JOURNAL OF COGNITIVE PSYCHOLOGY
2018, VOL. 30, NO. 7, 743–753
https://doi.org/10.1080/20445911.2018.1503278

Approach-avoidance, attentional and evaluation biases in hair pulling disorder and their relationship with symptom severity

Joyce Maas[a], Ger P.J. Keijsers[a,b], Mike Rinck[a] and Eni S. Becker[a]

[a]Behavioural Science Institute, Radboud University Nijmegen, Nijmegen, The Netherlands; [b]Clinical Psychological Sciences, Maastricht University, Maastricht, The Netherlands

ABSTRACT
The present study examined approach-avoidance, attentional and evaluation biases in Hair Pulling Disorder (HPD). Although none of the tasks showed indications of biased action tendencies in response to hair pulling-related pictures, or biased attention for hair pulling-related words, we found that patients were slower to react to hair pulling-related stimuli than to neutral stimuli. This slowing down may indicate that patients are ambivalent towards hair pulling. This "ambivalence" positively correlated with HPD symptom severity, but only on one of the three severity measures we assessed. Concerning action tendencies towards hair pulling-related words, patients were, however, faster to react to hair pulling-related words when compared to words related to resisting hair pulling. Future research is needed to disentangle this ambivalent response pattern in HPD.

ARTICLE HISTORY
Received 1 March 2018
Accepted 18 July 2018

KEYWORDS
Hair pulling disorder; approach-avoidance bias; evaluation bias; attentional bias

Hair Pulling Disorder (HPD; trichotillomania) is characterised by failing to resist the urge or tendency to pull out one's own hair. Most HPD patients pull out hairs from the head, but pulling hairs from other areas, such as eyebrows or eyelashes, is common also. Approximately 40–50% of patients pull out hairs from multiple parts of their body (Christenson & Mansueto, 1999; Flessner et al., 2008). HPD was categorised 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".

In HPD a large part of the hair pulling occurs in an automatic fashion, often in a "trance-like" state, although hair pulling certainly also occurs focused (e.g. seeking which specific hairs to pull, or pulling until it feels "just right"; see also Flessner et al., 2008). Often hair pulling occurs in the same context over and over again, with the implication that the urge to pull hair appears rather automatically when being presented with this context, for example when watching TV or while reading. Dual process models (e.g. Strack & Deutsch, 2004) explain why habits, such as HPD, can be quite persistent. According to these models impulsive, unconscious or automatic processes guide behaviour, unless enough cognitive capacity becomes available for reflective, conscious or controlled processes to intervene. In other words and specifically applied to HPD, actively resisting the urge to pull hair may work well until motivation subsides or a stressful time at work presents itself, or until someone is tired at the end of the day, or is simply double-tasking (such as watching TV). Investigating these "automatic" processes in HPD therefore appears to be a promising tool to find out more about underlying processes of HPD. With "automatic" we thus refer to behaviour that is elicited through associative links (e.g. Strack & Deutsch, 2004).

Automatic processes have been studied in many unwanted behaviours and in addictions using reaction time tasks. This research has demonstrated that people show biases to approach (approach bias) rather than avoid, attend to (attentional bias) rather than disengage from, and to positively evaluate (positive evaluation bias) rather than negatively evaluate stimuli related to their problematic habitual behaviour, such as smoking (Brignell, Griffiths, Bradley, & Mogg, 2009; Mogg, Bradley, Field, & De Houwer,

CONTACT Joyce Maas j.maas@uvt.nl

2003), eating (Veenstra & de Jong, 2010), and drinking (Field & Cox, 2008; Field, Kiernan, Eastwood, & Child, 2008; Palfai & Ostafin, 2003). Although other biases have been researched also, these three types of biases are most common in the research literature.

These findings suggest that the same automatic proccesses are present in patients with HPD and that these patients also have a tendency to approach, automatically attend to and positively evaluate hair-related stimuli. However, the only study investigating automatic processes in HPD by Lee, Franklin, Turkel, Goetz, and Woods (2012) showed an attentional *disengagement* rather than attentional *engagement* from hair cues at later (but not earlier) stages of attention. This bias was positively associated with HPD symptom severity. Schuck, Keijsers, and Rinck (2012) investigated approach-avoidance biases in skin picking disorder, which is included within the same DSM-5 category as HPD. Schuck et al. compared reaction times to pictures of affected skin, pictures of healthy skin, and neutral pictures showing textures of boxing materials (e.g. cardboard) and found avoidance of skin picking-related stimuli, i.e. skin picking patients were slower to pull than to push stimuli of affected skin when compared to the other stimuli used in the task and when compared to healthy controls. Interestingly, Schuck et al. also found that skin picking patients were slower to react to skin picking-related stimuli in general, either pulling or pushing, when compared to the other stimuli and when compared to healthy controls. This slowing down in reaction times was furthermore associated with symptom severity.

The results for HPD and skin picking thus diverge from the results for unwanted behaviours and addictions usually found in the literature. Why would automatic processes associated with HPD be different from automatic processes in other types of unwanted and addictive behaviours? Breiner, Stritzke, and Lang (1999) argue that approach and avoidance tendencies are, among other things, dependent upon previous experiences. That is (given that hair pulling does not necessarily result in positive experiences, but is more likely to lead to negative consequences), an avoidance bias, as well as a negative evaluation bias and attentional disengagement, should indeed be plausible. Central to the model by Breiner et al. is the experiences ambivalence regarding one's behaviour. The resulting competition between the tendency to approach and to avoid hair pulling behaviour may thus furthermore explain the slowing down in reaction times as found by Schuck et al. (2012).

As only two studies so far looked into HPD and skin picking, it is too early to draw any conclusions regarding automatic processes in HPD. Therefore, the aim of the present study was to gain further insight into the automatic processes and biases associated with HPD. We did not include a control group, as the aim of the study was to investigate within-group differences regarding automatic processes and biases in HPD using HPD-related and neutral stimuli. The study was not set up to investigate whether these biases were HPD-specific.

We expanded the studies by Lee et al. (2012) and Schuck et al. (2012) in three ways. First, the present study systematically investigated three possibly relevant biases at once: approach-avoidance biases, attentional biases, and evaluation biases.

Second, we improved and extended the stimuli in our tasks. While Lee et al. (2012) used pictures of healthy hair, we chose to use pictures of a hand pulling hair. Different from alcohol drinking, smoking, and eating, people usually do not see their own hair while pulling. We therefore aimed to resemble problematic hair pulling behaviour more closely than Lee at al did. In addition, we tailored the stimuli to the area of hair pulling (e.g. a hand pulling hairs from the scalp, a hand pulling hairs from eyebrows or eyelashes) depending on the patients' habit, as patients who pull hair from the scalp might not be triggered by a picture showing a hand pulling a hair from the eyebrows (cf. Amir, Najmi, and Morrison (2009), who followed a similar procedure in participants with obsessive-compulsive disorder). Further, many reaction time tasks, especially when used in training contexts, apply a counter category of stimuli in their design. Examples are pictures of fat food countered by picures of healthy food. In this case we therefore introduced stimuli related to resistance to hair pulling pulling (e.g. "resistance", "stopping", "refraining") as a counter category for the hair pulling-related stimuli (e.g. "stroking", "feeling", "hair"). As this is difficult, if not impossible, to catch in a picture, we added words to our tasks.

And third, immediately before measuring the biases in our study, we asked patients to touch or stroke their hair in ways they are used to do before they start hair pulling, to make the stimuli more salient in the experimental context.

In line with the findings by Lee et al. (2012) and Schuck et al. (2012), and in accordance with the model by Breiner et al. (1999), we expected HPD patients to show an avoidance tendency, a negative evaluation bias, and an attentional disengagement in reaction to cues related to hair pulling. We also expected patients to show a general slowing down of responses for hair pulling-related stimuli when compared to control stimuli, reflecting ambivalence in responding. Last, we expected these biases as well as this "ambivalence" to positively relate to patients' symptom severity before treatment, as measured by the Massachusetts General Hospital Hairpulling Scale (MGHHS; Keuthen et al., 1995) and the items of the Severity Urge Resistance Frequency Scale (SURF; based on Schuck, Keijsers, & Rinck, 2011).

Methods

Participants

Patients ($N = 54$) were recruited at Ambulatorium FSW, Nijmegen, the Netherlands, an academic outpatient centre with expertise in treating impulse-control disorders and unwanted habits. The study was advertised in local and national newspapers. All patients were included between October 2011 and March 2015. Patient characteristics are reported in Table 1.

The present study was part of a larger study investigating the addition of Cognitive Bias Modification (CBM) computer training to standard Cognitive Behaviour Therapy (CBT). Details on the effects of these interventions are reported in a separate paper Maas, Keijsers, Rinck, & Becker (2018). The present paper only covers the procedure and data from the baseline assessment (before the computer training).

Table 1. Patient characteristics, $N = 54$.

	Mean (*SD*) or *n* (%)
Age (years)	34.57 (12.1)
Gender (female)	50 (92.6%)
Duration of symptoms (years)	21.7 (11.6)
Education level	
Lower general secondary	6 (11.0%)
Intermediate general secondary	4 (7.0%)
Upper general secondary	2 (4.0%)
Vocational	15 (28.0%)
Higher vocational	9 (17.0%)
University	14 (26.0%)
Hair pulling site	
Scalp	29 (54.0%)
Eyelashes/eyebrows	13 (24.0%)
Facial hair	1 (4.0%)
Multiple sites	8 (15.0%)
Comorbidity	
Generalised anxiety disorder	4 (7.0%)
Social anxiety disorder	2 (4.0%)
Posttraumatic stress disorder	2 (4.0%)
Panic disorder	1 (2.0%)
Depressive disorder	1 (2.0%)
Other	7 (13.0%)

All patients were screened during two intake interviews. During the first intake interview, the Dutch version of the MINI-International Neuropsychiatric Interview (Sheehan et al., 1998) was completed. Inclusion criteria were an age between 17 and 65 and a current primary diagnosis of HPD according to DSM-IV criteria. Exclusion criteria were a current psychotic episode, substance abuse disorder, or an inability to speak and understand Dutch. Patients with other comorbid disorder 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 diagnoses anymore and patients were excluded from the study. Also, patients who refused the computer training or randomisation were excluded from the study. The excluded patients were offered standard CBT. After the first intake interview, patients received informed consent forms and oral and written information on the study. If the patients decided to participate, signed informed consent forms were collected during the second intake interview, approximately one week later. During the study 10 patients dropped out (refusing protocol adherence: $n = 5$, refusing study intervention: $n = 2$, loss of contact: $n = 2$, long commute: $n = 1$). However, all these patients completed the baseline assessment as reported in the present paper. 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).

Materials and procedure

Immediately before the CBM computer training and standard CBT, patients were invited for the baseline assessment. Patients were asked to complete the computer tasks (see below), after which they filled out several questionnaires (see below).

In the computer tasks, described in more detail below, we used ten pictures related to hair pulling versus ten neutral pictures unrelated to hair pulling. The former ones were pictures of a hand pulling hair. Patients who pulled hairs from their scalp were presented with pictures showing a hand pulling hairs from the scalp, whereas patients who pulled hair from eyebrows and eyelashes were presented with pictures showing a hand pulling hairs from those areas (several depicting the use of tweezers, others not). We also offered a mixed option for patients who pulled hairs from their head as well as from their eyebrows or eyelashes. This option was also offered to patients who pulled hairs from other parts of their body. The neutral pictures were pictures of a hand holding an office supply. Examples of the pictures are presented in the Appendix. In addition to these pictures, several computer tasks (see below) used ten words related to hair pulling and ten words related to resistance to hair pulling (either in addition to the pictures or instead of the pictures). Before the computer tasks started, patients were invited to touch or stroke their hair in ways they are used to before they start pulling, to make the stimuli more salient in the experimental context.

Computer tasks

Patients started with the *Affective Priming Task* (APT; Fazio, Sanbonmatsu, Powell, & Kardes, 1986), used to measure evaluation biases with categories of stimuli. Participants had to categorise two sorts of target words, namely valence words and tension words, into a positive category (e.g. "good", "relaxed", "relief") or a negative category (e.g. "bad", "stress", "tension"). We used ten valence words and ten tension words, of which half were positive and the other half negative. For this purpose, a keyboard was used with two marked keys (on the left and right side of the keyboard) representing the negative and positive category. The assignment of the keys to the categories was counterbalanced across participants. The task consisted of 160 trials. On each trial, before participants categorised a target word, a picture prime appeared. These prime pictures were hair pulling-related pictures (a hand pulling hair) and neutral pictures (a hand holding an office supply). Because the primes automatically activate affect, the standard observation is that people are faster to categorise the valence of a target if it is preceded by a prime with the same valence. Participants' attitudes can therefore be inferred from comparing the reaction times of congruent trials (positive prime picture before positive target word, or negative prime picture before negative target word) with the reaction times of incongruent trials (positive prime picture before negative target word, or negative prime picture before positive target word). Reaction times were analyzed separately for categorising the valence words and the tension words.

Next, the *Dot Probe Task* (Macleod, Mathews, & Tata, 1986) was used to measure attentional biases to the pictorial stimuli. These were the same stimuli (ten hair pulling-related pictures, ten neutral pictures) as the ones in the Affective Priming Task. In a total of 240 trials, participants were presented with a pair of pictures, presented side by side. In line with Lee et al. (2012), we used short (250 ms) and longer (500 ms) presentation times, to explore both early as well as later stages of attention. The pictures disappeared after either 250 ms or 500 ms, and immediately a probe replaced one of the pictures. On each trial participants had to respond whether the probe consisted of one dot (.) or two dots (:). For this purpose two keys were marked on the keyboard, one at the upper half of the keyboard and the other one at the bottom half of the keyboard. As people are usually faster identifying the probe when it appears behind the stimulus the person was already attending to, attentional biases can be inferred from the reaction times.

The third task was the *Modified Stroop Task* (Williams, Mathews, & Macleod, 1996), which was used to measure attentional biases for word stimuli. In this task, participants name the ink colour of each word presented presented on "cards" on a computer screen. There were six cards and each card showed 40 words. The six cards were presented in random order. The cards contained words related to hair pulling (e.g. "stroking"), words related to resisting hair puling (e.g. "refraining"), general positive words (e.g. "love"), general negative words (e.g. "war"), neutral words (e.g. "pencil"), and colour words (e.g. "blue"). The general positive and negative words were added for several reasons. First, as HPD is often comorbid with mood disorders (e.g. Houghton et al., 2016), it is interesting to compare general negative to hair pulling-related and resistance words. We added the positive words to not have a mood induction. Also, when using more categories, it is easier to hide what the task is about. All patients started with a practice card, consisting of a row of x's ("xxxx"). The cards containing colour words and xxx's were not included in the analyses of the present paper. The experimenter could not see the screen and was therefore blind to the conditions presented on the screen, but checked the answers using an answer sheet. The experimenter started the task on each trial by counting down and pressed the left key of the mouse when the participant named the last colour on each card, so that reaction times for the total card were registered. After another press, the next card appeared. Slower reaction times for a specific word category indicate attentional interference for that particular category,.

Finally, the *Approach-Avoidance Task* (AAT; Rinck & Becker, 2007) was used to assess approach-avoidance biases. Patients reacted to stimuli presented on the computer screen by pushing and pulling a joystick. This joystick was fastened on a table in front of the computer screen. Patients were instructed not to react to the content of the stimuli, but to their tilt: Pictures that were tilted to the right had to be pushed, whereas pictures that were tilted to the left had to be pulled. Following a correct response, the picture disappeared when the joystick was pushed or pulled by 30 degrees. Following an incorrect response, the picture stayed on the screen until the correct response was made. The task consisted of 140 trials. After each trial, the joystick had to be brought back to the central position to start the next trial. Zoom-effects were incorporated into the task, such that when a picture was pushed, the picture decreased in size, and when a picture was pulled, the picture increased in size. The zoom-effects increased the impression of pushing stimuli away or pulling them closer. There were five categories of stimuli: ten pictures related to hair pulling (a hand pulling a hair), ten neutral pictures unrelated to hair pulling (a hand holding an office supply), ten words related to hair pulling (e.g. "stroking"), ten words related to resisting hair pulling (e.g. "refraining"), and empty frames. Faster pulling indicates an approach bias, whereas faster pushing indicates an avoidance bias.

Self-report measures

To assess symptom severity a Dutch adaptation (Van Minnen, Hoogduin, Keijsers, Hellenbrand, & Hendriks, 2003) of the *Massachusetts General Hospital Hairpulling Scale* (MGHHS; Keuthen et al., 1995) was used, which consists of 7 items, rated for severity from 0 to 4 and assesses different aspects related to hair pulling: urge to pull, actual pulling, perceived control, and associated distress. The original version and its Dutch adaptation were shown to have good psychometric properties. In the present study the total score was used.

Severity, urge, resistance, and frequency of hair pulling were assessed with the *Severity Urge Resistance Frequency Scale* (SURF; based on Schuck et al., 2011), which consists of four 1-item questions. Frequency and severity were rated on a 5-point Likert scale ranging from 1 ("none") to 5 ("extreme"). Urge and resistance were measured with 100 mm visual analogue scales. Higher scores reflect higher symptom levels, except for Resistance, for which higher scores reflect more resistance to hair pulling. Example items are: 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?"). The SURF was developed as an addition to the MGHHS, with the purpose of being able to distinguish more clearly between the urge and the resistance to hair pulling when compared to the MGHHS. However, in the present study correlations between the four SURF items and the MGHHS total score were high and ranged from .64 to .81.

Patients' mood and stress level at time of testing was assessed with two items "How would you evaluate your mood right now" and "How stressed are you right now?". Both items had to be answered on a 5-point Likert scale ranging from 1 ("very bad" or "not at all", respectively) to 5 ("very good" or "very much", respectively).

Results

Sample characteristics

Patient baseline questionnaire scores, as well as patients' mood and stress levels at the time of testing are reported in Table 2. MGHHS scores were comparable to the scores reported in previous HPD studies (Diefenbach, Tolin, Hannan, Matlby, & Crocetto, 2006; Dougherty, Loh, Jenike, & Keuthen,

Table 2. Questionnaire baseline scores, $N = 54$.

Questionnaire	Mean (*SD*)
MGHHS	15.30 (5.06)
SURF	
Severity	3.11 (1.06)
Urge	61.70 (25.59)
Resistance	35.72 (26.78)
Frequency	3.81 (1.26)
Positive mood (range: 1–5)	3.74 (0.83)
Stress level (range: 1–5)	2.73 (1.09)

Note: MGHHS = Massachusetts General Hospital Hairpulling Scale, SURF = Severity Urge Resistance Frequency Scale, Positive mood and stress level = positive mood and stress level at the time of testing.

2006; Keijsers et al., 2006; Keuthen et al., 2012; Rogers et al., 2014; Van Minnen et al., 2003).

Data preparation

To correct for the potential effect of outlier reaction times (RTs), in all tasks medians were analyzed instead of means. Means reported in this paper therefore refer to the means of these median RTs (means of medians). Incorrect responses (≤2.5% of all data) were removed before aggregating the data. Also trials with extreme (< 300 ms or > 3000 ms; ≤1.1% of all data) RTs were removed, as RTs below 300 and above 3000 are highly unlikely, and were therefore also considered as errors.

Affective priming task (APT)

To examine evaluation biases related to hair pulling, two 2 (Target words: positive, negative) x 2 (Prime pictures: hair pulling-related, neutral) Repeated-Measures ANOVAs were conducted, one for the categorisation of valence target words (e.g. "good", "bad") and one for the categorisation of tension target words (e.g. "relaxed", "stressed"). We were specifically interested in the Target x Prime interactions, as these would demonstrate whether patients were indeed faster to categorise positive target words (either valence- or tension-related) after a positive prime (in this specific case a hair pulling-related picture) than negative target words, indicating a positive evaluation bias for hair pulling-related cues. The Repeated-Measures ANOVA for *valence target words* revealed a main effect for Target, $F(1, 53) = 18.36$, $p = .000$, $eta^2 = .26$, a marginally significant effect for Prime, $F(1, 53) = 3.09$, $p = .08$, $eta^2 = .06$, but a non-significant Target x Prime interaction, $F(1, 53) = 1.84$, $p = .18$, $eta^2 = .03$. Patients were slower in categorising negative targets words ($M_{hair} = 759$ ms, $SD_{hair} = 184$, and $M_{neutral} = 735$ ms, $SD_{hair} = 164$) than in categorising positive targets words ($M_{hair} = 695$ ms, $SD_{hair} = 154$, and $M_{neutral} = 689$ ms, $SD_{hair} = 172$). The Repeated-Measures ANOVA for *tension targets words* showed a significant main effect for Target words, $F(1, 53) = 5.06$, $p = .03$, $eta^2 = .09$, and no effects for Prime pictures, $F(1, 53) = 0.09$, $p = .76$, $eta^2 = .00$, or Target words x Prime pictures, $F(1, 53) = 0.01$, $p = .95$, $eta^2 = .00$. Again, patients were slower in categorising negative targets words ($M_{hair} = 803$ ms, $SD_{hair} = 191$, and $M_{neutral} = 799$ ms, $SD_{hair} = 199$) than in categorising positive targets words ($M_{hair} = 773$ ms, $SD_{hair} = 164$, and $M_{neutral} = 771$ ms, $SD_{hair} = 215$).

To investigate whether bias scores were related to symptom severity, Pearson correlations were calculated between APT-scores and scores on the MGHHS and SURF. APT-scores were calculated by subtracting negative scores from positive scores, before neutral stimuli were subtracted from hair pulling-related stimuli. None of the correlations between APT-scores on the one hand and MGHHS and SURF scores on the other hand were significant: all *p*s were larger than .32.

Dot probe task

Attentional biases towards hair pulling-related pictures were investigated with a 2 (Dot Position: behind hair pulling-related picture, behind neutral picture) x 2 (Picture Presentation Time: 250 ms, 500 ms) Repeated-Measures ANOVA. Here, especially the main effect of Dot Position was of interest, as this would indicate whether patients were indeed faster to detect a dot appearing behind a hair pulling-related cue, indicating an attentional bias for hair pulling-related cues. The main effect of Picture Presentation Time was significant, $F(1, 53) = 7.92$ $p = .007$, $eta^2 = .13$. Patients were faster to detect the location of the dot for a picture presentation time of 500 ms ($M_{hair} = 708$ ms, $SD_{hair} = 106$, $M_{neutral} = 702$ ms, $SD_{hair} = 103$) than for a picture presentation time of 250 ms ($M_{hair} = 725$ ms, $SD_{hair} = 103$, $M_{neutral} = 722$ ms, $SD_{hair} = 106$). No significant effects were found for Dot Position, $F(1, 53) = 0.37$, $p = .55$, $eta^2 = .01$ or for the 2 × 2 interaction, $F(1, 53) = 0.05$, $p = .82$, $eta^2 = .00$.

Difference scores were calculated for both the 250 and the 500 ms picture presentation time. These scores were created by subtracting RTs to neutral stimuli from RTs to hair pulling-related pictures. Again, none of the correlations between these difference scores and the scores on the MGHHS and SURF were significant: all *p*s were larger than .45.

Modified stroop task

The Modified Stroop Task was used to examine attentional biases associated with hair pulling-related words. First, a Repeated-Measures ANOVA was conducted to investigate whether there were overall differences in attentional bias between the word categories (neutral words, positive words, negative words, hair pulling-related words, words related to resisting hair pulling) of all the cards.

There were indeed differences, $F(4, 48) = 15.86$, $p = .000$, $eta^2 = .57$. Paired t-tests were conducted to examine differences between the categories of cards in more detail. Here, we were especially interested to find out whether patients were indeed slower to name the colour of hair pulling-related words when compared to any of the other categories, which would indicate an attentional bias towards, or attentional interference, to be more precise, of hair pulling-related words. Indeed, patients were always significantly slower to name the colour of hair pulling-related words ($M =$ 32204 ms, $SD = 8338$) when compared to the other word categories (generally negative: $M = 29511$ ms, $SD = 6731$, $t(51) = 4.26$, $p = .000$; generally positive: $M = 28218$ ms, $SD = 6424$, $t(51) = 5.77$, $p = .000$; resisting hair pulling: $M = 28781$ ms, $SD = 7275$, $t(51) = 5.25$, $p = .000$; neutral: $M = 27430$ ms, $SD =$ 5977, $t(51) = 7.25$, $p = .000$). Patients were also significantly slower to name the colour of the words related to resisiting hair pulling when compared to the neutral words, $t(51) = 2.16$, $p = .035$, just as they were slower to name colours for the negative words when compared to the general positive words, $t(51) = -2.36$, $p = .022$, and neutral words, $t(51) = -5.42$, $p = .000$.

All correlations between colour naming RTs of the hair pulling-related words and scores as assessed by the MGHHS and the SURF were non-significant: all *p*s were larger than .16.

Approach-avoidance task (AAT)

To investigate approach-avoidance biases related to hair pulling-related stimuli, two 2 (Category: hair pulling-related, neutral) x 2 (Movement: push, pull) Repeated-Measures ANOVAs were conducted, one for pictures and one for words. For the latter, the categories were hair pulling-related words and words related to resisting hair pulling. We were specifically interested in the Category x Movement interaction to find out whether HPD patients were faster to approach than to avoid hair pulling-related cues and whether they were faster approaching hair pulling-related cues when compared to neutral pictures and/or words related to resisting hair pulling. This would indicate an approach bias towards hair pulling-related cues. The Repeated-Measures ANOVA for the *pictures* showed a main effect for Category, $F(1, 53) = 19.69$, $p < .001$, $eta^2 = .27$. Patients were slower to react (push and pull) to the hair pulling-related pictures ($M_{pull} = 940$ ms, $SD_{pull} =$ 251, and $M_{push} = 918$ ms, $SD_{push} = 229$) than to the neutral pictures ($M_{pull} = 881$ ms, $SD_{pull} = 215$, and $M_{push} = 882$ ms, $SD_{push} = 199$). The main effects for Movement, $F(1, 53) = 0.44$, $p = .51$, $eta^2 = .01$, and for the Category x Movement interaction, $F(1, 53) = 0.61$, $p = .44$, $eta^2 = .01$, were not significant. The Repeated-Measures ANOVA for the *words* also showed a main effect for Category, $F(1, 53) = 13.68$, $p = .001$, $eta^2 = .21$, and again not for Movement, $F(1, 53) = 1.40$, $p = .24$, $eta^2 = .03$, or for Category x Movement, $F(1, 53) = 1.50$, $p = .23$, $eta^2 = .03$. This time, however, patients were faster to react (push and pull) to hair pulling-related words ($M_{pull} = 833$, $SD_{pull} = 196$, and $M_{push} = 829$, $SD_{push} = 183$) than to words related to resisting hair pulling ($M_{pull} = 879$, $SD_{pull} = 204$, and $M_{push} = 852$, $SD_{push} = 192$). Although the Category x Movement interaction was not significant, the main effects of Category may indicate ambivalence towards hair pulling-related pictures as well as resistance/self-control words.

Before calculating Pearson correlations, AAT-scores were created: pull scores were subtracted from push scores, and the resulting scores for the neutral pictures were subtracted from the scores for the hair pulling-related pictures. Similarly, for the words, pull scores were subtracted from push scores, after which 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. Additionally, to investigate the association between symptom severity and the main effect of Category (the "ambivalence"), in order to investigate speed of response independent of movement, push and pull RTs were averaged and the resulting scores for the stimuli unrelated to hair pulling (neutral pictures and resistance/self-control words) were subtracted from scores for the stimuli related to hair pulling. Positive scores here indicate slower RTs in reaction to hair pulling-related stimuli.

A significant correlation was found between the main effect of Category for hair pulling-related pictures and SURF Severity score ($r = .28$, $p = .043$). All other correlations were non-significant: (all *p*s were larger than .15). This positive correlation indicates that the slower RTs in response to hair pulling-related *pictures* were associated with higher symptom severity.

Discussion

The aim of the present study was to investigate automatic processes and cognitive biases in patients suffering from Hair Pulling Disorder (HPD). In line with earlier findings by Lee et al. (2012) and Schuck et al. (2012), who investigated attentional biases in HPD patients and approach-avoidance biases in skin-picking patients, respectively, we expected HPD patients to show an avoidance tendency, a negative evaluation bias, an attentional disengagement, as well as a general slowing down in reaction to stimuli related to hair pulling. We expected these biases and the slowing down to be positively related to patients' symptom severity before treatment.

In the Approach-Avoidance Task, words as well as pictures were used to investigate approach-avoidance action tendencies. Note that control categories for pictures and words were different: The *pictures* were either related to hair pulling or were neutral; the *words* were related to hair pulling or related to resisting hair pulling. The Modified Stroop Task used these same words. In line with the expectations, our data showed that patients reacted more *slowly* to hair pulling-related pictures than to neutral pictures. In the Modified Stroop Task, patients were also significantly slower to name the colour of hair pulling-related words when compared to the other word categories used in this task. However, for words in the Approach-Avoidance Task the pattern was different: Patients reacted *faster* to hair pulling-related words than to words related to resisting hair pulling. Since categories differed for pictures (hair pulling-related and neutral) and words (hair pulling-related and resisting hair pulling), inferences about the findings for pictures and words within our study cannot be made based on direct comparisons.

We interpreted our results as ambivalence regarding hair pulling, in line with Breiner et al. (1999). In other words, patients likely displayed a competition between approaching and avoiding or between attending to or disengaging from hair pulling-related stimuli, resulting in a slower responses. Schuck et al. (2012) found similar increase in reaction times in their Approach-Avoidance Task, which they interpreted as distraction, possibly caused by looking at pictures of affected skin. Whether slowing down in reaction to disorder-specific stimuli is brought forward by ambivalence or distraction can be investigated in future research, for example by recording eye movements and gazing patterns.

Although we used the words related to resisting hair pulling as a control category for the hair pulling-related words, our findings may suggest that resisting hair pulling represents a relevant element of the hair-pulling behaviour. Patients may react more slowly to words related to resisting hair pulling because it is exactly this self-control that they seek, but as yet are insufficiently able to sustain. Words related to resisting hair pulling are ambiguous, even more so than hair pulling-related words, because they are likely to represent personal failure as well as a strived-at goal. It has been suggested that negative beliefs about one's self-control ability are a crucial part of unsuccessful behaviour regulation (Alberts, Martijn, Greb, Merckelbach, & de Vries, 2007; Keijsers, Maas, Van Opdorp, & Van Minnen, 2016). However, at this point firm conlusions are difficult to draw with regard to the present findings. We did not include neutral words in our study and our explanations here are based on post-hoc interpretations of the data, and thefore need further investigation before inferences on the role of automatic beliefs about one's self-control can be made.

We found a significant positive correlation between the ambivalent response pattern and hair pulling symptom severity, which shows that higher ambivalence scores for hair pulling-related pictures were associated with higher symptom severity levels, as assessed by the SURF Severity scale. These results are in line with Schuck et al. (2012) who found that both the slower responses and the avoidance effect were positively associated with skin picking symptom severity. However, in our study, this was the only significant correlation among many non-significant ones, therefore we have to consider the possibility that it was a chance finding.

The present study did not find support for an avoidance tendency, a negative evaluation bias, or an attentional disengagement in HPD patients despite the fact that we used picture and word stimuli, we tailored the pictures to the patients' areas of hair pulling, and we applied not one but several reaction time tasks. In addition, we asked patients to touch or stroke their hair before starting the Approach-Avoidance Task and to stop just before they wanted to pull, in order to increase the patients' urge and to make the stimuli more salient. In a pilot test patients did indeed report an urge to pull hair when stroking their hair. However, as we did not measure this (increase in) urge in the present study, we cannot be sure that this is a necessary component of the Approach-Avoidance Task for HPD patients. Also, we did not consider biases such as interpretation biases and response inhibition. That is, interpretation biases might be highly applicable when considering the self-control cognitions patients experience before and after hair pulling (Maas et al., 2015). Also, impaired motor inhibition has been observed in hair pulling patients (Chamberlain, Fineberg, Blackwell, Robbins, & Sahakian, 2006; Odlaug, Chamberlain, Harvanko, & Grant, 2012).

So, why did we fail to find strong evidence of cognitive biases? There are several possibilities. One possibility is that, despite our efforts to represent the patients' hair pulling behaviour as closely as possible, we nevertheless failed to select relevant external (that is, visible) stimuli for patients suffering from HPD. Different from addictive behaviours, such as smoking and drinking alcohol, hair pulling is likely not driven by visible external stimuli (e.g. glass of beer, brand label, cigarette, food), but by internal stimuli, such as an itching feeling, a hair that feels different, context, postural position, cognitions, and mood. Moreover, biases may differ between disorders. HPD was categorised 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". HPD shares similarities with both types of disorders (Grant, Odlaug, & Potenza, 2007). Similar to obsessive-compulsive disorders, HPD is characterised by repetitive behaviour and impaired inhibition. This impaired inhibition may be accompanied by feelings of anxiety (as in obsessive-compulsive disorders), but also by craving and pleasurable feelings related to hair pulling (as in addictions). It is still unclear whether and how this may affect biases associated with HPD.

Several methodological limitations need to be mentioned as well. First, we did not counterbalance the order of the computer tasks and questionnaires. This may have distorted results on later tasks, as participants may have gotten fatigued or bored, or tasks may have affected each other. Moreover, we used the same stimuli across tasks, which increased comparability, but may have led to habituation and practice effects, possibly blunting effects of the biases. Future research should use different stimulus sets and counterbalance tasks and questionnaires. Second, we did not include a healthy control group, so it is unclear whether our findings are HPD-specific or possibly also relevant for patients with other obsessive-compulsive and related disorders. Also, the majority of our sample was female, which makes it difficult to generalise our results to males. As most hair pulling patients are female, however, we believe that our sample reflects the hair pulling population well.

Despite these limitations, the current study also yielded promising results with regard to potential effects of stimulus ambivalence. Taken together, in line with Lee et al. (2012) and Schuck et al. (2012), and in accordance with the model by Breiner et al. (1999), we found that HPD patients were slower to respond to hair pulling-related pictures and resistance/self-control words in the Approach-Avoidance task and to hair pulling-related words in the Modified Stroop Task. This slowing down may reflect ambivalence regarding hair pulling and resistance/self-control in HPD patients. Ambivalence for pictures was positively related to the SURF Severity scale. Future research is needed to further disentangle this "ambivalence" effect.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Alberts, H. J., Martijn, C., Greb, M. C., Merckelbach, H., & de Vries, N. K. (2007). Carrying on or giving in: The role of automatic processes in overcoming ego depletion. *British Journal of Social Psychology*, *46*, 383–399. doi:10.1348/014466606X130111

Amir, N., Najmi, S., & Morrison, A. S. (2009). Attenuation of attention bias in obsessive-compulsive disorder. *Behaviour Research and Therapy*, *47*, 153–157. doi:10.1016/j.brat.2008.10.020

Breiner, M. J, Stritzke, W. G. K, & Lang, A. R. (1999). Approaching avoidance: A step essential to the understanding of craving. *Alcohol Research & Health*, *23*, 197–206.

Brignell, C., Griffiths, T., Bradley, B. P., & Mogg, K. (2009). Attentional and approach biases for pictorial food cues. Influence of external eating. *Appetite*, *52*, 299–306. doi:10.1016/j.appet.2008.10.007

Chamberlain, S. R., Fineberg, N. A., Blackwell, A. D., Robbins, T. W., & Sahakian, B. J. (2006). Motor inhibition and cognitive flexibility in obsessive-compulsive disorder and trichotillomania. *American Journal of Psychiatry*, *163*, 1282–1284. doi:10.1176/appi.ajp.163.7.1282

Christenson, G. A., & Mansueto, C. S. (1999). Trichotillomania: Descriptive characteristics and phenomenology. In D. J. Stein, G. A. Christenson, & E. Hollander (Eds.), *Trichotillomania* (pp. 1–41). Washington, DC: American Psychiatric Press.

Diefenbach, G. J., Tolin, D. F., Hannan, S., Matlby, N., & Crocetto, J. (2006). Group treatment for trichotillomania: Behaviour therapy versus supportive therapy. *Behavior Therapy*, *37*, 353–363. doi:10.1016/j.beth.2006.01.006

Dougherty, D. D., Loh, R., Jenike, M. A., & Keuthen, N. J. (2006). Single modality versus dual modality treatment for trichotillomania: Sertraline, behaviour therapy, or both? *The Journal of Clinical Psychiatry*, *67*, 1086–1092. doi:10.4088/JCP.v67n0711

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, *50*, 229–238. doi:10.1037/0022-3514.50.2.229

Field, M., & Cox, W. M. (2008). Attentional bias in addictive behaviours: A review of its development, causes, and consequences. *Drug and Alcohol Dependence*, *97*, 1–20. doi:10.1016/j.drugalcdep.2008.03.030

Field, M., Kiernan, A., Eastwood, B., & Child, R. (2008). Rapid approach responses to alcohol cues in heavy drinkers. *Journal of Behavior Therapy and Experimental Psychiatry*, *39*, 209–218. doi:10.1016/j.jbtep.2007.06.001

Flessner, C. A., Conelea, C. A., Woods, D. W., Franklin, M. E., Keuthen, N. J., & Cashin, S. E. (2008). Styles of pulling in trichotillomania: Exploring differences in symptom severity, phenomenology, and functional impact. *Behaviour Research and Therapy*, *46*, 345–357. doi:10.1016/j.brat.2007.12.009

Grant, J. E., Odlaug, M. L., & Potenza, M. N. (2007). Addicted to hair pulling? How an alternate model of trichotillomania may improve treatment outcome. *Harvard Review of Psychiatry*, *15*, 80–85. doi:10.1080/10673220701298407

Houghton, D. C, Maas, J, Twohig, M. P, Saunders, S. M, Compton, S. N, & Neal-Barnett, A. M. (2016). Comorbidity and quality of life in adults with hair pulling disorder. *Psychiatry Research*, *239*, 12–19. doi:10.1016/j.psychres.2016.02.063

Keijsers, G. P. J., Maas, J., Van Opdorp, A., & Van Minnen, A. (2016). Addressing self-control cognitions in the treatment of trichotillomania: A randomized controlled trial comparing cognitive therapy to behaviour therapy. *Cognitive Therapy and Research*, *40*, 522–531. doi:10.1007/s10608-016-9754-4

Keijsers, G. P. J., Van Minnen, A., Hoogduin, C. A. L., Klaassen, B. N. W., Hendriks, M. J., & Tanis-Jacobs, J. (2006). Behavioural treatment of trichotillomania: Two-year follow-up results. *Behaviour Research and Therapy*, *44*, 359–370. doi:10.1007/s10608-016-9754-4

Keuthen, N. J., O'Sullivan, R. L., Ricciardi, J. N., Shera, D., Savage, C. R., Borgmann, A. S., … Baer, L. (1995). The Massachusetts General Hospital (MGH) hairpulling scale: 1. Development and factor analyses. *Psychotherapy and Psychosomatics*, *64*, 141–145. doi:10.1159/000289003

Keuthen, N. J., Rothbaum, B. O., Fama, J., Altenburger, E., Falkenstein, M. J., … Welch, S. S. (2012). DBT-enhanced cognitive-behavioural treatment for trichotillomania: A randomized controlled trial. *Journal of Behavioral Addictions*, *1*, 106–114. doi:10.1556/JBA.1.2012.003

Lee, H., Franklin, S. A., Turkel, J. E., Goetz, A. R., & Woods, D. W. (2012). Facilitated attentional disengagement from hair-related cues among individuals diagnosed with trichotillomania: An investigation based on the exogenous cueing paradigm. *Journal of Obsessive-Compulsive and Related Disorders*, *1*, 8–15. doi:10.1016/j.jocrd.2011.11.005

Maas, J., Keijsers, G. P. J., Cangliosi, C. M., van der Veld, W., Tanis-Jacobs, J., & Van Minnen, A. (2015). The self-control cognition questionnaire: Cognitions in the maintenance of unwanted habits. *European Journal of Psychological Assessment*. doi:10.1027/1015-5759/a000290

Maas, J., Keijsers, G. P. J., Rinck, M., & Becker, E. S. (2018). Does cognitive bias modification prior to standard brief cognitive behavior therapy reduce relapse rates in hair pulling disorder? A double-blind randomized controlled trial. *Journal of Social and Clinical Psychology*, *37*, 453–479.

Macleod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*, 15–20. doi10.1037/0021-843X.95.1.15

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: Relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction*, *98*, 825–836. doi:10.1046/j.1360-0443.2003.00392.x

Odlaug, B. L., Chamberlain, S. R., Harvanko, A. M., & Grant, J. E. (2012). Age at onset in trichotillomania: Clinical variables and neurocognitive performance. *The Primary Care Companion for CNS Disorders*, *14*, 12m01343. doi:10.4088/PCC.12m01343

Palfai, T. P., & Ostafin, B. D. (2003). Alcohol-related motivational tendencies in hazardous drinkers: Assessing implicit response tendencies using the modified-IAT. *Behaviour Research and Therapy*, *41*, 1149–1162. doi:10.1016/S0005-7967(03)00018-4

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*, 105–120. doi:10.1016/j.jbtep.2006.10.001

Rogers, K., Banis, M., Falkenstein, M. J., Malloy, E. J., McDonough, L., Nelson, S. O., … Haaga, D. A. F. (2014). Stepped care in the treatment of trichotillomania. *Journal of Consulting and Clinical Psychology*, *82*, 361–367. doi:10.1037/a0035744

Schuck, K., Keijsers, G. P. J., & Rinck, M. (2011). The effects of brief cognitive-behaviour therapy for pathological skin picking: A randomized comparison to wait-list control. *Behaviour Research and Therapy*, *49*, 11–17. doi:10.1016/j.brat.2010.09.005

Schuck, K., Keijsers, G. P. J., & Rinck, M. (2012). Implicit processes in pathological skin picking: Responses to skin irregularities predict symptom severity and treatment susceptibility. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*, 685–691. doi:10.1016/j.jbtep.2011.09.004

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., … Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry*, *5*, 22–33.
Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*, 220–247. doi:10.1207/s15327957pspr0803_1
Van Minnen, A., Hoogduin, C. A. L., Keijsers, G. P. J., Hellenbrand, I., & Hendriks, G. J. (2003). Treatment of trichotillomania with behavioral therapy or fluoxetine. *Archives of General Psychiatry*, *60*, 517–522. doi:10.1001/archpsyc.60.5.517
Veenstra, E. M., & de Jong, P. J. (2010). Restrained eaters show enhanced automatic approach tendencies towards food. *Appetite*, *55*, 30–36. doi:10.1016/j.appet.2010.03.007
Williams, J. M. G., Mathews, A., & Macleod, C. (1996). The emotional stroop task and psychopathology. *Psychological Bulletin*, *120*, 3–24. doi:10.1037/0033-2909.120.1.3

Appendix

Examples of pictures that were used in the Approach-Avoidance Task: pictures representing pulling hairs from the scalp, eyelashes and eyebrows, and pictures of neutral office supplies.