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DOES COGNITIVE BIAS MODIFICATION PRIOR TO STANDARD BRIEF COGNITIVE BEHAVIOR THERAPY REDUCE RELAPSE RATES IN HAIR PULLING DISORDER? A DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL

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Background: In line with previous research in alcohol addiction, we tested whether an Approach-Avoidance Training (AAT) prior to standard six-session Cognitive Behavior Therapy (CBT) for Hair Pulling Disorder (HPD) reduced problematic relapse, commonly found in this population. Method: Prior to CBT, 54 outpatients with a primary diagnosis of HPD were randomly assigned (double-blind) to either a training condition (n = 27), learning to avoid hair-pulling-related stimuli, or to a control condition (n = 27). Symptom severity was assessed with the Massachussetts General Hospital Hairpulling Scale, Severity Urge Resistance Frequency Scale, Self-Control Cognition Questionnaire, and Alopecia Scale. Results: In line with existing research, CBT showed to be an effective treatment for HPD in the short-term. There was no significant symptom increase after one and three months, but effect sizes were reduced approximately by half at the twelve-month measurement. The AAT training prior to CBT did not result in enhanced symptom reduction or reduced relapse after CBT. Conclusions: AAT training could not re-

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solve the substantial relapse after successful CBT. Future research should take into account the complexity of stimuli that elicit hair pulling (e.g., tactile stimuli) and consider investigating other types of biases.

Keywords: Hair Pulling Disorder, Cognitive Bias Modification, Approach-Avoidance Task, relapse, implicit processes

Individuals suffering from Hair Pulling Disorder (HPD; trichotillomania) pull out hairs from their body, resulting in hair thinning or bald spots. Many patients pull hairs from the scalp, but pulling from other areas, such as eyelashes and eyebrows, is also common. Approximately 40 to 50% of patients pull out hairs from multiple parts of their body (Christenson & Mansueto, 1999; Flessner et al., 2010). Hair pulling disorder was categorized as an impulse-control disorder not otherwise specified in the DSM-IV-TR. In the DSM-5 it is classified within the category 'obsessive-compulsive and related disorders'. To date, the true prevalence of HPD is still unknown, as there have been no large-scale epidemiological studies. Duke, Keeley, Geffken, and Storch (2010) reported prevalence rates in college students varying from 1 to 13.3%. Although once thought to be a rare condition, HPD seems to be rather common.

Immediate results of brief Cognitive Behavior Therapy (CBT) and Habit Reversal Treatment, which lies at the core of CBT treatment, tend to be excellent and CBT has been established as the treatment of choice for HPD. However, the results of controlled studies regarding long-term treatment effects are less consistent and relapse is typically high (Azrin, Nunn, & Frantz, 1980; Bloch et al., 2007; Diefenbach, Tolin, Hannan, Maltby, & Crocetto, 2006; Dougherty, Loh, Jenike, & Keuthen, 2006; Keijsers et al., 2006; Keijsers, Maas, Van Opdorp, & Van Minnen, 2016; Keuthen et al., 2012; McGuire et al., 2014; Ninan, Rothbaum, Marsteller, Knight, & Eccard, 2000; Rogers et al., 2014; Van Minnen, Hoogduin, Keijsers, Hellenbrand, & Hendriks, 2003; Woods, Wetterneck, & Flessner, 2006). Keijsers and colleagues (2006) found an effect size reduction of no less than 70% two years after treatment. HPD thus appears to be quite sensitive to CBT in the short-term, but after several months symptoms tend to reoccur.

These findings in regard to relapse may indicate that automatic processes or conditions in addition to the manifest behavioral level remain unaffected by treatment and maintain the likelihood of symptom reoccurrence. That is, treatment may have taught patients to actively resist the urge to pull hair, but after a while the habitual nature of the behavior may lead patients back to their behavior of hair pulling. Although in HPD some of the hair pulling takes place in a focused way (e.g., seeking which specific hairs to pull, or pulling until it feels 'just right'; see also Flessner et al., 2008), most hair pulling indeed occurs in an habitual, automatic fashion without the patient even being aware of it. Investigating automatic processes in HPD may therefore be a promising tool to find out more about underlying processes of HPD.

A vast amount of research has brought forward evidence that in many unwanted habits and addictive behaviors biased automatic processing is implicated. More specifically, unwanted habits have been associated with an implicit tendency to approach rather than avoid stimuli (approach-avoidance bias; e.g., Brignell, Griffiths, Bradley, & Mogg, 2009; Machulska, Zlomuzica, Adolph, Rinck, & Margraf, 2015; Veenstra & de Jong, 2010), automatically attend to (attentional bias; e.g., Field & Cox, 2008; Mogg, Bradley, Field, & De Houwer, 2003), and positively evaluate (evaluation bias; e.g., Craeynest et al., 2005; Hoefling & Strack, 2008) habit-related stimuli, such as cigarettes in smoking, food in overeating, and alcohol in alcohol drinking. The results typically found in the field may thus imply that HPD patients also have a tendency to automatically approach rather than avoid, automatically attend to and positively evaluate hair-related stimuli. However, research into automatic processes associated with HPD is still scarce. Up to date, Lee, Franklin, Turkel, Goetz, and Woods (2011) were the only ones to study automatic processes in HPD. Lee and colleagues compared patients' attentional bias towards stimuli depicting hair to threat-related and neutral pictures. In contrast to the typical research findings in the field as briefly described above, the results showed an attentional disengagement from hair cues at later (but not earlier) stages of attention. It is therefore unclear how these results relate to the literature. It furthermore remains unclear which biases are relevant to HPD: approach-avoidance biases, attentional biases, evaluation biases, or all of them.

Highly relevant for the treatment of unwanted habits, automatic biases can be retrained. For this purpose computerized training methods have been developed ranging from attention bias training, evaluation bias training, and approach-avoidance training to cognitive control training (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013). These so-called Cognitive Bias Modification (CBM) training methods have been most extensively applied in the anxiety and depressive disorders, but with mixed results (Cristea, Kok, & Cuijpers, 2015; Hakamata et al., 2010; Hallion & Ruscio, 2011), and mostly focusing on attention bias training. Less research has been done in other areas, such as unwanted habits and addiction, and using other paradigms, such as the Approach-Avoidance Training (Wiers, Rinck, Kordts, Houben, & Strack, 2010). Results in this area so far, however, seem optimistic. Kakoschke, Kemps, and Tiggeman (2017) reviewed the literature on approach bias modification for appetitive behavior (alcohol use, cigarette smoking, and unhealthy eating). Their review included fifteen publications and concluded that results were positive: Approach bias modification generally resulted in a reduced approach bias for appetitive cues as well as in a reduction of actual consumption behavior. Wiers et al. (2015) furthermore found that re-training of approach biases resulted in reductions in medial prefrontal cortex activation in trained alcoholic patients when compared to controls, which correlated with the reductions in approach bias scores.

Importantly, considering the high relapse rates in HPD, CBM may be of value for relapse prevention. Wiers, berl, Rinck, Becker, and Lindenmeyer (2011) for example showed that patients who had received an Approach-Avoidance Training in which they learned to avoid alcohol pictures showed 13% less relapse one year later, compared to patients who had received a sham training. This effect was replicated by Eberl and colleagues (2013, 2014). In the present study, we aimed to extend these findings to an HPD patient sample. The present study was part of a larger study (1) investigating automatic processes underlying HPD and (2) re-training automatic processes in order to reduce relapse rates. As it remains unclear which automatic biases are relevant to HPD, related to the first aim, we assessed baseline (before CBM training and before CBT) approach-avoidance biases, attentional biases, as well as evaluation biases. Detailed results of these baseline results are reported in a separate paper (Maas, Keijsers, Rinck, & Becker, 2018). The present paper focuses on the second aim; the results of the CBM training. In line with Wiers and colleagues (2011) we used an Approach-Avoidance Training. We chose to retrain approach-avoidance biases rather than attentional or evaluation biases because of the promising results of Wiers and colleagues and Eberl and colleagues (2013), and because approach-avoidance tendencies seem to resemble the act of hair pulling most closely. That is, rather than hypervigilence for (attentional bias) or general extreme positive associations with (evaluation bias) hair, HPD does involve the actual approach of hair, and difficulties in avoiding this tendency (approach-avoidance bias). In the present study patients were either trained to avoid hair pulling-related stimuli (training condition) or they received a sham AAT training (control condition). After the AAT training, all patients received standard brief CBT for HPD. We collected data at one, three, and twelve months follow-up and expected patients in the training condition to show significantly less relapse, here defined as a significant increase of symptoms, after CBT than patients in the control condition.

METHODS

PARTICIPANTS

Patient characteristics are reported separately for both conditions in Table 1. Conditions did not differ significantly with respect to age, gender, duration of symptoms, education level, hair pulling site, or comorbid conditions (all *p*s > .18). Fifty-four patients applied between October 2011 and March 2015 to participate in this parallel group design study, carried out at Ambulatorium FSW, Nijmegen, the Netherlands, an academic outpatient center with expertise in treating body-focused repetitive disorders.

Figure 1 displays the flow diagram of patient inclusion and (reasons for) treatment drop-out of the patients. The treatment drop-out rate did not differ significantly between the training condition ($n = 7$) and the control condition ($n = 3$), $\chi^2 = 1.11$, $p = .29$. Additional missing data resulted from therapists or patients

TABLE 1. Patient Characteristics, *N* = 54

	Training group (*n* = 27) Mean (*SD*) or *n* (%)	Control group (*n* = 27) Mean (*SD*) or *n* (%)
Age (years)	32.4 (12.5)	35.4 (12.9)
Gender (female)	26 (96.3%)	24 (92.3
Duration of symptoms (years)	21.75 (12.0)	21.6 (11.5)
Education level		
Lower general secondary	4 (16.0%)	2 (8.0)
Intermediate general secondary	1 (4.0%)	3 (12.0)
Upper general secondary	1 (4.0%)	1 (4.0)
Vocational	10 (40.0%)	5 (20.0)
Higher vocational	3 (12.0%)	6 (24.0)
University	6 (24.0%)	8 (36.0)
Hair pulling site		
Scalp	14 (56.0%)	15 (57.7)
Eyelashes/eyebrows	9 (36.0%)	4 (15.4)
Facial hair	1 (4.0%)	0 (0.0)
Multiple sites	1 (4.0%)	7 (26.9)
Comorbidity		
Generalized anxiety	3 (12.0%)	1 (4.0)
Social anxiety	2 (8.0%)	0 (0.0)
Posttraumatic stress disorder	2 (8.0%)	0 (0.0)
Panic disorder	0 (0.0%)	1 (4.0)
Depressive disorders	1 (4.0%)	1 (4.0)
Other	3 (12.0%)	4 (16.0)

who had failed to complete questionnaires during booster sessions (i.e., assessment drop-outs; $n = 9$). Finally, twelve patients were lost at 12-month follow-up, because they did not complete the questionnaires we sent via mail. We compared these 12-month assessment drop-outs from both conditions, as not retrurning the questionnaires might perhaps indicate treatment dissatisfaction. However, the number of 12-month assessment drop-outs did not differ between the training condition ($n = 7$) and the control condition ($n = 5$), $\chi^2 = 0.11$, $p = .74$.

The necessary ethical approval was obtained from the local ethics committee (Commissie Mensgebonden Onderzoek Arnhem-Nijmegen). The trial was registered at the Nederlands Trial Register (NTR4522).

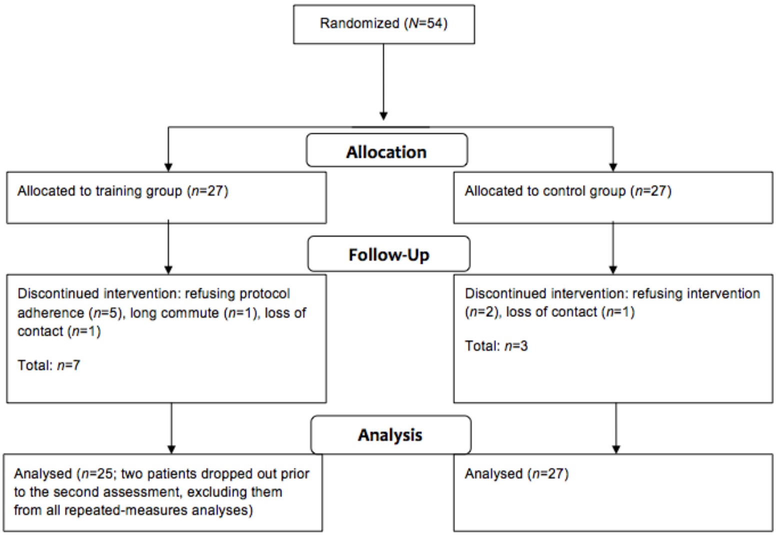

FIGURE 1. Patient flow chart

Criteria for inclusion consisted of a current primary diagnosis of HPD according to DSM-IV and an age between 18 and 65. Patients with other comorbid disorders were included, but with the understanding that the present study and treatments were only directed at treating HPD. When urgency of comorbid disorders warranted a change of focus during treatment, HPD was not considered the primary diagnosis, and patients were considered not to meet the criteria for inclusion anymore. Patients were excluded from the study if they suffered from a current psychotic episode, substance abuse disorder, or an inability to speak and understand Dutch. Patients who refused the computer training and/or randomization were also excluded from the study. Those patients were offered treatment fitted to their specific needs.

PROCEDURE

Patients were screened during two intake interviews. After the first interview, they received informed consent forms and written information on the study from the therapist performing the intake interview. The information letter explained that patients who decided to participate in the experiment would receive six additional sessions of computer training before the start of standard treatment. Patients were made aware of the fact this was an experimental treatment and that, although promising results had been found in alcoholic patients, the training had never been tested in HPD and could therefore be without effect. The information letter furthermore explained there were two computer training conditions—one general condition and one focusing specifically on HPD—and that they would be randomly allocated to one of the two conditions. Patients were ensured that their choice not to participate or to prematurely discontinue the study would not negatively affect their standard treatment. Patients who decided not to participate received standard CBT without additional AAT training. If they decided to participate, signed informed consent forms were collected during the second intake interview by the same therapist, approximately one to two weeks later.

Depending on the order of inclusion into the study, participants were assigned to either the training condition or the control condition following a randomization order, which was prepared in advance by the principal investigator who was not involved in the intake and training procedure, or treatment. This way, patients and therapists remained blind to the condition the patient was assigned to. Patients received six weekly 45-minute sessions of computer training. The training was carried out individually in a private therapy room without the therapists being present during the computer task. After these first six weeks, all patients received six 45-minute sessions of standard manual-based CBT once every two weeks (Hoogduin, Hagenaars, van Minnen, & Keijsers, 2011; also see Keijsers et al., 2006, 2016; Schuck, Keijsers, & Rinck, 2010; Van Minnen et al., 2003), performed by other therapists than the ones assisting them with the AAT training. One and three months after completing CBT, patients received a CBT booster session. After twelve months, they received follow-up questionnaires via mail.

The manual-based CBT (Hoogduin et al., 2011) was delivered by therapists who were master-level students and worked to fulfill a clinical internship at Ambulatorium FSW. All therapists were carefully trained in the delivery of the treatment and were supervised weekly by a licensed clinical psychologist to ensure that they adhered to the manual. Habit reversal lies at the core of the applied CBT treatment. The main elements were stimulus control interventions (changing the environment and the habit), stimulus-response interventions (interrupting the stimulus-response chain and introducing an incompatible response), and response consequences (self-rewards). In session 1, the rationale of the treatment was explained to the patient and a self-monitoring diary to monitor hair pulling was introduced. Patients filled these out throughout the entire treatment. In session 2, stimulus-control interventions were proposed and decided on. Further, tools were introduced to increase awareness of hair pulling (e.g., using gloves in high-risk situations, putting bandages on fingers, or wearing perfume or bracelets around the hand that is used to pull hair). Stimulus-response interventions (calling a friend, taking a walk, or cleaning the room before the patient is allowed to pull hair) that postpone hair pulling were the main topic of session 3. Response consequences were introduced and used whenever pulling exceeded agreed upon levels. In sessions 4 and 5, these interventions were extended. Session 6 was used to discuss relapse prevention strategies. Patients were told that lapses are common but can be successfully dealt with by strictly adhering to helpful interventions again in the forthcoming days after the lapse, thereby preventing lapses turning into relapses.

Questionnaire assessments were conducted at six points in time and computer tasks at two points in time. During the first visit, patients completed the baseline assessment (Time 1) and the first training session of the Approach-Avoidance Training (AAT). In the following weeks, another five training sessions followed, approximately one each week. Questionnaires were again administered before the first CBT session (Time 2), after the sixth and last CBT session (Time 3), prior to the one-month (Time 4) and three-months (Time 5) follow-up booster sessions, and at twelve-months follow-up (Time 6). Three computer tasks were completed before the first (Time 1) and after the sixth computer training session (Time 2): an Affective Priming Task (Fazio, Sanbonmatsu, Powell, & Kardes, 1986), a Dotprobe Task (MacLeod, Mathews, & Tata, 1986), and a Modified Stroop Task (Williams, Matthews, & Macleod, 1996). The findings for these computer tasks are beyond the scope of the present paper, however, except with regard to the generalization effects of the AAT training.

MATERIALS

Approach-Avoidance Task

Action tendencies were trained with the AAT (Rinck & Becker, 2007) that uses a joystick to push (avoidance) and pull (approach) hair pulling-related stimuli. The joystick was fastened to a table in front of a computer screen. Pictures that were tilted to the right had to be avoided, and therefore pushed, whereas pictures that were tilted to the left had to be approached, and therefore pulled. The task included zoom-effects: Pictures that were pushed decreased in size, whereas pictures that were pulled increased in size. These zoom-effects increased the impression of approach and avoidance. The zoom effects were dynamic, such that back-and-forth movements of the joystick were accompanied by corresponding increases and decreases of the picture size. Following a correct response, the picture disappeared from the screen. Following an incorrect response, the picture stayed on the screen until the correct response was made. After each trial, the joystick had to be brought back to the central position to start the next trial.

The AAT included five categories of stimuli: 20 pictures related to hair pulling (e.g., a hand pulling a hair), 20 neutral pictures not related to hair pulling (e.g., a hand holding a stapler), 10 words related to hair pulling (e.g., stroking), 10 words related to resistance (e.g., resistance), and 10 empty frames (a white border on a black background). The pictures related to hair pulling were tailored to the patients' main area of hair pulling: one version showing pictures of a hand pulling hairs from the scalp, a second version showing pictures from a hand pulling hair from eyebrows or eyelashes, and a third version showing both types of pictures. Patients pulling hair from another body part were always offered the mixed version.

Every session started with 10 practice trials consisting of empty frames, followed by 140 measurement trials to assess the patients' bias in action tendencies to hair pulling-related stimuli. After the measurement trials, two training blocks of 210 trials each followed. During the training trials, the contingency differed between groups: While patients in the training group always had to push hair pulling-related stimuli away (i.e., these stimuli were always tilted to the right) and always had to pull hair pulling-unrelated stimuli closer (i.e., these stimuli were always tilted to the left), patients in the control condition had to both push and pull both types of stimuli equally often (i.e., all stimuli were tilted to the left or right equally often).

In R. Wiers et al.'s (2011) training pictures of alcohol brands were shown during the AAT training to increase the alcoholic patients' craving for beer. We knew from piloting that picures of hair pulling alone did not affect HPD patients' urge to pull hair enough. Therefore, in addition to the presentation of the pictures we asked patients to touch or stroke their hair in ways they are used to before they start pulling their hair in order to increase their urge to pull hair and hence making the stimuli more salient in the experimental context. They did this at the start of each training session and two times during the training session. Patients were instructed to start or continue the task just before actual hair pulling occurred.

QUESTIONNAIRES

To assess symptom severity, the Massachusetts General Hospital Hairpulling Scale (MGHHS; Keuthen et al., 1995, 2007) was used. The MGHHS consists of 7 items, rated for symptom severity from 0 to 4 (with higher scores reflecting more severe symptoms) and assesses various aspects related to hair pulling: urge to pull, actual pulling, perceived control, and associated distress. The MGHHS (Keuthen et al., 1995, 2007) and its Dutch adaptation (Van Minnen et al., 2003) have shown to have good psychometric properties. In the present study the total score was used. To assess severity, urge, resistance, and frequency of hair pulling, the Dutch Severity Urge Resistance Frequency Scale (SURF; based on Schuck et al., 2010) was used. The SURF actually is a collection of four 1-item questions instead of a scale of which the total score can be computed: Severity (How severe was the hair pulling during the past week?), Urge (How strong was the urge to pull hair during the past week?), Resistance (How well were you able to resist the urge to pull hair during the past week?), and Frequency (During the past week, how often did you pull hair on an average day?). This measure was developed by Schuck et al. with the purpose of being able to distinguish more clearly between the urge to give in to an unwanted habit and the ability to resist the urge than does the MGHHS. In the present study correlations between the four SURF items and the MGHHS total score were high and ranged from .64 to .81, however, indicating that both instruments measure similar constructs. In addition to MGHHS and SURF, severity of hair loss was rated by the patient on a scale inspired by the Alopecia scale, which is usually rated by the diagnostician (for a review of several hair pulling scales, including the Alopecia scale, see Diefenbach and colleagues, 2005). Severity of hair loss was rated with one item from 0 (no hair loss) to 7 (bald). Automatic thoughts related to hair pulling, so-called self-control cognitions (e.g., After a hard day's work, I often feel that I deserve to pull hair, The urge to pull hair is so strong that I think I am not able to resist, When I feel bad I think that hair pulling will help me to feel better for a moment), were assessed with the Self-Control Cognition Questionnaire (SCCQ; Maas et al., 2017), which consists of 11 items and has good psychometric properties. In the present study the total score was used.

Analyses

An a priori sample size calculation was performed with G*Power for *F*-tests for repeated-measures ANOVAs with within-between interactions. The effect size of training-specific changes in the AAT-effect was determined from the Time × Condition interaction (partial $eta^2 = .05$) reported by R. Wiers et al. (2011), resulting in an estimated medium effect size of $f = .23$. *Alpha* error probablility was set to $p = .05$, with a corresponding power of 1–ß = .80. The total sample size needed for this AAT-effect was estimated at 40 (20 patients per group). Data collection was predetermined to run until March 2015. By this time, we had we included 54 patients, yielding power of 1–ß = .91 for an effect size of 1–ß = .23, or 1–ß = .80 for an effect size of $f = .20$.

Data were analyzed with IBM SPSS version 23. In all analyses, an *alpha* of .05 was used. The present paper only briefly summarizes AAT training and reaction time data, but mainly focuses on questionnaire data. These data were analyzed in two ways because at some of the time points the amount of missing data was quite substantial: First, we computed Time (before AAT, after AAT, after CBT, 1-month follow-up, 3-months follow-up, 12-months follow-up) × Group (training, control) repeated-measures ANOVAs. Second, we computed multivariate multilevel analyses using MLWin version 2.23. However, it turned out that the findings hardly differed between the two statistical approaches. Therefore, we chose to report only the repeated-measures ANOVA analyses, as these analyses allow for a more straightforward interpretation. Differences between the repetead-measures ANOVAs and the multivariate multilevel analyses are briefly discussed after reporting the main results. To assess clinical relevance of our findings, we reported Cohen's *d* including a 95% confidence interval.

RESULTS

BASELINE CHARACTERISTICS

Questionnaire baseline scores are reported in Table 2. MGHHS scores were comparable to the scores reported in previous HPD studies (Diefenbach et al., 2006; Dougherty et al., 2006; Keijsers et al., 2006; Keuthen et al., 2012; Rogers et al., 2014; Van Minnen et al., 2003).

AAT Training

To correct for the potential effect of outlier reaction times, medians were analyzed instead of means. Incorrect responses and trials with extreme (<300 ms or >3,000 ms) reaction times were removed before aggregating the data. To create AAT-scores for the pictures, pull scores were subtracted from push scores, and the resulting scores for the neutral pictures were subtracted from those for the hair pulling-related pictures. Similarly, for the words, pull scores were subtracted from push scores, after which the scores for words related to resisting hair pulling were subtracted from the scores for the hair pulling-related words. Positive differences scores indicate relative approach towards hair pulling-related stimuli (pictures and words) when compared to neutral stimuli (pictures and words), and negative difference scores indicate relative avoidance from hair pulling-related stimuli when compared to neutral stimuli.

We first checked whether implicit action tendencies had been successfully manipulated by the AAT in the training condition. Two separate analyses were conducted, one Time (before vs. after AAT) × Group (training, control) repeated-measures ANOVA for pictures and one for words. No training effects could be detected: the Time x Group interactions (both *p*s > .07) were both non-significant with an eta^2 of .004 for the pictures and .063 for the words. Although there seemed to be a trend for the AAT words, this effect was driven by pre-training differences between both groups. More specifically, a marginally significant avoidance effect (p = .053) for the resistance words relative to hair pulling words was apparent in the training group (hair pulling words: M = −6, SD = 124; resistance words: M = −64, SD = 101), but not in the control group (hair pulling words: −1, SD = 96; resistance words: M = −64, SD = 101). In the last training session, means were similar in both conditions (training: M = -9, SD =120; control: M = −7, SD = 50; p = .937). There were no pre-training biases present for the pictures (p = .44). Finally, no generalization effects were found on the APT, DPT, or Modified Stroop Task (all *p*s > .52).

QUESTIONNAIRES: GROUP DIFFERENCES

Overall, according to the Time (before AAT, after AAT, after CBT, 1-month follow-up, 3-months follow-up, 12-months follow-up) x Group (training, control) repeated-measures ANOVAs, patients significantly improved from Time 1 to Time 6, indicated by significant main effects of Time on all questionnaires: MGHHS: F(5, 20) = 9.55, p < .001; SURF Severity: F(5, 17) = 3.08, p = .04; SURF Urge: F(5, 17) = 4.80, p = .01; SURF Resistance: F(5, 17) = 6.36, p = .002; SURF Frequency: F(5, 17) = 5.70, p = .003; SCCQ: F(5, 18) = 9.99, p < .001; Severity of hair loss: F(5, 18) = 5.64, p = .003. However, the AAT training never significantly affected treat-

TABLE 2. Questionnaire Baseline Scores, *N* = 54

Questionnaire	Training group (*n* = 27) Mean (*SD*)	Control group (*n* = 27) Mean (*SD*)	*t*(*df*) *p*
MGHHS	14.19 (6.24)	16.41 (3.28)	*t*(52) = 1.64 *p* = .11
SURF			
Severity	2.96 (1.13)	3.26 (0.98)	*t*(52) = 1.03 *p* = .31
Urge	55.22 (30.29)	68.42 (17.81)	*t*(51) = 1.93 *p* = .06
Resistance	41.44 (30.73)	29.77 (20.92)	*t*(51) = −1.61 *p* = .11
Frequency	3.67 (1.52)	3.96 (0.94)	*t*(52) = 0.86 *p* = .39
SCCQ	32.74 (9.57)	28.70 (6.93)	*t*(52) = −1.78 *p* = .08
Severity of hair loss	3.98 (1.99)	3.92 (1.52)	*t*(52) = −0.12 *p* = .91

Notes. MGHHS = Massachusetts General Hospital Hairpulling Scale; SURF = Severity Urge Resistance Frequency Scale; SCCQ = Self-Control Cognition Questionnaire.

ment outcome from Time 1 to Time 6, as indicated by the non-signficant Time × Group interactions: MGHHS: $F(5, 20) = 1.57$, $p = .21$; SURF Severity: $F(5, 17) = 1.01$, $p = .44$; SURF Urge: $F(5, 17) = 1.11$, $p = .39$; SURF Resistance: $F(5, 17) = 0.89$, $p = .51$; SURF Frequency: $F(5, 17) = 1.53$, $p = .23$; SCCQ: $F(5, 18) = 0.99$, $p = .45$; Severity of hair loss: $F(5, 18) = 0.19$, $p = .96$. As the number of assessment drop-outs was particularly high at Time 6, we repeated the analyses only including Time 1 through Time 5. Results were similar to the previous analyses (significant main effects of Time, non-significant Time × Group interactions), except with regard to the Time x Group interaction for the SCCQ that was significant, $F(4, 28) = 2.96$, $p = .04$. However, when taking a closer look at the scores, the training group started treatment with a slightly higher score on the SCCQ, although not significantly different from the control group, $F(1, 52) = 3.15$, $p = .08$, but groups did not differ at Time 5, $F(1, 37) = 0.42$, $p = .52$.

Questionnaires: Pooled Results

In order to more closely examine the treatment effects, we compared the means between the individual time points. For each of the time frames, Table 3 reports the means of the time points, the statistics (and number of patients included) for comparing them, and their differences expressed in Cohen's *d*. As the AAT training had no effect, Table 3 shows the pooled group estimates. Means and standard deviations vary slightly between the time frames (columns) due to the pairwise deletion procedure.

In general, results showed that patients improved significantly as a result of treatment. For the MGHHS, SURF Severity, SURF Frequency, SCCQ and Severity of hair loss data, patients showed improvement from baseline to the end of AAT training with medium effect sizes (Table 3: Time 1 – Time 2). Improvements resulting from CBT, however, were much larger on all questionnaires (Table 3: Time 2 – Time 3). Overall, these treatment results were maintained until three months follow-up, with the exception of SURF Resistance, which showed a significant symptom increase one month after treatment completion already (Table 3: Time 3 – Time 5). At twelve-month follow-up, all TTM-symptom measurements showed significant increase of symptoms, except the SCCQ (Table 3: Time 3 – Time 6). When compared to pretreatment symptom levels, improvement was still significant on all questionnaires, except for SURF Urge, which failed to show significant improvement when compared to baseline (Table 3: Time 1 – Time 6). Multivariate multilevel analyses were slightly more positive with regard to SURF Severity and Severity of hair loss, in the sense that these analyses did not show a significant increase of symptoms at any of the follow-up measurements. Other conclusions did not differ between the two statistical approaches.

DISCUSSION

The present study examined whether adding an AAT training (Rinck & Becker, 2007) prior to standard CBT was helpful to reduce relapse, here defined as significant symptom reoccurrence, after successful CBT for patients suffering from Hair Pulling Disorder (HPD). We expected the training group, receiving an active AAT training, to show less relapse after standard CBT for TTM compared to the control group receiving a sham training. However, the AAT training failed to produce implicit training effects. Hence, it can be argued that our experimental manipulation was unsuccessful, and therefore, that no further effects could be expected on symptom reduction or relapse during or after CBT (see also Clarke, Notebaert, & Macleod, 2014). This was indeed the case. The questionnaire data in regard to symptom levels and self-control cognitions were unaffected by the AAT training during, or after treatment, or at follow-up measurements. We therefore conclude that the AAT training did not appear to aid in symptom reduction and, importantly, did not appear to reduce relapse after CBT treatment.

Although there were no AAT training effects, our findings showed that the brief CBT for HPD in itself was successful. For the patients in the experimental and in the control group, there was an overall improvement from pre-treatment measurement to twelve months follow-up. Because training condition did not affect the results on any of the questionnaires, findings of patients of both conditions were combined to evaluate the effects of CBT between individual time points. There was a slight improvement in TTM symptoms in the time the AAT training and sham training were offered, but the improvements were much larger (Cohen's *d*s between .89 and 1.22) when CBT was offered. Since the patients' improvements prior to CBT were not different for the AAT training and the sham training, they should be best considered as effects due to hope, expectancy, and weekly contact with a therapist. Therapists at that point had not discussed the symptoms with the patients but evaluation forms showed that patients indeed had enjoyed the AAT and sham training and some patients reported to also believe that the training had immediately alievated their symptoms.

The present data also showed that patients demonstrated maintenance of treatment results at one- and three-months follow-up assessments. Only for the Resistance-scale of the SURF, there was a significant increase of symptoms after one month, indicating that patients estimated that it was harder for them to resist the urge to pull hair, as compared with the same estimation immediately after treatment.

TABLE 3. Scores on Self-report Questionnaires Across Consecutive Time Frames Before, During and After Treatment, Accompanied by Test Statistics and Effect Sizes

Questionnaire	Time 1 – Time 2	Time 2 – Time 3	Time 3 – Time 4	Time 3 – Time 5	Time 3 – Time 6	Time 1 – Time 6
MGHHS	***n* = 52**	***n* = 41**	***n* = 34**	***n* = 36**	***n* = 29**	***n* = 32**
M(SD) 1	15.63 (4.67)	14.22 (4.61)	8.90 (5.13)	8.38 (4.97)	8.43 (5.48)	15.94 (4.24)
M(SD) 2	13.88 (4.62)	8.21 (5.19)	9.21 (5.52)	9.71 (6.33)	13.33 (5.93)	13.45 (5.75)
	$F = 6.10$	$F = 50.14$	$F = 0.10$	$F = 1.90$	$F = 16.43$	$F = 5.28$
	$p = .02$	$p < .001$	$p = .75$	$p = .18$	$p < .001$	$p = .03$
Cohen's *d* (95% CI)	0.38 (−0.17–0.93)	1.22 (0.56–1.89)	−0.06* (−0.73–0.61)	−0.23 (−0.89–0.42)	−0.86 (−1.62–0.10)	0.49 (−0.21–1.20)
SURF Severity	*n* = 52	*n* = 41	*n* = 35	*n* = 35	*n* = 27	n = *30*
M(SD) 1	3.15 (1.04)	2.91 (1.00)	2.11 (1.02)	2.09 (1.01)	2.15 (1.10)	3.27 (1.05)
M(SD) 2	2.84 (1.00)	2.05 (0.97)	2.16 (0.86)	2.19 (1.11)	2.70 (1.10)	2.67 (1.06)
	$F = 5.93$	$F = 20.66$	$F = 0.06$	$F = 0.28$	$F = 5.91$	$F = 6.93$
	$p = .02$	$p < .001$	$p = .81$	$p = .60$	$p = .02$	$p = .01$
Cohen's *d* (95% CI)	0.30 (−0.24–0.85)	0.87 (0.23–1.15)	−0.05 (−0.72–0.61)	−0.09 (−0.76–0.57)	−0.50 (−1.27–0.27)	0.57 (−0.16–1.30)
SURF Urge	*n* = 51	*n* = 41	*n* = 35	*n* = 35	*n* = 27	*n* = 30
M(SD) 1	63.49 (24.17)	59.66 (23.04)	34.37 (29.53)	31.80 (27.81)	37.96 (30.23)	66.03 (23.82)
M(SD) 2	59.12 (22.98)	33.10 (29.11)	42.03 (29.52)	41.23 (30.56)	52.96 (29.00)	55.10 (28.51)
	$F = 1.19$	$F = 35.98$	$F = 1.75$	$F = 2.84$	$F = 6.75$	$F = 3.11$
	$p = .28$	$p < .001$	$p = .19$	$p = .10$	$p = .02$	$p = .09$
Cohen's *d* (95% CI)	0.19 (−0.37–0.74)	1.01 (0.36–1.66)	−0.26 (−0.92–0.41)	−0.32 (−0.99–0.34)	−0.51 (−1.27–0.26)	0.42 (-0.31-1.14)
SURF Resistance	*n* = 51	*n* = 41	*n* = 35	*n* = 35	*n* = 27	*n* = 30
M(SD) 1	34.16 (25.62)	39.98 (25.94)	71.69 (30.34)	71.26 (30.72)	72.44 (31.14)	32.07 (24.94)
M(SD) 2	40.53 (24.50)	71.98 (30.00)	57.60 (32.84)	54.83 (34.12)	53.63 (29.28)	52.73 (28.79)

	F = 2.37	F = 33.71	F = 4.68	F = 5.45	F = 9.16	F = 9.26
	p = .13	p < .001	p = .04	p = .03	p = .01	p = .01
Cohen's d (95% CI)	0.25 (–0.30–0.81)	1.14 (0.48–1.80)	–0.44 (–1.11–0.23)	–0.51 (–1.18–0.17)	–0.62 (–1.40–0.15)	0.77 (0.03–1.51)
SURF Frequency	n = 52	n = 41	n = 35	n = 35	n = 27	n = 30
$M(SD)$ 1	3.84 (1.21)	3.45 (1.38)	2.19 (1.39)	2.13 (1.42)	2.28 (1.47)	4.07 (1.01)
$M(SD)$ 2	3.41 (1.39)	2.06 (1.35)	2.47 (1.45)	2.53 (1.61)	3.19 (1.64)	3.10 (1.60)
	F = 8.21	F = 40.51	F = 1.38	F = 2.24	F = 9.17	F = 13.34
	p = .006	p < .001	p = .25	p = .14	p = .005	p = .001
Cohen's d (95% CI)	0.33 (–0.22–0.88)	1.02 (0.37–1.67)	–0.20 (–0.86–0.47)	–0.26 (–0.93–0.40)	–0.58 (–1.36–0.19)	0.73 (–0.01–1.46)
SCCQ	n = 52	n = 41	n = 35	n = 36	n = 27	n = 30
$M(SD)$ 1	31.19 (8.26)	27.98 (9.39)	21.91 (8.59)	21.28 (8.18)	21.41 (7.89)	31.13 (8.22)
$M(SD)$ 2	29.17 (10.13)	21.90 (8.43)	21.27 (8.60)	20.75 (8.47)	22.67 (7.97)	23.20 (7.81)
	F = 6.06	F = 17.01	F = 0.28	F = 0.16	F = 0.77	F = 26.10
	p = .02	p < .001	p = .60	p = .70	p = .39	p < .001
Cohen's d (95% CI)	0.22 (–0.33–0.76)	0.68 (0.05–1.31)	0.07 (–0.59–0.74)	0.06 (–0.59–0.72)	–0.16 (–0.91–0.60)	0.99 (0.23–1.75)
Severity of hair loss	n = 52	n = 40	n = 35	n = 36	n = 27	n = 30
$M(SD)$ 1	4.07 (1.67)	3.51 (1.60)	2.34 (1.58)	2.22 (1.50)	2.06 (1.60)	3.45 (1.44)
$M(SD)$ 2	3.67 (1.76)	2.29 (1.51)	2.51 (1.58)	2.36 (1.59)	2.59 (1.65)	2.57 (1.57)
	F = 8.30	F = 35.48	F = 0.89	F = 0.41	F = 9.43	F = 15.14
	p = .006	p < .001	p = .35	p = .52	p = .005	p = .001
Cohen's d (95% CI)	0.23 (-0.31-0.78)	0.78 (0.14–1.43)	-0.11 (-0.77-0.56)	–0.09 (–0.74–0.56)	–0.33 (–1.09–0.43)	0.58 (–0.15–1.32)

Notes. Time 1 = before AAT training; Time 2 = after AAT training; Time 3 = after CBT; Time 4 = 1 month follow-up; Time 5 = 3 month follow-up; Time 6 = 12 month follow-up; MGHHS = Massachusetts General Hospital Hairpulling Scale; SURF = Severity Urge Resistance Frequency Scale; SCCQ = Self-Control Cognition Questionnaire.
*Strictly speaking, an effect size is normally not expressed as negative, nevertheless we chose to report it this way, to emphasize that symptoms increased again.

For the twelve-month follow-up results, the conclusions derived from the Repeated-Measures ANOVAs and from the multivariate analyses differed slightly; for SURF Severity and Severity of hair loss, the multivariate multilevel analyses did not point at significant symptom increase after twelve months, but the Repeated-Measures ANOVAs did. When opting for the most conservative conclusion while trying to capture the overall line of findings, it should be inferred that CBT produces good outcomes for patients with HPD. These outcomes remain stable one and three months after treatment but do fail to do so in the subsequent period and after one year have reduced by half compared to the treatment effects immediately after treatment. When comparing the twelve months follow-up results to pretreatment questionnaire scores, effect sizes were still medium to large, however.

Considering the inferences above, one should keep in mind that we did not include a waitlist control group. All patients received some form of AAT training (sham or not) plus CBT. Therefore, we cannot know for sure which part of symptom reduction (but also relapse) can be uniquely ascribed to CBT only. Our power analysis was based on the first study of *R*. Wiers and colleagues (2011) on the effects of AAT training in alcoholics. Based on this analysis we would argue that we had included enough patients for a sufficiently powered analysis of the AAT data themselves. It must be noted, however, that effect sizes reported in replication studies (Eberl et al., 2013, 2014) were smaller. If effects are small (e.g., $f = .10$), a much larger sample ($N = 200$) would have been needed to detect them with sufficient power (1–ß = .80). In contrast to the AAT analyses, the effect sizes in the CBT analyses were large as well as consistent across questionnaires with regard to the insignificant symptom increase at one- and three-month follow-ups, and significant symptom increase at the twelve-month follow-up.

A variety of reasons might explain why the AAT training was without any clear effect on clinical symptoms. In the Introduction we argued why we chose to retrain approach-avoidance biases in patients with HPD rather than to try to affect attentional biases or evaluation biases. Our main argument was that approach-avoidance tendencies seem to resemble the act of hair pulling, as HPD involves actual approach of hairs when pulling. Based on the present findings, however, it is possible to argue that approach-avoidance tendencies are irrelevant for patients suffering from HPD, meaning that these tendencies do not play a role in maintaining the disorder or in its proness to symptom reoccurrence.

Another reason why the AAT training was without effect might have been that we selected the wrong type of stimuli for the AAT training. Up to date, there has been only one other study investigating automatic processes in HPD. Lee and colleagues (2011) investigated attentional biases towards stimuli depicting hair using hair-related (but not pulling-related), threat-related, and neutral pictures. Unlike Lee and colleagues, we used stimuli closely related to hair pulling, we tailored the stimuli to the participants' area of hair pulling, and we applied hair-related words as well as pictures. Moreover, we asked patients (in both conditions) to touch and stroke their hair at the start of each of the training sessions and at several times during sessions to increase the urge to pull hair and to make the stimuli more salient in the experimental context. When testing our stimuli in a pilot test, patients did indeed report an urge to pull hair when touching or stroking their hair. Despite our efforts to represent the patients' hair pulling behavior as closely as possible, we might still have failed to select those stimuli that are most relevant for patients suffering from HPD. In retrospect, we might have needed to focus more on internal and tactile stimuli. That is, given the right context (sitting on the couch, watching TV, being alone), internal stimuli (urge, itching sensations) seem to elicit hair pulling. These internal stimuli are not well represented by hair pulling images, hair pulling words, or words concerning resisting hair pulling.

Future research might want to take into account the complexity of stimuli that elicit hair pulling and consider investigating other types of biases. For example, interpretation biases were not studied in the present experiment, but might be highly applicable when considering the self-control cognitions patients experience before and after hair pulling (Maas et al., 2017). Also, impaired motor inhibition has been observed in hair pulling patients (Chamberlain, Fineberg, Blackwell, Robbins, & Sahakian, 2006; Odlaug, Chamberlain, Harvanko, & Grant, 2012), indicating response inhibition training might be beneficial. Last, although during the pilot test patients indicated touching or stroking their hair increased the urge to pull hair in the experimental context, we did not assess this (increase in) urge in the present study. Therefore at this stage we fail to supply empirical data that stroking one's hair is a helpful component of the AAT for HPD.

Although the present study cannot provide definite answers as to how to decrease relapse, we do like to stress that our findings quite dramatically show that it is important to include long-term follow-ups when studying treatment effects in HPD. Results regarding relapse as reported in the literature are quite inconsistent. At three- to six-month follow-ups, some studies report good treatment maintenance (e.g., Azrin et al., 1980, Keuthen et al., 2012; Woods et al., 2006), but other studies report relapse (e.g., Diefenbach et al., 2006; Keijsers et al., 2006; Rogers et al., 2014). Reported long-term follow-ups are rare (for an exception, see Keijsers et al., 2006, 2016), reporting results until 24-month follow-up, showing findings similar to the present study), but appear crucial given our results.

Taken together and in line with the existing literature, CBT showed to be an effective treatment for HPD in the short-term. Effects were stable up to three months after CBT, when the last booster session took place. Although at the twelve-month follow-up, effect sizes were still medium to large, symptom increase was significant. Although in this study, AAT training could not reduce the high relapse typically found after successful CBT, this absence of evidence for the effectiveness of AAT training in symptom and relapse reduction in HPD, does not neccesarily mean that CBM is in fact ineffective (Clarke et al., 2014), considering that there were no pre-existing biases to the stimuli used in the present study. Investigating other biases and stimuli seem promising areas for future research.

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