originally developed to treat individuals with Borderline Personality Disorder, DBT has been effective with a variety of conditions characterized by impulsivity and ER problems.

Keuthen and colleagues (Keuthen, Rothbaum, et al., 2010) conducted an open clinical trial of DBT with individuals with TTM. Ten female participants received an 11-week program of DBT-enhanced CBT/HRT. The protocol included (a) psychoeducation and self-monitoring; (b) competing response, stimulus control, and prevention training; (c) mindfulness training; (d) ER and distress tolerance training; and (e) relapse prevention. Three sessions focused directly on ER; six sessions focused on mindfulness skills and distress tolerance. Participants were assessed pre- and post-treatment with several clinician-administered measures of TTM and other psychopathology, including the NIMH-TIS. They also completed self-report measures of TTM and ER, including the MGH-HPS, the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), the Affective Regulation Rating (ARR)—a measure designed for the study—and the Generalized Expectancy for Negative Mood Regulation Scale (NMR; Catanzaro & Mearns, 1990).

Eight of 10 participants were full treatment responders (score of ≤ 2 on the Clinical Global Improvement Scale [CGI; Guy, 1976] and $\geq 35\%$ decrease on the MGH-HPS) post-treatment. HP severity on the MGH-HPS decreased significantly from pre- to post-treatment. Group total scores on impairment from TTM improved significantly from pre- to post-treatment, as did total scale scores on ER measures. Impairment from TTM, as measured by the NIMH-TIS, decreased significantly from baseline to post-treatment and remained stable over the 3-month maintenance period. Importantly given the history of non-maintenance of gains in individuals with TTM treated with CBT/HRT, participants' improved functioning was maintained or improved from post-treatment to the end of the maintenance phase (three months, including four booster sessions) and the two treatment non-responders became partial responders (score of ≤ 2 on the CGI or decrease $\geq 35\%$ on the MGH-HPS). CGI (not available at baseline) scores improved significantly from post-treatment to 3-month maintenance. At 3-month and 6-month follow-ups (three and six months after the maintenance period, respectively), all participants remained either full or partial treatment responders, despite some loss of treatment gains in ER and TTM symptoms (Keuthen et al., 2011).

Secondary analyses were conducted to determine the relationship between ER and TTM severity. Baseline ER and TTM severity were not significantly correlated overall, but change in HP severity correlated significantly with change in total score on the ER scales, and correlations between changes in capacity for ER and changes in TTM severity remained significant at 3-month and 6-month follow-ups (Keuthen et al., 2011). These results suggest that DBT-enhanced CBT/HRT produced significant change in both TTM symptoms and ER, and that these two variables may change together.

To more rigorously explore the use of DBT for TTM, Keuthen et al. (2012) subsequently conducted a randomized controlled trial comparing DBT-enhanced CB for TTM with a minimal attention control (MAC) comparison group. Twenty participants received 11 sessions of DBT-enhanced treatment; 18 were assigned to the comparison group. All participants completed measures of ER (DERS, ARR, NMR), HP severity and impairment (NIMH-TIS, MGH-HPS, and National Institute of Mental Health Trichotillomania Severity Scale [NIMH-TSS]), and experiential avoidance (AAQ).

The results indicated that DBT-enhanced CB treatment effectively decreased TTM severity and impairment, decreased experiential avoidance, and improved ER. Although gains in TTM severity and impairment were not entirely maintained, participants remained significantly improved at 3-month maintenance, 3-month follow-up, and 6-month follow-up. Significant differences between groups were observed for change in HP severity and impairment, and in change in ER capacity on the ARR, with the active treatment group improving more than the MAC group. The treatment group did not demonstrate greater change than the control group in experiential avoidance or in ER on the DERS or the NMR. The authors suggested that the AAQ, DERS, and NMR may not be the best measures of experiential avoidance and ER, for individuals with TTM, and hypothesized that the ARR better assesses the full range of emotional triggers potentially related to TTM.

No significant correlations were observed between change in ER scores and change in measures of TTM from pre- to post-treatment in the entire sample. However, change in DERS total scores from pre-treatment to 3-month maintenance were significantly correlated with changes in MGH-HPS and NIMH-TSS total scores during the same period. Change in ARR scores from pre-treatment to 3-month follow-up were correlated with changes in MGH-HPS and NIMH-TSS total scores during the same period. From pre-treatment to 6-month follow-up, changes in ARR scores were significantly correlated with changes in total scores on the MGH-HPS and NIMH-TIS. Marginally significant correlations between change in ER and change in TTM severity at various follow-up points were reported; the authors hypothesized that the increasing correlations between TTM severity and ER capacity over time may be attributable to increased emotional awareness as participants completed treatment.

Overall, the results of studies exploring the use of DBT-enhanced treatments for TTM indicate that this option is effective in producing improvement in both TTM symptoms and in capacity for ER. Limited correlations between changes in these two variables prevent us from concluding that addressing deficits in ER promotes improvement in TTM. However, the findings are overall congruent with the conceptualization of TTM and other BFRBs as a maladaptive ER mechanism, and indicate that further trials of DBT and other ER-based treatments for BFRBs are warranted. The results of treatment trials are summarized in Table 4.

4.8. Implications of research on the ER model

The present review and synthesis of the research on the ER model for BFRBs provides support for the key role of emotional variables in the initiation, reinforcement, and maintenance of BFRBs. The results of studies exploring psychiatric comorbidity and psychological symptoms in individuals with BFRBs indicate that this population suffers from greater comorbidity and more psychological symptoms than are observed in control populations. No causal direction can be confirmed, but such findings suggests that individuals with BFRB experience dysfunctional emotion regulation. The conclusions that can be drawn from the naturalistic studies described here are limited by the use of retrospective reports, but the results suggest that negative affective states precipitate or cue body-focused behavior. Relief from negative affective states seems to reinforce BFRB, although engaging in an episode of BFRB may subsequently trigger or increase the intensity of emotions such as

Table 4
Trials of ACT, ACT-enhanced HRT, and DBT-enhanced HRT for BFRBs.

Authors	BFRB	Samples	Design	Treatment components	Key results
ACT					
Flessner, Busch, et al. (2008)	HP and SP	Clinical ($N = 5$)	Comparison of component sequencing in 10-week protocol (HRT/ACT versus ACT/HRT)	Values, willingness, cognitive defusion, acceptance of urges, HRT components	All participants significantly reduced pulling/picking independently of treatment component sequence
Twohig et al. (2006)	SP	Clinical ($N = 5$)	8-Week ACT protocol	Values, mindfulness, acceptance of urges, cognitive defusion	4 of 5 participants significantly decreased skin-picking; only 1 maintained gains entirely; 3 of 5 participants reduced experiential avoidance, with maintained gains
Twohig and Woods (2004)	HP	Clinical ($N = 6$)	7-Week ACT/HRT protocol	Values, acceptance of urges, cognitive defusion, HRT components	3 participants significantly decreased hair-pulling; results maintained for 3 of 4 responders; non-significant decrease in experiential avoidance
Woods, Wetterneck, et al. (2006)	HP	Clinical; treatment ($n = 12$); control ($n = 13$)	10-Session ACT/HRT versus waitlist control	Values, acceptance of private events, cognitive defusion, HRT components	Treatment group significantly reduced hair-pulling and experiential avoidance; not all gains maintained
DBT					
Keuthen, Rothbaum, et al. 2010) and Keuthen et al. (2011)	HP	Clinical ($N = 10$)	11-Week DBT-enhanced CBT protocol	Mindfulness, distress tolerance, emotion regulation, HRT components	8 of 10 participants significantly reduced hair-pulling and improved emotion regulation); majority of gains maintained or improved at 3- and 6-month follow-up
Keuthen et al. (2012)	HP	Clinical ($n = 20$ DBT; $n = 18$ control)	11-Week DBT enhanced CBT protocol versus minimal attention control (MAC) condition	Mindfulness, distress tolerance, emotion regulation, HRT components	DBT group significantly decreased TTM severity and impairment, decreased experiential avoidance, and improved ER; majority of gains maintained over time; between-group differences reported in change in TTM severity and impairment, and in some measures of ER

shame or guilt. The results of studies that measured BFRB in experimental conditions collectively indicate that the behavior is differentially related to diverse emotions and affective states. Studies devoted to identifying emotions and contexts that put individuals with BFRBs at "high risk" for episodes of BFRB indicate that boredom, tension, anxiety and frustration may be particularly relevant; such findings may allow clinicians to develop interventions that target high-risk emotions.

The presence of BFRB subtypes (i.e., focused vs. automatic) and fluctuations in degree of awareness during an episode of HP, SP, and NB may imply that BFRBs are related to ER in some individuals and not others, or that ER is relevant in some but not all episodes of BFRB in a given individual. These findings (e.g., Flessner, Woods, et al., 2008; Walther et al., 2009) have significant implications for treatment. If ER is the function of focused BFRB, effective treatment will require a component designed to teach new methods of coping with painful emotion. That is, CBT/HRT may be an effective intervention for individuals whose episodes of BFRB are primarily automatic; however, individuals who engage in primarily focused HP, SP, or NB may benefit from treatments that directly address effective management of negative emotions or other difficult private experiences (Franklin, Zaggrabe, & Benavides, 2011). Finally, although treatment outcome data cannot conclusively answer questions about etiological models for BFRBs, the results of trials of ACT and DBT for BFRBs are promising and provide support for an ER component to BFRBs.

4.9. Recommendations for future research on BFRBs and ER

Although research on BFRBs has advanced significantly in the past two decades, the body of research presented here also has significant limitations. One of the primary limitations of studies of BFRBs is the lack of consensus regarding diagnostic criteria. This problem is particularly prevalent in research on SP and NB; the inclusion of SP in the upcoming DSM-5 should facilitate consistency across studies and allow research in this area to proceed in an organized and uniform fashion. The new classification of SP as Excoriation Disorder (Skin-Picking Disorder) will also facilitate awareness of this problem in psychiatric and dermatological settings.

Treatment outcome and experimental research constitute promising avenues for exploration of the ER model for BFRBs. First, results from trials of ACT and DBT for individuals with TTM and SP are encouraging, and indicate that acceptance and ER-based treatments, particularly in combination with standard CBT/HRT strategies, can decrease problematic body-focused behavior and improve ER. Replication of Keuthen and colleagues' trials of DBT for TTM (Keuthen, Rothbaum, et al., 2010; Keuthen et al., 2012), and trials of interventions that evaluate primary pulling or picking style (i.e., automatic vs. focused) and structure treatment accordingly are particularly warranted. Randomized controlled trials comparing treatments that focus on ER with standard CBT/HRT would provide gold-standard evidence for the role of ER in BFRBs.

Second, experimental studies would permit further investigation of specific emotions or states that may be particularly relevant to BFRBs. If frustration, impatience, dissatisfaction, and boredom are preferentially related to BFRBs, the frequency of the behavior should peak in experimental conditions designed to induce those emotions. Recent research has provided support for BFRBs as a method of regulating frustration and boredom (e.g., Duke, Keeley, Ricketts, et al., 2010; Teng et al., 2004; Williams et al., 2006), but this model warrants investigation in a clinical population.

Third, the dimensions of automatic and focused HP and SP (Flessner, Woods, et al., 2008; Walther et al., 2009) have been supported, but further exploration of BFRB subtypes is warranted. In combination with the identification of individual "high risk" emotions, investigation of individual subtypes (focused vs. automatic) would permit the development of treatments designed specifically to address individual's diverse and idiosyncratic presentation of BFRB.

A fourth direction for future research is further exploration of the role of emotional variables in BFRBs other than TTM. Although some correlational and experimental research supports the ER model for SP and NB, the majority of research on BFRBs focuses on TTM. The existence of concrete diagnostic criteria facilitates research, and the greater

attention paid to TTM is probably a function of this disorder's inclusion in the DSM. Some authors (e.g., Snorrason et al., 2012; Teng et al., 2002) have argued that BFRBs are best conceptualized as a cohesive group of disorders, but some BFRBs (e.g., neck-cracking, teeth-grinding) have not been explored and could benefit from investigation. In particular, it would be interesting to explore whether or not the dimensions of focused and automatic behavior are present in other BFRBs and whether or not these dimensions correspond respectively to efforts to regulate emotion and simple habits, as hypothesized. Research on the etiology of BFRBs other than TTM, SP, and NB could yield information that would allow this group of disorders to be appropriately defined and subsequently included in future versions of the DSM. Inclusion in the DSM would in turn facilitate differential diagnosis of BFRBs other than TTM and SP, and would allow future research on BFRBs to proceed in an organized, integrated, and efficient manner (Teng et al., 2002).

5. Limitations of psychological models

The CB and ER models provide an explanation for the presence and/or maintenance of BFRBs, but do not account for the initial development of the behaviors. That is, the ER and CB models both explain how BFRBs are maintained by relief from unpleasant thoughts and emotions but do not explain why, in the face of discomfort, distress, desire for distraction, or other triggers, individuals pull out hair, pick skin, or bite nails rather than engaging in constructive behavior (e.g., physical exercise) or in alternative destructive behavior (e.g., binge eating, binge drinking). Penzel's (2002) SR model provides a biological rationale for the original development of BFRBs that accounts for automatic and focused subtypes; integration of the SR model or of biological or neurological models with the ER or CB models could provide a more complete explanation for the development and maintenance of BFRBs.

A second limitation of the models presented here are that they do not address certain cognitive elements related to BFRBs, such as perfectionism (e.g., unrealistic standards and expectations), and beliefs about actions and about self-control (e.g., O'Connor, Laverdure, Roberts, Goulet, & St-Pierre-Delorme, 2010). Although the CB model incorporates thoughts as triggers or as cues for episodes of BFRB, core beliefs and personality factors are not addressed. The addition of cognitive factors to psychological models could result in a more comprehensive and complete account of BFRBs.

Finally, as discussed above, questions remain about the applicability of the ER model and other psychological models to BFRBs such as NB, knuckle-cracking, and neck- or jaw-cracking; research on BFRBs other than HP, SP, and NB is necessary.

6. Limitations of the review

Several limitations of the present article must be acknowledged. First, in order to thoroughly review a specific body of research, this review addresses only psychological models for BFRBs, and does not discuss ethological or neurobiological models. Comparison of various types of etiological models constitutes a valuable exercise in identifying the model that best corresponds with the current research evidence about BFRBs, and future research should endeavor to develop this comparison. Second, the present article focuses on TTM, SP, and NB to the exclusion of other BFRBs such as teeth-grinding, knuckle- and joint-cracking, and skin-scratching, among others. The number of BFRBs addressed in the present article was limited and drew on the available research, but a wider exploration of BFRBs is indicated.

Despite these limitations, the present compilation and synthesis of the available scientific research about ER and BFRBs constitutes a significant contribution to the literature in this area. Research about emotional variables related to BFRBs is limited but growing; the increased attention to emotional variables on the part of researchers in this area may reflect recognition that CBT/HRT for BFRBs has not yielded consistent results. Further, the current popularity of acceptance-based treatments has prompted both clinicians and researchers to reconsider the roles of emotional expression and avoidance in maladaptive behaviors; the recent focus on emotions in research on BFRBs may reflect a general shift in the field of clinical psychology. Despite limitations in the current body of research about BFRBs, the results of research on ER and BFRBs to date allow us to safely conclude that emotional variables play a significant role in BFRBs.

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