

Reducing risky behavior with habit reversal: A review of behavioral strategies to reduce habitual hand-to-head behavior

Megan R. Heinicke

Department of Psychology, California State University, Sacramento

Jordan T. Stiede

Department of Psychology, Marquette University

Raymond G. Miltenberger

Department of Child and Family Studies, University of South Florida

Douglas W. Woods

Department of Psychology, Marquette University

Habit reversal training (HRT) has been a mainstay of behavior analysts' repertoire for nearly the last 50 years. HRT has been effective in treating a host of repetitive behavior problems. In the face of the current coronavirus pandemic, HRT has practical public health importance as a possible intervention for reducing hand-to-head behaviors that increase the risk of viral infection. The current paper provides a brief review of HRT for hand-to-head habits that is designed for a broad audience and concludes with practical suggestions, based on HRT, for reducing face-touching behaviors.

Key words: COVID-19, coronavirus, habit reversal, face-touching

Throughout his career, B. F. Skinner recognized the importance of behavior analysis in helping to solve various crises confronting humankind. Although he recognized that biology, chemistry, physics, engineering and their resulting technologies were of great assistance in overcoming problems such as war, overcrowding, pollution, and illness, Skinner also recognized that many of these issues were initiated or exacerbated by our own behavior (Skinner, 1971). He made this clear in the following quote:

The application of the physical and biological sciences alone will not solve our problems because the solutions lie in another field.... In short, we need to make vast changes in human behavior, and we cannot make them with the help of nothing more than physics

or biology, no matter how hard we try.... What we need is a technology of behavior. (Skinner, 1971, pp. 4-5).

Today a pandemic is sweeping the world in the form of a novel coronavirus. This virus was not made by humans, but human behavior plays a key role in its spread. As of the writing of this paper, there is no known cure or prevention strategy given to us by the fields of biology, chemistry, or engineering. The most effective steps we can take to prevent infection and lower the resultant death rates is to change our behavior; from changing our work habits to changing the frequency of handwashing, to staying a particular distance from others, to wearing masks in public places, to reducing our hand-to-head contact. Fortunately, nearly 50 years of behavioral science exists and can help guide us toward altering some of these behaviors. In the current paper, we focus on behavioral strategies to reduce hand-to-head habitual behavior.

Address correspondence to: Megan R. Heinicke, Department of Psychology, California State University, Sacramento, CA 95819-6007; email: megan.heinicke@csus.edu

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Coronavirus

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the cause of the 2019 novel coronavirus disease (COVID-19; Centers for Disease Control and Prevention [CDC], 2020). Although the virus is spread primarily through close contact with others via respiratory droplets produced when an infected individual coughs, sneezes, talks, or breathes (CDC, 2020), other modes of transmission are also prevalent. For example, Cai et al. (2020) suggested that SARS-CoV-2 can live on surfaces or objects such as elevator buttons or bathroom sinks. Uninfected individuals can touch these infected surfaces and become infected themselves if they then touch their own eyes, nose, or mouth. As a result, the CDC and World Health Organization (WHO) have instructed the public to maintain a safe distance from others, frequently wash hands, and avoid touching one's own eyes, nose, and mouth with unwashed hands (CDC, 2020; WHO, 2020).

Unfortunately, hand-to-head and hand-to-face touching is quite common. For example, one study demonstrated that medical students habitually touched their face an average of 23 times per hour during class (Kwok et al., 2015). Likewise, in a simulated cabin of a commuter train, participants touched their face an average of 17.8 times per hour, with males touching their faces significantly more than females (Morita et al. 2019). Even when individuals know face-touching can increase the risk of infection, the behavior is difficult to stop. Macias et al. (2009) found that individuals in the community touched their faces approximately 3 times per hour during the influenza A (H1N1) pandemic, and Elder et al. (2014) found that even hospital staff, who understand the link between face-touching and respiratory infections, touched their faces approximately 10 times per hour during the workday. Combined, these studies suggest that face-touching

is a prevalent, habitual behavior that is unlikely to decrease without specific strategies.

Habit Reversal Training (HRT)

Habits are repetitive behaviors that are often automatically reinforced and occur outside the awareness of those who do them. For nearly 50 years, applied behavior analysis developed and refined technology designed to reduce the frequency of habitual behavior. Azrin and Nunn (1973) first developed a set of behavioral procedures designed to reduce repetitive behaviors such as tics, stuttering, hair pulling, skin picking, nail biting, and thumb sucking. The breadth and scope of HRT's effectiveness with a large variety of habitual behaviors strongly suggests the procedures are useful for reducing hand-to-head behaviors like hair pulling, nail biting and thumb sucking, and that they will likely be effective in reducing all forms of face-touching (Bate et al., 2011; Friman et al., 2001).

As originally developed, HRT consisted of numerous distinct procedural elements (Azrin & Nunn, 1973). However, various treatment dismantling studies suggest that a simplified HRT consisting of two core elements, awareness training and competing response training, is as effective as the full package (Miltenberger et al., 1998). A third component, social support training, may also play a key role in behavior change, but this may be more relevant for children (Woods et al., 1996) than adults (Flessner et al., 2005; Miltenberger et al., 1985). Each of these components is described below, with face-touching used as the example habitual behavior.

Awareness training is the first step in HRT. Awareness of a habit is increased through three specific techniques: (a) response description, (b) response detection, and (c) early warning training. Response description involves working with clients to develop a detailed description of

their own repetitive behavior (e.g., every time the client contacts their face with any portion of their hand, including rubbing their eyes and resting their hand(s) on their cheek or chin) in order to understand the specific movements associated with the action. If the client fails to describe a key feature of the behavior (e.g., rubbing one's lips before biting the nails), the therapist acknowledges this and helps the client describe the behavior in greater detail until the behavior is described thoroughly (Woods et al., 2008). Next, in response detection, clients are instructed to acknowledge each occurrence of the target habit, as it occurs in front of the therapist. The therapist praises the client for accurately recognizing each behavior and alerts the client if the target habit occurs without client acknowledgement. As clients become more accurate and comfortable detecting their own habits, the therapist asks them to acknowledge the earliest signs of the behavior, such as an urge to do the movement (e.g., thinking about pushing on one's temples during a stressful task) or an early portion of the behavior (e.g., the elbow flexing that occurs prior to the hand going to the head). This latter element is labeled "early warning training." The therapist also asks the client to identify events or situations in which the habit is more likely to occur, so the client is more likely to catch the habit occurring in those situations. After completing awareness training, clients should be aware of every instance of the habit as it occurs, along with when and where the habit is about to occur.

After the client reliably acknowledges the occurrence of the habit in real time, the next element of HRT is implemented. Competing response training involves teaching the client to engage in a behavior that physically prevents the completion of the habit (Woods et al., 1996). Clients are instructed to do the competing response contingent on one of the warning signs or upon the actual occurrence of the habit behavior. Competing responses should be (a) physically incompatible with the target habit and

make the habit difficult to do simultaneous with the competing response, (b) capable of being maintained for at least 1 min contingent on the habit, (c) socially inconspicuous and easily blend in with normal ongoing activities, and (d) capable of being performed anywhere without the use of particular items of clothing or other objects that may not always be available. Examples of competing responses for clients seeking to reduce face-touching include clenching their hands into a fist and holding the fist at their side, folding their hands, sitting on their hands, and folding their arms across the chest.

After working with the client to select a competing response, the therapist helps the client use it in session. First, the therapist models the correct implementation of the competing response (e.g., curling fingers tightly toward palm and folding the thumb diagonally across the fingers). Then, the client practices the competing response while the therapist provides feedback. After the client correctly performs the competing response, they are asked to simulate the habit (e.g., eye rubbing) and interrupt it by engaging in the competing response for 1 min. The therapist should praise the client if the competing response is done correctly or provide feedback if not done or done incorrectly (e.g., placing their nonfisted hand on their lap, only holding a fist for 10 s). Further, to help clients learn to use the competing response in everyday situations, the therapist continues to interact (e.g., play games, continue conversation) with the client as the client performs the competing response (e.g., when the client notices their hand moving toward their face or when they recognize they have already started to touch their face). After learning to implement the competing response effectively in session, the client is instructed to use the competing response in all settings outside of session after actual occurrences of the habit behavior or its warning signs. The client is told to focus on high-risk situations in particular and is reminded to use the competing response

consistently in those situations. Through repeated contingent practice of these exercises, inhibition of face-touching will become the stronger repertoire.

The final phase of habit reversal training is social support, in which family or friends learn to praise the client for correct implementation of the competing response (e.g., "I just noticed that you sat on your hands right when you were about to bite your nails. Nice catch!"). The support person is also taught to remind the client to practice their competing response if the client misses an occurrence of the habit or does not use the competing response correctly. For example, if a roommate is designated as a support person and notices the client is rubbing their eyes while doing homework, the roommate should politely prompt the client to sit on their hands as soon as possible. Social support is implemented to provide intermittent, immediate reinforcement for use of the competing response.

Research Support for HRT to Reduce Hand-to-Head Behavior

Although researchers have studied the rate of habitual face-touching in nontreatment-seeking populations, such as college students, train commuters, and hospital staff (Elder et al., 2014; Kwok et al., 2015; Morita et al. 2019; Woods & Miltenberger, 1996a), treatments to reduce face-touching for these same populations have not yet been evaluated. However, HRT has been demonstrated effective in reducing various habitual behaviors that involve touching the face (or head), such as nail-biting, thumb-sucking, and hair-pulling, for treatment-seeking individuals with and without clinical diagnoses (Bate et al., 2011; Himle et al., 2006; Hwang et al., 2012; Miltenberger et al., 1985, 1998; Woods & Miltenberger, 1995, 1996b; Woods et al., 2000). Thus, we reviewed this body of literature with the aims of 1) synthesizing the available research support for HRT to reduce face-touching for a broader audience, and 2)

extrapolating recommendations for the self-administration of HRT for community members wishing to do their part to decrease the spread of COVID-19.

Study Characteristics

We searched the peer-reviewed literature for empirical evaluations of HRT to reduce habitual behavior involving hand-to-face or head contact (e.g., nail biting, hair pulling, thumb sucking) and found 39 articles that reported using between-group and single-case experimental designs. These articles were published in 15 journals (e.g., *Behavior Research and Therapy*, *Journal of Applied Behavior Analysis*) from 1973 to 2018. Most studies evaluated the simplified HRT package that included awareness training, competing response training, and social support. Across these articles, HRT was evaluated for over 700 participants, most of whom were female. Approximately the same number of studies included participants over and under the age of 18 as well as participants with and without clinical diagnoses (e.g., trichotillomania) related to the targeted habit. Lastly, only two studies evaluated HRT for individuals with intellectual disabilities (i.e., Long et al., 1999; Rapp, Miltenberger, & Long, 1998).

Habit reversal has mainly been applied to one habit behavior rather than multiple, co-occurring habits. The most common habits included hair pulling, nail biting, thumb or finger sucking, and skin picking. Eye rubbing (Miltenberger & Fuqua, 1985) was evaluated in one study. Researchers have evaluated behavior change using both indirect (e.g., clinician-administered rating scales, permanent product recording) and direct (e.g., real-time recording, self-monitoring) measures in approximately the same number of studies. In addition, HRT was mostly implemented in university or clinic settings rather than participants' homes or communities. The reported length of HRT ranged

from 1-2 hr, and maintenance of treatment effects ranged from 1 week to 20 months. Lastly, social validity (i.e., participants' opinions regarding treatment acceptability and the importance of treatment outcomes) was assessed in roughly half of the studies, and most researchers used the Treatment Evaluation Inventory-Short Form Rating Form (Kelley et al., 1989). Overall, we found that both participants and parents of young participants found HRT acceptable and effective.

Efficacy of Habit Reversal

Researchers have demonstrated the efficacy of HRT in reducing hand-to-face and head habits using both single-case (e.g., Rapp, Miltenberger, Long, et al., 1998) and group designs (e.g., Flessner et al., 2005). For example, studies revealed significant effects of HRT in comparison to a placebo (Twohig et al., 2003) and a waitlist control group (Teng et al., 2006; Woods et al., 1999). Habit reversal was also shown to be more effective than negative practice (i.e., engaging in the habit repeatedly; Azrin et al., 1980a, 1980b), aversive stimulation (i.e., bitter taste placed on fingernails; Azrin, Nunn, & Frantz-Renshaw, 1980), decoupling (i.e., engaging in a motor sequence similar to the habit that ends in a new movement; Moritz et al., 2012), and a web-based self-help tool (Rogers et al., 2014). Likewise, HRT was shown to be as effective as a combination of behavioral procedures that included differential reinforcement of other behavior, escalating reinforcement schedules, rules, and a token system (Christensen & Sanders, 1987).

Various studies also examined the role played by key elements in the HRT procedure. For example, Flessner et al. (2005) compared HRT with and without social support and found both packages were effective. In addition, Horne and Wilkinson (1980) found participants who received competing response training to be less likely to relapse at follow up

when comparing a treatment package of nail care + competing response training (with and without goal setting) to only nail care + goal setting. Currently, the literature supports using a competing response for 1-3 min contingent upon each instance of the habit (Miltenberger & Fuqua, 1985). In fact, Twohig and Woods (2001a) found better long-term effects of HRT when participants engaged in a competing response for 1- or 3-min compared with a shorter, 5-s duration. The most common competing responses included in the identified studies were clenching hands into a fist, grasping objects, sitting on hands, placing hands into pockets, and folding either the hands or arms.

Recognizing the potentially key role awareness training plays in HRT's effectiveness (Woods et al., 1996), researchers have also attempted to enhance awareness training in order to increase its therapeutic benefit. This has been done primarily through the development and use of technology designed to increase awareness of ongoing action. Awareness enhancement devices (AEDs) have been evaluated both as a monotherapy (Ellingson et al., 2000; Himle et al., 2008; Stricker et al., 2001, 2003) and in combination with other HRT components (Himle et al., 2018; Rapp, Miltenberger, & Long, 1998). Almost all versions of these AEDs involved participants wearing a receiver either around their neck (similar to a necklace) or pinned to their shirt with transmitters on their wrists (similar to bracelets). The AEDs then emitted either a vibration or a tone when the transmitters were within a certain distance of the receiver (Ellingson et al., 2000; Rapp, Miltenberger, & Long, 1998; Stricker et al., 2001, 2003) or if the participants' hand was near or touching their head for 2-3 s (Himle et al., 2008, 2018). All studies evaluating AEDs reported large treatment effects; however, Stricker et al. (2003) only found AEDs effective after increasing the intensity of the tone from 65 dB to 90 dB. It is also

worth mentioning that only one AED study (Rapp, Miltenberger, & Long, 1998) included individuals with intellectual disabilities, and the authors did not observe treatment effects of HRT until an AED was added to the treatment package.

We also found evaluations of adjunct procedures in combination with HRT following relapse (Fleming, 1984) or in the face of limited success with HRT alone (Long et al., 1999, 2000; Rapp et al., 1999). For example, HRT significantly decreased hair pulling for a college student; however, after relapsing 2 weeks following treatment, Fleming (1984) demonstrated further improvement after reimplementing HRT in combination with self-reinforcement. Similarly, Long et al. (1999, 2000) and Rapp et al. (1999) found adjunct interventions necessary to improve treatment outcomes of HRT for either certain participants (i.e., Long et al., 1999; Rapp et al., 1999) or certain habit behavior topographies (Long et al., 2000). These additional treatments included remote prompting or detection, differential reinforcement procedures, and response cost. It should be noted that in all of these studies requiring adjunct treatment components, the clients were either young children (i.e., 5-6 years old; Long et al., 2000; Rapp et al., 1999) or adults with mild to moderate intellectual disabilities (Long et al., 1999), suggesting that certain modifications to HRT may be needed for particular populations.

Lastly, HRT has also been evaluated in combination with other interventions, the most common being traditional cognitive behavior therapy (Ninan et al., 2000) and two of its offshoots: acceptance and commitment therapy (Crosby et al., 2012; Flessner et al., 2008; Haaland et al., 2017; Twohig & Woods, 2004; Woods et al., 2006) and dialectical behavior therapy (Keuthen et al., 2011). We also identified studies designed to evaluate HRT in combination with either medication (Dougherty et al., 2006) or additional behavior-analytic

procedures (Horne & Wilkinson, 1980; Ladouceur, 1979). We have not summarized the findings of these studies given they do not align with the main aims of our brief review. Instead, we direct any interested readers to these publications for additional details.

Outcomes Summary

Of the 39 studies identified for this review, 35 reported robust effects of HRT for reducing hand-to-face or head contact, and treatment effects were either moderately or largely maintained. When relapse issues surfaced, follow up phone calls or booster sessions were generally effective in reestablishing treatment effects, and both participants and the parents of child participants viewed HRT as acceptable and effective. Overall, our findings align with a 2011 meta-analysis that concluded there is sufficient support for classifying HRT as a well-established treatment for habit disorders (including oral-digit habits, nail biting, and thumb sucking; Bate et al., 2011).

Limitations of Current Research

HRT has been evaluated for nearly 50 years as a treatment for habitual behavior. It has been studied using experimental single-subject designs, uncontrolled group designs, and randomized controlled trials. It has been tested as a monotherapy and has been utilized in conjunction with other treatments. Overall, data suggest the treatment is an effective and robust method for reducing habitual behavior across a wide array of topographies. That said, there are limitations to the existing literature, particularly as they pertain to reducing behaviors that could otherwise increase the risk of viral infection.

First, HRT has not been tested with all forms of benign face-touching (e.g., resting one's head on their hand) that could lead to increased risk of infection. However, HRT has been tested and proven efficacious for various forms of face-touching that yield other negative

physical outcomes (i.e., loss of nails, loss of hair, creation of sores on the skin, dental malocclusions). Because we have reason to believe that all face-touching primarily serves the same function (automatic reinforcement; Miltenberger et al., 1998) regardless of the negative consequences caused by behavior, we are confident that treatments that are effective for one form of face-touching will likely have some positive effect for other forms. Nevertheless, single-subject experimental designs and controlled group trials evaluating HRT for all forms of face-touching are essential in allowing us to move beyond extrapolation from current research to making definitive claims about the efficacy of HRT for more benign forms of face-touching. Second, additional research needs to be conducted on how and for whom HRT needs to be modified to maximize treatment effectiveness. For example, it appears that adjunct interventions may be necessary for younger children or for individuals with intellectual disabilities. By better understanding possible enhancements to treatment, and for whom they are most appropriate, we can make the robust effects of HRT even stronger. Finally, researchers and clinicians need to consider the ability of HRT, in its current form, to be widely disseminated. At present, HRT is conducted between a single therapist and an individual or small group of clients. This mode of delivery, while appropriate for clinical populations, is not feasible in the public health arena, where the intervention needs to be delivered at scale for broad public implementation. Some research has called into question the efficacy of self-help formats for wide dissemination (Moritz et al. 2012), but it is possible that via enhanced written instructions (e.g., Berkman et al., 2019; Graff & Karsten, 2012) or web-based technologies, the treatment could be brought to scale.

Practical Recommendations for Decreasing Face-touching Using Self-Administered HRT

In light of research demonstrating the effectiveness of the awareness and competing

response components of HRT for decreasing hand-to-face or hand-to-head habits, such as nail biting, thumb and finger sucking, hair pulling, and skin picking, we offer the following recommendations, based on HRT, but adapted for wide distribution in a self-administered format for increasing awareness and using a competing response to decrease face-touching. The Appendix is provided as a resource for distribution.

Increasing Awareness

To stop face-touching, one must first become aware of every instance of the behavior and when the behavior is about to occur.

Step 1

First, identify what behavior you engage in when you touch your face. Do you touch your eyes, touch your mouth, touch your nose, bite your nail, or engage in some other behavior? Take a moment and think about all the ways you touch your face, especially around your mouth, eyes, or nose where the virus can be transmitted. Use a worksheet (see Appendix) to describe what you are doing when you touch your face. Now think about all the situations in which you touch your face (such as at your desk, or when watching television, or in front of the computer). Use the Appendix to describe these high-risk situations.

Step 2

After you can clearly describe the behavior and when or where it occurs, the next step is to practice noticing when you do the behavior or when you are about to do the behavior. To get better at noticing the behavior, we recommend exercises in which you simulate the behavior. To set up one of these exercises, start by thoroughly washing your hands. Next, put yourself into one of the circumstances where you are likely to do the behavior. Simulate the behavior but stop just short of touching your face. For

example, take your hand from your lap while sitting on the couch and raise it to your face to rub your eyes, but stop just before you touch your eyes. Notice how your arm feels rising to your face, observe the motion of your hand as it approaches your face. Now repeat the process, but each time you repeat it, stop the behavior earlier and earlier. For example, stop when you see your hand rise above your shoulder, stop when your hand rises above your chest, when it rises above your waist, when your hand first leaves your lap. As you simulate the behavior and become more and more aware of the motion in each practice, you are more likely to notice when you start to touch your face throughout the day.

Other Strategies

If you find you are still touching your face after practicing these exercises, there are further steps you can take to increase awareness. One additional step you could take is to video record yourself in your high-risk situations and then review the video to detect each instance of face-touching. Another step is to enlist social support by having someone close to you (spouse, friend, sibling, etc.) remind you each time that person sees you touch your face. Yet another step would be to wear something on your wrist or fingers that would remind you the behavior was occurring or about to occur. For example, wearing a jingly bracelet on your wrist or tape on your fingertips might alert you to face-touching movements.

Practice a Competing Response

After becoming better at noticing your face-touching movements, the next step is to learn to do a different behavior each time you start to touch your face. We call this a competing response because it should compete with or replace the face-touching behavior. There are three steps to using a competing response.

Step 1

Identify a simple behavior you can do with your hands that would make face-touching impossible. It should be a behavior you can do anywhere but particularly when you would typically touch your face. An example of a competing response could be making a fist and holding it in your lap.

Step 2

Practice the competing response. Using the same exercises, simulate your face-touching and then immediately interrupt the behavior and engage in your competing response for 1 min. Bring your hand all the way up to your face but interrupt the behavior before touching your face and do your competing response. Practice this a few times. As before, practice several times and interrupt the movement of your hand earlier and earlier each time and immediately use your competing response. The point of the exercises is to catch the behavior as soon as it starts to occur, interrupt the behavior, and engage in the competing response instead of touching your face.

Step 3

Use the competing response. The goal of these exercises is to make it more likely you will catch yourself starting to touch your face and use the competing response in everyday life. You will want to practice these exercises until you catch every movement of your hand toward your face and make the competing response your new habit. Continue to use the competing response during all waking hours to keep your hands away from your face.

Other Strategies

Additional strategies may help you use your competing response consistently. One is to keep a tally sheet with you in your high-risk situations. Create two columns on the sheet. Each time you touch your face, mark it in one

column and each time you use your competing response before touching your face, mark it in another column. In this way you can track your progress in replacing face-touching with your competing response. Another strategy is to continue to enlist your social support person to remind you to use your competing response when that person observes face-touching.

Conclusion

In the face of the current and future pandemics, behavioral sciences need to take their place alongside other sciences such as biology and chemistry. It has become clear that not only do we need science to help prevent and treat the spread of disease through vaccinations and pharmacotherapeutics, but science is needed to alter the very human behaviors (e.g., face-touching, handwashing, social distancing, following stay-at-home orders, wearing face masks) that contribute to disease transmission. Fortunately, behavioral technology developed over the last 50 years in the form of HRT provides a potentially useful tool that can help decrease disease transmission. Our hope, and consistent with Skinner's vision (Skinner, 1948), is that behavior analysis will continue to develop powerful technologies that will become known and used by all people, not just the scientists and practitioners of behavior analysis. Indeed, we hope that behavior analysis will be widely disseminated for the betterment of humanity.

An asterisk (*) indicates studies included in this review that are not cited within the paper.

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