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Psychological Treatment of Tourette Syndrome

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Tourette's disorder, commonly referred to as Tourette Syndrome (TS), is a neuropsychiatric disorder characterized by multiple motor and vocal tics (APA, 2013). Although pharmacotherapy has historically been considered the first-line intervention for treating tics and remains the most widely used treatment modality, treatment gains are usually modest and many individuals experience treatment-limiting side effects or prefer a nonmedical approach to treatment. Fortunately, behavioral interventions have emerged as an effective alternative for those who cannot tolerate the most effective medications, as an adjunct to medication, or for those who prefer a nonmedical approach to treatment. In this chapter, we describe the current state of evidence-based psychological approaches for the treatment of TS and tics with emphasis on a multicomponent behavioral treatment known as Comprehensive Behavioral Intervention for Tics (CBIT). We also briefly review the application of an adapted version of exposure and response prevention (ERP) as an emerging approach to the treatment of tics that has shown promise in preliminary studies.

Because this chapter focuses exclusively on treatment, it is important to note from the outset that readers are likely to benefit the most if they have a prerequisite understanding of the phenomenology of tics and premonitory urges, the natural course of TS and tic disorders, and the assessment and differential diagnosis of TS and associated comorbid conditions. Other reviews of tic disorders within this series and elsewhere (see Himle & Hayes, 2014) are recommended readings.

Overview and Rationale for a Comprehensive Behavioral Intervention for Tics (CBIT)

The Early Habit Model of Tics

The idea that tics can be successfully managed using behavioral techniques is not new. As early as 1973, psychologists Nate Azrin and Greg Nunn proposed a behavior-analytic model that likened tics to other problematic "nervous habits," such as hair pulling, nail biting, and skin picking (Azrin & Nunn, 1973). The original habit model

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proposed that tics, along with other problematic habitual behaviors, begin as normal reactions to injury, stress or emotional trauma that persist long after the injury or trauma has passed and/or have been altered in form or frequency to a problematic level. It was also argued that because tics occur with high frequency and regularity, they become blended and incorporated into normal ongoing behaviors that are strengthened through automatic and social reinforcement (e.g., removal of tension or premonitory urges, social reactions). As a result, tics become overlearned (i.e., automatic) behaviors that are performed outside of the individual's awareness and thus cannot be easily inhibited.

Although Azrin and Nunn's (1973) view of the underlying cause of tics has failed to garner empirical support and has been largely rejected in favor of a neurobiological model of etiology (Singer, 2005), it did lay the groundwork for our current understanding of how tics can be shaped in frequency, form, and intensity through internal (i.e., private) and external (i.e., social) reinforcement contingencies. It also led to the development and testing of a set of behavioral techniques, referred to as habit reversal training (HRT), designed to help the individual become more aware of each instance of the tic and interrupt its performance, thereby decreasing tic frequency and intensity.

Although several decades of research have provided strong support for the efficacy of HRT for reducing tics, dissemination and utilization have been surprisingly slow among interdisciplinary treatment providers as well as families and patients who might benefit from this treatment modality. Recent large surveys of parents ($N=487$) and adults ($N=465$) with tic disorders found that only 7% of children/parents and 4% of adults reported having received HRT and only 16% and 8% of children/parents and adults, respectively, reported having received any form of behavior therapy (Woods, Conelea, & Himle, 2010). In contrast, the same study found that 83% of children/parents and 93% of adults reported having been treated with medication. Although the exact reasons for this are unclear, it is likely due in part to concerns among medically focused treatment providers that the promotion of behavior therapy ignores the strong evidence showing that tics have a neurobiological origin in favor of unsupported psychological models such as the traumatic response etiology proposed in Azrin and Nunn's (1973) habit model (Scahill et al., 2013). Such focus on a purely psychological model of etiology likely contributed to the proverbial throwing of the baby (HRT) out with the bathwater.

The Integrative Behavioral Model of Tics

More recently, HRT has been incorporated into a more comprehensive integrative behavioral model that takes into account both biological and environmental factors in understanding the cause and course of tics (Woods et al., 2008). In contrast to Azrin and Nunn's (1973) habit model, the underlying assumption of the integrative behavioral model is that although the exact genetic and neurobiological dysfunctions that give rise to tics remain unknown, there is considerable evidence that tics have a biological etiology (Singer, 2005). However, one still cannot ignore the substantial body of evidence also suggesting that once tics are performed, their frequency, form, and intensity are shaped by internal (i.e., psychological) and external (i.e., social) factors (Himle et al., 2014; Silva, Munoz, Barickman, & Friedhoff, 1995).

The idea that tics are influenced by psychological and social factors is not new. Even the earliest case reports by Gilles de la Tourette and others acknowledged the tendency for tics to fluctuate contextually – seemingly in response to the patient's demeanor (e.g., nervousness), as well as in response to contexts and interactions (Lajonchere, Nortz, & Finger, 1996; Rickards, Woolf, & Cavanna, 2010). As noted above, Azrin and Nunn's habit model also proposed that tics are influenced by internal processes (e.g., tension reduction) as well as social interactions and they incorporated specific procedures into HRT in part to extinguish social reinforcement for tics (Azrin & Nunn, 1973).

Based on the idea that tics have a neurobiological etiology, yet are shaped in form, frequency, and intensity by learning processes, the integrative behavioral model outlines a comprehensive (albeit still incomplete) explanation for how internal and external factors might account for some of the variation in tic presentation observed both within and between individuals. Specifically, the integrative model emphasizes two classes of variables shown to influence tics: antecedents and consequences. Antecedents are the collection of contextual variables or stimuli that precede tics and are associated with an increased likelihood that a tic will occur (Woods, Walther, Bauer, Kemp, & Conelea, 2009). These variables can be either social or private. Social antecedents include particular settings, people, or activities that are associated with a worsening of tics. For example, an individual's tics may occur more or less frequently than usual when at school or work, when around a particular person, or while engaged in specific activities such as talking in front of others, playing videogames, or completing schoolwork (Himle et al., 2014). Private antecedents are those that are not directly observable by others. Examples include premonitory urges, mood states (e.g., anxiety, excitement, anticipation, anger), and specific thoughts (e.g., "I hope I don't tic because people will notice and comment") that increase the likelihood that a tic will occur or will increase tic frequency and intensity.

In contrast to antecedents, consequences are social or private reactions that occur *after* tics (i.e., contingent upon tics) that shape the frequency, form, or expression of the tic in the future. As an example of how social consequences can impact tics, several experimental studies have shown that some individual's tics can be exacerbated by tic-contingent attention (Lahey, McNees, & McNees, 1973; Watson & Sterling, 1998) and/or escape from tasks (Dufrene et al., 2013). This is not to say that an individual is tic-ing purposely in order to obtain attention or avoid a difficult task, but rather that these consequences can alter the frequency and form of tics whether or not the individual recognizes the contingency is in place. Private contingencies typically include alterations in internal states (e.g., a calming effect when excited or nervous) or the reduction of a premonitory urge. This later phenomenon is referred to as the "urge-reduction" hypothesis and refers to that fact that some individuals experience an escalating premonitory urge that builds up prior to performing a tic and that is alleviated when the tic is performed (Evers & van de Wettering, 1994). This pattern is believed to strengthen tics through negative reinforcement much in the same way that OCD-related compulsions are believed to be reinforced by the reduction of anxiety associated with obsessions (Houts, 2005).

Based on this model, a more comprehensive and expanded version of HRT, referred to as Comprehensive Behavioral Intervention for Tics (CBIT), has been developed and tested in large randomized controlled trials of children and adults with TS (Piacentini et al., 2010; Wilhelm et al., 2012). The overarching rationale for CBIT is

that if the environmental (i.e., behavioral) factors that are responsible for tic exacerbation and fluctuation can be systematically identified, a patient may be able to modify his or her environment and/or learn a specific set of skills to reduce the frequency and forcefulness of tics. Expanding upon the early work of Azrin and Nunn (1973), CBIT combines HRT with psychoeducation, relaxation training, and a collection of function-based techniques to systematically address both internal and external tic-exacerbating variables. Below we provide detailed descriptions of each of the primary components of the CBIT protocol.

Components of the CBIT Protocol

Psychoeducation

Prior to beginning CBIT, it is important that the patient and his or her family have a thorough understanding of TS and tics and understand the rationale for a behavioral approach to treatment. While psychoeducation is considered commonplace in most psychological therapies, it is particularly important when treating TS. Although our understanding of TS has improved considerably, stereotypes and misunderstandings persist. For example, the media still often portrays TS as the "swearing disease" despite the fact that coprolalia (inappropriate vocal tics) is a relatively uncommon symptom in TS and is not a diagnostic requirement (APA, 2013). Similarly, it is not uncommon for patients to report that they have been told that they do not have TS because they do not have associated comorbidity (e.g., ADHD or OCD) or to have received mixed messages about whether certain symptoms are actually tics versus some other problem such as noncompliance. Psychoeducation about tic disorders can help to clarify these misunderstandings and can alleviate stigma and blame.

Another reason that psychoeducation is important when treating TS is that it affords the therapist the opportunity to address any misbeliefs or reservations the patient may have about a behavioral approach to treating tics. It is not uncommon for patients to have been told that targeting tics with behavioral techniques will lead to symptom substitution (replacing one tic with another) and worsening of tics following attempts at suppression (the rebound effect), neither of which has empirical support. Finally, providing a thorough rationale for treatment ensures that the patient is "on board" with a behavioral treatment approach. We often find that when we describe the integrative model to patients, emphasizing the idea that tics have an underlying biological cause yet are affected by factors in the patient's day-to-day environment, they express that they finally feel that someone really understands both their public and private experiences with TS, which can facilitate motivation and compliance with treatment and foster a strong therapeutic alliance between the therapist and patient. Although psychoeducation is often done formally at the first session, it is best viewed as an ongoing process that continues throughout the course of treatment.

Function-based Assessment and Intervention (FBAI)

Although FBAI has long been a staple of behavior analytic treatment for reducing problematic behaviors (Hanley, Iwata, & McCord, 2003), its application to tics is relatively new. The purpose of FBAI is to systematically identify and alter antecedents

and tic-contingent consequences that exacerbate tics (Himle et al., 2014; Woods et al., 2008). To begin, the therapist interviews the patient (and the parent in the case of a child patient) about any situations that reliably produce tic exacerbations. In addition, patients and parents are asked to monitor and record throughout the week any specific times, activities, or places in which their tics were particularly frequent or forceful, paying particular attention to where they were, what they were doing, who else was present, and what or how they were thinking or feeling. If tic-exacerbating situations are identified, the therapist and patient work together to identify any commonalities associated with exacerbations, such as particular settings or activities, the presence of certain people, or common mood states or thoughts. Some patients will find that they are able to generate a long list of tic-exacerbating factors whereas others will not. Why some patient's tics are more reactive to environmental cues than others remains unclear.

When tic-exacerbating factor are identified, the next step is to assess for potential consequences that could be reinforcing the tic. The therapist assesses this by asking the patient (or parent or teacher) to pay particular attention to how others react to his or her tics. Reactions that exacerbate tics can generally be subsumed under two categories- attention and escape. Examples of tic-exacerbating attention include glances or comments from others, snickering or shushing, teasing, being told to stop tic-ing, or even positive reactions such as comfort and encouragement (Himle et al., 2014). As an example of escape, a common scenario for children is that they are instructed or allowed to leave the room during a tic-exacerbation in order to "get their tics out." While there is no empirical basis for the notion that "getting tics out" has any immediate benefit or reduces tics, such breaks can be helpful for some children. However, when this pattern emerges, the therapist should carefully consider what the child is doing during the breaks. For example, if the child is escaping to a more preferred task, such breaks could actually be contributing to a worsening of tics. In addition, it is often the case that "tic breaks" are encouraged in response to a tic exacerbation, which raises the question of why the exacerbation happened in the first place. For example, it is possible that the child is having an exacerbation because he or she is anxious, stressed, being teased, or is having trouble with a particular educational task. Each of these might suggest different interventions (e.g., stress reduction, peer interventions for teasing, or remedial education and assistance) that will negate the need for tic breaks and keep the child engaged in the task at hand.

If the therapist and patient are able to identify specific antecedents and consequences that are associated with tic exacerbations, they can then use this information to collaboratively develop function-based treatment strategies. Simply put, the goal is to minimize or eliminate antecedents and consequences that make tics worse. If it is not possible to eliminate a certain antecedent or consequence, the patient is encouraged to use other treatment strategies, such as HRT or relaxation skills (described below) when in a tic-exacerbating situation. A sample of common tic exacerbating antecedents and consequences, along with examples of strategies for addressing each, is provided in Table 53.1. It should be noted, however, that while FBAI can help to reduce tic exacerbations, the focus should be on identifying *problematic* exacerbations. Even though some tic-exacerbating antecedents or consequences cannot be realistically or easily altered, they can sometimes be avoided in situations for which an exacerbation would cause a problem for the patient. For example, talking about tics has been shown to increase tics in some individuals

Table 53.1 Examples of function-based treatment recommendations for common tic-exacerbating antecedents and consequences

Tic-exacerbating situation	*Sample function-based recommendations*
Videogames	• Limit time spent playing videogames and/or to times when an exacerbation would not be problematic. • Take break from videogames to practice HRT, then allow additional playing time as a reward for effort.
Presence of a particular person	• Carefully examine how that person reacts to tics (consequence) and make appropriate consequence-based recommendation (see below). • Practice HRT while in the presence of that person.
Stress	• Teach relaxation or other stress/anxiety management skills.
When tired	• Establish good sleep hygiene and bedtime routine.
Anticipation	• Develop a consistent schedule. • Give child advanced warning of schedule changes. • Encourage follow-through with activities regardless of tic exacerbation.
After school	• Allow child 15–20 minutes of free time before making demands (e.g., homework), then follow-through with regular routine. • Schedule HRT homework time for immediately after school.
When told to try to stop tic-ing or teasing	• Educate others about tics, with emphasis on the fact that they are involuntary as well as how they can be worsened by reactions. • Teach the patient how to educate others about tics and encourage self-disclosure to others. • Implement parent, peer, or sibling intervention with emphasis on ignoring tics.
Before or during difficult or nonpreferred tasks	• Determine why task is difficult (e.g., a particular subject in school) and provide assistance or remedial intervention. • Encourage additional practice with task (e.g., giving a speech). • If "tic breaks" are necessary, for example, leaving the school classroom, bring school work with and complete it. Ensure follow-through with task after break. • Reduce demands initially (but cautiously) and re-introduce gradually.

Note: These are just a few examples of commonly used function-based recommendations. For a more comprehensive list see Woods et al. (2008).

(Dufrene et al., 2013; Woods, Watson, Wolfe, Twohig, & Friman, 2001). While it is indeed sometimes necessary to talk about tics, such discussions should take place at a time when an exacerbation would not be problematic. In addition, some exacerbations simply must be tolerated until the patient learns better tic management skills. For example, suggesting that the patient eliminate holidays, vacations, or videogames because they exacerbate tics is not likely to be well received by the patient. On the other hand, these can be good opportunities to practice using other tic management skills, such as HRT.

Relaxation Training

Given that anxiety and stress have been shown to worsen tics in most individuals (Silva et al., 1995), relaxation training is included as a primary component of CBIT. While relaxation training has not been shown to be an efficacious stand-alone treatment for tics (Bergin, Waranch, Brown, Carson, & Singer, 1998), it has been shown to reduce anxiety and stress (Manzoni, Pagnini, Castelnuovo, & Molinari, 2008) and can therefore indirectly reduce tics, at least temporarily. In addition, tics can often make muscles tight and tense, which can exacerbate tics and cause other difficulties such as tension headaches and muscle aches. Relaxation training can help to reduce the patient's overall level of tension. The two types of relaxation exercises typically taught in CBIT include diaphragmatic breathing and progressive muscle relaxation. Numerous instructional books, procedural protocols, and multimedia aids are available to assist the reader in conducting relaxation training (Davis, Eshelman, & McKay, 2008; Pincus, 2012), so these procedures will not be described in detail here.

Habit Reversal Training (HRT)

As noted above, HRT is a collection of behavioral techniques designed to increase a patient's awareness of discrete occurrences of a targeted tic and then interrupt the tic so that it is no longer part of a normal chain of behavior. Although the HRT protocol has undergone several iterations over the past half-century (Woods & Miltenberger, 1995), it generally consists of four primary therapeutic techniques: awareness training, competing response training, habit control motivation, and generalization training (Azrin & Nunn, 1973). The treatment protocol is designed such that all of the elements of HRT are applied to each of the patient's tics separately and the patient is assigned practice with HRT techniques between each session. Although it is customary to conduct weekly sessions and to address one tic each week, it is important to note that HRT activities build upon each other and require consistent practice on the part of the patient to be effective. Because there is considerable individual variability in motivation, compliance, and treatment response, it is important for therapists to take a flexible approach to treatment course. For example, as described below, a patient's ability to successfully use a competing response to consistently interrupt tic occurrence will depend upon his or her ability to detect discrete instances of the tic on moment-to-moment basis (i.e., his or her mastery of awareness training). While some patients are able to master awareness training very quickly, often during a single session, others (especially children) might require considerable practice thus requiring multiple sessions to address a single tic. Introducing competing response training too early, before awareness training is mastered, is a common mistake and is likely to frustrate the patient and can lead to treatment failure. In addition, even for those patients who master HRT quickly, some tics are likely to be more resistant to treatment than others and thus may require more than one session/week to address.

Describing and Prioritizing Target Tics

Prior to beginning HRT, the patient and therapist work together to come to agreement about which tic to address first and the order in which remaining tics will be targeted in treatment. As most individuals present with multiple tics, the first step in this

process is to generate a list of the patient's current tics along with a detailed description of each. The descriptions, which are based on both client report and clinician observation, include as much detail as possible regarding the sequence of movements and the muscles involved in the tic from start to finish, as well as any associated premonitory urges. Any variations in the expression of the tic are also be noted as this can provide important information later in treatment when choosing an appropriate competing response.

After a complete list of target tics has been generated, the client is asked to rate each of them in terms of how bothersome they are on a day-to-day basis (we prefer to use a 0–10 subjective units of discomfort scale). The tics are then ranked from most to least bothersome hierarchically. As a general rule of thumb, it is preferable to begin by working on the most bothersome tic, which may or may not be the most frequent, forceful, or noticeable. However, other factors such as the frequency with which the tic occurs and whether the form of the tic is one that lends itself to teaching HRT to a treatment naive client are also considered. Some tics, such as eye blinking and darting, blocking tics (i.e., tics that involve difficulty *initiating* a movement or vocalization), and "sensory tics" (i.e., tics that have a strong urge component with only subtle observable motor component), though amenable to HRT, are often more difficult to address than tics that involve major muscle groups and are easily observed (e.g., head jerking, tics involving the limbs). Likewise, a tic that does not occur in session or occurs with relatively low frequency offers few opportunities for the client to practice HRT, both in session and between sessions. In such cases, these tics are usually saved for later in the course of treatment, after the patient has mastered HRT. In some cases, multiple tics may be topographically similar enough that they can be addressed simultaneously or are best addressed in successive sessions because of the similarities in how HRT will be applied. For example, various vocal tics that involve exhalation out the mouth (e.g., a grunting tic and a throat clear) can often be addressed using the same competing response (as described below). In summary, prioritizing which tics to address first should be a mutual decision between the client and the therapist with the goal of maximizing the likelihood of initial success in therapy, which can aid in treatment engagement and motivation.

Awareness Training (AT)

After the patient and therapist agree on the order in which tics will be addressed in treatment, AT for the first target tic is introduced. The rationale for AT is that tics tend to occur with such high frequency and regularity that they become blended with normal movements and are performed automatically and outside of the individual's immediate awareness. To be clear, most (but not all) individuals are aware that they "have tics," but most individuals, especially young children as well as those who have had tics for many years, are relatively poor at detecting exactly when, where, or how often specific tics occur. To illustrate this point, it is not uncommon to encounter a situation in which a patient reports during a clinical encounter that a particular tic has not occurred recently, despite the fact that the clinician is observing the patient tic repeatedly during the interview. Likewise, it is common for a caregiver and child to disagree vehemently over how often a particular tic is occurring on a day-to-day basis.

The goal of AT is not to simply assess whether the patient knows he or she "has a particular tic" or generally knows when or how often he or she is tic-ing (a lot, a little, etc.), but rather to use a specific set of techniques to help the patient recognize discrete instances of a particular tic as he or she goes about daily activities. Three primary techniques are used to help an individual become more aware of discrete tics. These include: (1) self-monitoring, (2) response description, and (3) response detection, each of which is described below. Although some parents and patients may express concern that increasing awareness of this nature will result in an increase in tics, several studies have shown that although AT is not considered an effective stand-alone treatment for tics, many individuals will show a transient *decrease* in overall tic frequency and intensity following AT (Peterson & Azrin, 1992) and that exacerbations following AT are uncommon and are rarely problematic.

The first step in AT is to teach the patient to self-monitor his or her target tic throughout the day, across multiple settings and activities, and to record each instance of the tic in a small notebook or other recording device, such as a smartphone. The patient is also instructed to conduct a period of focused self-monitoring (e.g., 30–60 minutes) at a dedicated time each day during which they can focus their attention on the targeted tic. The information gathered during self-monitoring provides useful data regarding the frequency of the targeted tic outside of the clinical setting and can be used to track treatment progress and inform treatment implementation and progression. Self-monitoring also encourages the patient to attend to when and where the target tic is occurring, which itself can increase awareness. Finally, whenever possible, a support person, such as a parent or spouse, is asked to independently monitor each of the patient's tics as they progress through treatment, especially during the focused self-monitoring periods. In addition to providing an additional source of information about the frequency of tics, the level of correspondence between the patient and support person can be used as an index of the patient's level of awareness for the tic being targeted in treatment.

After the patient is taught to self-monitor his or her tics, the therapist and patient begin in-session AT activities, the first of which is response description. In response description, the patient is asked to describe, in as much detail as possible, each movement and sensation involved in the tic. While some patients are able to offer rich and detailed descriptions of their tic from the outset, most patients will initially offer a superficial description of the tic based on the way it looks or sounds to an outside observer, such as "I jerk my head back" or "I make a grunting sound." In most cases, such descriptions capture only a small portion of the movements and sensations that are involved in actually producing the tic. To facilitate a more detailed description of the tic, the therapist asks the patient to sit and attend to his or her tic (often with their eyes closed) or watch him- or herself in a mirror and notice all of the muscle movements involved in the tic. He or she is also asked to notice internal sensations such as urges, tensions, etc. If the patient is not actively tic-ing in session, he or she can be asked to simulate the tic as accurately as possible. It is sometimes also helpful to ask the patient to describe the tic, step-by-step, in enough detail that the therapist can accurately simulate the tic. By simulating the tic, the therapist can introspect on his or her own behavior to note what muscle contractions and movements are required to produce the tic and share this information with the patient.

During the response description process, patients often learn that their tics involve a much more complex and nuanced set of actions than what was originally reported.

For example, the patient might come to realize that what was initially described as a "head jerking" tic involves first moving his or her chin toward the sternum causing a stretching in the back of the neck, followed by forceful contraction of the muscles in the back of the neck, which results in rapidly tilting his or her head backward (lifting the chin) while throwing the shoulders back, and simultaneously raising the eyebrows before returning his or her head and shoulders back to normal. For vocal tics, patients often come to realize that although they describe the tic by how it sounds (i.e., its meaning to others), the production of the tic actually involves a series of movements such as inhaling/exhaling through the mouth or nose, contraction of the stomach and back muscles, movements of the mouth and face, etc. Patients might also come to recognize particular sensations associated with vocal tics such as the feeling of air flowing in and out of the mouth or nose. Most often, the actual sound or meaning of the tic is largely irrelevant to how the tic is actually produced. In addition, a patient might (but not always) notice that the tic begins with a premonitory urge or tension, either localized to the muscles involved in the tic (e.g., in the back of the neck) or more generally throughout the body, which is temporarily alleviated upon completion of the tic. Each of these movements and sensations can be thought of as "links" in a "tic chain" in which the first link is the very first movement, sensation, or urge that signals the tic is about to occur and the last link is completion of the tic and/or temporarily relief of a premonitory urge. Throughout the response description process, the therapist keeps a written record of each of the components of the "tic chain" so that additional "links" can be added as the patient progresses through HRT.

After a patient has generated a detailed description of all of the movements, sensations, and urges involved in the tic, response detection is introduced. The purpose of response detection is to teach a patient to recognize each and every instance of the targeted tic as early as possible in the tic chain. To conduct response detection, the therapist sits across from the client and asks him or her to indicate (by raising a finger) each time a tic occurs or as soon as he or she notices the earliest link in the tic chain (e.g., a premonitory urge). Each time the patient correctly indicates that a tic has occurred, the therapist offers praise and encourages the patient to continue to try to catch the tic as early as possible. If the patient fails to recognize the tic, the therapist indicates the "miss" by raising his or her own finger and again offers encouragement. This process continues until the patient is able to correctly identify several consecutive tics, ideally before the tic occurs or very early in the tic chain, or until the therapist is satisfied that the client has good awareness of the target tic. As a general rule of thumb, it is recommended that the client is able to *independently* detect at least 80% of his or her tics across a 10–20-minute period or 10 consecutive tics in the case of low-frequency tics.

As noted earlier, a patient's ability to consistently detect discrete instances of a target tic is a prerequisite for the remaining components of HRT. In our experience, insufficient awareness is the one of the most common pitfalls to successful HRT, so it is best to be conservative when making a decision about whether the patient has mastered AT. If a patient is having difficulty detecting tics, it is advisable to send them home to self-monitor and practice AT (along with a social support person, if possible) before introducing the remaining elements of HRT. In addition, the goal of AT is to help the patient gain better awareness of his or her tics throughout the day while engaged in routine activities. To facilitate this, response detection is conducted while

Table 53.2 Summary of awareness training (AT)

1. Provide rationale for AT	Describe the rationale for AT. Address any concerns the patient might have that focusing on tics may cause tics to worsen.
2. Response description	Ask the patient to describe, in as much detail as possible, each of the movements and sensations involved in producing the target tic, using a mirror if necessary. If patient is not tic-ing in session, ask patient to simulate tic. Record details of the "tic chain."
3. Response detection	While having a conversation, ask the patient to indicate each time a tic occurs or is about to occur with an emphasis on catching the tic as early as possible in the tic chain. If patient misses a tic, point out the "miss." Continue until patient is able to independently catch 80% of tics across a 10–20-minute period or the therapist is satisfied that the patient has good awareness.
4. Self-monitoring	Ask client (and parent in the case of a child) to self-monitor tics throughout the day as well as during focused 30–60-minute practice sessions at least a few times each week.

engaging in conversation (or playing a game with a child), which tends to be a much more difficult task than detecting tics when free from distraction (Table 53.2).

Competing Response Training (CRT)

After the patient has achieved sufficient awareness of his or her target tic, CRT is introduced. The purpose of CRT is to teach the patient to engage in a behavior that is directly incompatible with performance of the tic (i.e., a competing response, CR) as early as possible in the tic chain, ideally when the patient detects that a tic is about to occur, in order to interrupt the tic mid-performance or prevent its occurrence. Importantly, it is essential that the CR be used *contingent upon* the earliest tic warning sign (i.e., a premonitory urge or the earliest possible movement in the tic). Using the detailed description of the tic ascertained during AT, the therapist and patient select a CR that (1) is directly incompatible with the earliest movements in the tic chain, (2) is less socially noticeable than the tic itself, (3) can be performed for several minutes, and (4) can be performed across most settings and activities. For tics that are particularly complex, orchestrated, or involve multiple muscle groups (e.g., a tic that begins with head rolling followed by extension and twisting of the arms), it is recommended that the CR be incompatible with the initial tic movement (in this case the head roll) as preventing the earliest movement in the tic chain generally prevents the rest of the tic from being expressed. Examples of CRs for common motor and vocal tics are provided in Table 53.3.

After an appropriate CR has been selected, the patient is instructed to practice using the CR whenever he or she detects that a tic is about to occur, or as early in the tic chain as possible, and to continue using the CR for at least a minute or until the urge to tic subsides (whichever is longer), which in our experience can range from a few seconds to several minutes or longer. Using procedures similar to those described in the response detection portion of AT above, the therapist and patient sit across from each other while the patient practices using the CR. When the patient is observed using the CR, the

Table 53.3 Examples of competing responses (CRs) for common motor and vocal tics

Tic	*Competing response*
Eye blinking	Controlled, intentional blinking at a rate slightly slower than typical (approximately one blink every 1–2 seconds).
Eye darting	Direct gaze to specific object in the room and engage in controlled blinking as described above.
Face grimace	Pull upper lip down placing it gently between upper and lower teeth. Raise eyebrows slightly.
Backward head jerking	Rotate forehead slightly forward, gently tense muscles of front side of neck.
Foreword head jerking	Rotate forehead slight back, gently tensing muscles in back side of neck.
Upward shoulder shrug	Pull shoulders down, pin elbow to hip.
Lateral arm jerk	Pin elbow to hip, place hands in lap.
Vocal tic involving inhalation through nose (e.g., sniff, grunt)	Reverse air pattern involved in the tic using controlled breathing in through the mouth (count 2–3 seconds on inhale), pause (1 second), out through the nose (count 2–3 seconds on exhale).
Vocal tic involving inhalation through the mouth (e.g., gasping)	Reverse air pattern involved in the tic using controlled breathing in through the nose and out through the mouth using the counting schedule described above.
Vocal tic involving exhalation through the mouth (e.g., saying words or parts of words)	Reverse air pattern involved in the tic using controlled breathing in through the mouth and out through the nose using the counting schedule described above.

Note: These are just a few examples of commonly used CRs. There is not a single correct CR for any given motor or vocal tic. Rather, the therapist should use the procedures for selecting a CR outlined in this chapter (also see Table 53.4). For a more comprehensive list of CRs, see Carr (1995) and Woods et al. (2008).

therapist provides descriptive praise and encouragement. When the therapist observes the target tic in the absence of the CR, or if the patient releases the CR before the requisite 1 minute has passed, the therapist prompts the patient to use the CR.

For patients who report the presence of a premonitory urge, it is also useful for the therapist to elicit periodic urge ratings (we use a 1–10 scale) to assess changes in urge strength during CR practice. This allows the therapist to assess the rate of urge habituation during and between sessions, which is an important indicator of treatment progress. In addition, many patients express skepticism that their urges will decrease and are surprised to learn that they will indeed habituate if the CR is used continuously, which is an important learning experience for many individuals and often serves to increase their motivation to use the CR regularly. Finally, monitoring urge ratings can help to alert the therapist if the patient releases the CR before habituation has occurred so that he or she can prompt the patient to continue to use the CR for a longer period of time. It is important to note, however, that for some individuals, urges do not dissipate completely when the CR is used. In these cases, the patient is asked to continue to use the CR until the urge reaches a manageable level; that is, the urge has reduced enough that they can discontinue using the CR without immediately performing the tic.

Table 53.4 Summary of competing response (CR) training

1. Select an appropriate competing response for the target tic using the following criteria:
   a the CR should be directly incompatible with the earliest movement involved in the tic. For vocal tics, the CR should involve reversing the air-flow pattern involved in producing the tic (see Table 53.3);
   b the CR should be less socially noticeable than the tic itself;
   c the CR should be something that that patient can do for at least 1 minute or until the urge to tic subsides;
   d the CR should be something that the patient can do almost any time and anywhere. To the extent possible, it should not interrupt ongoing activities.
2. Instruct the patient to practice using the CR in session. The patient should initiate use the identified CR as soon as he or she recognizes the first movement involved in the tic or, ideally, when he or she recognizes the premonitory urge. Once initiated, the CR should be held for 1 minute or until the urge to tic dissipates to a manageable level. If the patient's tic "breaks through" the CR, decide if a different practice is needed or modify the CR.
3. Provide praise and encouragement each time the patient uses the CR. If the target tic is observed and the patient does not use the CR, prompt the patient to use the CR immediately. Elicit and record/graph periodic urge ratings.

Once the patient has demonstrated mastery of HRT for the target tic, he or she is asked to continue self-monitoring the tic on a daily basis and to practice using the CR regularly between sessions "as much as possible" and time is set aside each day for dedicated practice (Table 53.4).

Habit Control Motivation

As clinicians are well aware, regardless of the nature of the presenting problem and the intervention being used, clients will vary in their degree of motivation and compliance with treatment. This may be especially true for HRT, which requires considerable effort on the part of the patient and the procedures can be tedious and repetitive. In addition, most adults have lived with their tics for many years and particular tics may have become a deeply ingrained part of their behavioral repertoire, making them difficult to recognize and control. Although many adults report that their tics have historically caused significant disruption, impairment, and stigma, they may be skeptical of trying HRT, possibly because they have tried suppressing or altering their tics for years (or attempted various unsuccessful interventions) with little or no lasting benefit. In contrast, children may lack motivation to work diligently on their tics because they have experienced less direct sequela or because of the time and effort involved. The bottom line is that HRT requires significant effort and progress in treatment can sometimes be slow. As such, whether working with adults or children, it is important to increase motivation and compliance with treatment to the extent possible. Several procedures can be useful in this regard.

First, especially for young children, behavioral reward programs, such as token economies, are used to reinforce participation in HRT. Because not all children respond to treatment at the same rate (or at all), we prefer to reinforce effort, such as completing therapy homework and practice, working hard in sessions, etc., rather

than rewarding tic reduction per say. Second, for both children and adults, it can be helpful to conduct a thorough inconvenience review, highlighting not only the problems that tics have caused, or could potentially cause in the future, but also how things will be improved if they learn to better control or reduce their tics. In addition to identifying reservations about treatment, having a written record of such inconveniences can be an invaluable tool "when the going gets tough" to remind the client of the potential long-term benefits of HRT. Third, it is often useful to recruit a social support person (e.g., a parent or spouse) to reinforce successful use of HRT and to prompt use of the CR when they observe the patient tic-ing. While is not always feasible for adults to recruit a support person, we find this component especially important when treating children. It is important to note, however, that social support needs to be constructive and supportive so as not to embarrass the patient in public or frustrate him or her as she learns to use HRT. Finally, once the patient has mastered HRT, encouraging him or her to practice using the CR in social settings can create a sense of mastery over tics and allows the opportunity for natural positive social contingencies to reinforce tic control.

Generalization Training

The final component of HRT is generalization training, which consists of two primary activities. First, patients are encouraged practice using HRT strategies in as many "high-risk" situations as possible. Although many individuals who are successfully treated with HRT experience a general decrease in tics across all settings, some will continue to experience contextual exacerbations, especially if HRT is not practiced consistently in those settings. While generalization training can usually be conducted in vivo, it is sometimes necessary to work up to difficult situations gradually or to use symbolic rehearsal (Azrin & Nunn, 1973) in which the patient imagines him- or herself in a particular high-risk situation while practicing using a CR. Second, because new tics often emerge over time, even in patients who are successfully treated with HRT, it is important to ensure that the patient can generalize and adapt the HRT skills they have learned to address new tics that may arise in the future. To assess whether the patient has mastered HRT skills, patients are asked to play the role of the therapist and to develop and implement a treatment plan for a hypothetical tic simulated by the therapist. This allows the therapist to do additional teaching in HRT techniques and correct any mistakes or misunderstandings regarding the HRT protocol.

Evidence Base for HRT and CBIT

Research demonstrating the efficacy of HRT/CBIT for treating motor and vocal tics in children and adults spans almost half a century. While most of the early studies relied on small-N designs utilizing small sample sizes (see Himle et al., 2006, for a review), several small, randomized controlled trials (RCTs) have shown HRT to be more effective than wait-list control and supportive psychotherapy (Azrin & Peterson, 1990; Deckersbach, Rauch, Buhlman, & Wilhelm, 2006; Wilhelm et al., 2003). While there is considerable variability in the degree to which children and adults will

respond to HRT, these studies have found tic reductions ranging from 30% to 90% and good maintenance of treatment gains for up to 1 year posttreatment. In addition, a recent meta-analysis summarizing the results from five RCTs examining HRT for tics found an overall strong effect size ($d = 0.78$) (Bate, Malouff, Thorsteinsson, & Bhullar, 2011).

The strongest evidence for the efficacy of the full CBIT protocol comes from two large multisite RCTs (a child and adult trial) comparing CBIT to a supportive psychotherapy (PST) (Piacentini et al., 2010; Wilhelm et al., 2012). The child trial included 126 children with CTD who were randomly assigned to receive 10 weekly sessions of CBIT or PST. In this trial, 53% of children who received CBIT were rated as treatment responders by treatment-blind clinicians compared with only 19% of children who received PST. In addition, there was a 31% reduction in overall tic severity in the CBIT group compared with a 14% reduction in children assigned to PST and treatment gains were generally maintained at 6 months posttreatment (Piacentini et al., 2010). In the adult trial, 122 adults with CTD were likewise randomly assigned to CBIT or PST. Results showed that 38% of adults who received CBIT were treatment responders compared with 6% in the PST group with a 26% reduction in overall tic severity in the CBIT group compared with only 11% reduction in the PST group (Wilhelm et al., 2012). Furthermore, the percentage of treatment responders and effect sizes reported in these two trials were comparable to those reported in clinical trials of tic-suppressing medications (Scahill et al., 2013), which are known to have treatment-limiting side effects for many patients and may not be a preferred intervention.

Overview of Exposure and Response Prevention (ERP)

Another behavioral treatment approach that has shown initial promise in the treatment of tics is an adapted form of exposure and response prevention (ERP) (Verdellen, Keijsers, Cath, & Hoogduin, 2004), a well-established behavioral intervention for treating obsessions, compulsions, and anxiety associated with OCD. The rationale for ERP in the treatment of OCD is that compulsions are negatively reinforced because they serve to reduce anxiety associated with an obsessional thought. During ERP, an individual is taught to gradually confront stimuli that elicit obsessions and associated anxiety while inhibiting the compulsion, thereby promoting anxiety habituation and extinguishing the negative reinforcement cycle.

The rationale for applying ERP to tics is based on the urge-reduction model of tics described earlier in this chapter (Evers & van de Wettering, 1994). Briefly, there is considerable evidence showing that some individuals experience aversive premonitory urges that escalate prior to tics and are temporarily alleviated when the tic is performed (Leckman, Walker, & Cohen, 1993). Similar to the negative reinforcement model for OCD, the urge-reduction model posits that tics are strengthened, through negative reinforcement, by this temporary relief from the aversive internal sensation. Over time, the urge–tic–relief cycle serves to increase the frequency and intensity of tics. To break this cycle, ERP uses a set of techniques designed to "expose" the individual to the aversive premonitory urge while preventing the occurrence of the tic (i.e., response prevention). Doing so should, theoretically, allow the urge to naturally

habituate (i.e., decrease), resulting in a reduction in the overall frequency and intensity of tics (Hoogduin, Verdellen, and Cath, 1997).

While the ERP model shares many similarities with the integrative model and HRT component of CBIT described above, ERP differ from HRT in several important ways (Verdellen, van de Griendt, Kriens, & van Oostrum, 2011b). First, HRT is designed to target each tic separately, whereas ERP targets all of the tics at once. Second, in HRT, the patient is taught to use specific competing responses to interrupt tics. In ERP, no specific tic-inhibiting strategy is taught. Rather, the patient is instructed to "suppress" his or her tics (which most individuals with tics can temporarily do) for as long as possible while recording tic occurrence and the intensity of the associated urges. During the suppression periods, the therapist records the occurrence of tics as well as the duration of tic-fee intervals and encourages the patient to suppress his or her tics for progressively longer durations of time. Finally, the patient is encouraged to bring tic-eliciting objects, activities, or people into the session in order to elicit premonitory urges. Patients are also asked to practice tic suppression between sessions and in high-risk tic-eliciting situations. In addition, as in CBIT, psychoeducation, daily self-monitoring, reinforcement, and motivation techniques are included in the ERP protocol (Verdellen et al., 2011b).

Evidence Base for ERP

While the number of research studies examining the efficacy of ERP remains small, the studies that have been conducted show promising results. In an initial study, Hoogduin and colleagues (1997) treated four individuals (three adults and one child) with TS using 10 2-hour sessions of ERP and found that tics were significantly reduced at posttreatment for three of the four participants and that all three responders reported a reduction in premonitory urges within the treatment sessions. In a follow-up study, Verdellen and colleagues (2004) randomized 43 individuals with TS (7–55 years, mean age = 20.6 years) to either ERP (consisting of 12, 2-hour sessions) or HRT (consisting of 10, 1-hour sessions). Significant pre- to posttreatment reductions in overall tic severity were observed in both treatment conditions with no differences between the two groups. Treatment effect sizes for both groups were comparable to those observed in randomized controlled trials of HRT.

Common Challenges to Treatment

Dissemination and Utilization

As noted earlier, dissemination and utilization of behavior therapy in the treatment of tics has been surprisingly slow among interdisciplinary treatment providers and a recent survey found that only a small subset of families and patients report having received behavior therapy for tics (Woods, Conelea, & Himle, 2010). In this same study, the most commonly reported barriers to receiving behavior therapy were a lack of awareness about behavioral techniques for tics and/or not having access to a trained provider.

Although the problem of utilization due to a lack of trained providers is not unique to behavioral treatments for tic disorders, it remains a significant obstacle. In a survey of psychologists and physicians, Marcks, Woods, Teng, and Twohig (2004) found that only 36% of providers reported having even heard of HRT and less than 10% reported knowing how to implement the procedure. Likewise, a survey of 135 training directors from APA-approved clinical psychology doctoral programs in the United States found that less than half of those surveyed reported that their trainees receive didactic or supervised clinical training in HRT (Crits-Christoph, Frank, Chambles, Brody, & Karp, 1995). Fortunately, organizations such as the US National Tourette Syndrome Association (TSA) and the Centers for Disease Control and Prevention (CDC) have partnered to launch training initiatives such as workshops and intensive provider trainings (see www.tsa-usa.org). Step-by-step treatment manuals have also been published to guide therapists when delivering treatment (Verdellen et al., 2011a; Woods et al., 2008). In addition, alternative modes of delivery such as telehealth (Himle et al., 2012) and intensive outpatient delivery of CBIT (Blount, Lockhart, Garcia, Raj, & Peterson, 2014) have shown promise in initial research studies. It is hopeful that these efforts will increase treatment utilization for patients in underserved areas who do not otherwise have access to behavior therapy.

Another barrier to the acceptance, utilization, and dissemination of behavior therapy for tics is the persistence of clinical lore suggesting that treating tics with behavioral techniques will lead to unintended negative "side effects." In our experience, which is consistent with surveys of both patients and professionals (Conelea et al., 2010; Marcks et al., 2004), the most commonly raised concerns are that procedures such as HRT and ERP will result in a paradoxical increase in tics. As mentioned earlier, patients are often concerned that suppressing or interrupting a specific tic will cause other tics to emerge or worsen (often referred to as "tic substitution"), or will cause a short- or long-term increase in tic frequency or intensity when the patient becomes more aware of the tic during AT or stops using the competing response (referred to as the "tic rebound effect").

Although the exact historical origins of these concerns are unclear, it is important that clinicians openly discuss these concerns with patients when treating tic disorders as they can decrease compliance with behavioral treatment techniques. Fortunately, patients can be reassured that several recent systematic studies have failed to find evidence of tic worsening or tic substitution during or following behavior therapy, or following tic suppression more generally (Himle & Woods, 2005; Scahill et al., 2013). Most convincingly, tic substitution and tic worsening were carefully tracked on a weekly basis during the CBIT randomized controlled trials. Not only were these "unintended consequences" rare, they did not differ between those who received CBIT and those who received supportive psychotherapy, in which tics were not directly targeted (Piacentini et al., 2010; Wilhelm et al., 2012). To be clear, some patients may experience an increase in premonitory urges during behavior therapy (Himle, Woods, Conelea, Bauer, & Rice, 2007) as a part of normal habituation and extinction processes, but if treatment is administered correctly and practiced regularly, these urges are likely to decrease in overall frequency and intensity along with the tics. Likewise, given the well-known waxing-and-waning course of tics, new tics are likely to emerge (or existing tics worsen) during the course of treatment, but this is usually unrelated to the treatment.

Choosing Appropriate Treatment Targets

Comorbidity is common in TS and differential diagnosis can be difficult (e.g., differentiating between tics vs. compulsions vs. noncompliance) (Scahill, Sukhodolsky, & King, 2007). Often, patients and parents "lump" comorbid symptoms under the diagnostic label of TS. This can be problematic because CBIT is specifically designed to treat motor and vocal tics and is not likely to have a meaningful effect on associated non-tic symptoms, such as symptoms of ADHD and OCD. Although tics have been shown to be associated with impaired functioning and decreased quality of life, internalizing and externalizing symptoms are often more problematic than the tics themselves and may require more immediate clinical attention (Storch et al., 2007; Sukhodolsky et al., 2003). Conducting a thorough diagnostic evaluation prior to treatment and discussing which symptoms are most problematic for the patient can ensure that the therapist is addressing the most important symptoms in treatment and that CBIT is the most appropriate intervention.

Patient and Parent Readiness and Compliance

Behavior therapy has shown to be an effective intervention for children 8 years and older. Given that the average age of tic onset in TS is around 5 or 6 years of age (Leckman, King, & Cohen, 1999), it is not uncommon for therapists who work with TS to be asked whether behavior therapy is effective for this younger age group and whether earlier intervention can alter the progression and course of tics. Unfortunately, we do not yet have answers to these questions. While there is currently an ongoing clinical study examining whether the CBIT protocol can be adapted for younger children (ages 4–7 years), outcome data are not yet available. If the results are promising, we assume that a detailed protocol outlining the necessary modifications to treatment for this age group will be forthcoming. While it is our experience that some mature 6- and 7-year-old children can learn CBIT using existing treatment protocols, children in this age group are often not bothered by their tics, which can lead to problems with motivation and treatment. Regardless of how motivated the child's parents are for their child to be treated, the child must be ready and willing to put significant effort into treatment if CBIT is to be effective. Likewise, parent motivation for, and commitment to, treatment must also be considered. CBIT and ERP require significant time, effort, and investment on the part of caregivers. They must be willing to carve out time in their day to attend sessions and to work with their child on therapy-related homework if treatment is to be successful. Finally, comorbid problems such as ADHD and general noncompliance can interfere with successful CBIT delivery and may need to be addressed with different therapeutic techniques and/or medication prior to beginning behavior therapy for tics.

Conclusions

Recent advancements in the understanding of tic disorders have led to exciting new directions in clinical care for individuals suffering from TS. The past 10 years have witnessed a shift in conceptualizing TS as a purely neurological problem to a neurodevelopmental syndrome whose manifestation is influenced by complex biological–environmental interactions. Although pharmacotherapy has historically been considered the fist-line intervention for treating tics and remains the most widely used treatment

modality, behavior therapy has emerged as an effective alternative or adjunctive treatment approach. Treatments including CBIT and ERP have shown to be particularly effective. In fact, the evidence is strong enough that several international psychological and medical organizations now recommend behavior therapy as a first-line intervention (prior to or in conjunction with medication) for the treatment of tics (Murphy et al., 2013; Steeves et al., 2012; Verdellen et al., 2011a). This is all for naught, however, if patients and families do not have access to knowledgeable providers. Fortunately, recent dissemination efforts are beginning to bridge this gap.

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