Chapter 4

Implicit stigmatization-related biases in individuals with skin conditions and their significant others

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ABSTRACT

Objective: Stigmatization is common in people with chronic skin conditions and may also affect their significant others (SOs). The fast and implicit processing of stigmatization-related stimuli has received little attention in these populations; however, such knowledge may offer indications for new treatment methods. This study aimed to investigate implicit processing of stigmatization-related stimuli in people with skin conditions and their SOs.

Method: A modified Stroop task and 2 approach-avoidance tasks were administered to participants with chronic skin conditions (alopecia: $n = 50$ and psoriasis: $n = 50$); their significant others (alopecia SOs: $n = 47$ and psoriasis SOs: $n = 50$); and controls ($n = 50$). The aim was to examine attentional and behavioral biases toward disease-related and social threat-related stigmatization stimuli.

Results: An attentional bias to disease-related stimuli was found in participants with alopecia and their SOs, compared with controls ($p < .001$). This effect was not found for participants with psoriasis and their SOs. Increased behavioral avoidance of disgusted faces was found in participants with psoriasis and their SOs, compared with controls ($p = .047$). This effect was not found in participants with alopecia and their SOs.

Conclusions: These results provide support for the idea that individuals with skin conditions and their SOs are characterized by a stigmatization-related stimulus bias regarding implicit cognitive and behavioral reactions, in comparison to healthy individuals. Furthermore, preliminary results suggest that these processes may differ across skin conditions, with people with psoriasis being more affected by social reactions (i.e. disgusted faces) and people with alopecia by disease-related cues possibly related to internalized self-stigma.

INTRODUCTION

The visible marks of a skin condition can have substantial social consequences. In alopecia, people experience hair loss, ranging from minor patches to loss of all scalp and body hair. This may have negative consequences for social interactions, body image, and self-esteem [e.g., 1]. Psoriasis is characterized by red patches of skin covered with silvery scales, that may be unjustly viewed as "unclean" and likely to be contagious [e.g., 2, 3], resulting in negative social reactions. People with chronic skin conditions frequently experience stigmatization [e.g., 4], which can be defined as an awareness of social disapproval, discrediting, or devaluation based on an attribute or physical mark [5]. In self-stigma, stigmatization becomes internalized, as the stigmatized individual endorses stereotypes about the discreditable attribute that he or she has and applies them to him/herself [6]. Self-stigma has been associated with negative psychological and physical health outcomes [e.g., 7, 8].

Stigmatization and self-stigma are usually assessed by questionnaires [9]. However, dual-process models suggest that information processing and behavior are influenced not only by the relatively slow, reflective processes assessed by questionnaires, but perhaps even more by the fast, reflexive reactions assessed by indirect tasks [10]. The experience of stigmatization in people with skin conditions may also be reflected in these implicit processes. Biases could then be expected regarding (a) social threat-related stimuli (perceived stigma) and (b) disease-related stimuli to assess the individual's response to his or her own condition (self-stigma). While disease-related and social threat-related attentional biases were previously found in individuals with psoriasis [11], it is unknown whether they also occur on a behavioral level (e.g., in avoidance responses) and/or in other skin conditions.

As theorized in disease-avoidance models [12], visible cues of disease, such as skin lesions, may activate disgust reactions and motivate behavioral avoidance. Disgust-related brain regions were found to be activated in healthy participants when they were shown pictures of stigmatized groups [e.g., 13]. Given that people with skin conditions may experience and/or anticipate these disgust reactions, they may develop a behavioral avoidance bias to social threat-related information (e.g., disgusted faces), similar to the biases seen in social anxiety [e.g., 14]. In line with this, a reduced ability to identify disgusted faces, and diminished associated brain activity, was found in psoriasis; this suggests an avoidance-based coping mechanism [15]. In addition to social threat-related stimuli, biases may also be present for disease-related stimuli. An eye-tracking study showed that people with acne automatically gazed more at acne lesions than did controls, which suggests an attentional bias [16]. Also, in pathological skin picking, greater behavioral avoidance of pictures of skin irregularities was found compared to controls [17].

Social threat-related and disease-related biases may also occur in significant others (SOs), because they often experience increased distress and a substantial burden because of the chronic skin condition [e.g., 18]. No research has yet focused on these biases in significant others of individuals with chronic skin conditions. However, indications of a larger implicit preference for clear skin were found in people from the general population who knew someone with a skin condition than in people who did not. The authors explained this finding by suggesting that these individuals attempted to suppress their stereotypical reaction, which

required cognitive effort [19]. The current study explores whether social threat-related and disease-related biases also occur in SOs.

This study examines attentional bias and approach-avoidance tendencies in relation to disease-related and social threat-related stigmatization stimuli using reaction time (RT) tasks, to gain new insights into the concept of stigmatization, which has previously only been examined using questionnaires. It was hypothesized that, compared with controls, people with chronic skin conditions and their SOs would show an attentional bias and an increased avoidance reaction toward both stimulus categories. The two skin conditions were exploratively compared, with the expectation that both conditions would show similar biases.

METHOD

This section provides a condensed summary of the methods used. For detailed information, we refer to the online supplemental material (see page 63). This study included 247 participants: people with chronic skin conditions, their SOs, and controls from the general population (see Table S1, online supplemental material). Attentional bias to disease-related and social threat-related words was assessed with a modified Stroop task ([20]; Table S3). Approach-avoidance tendencies regarding disease-related and social threat-related pictures were assessed with two approach-avoidance tasks (AATs; [21]). Last, questionnaires were administered regarding disease severity, self-perceived visibility, psychological distress, social anxiety, and fear of negative evaluation. For all picture (AATs) or word (modified Stroop task) categories, repeated-measures ANOVAs were conducted to compare the RTs of individuals with each chronic skin condition and their SOs with those of controls.

RESULTS

This section summarizes the main results. For more details, see online supplemental material.

Attentional bias: modified Stroop task

Mean RTs for the modified Stroop task are presented in Figure 1 and Table S4. People with alopecia, their SOs, and controls differed in their RTs to specific word categories ($p = .002$, $\eta_p^2 = .09$): people with alopecia and their SOs were slower than controls to name colors of hair-related words compared with neutral words ($p = .001$, $\eta_p^2 \geq .10$). No differences were found between people with psoriasis, their SOs, and controls regarding the RTs for skin-related words compared with neutral words ($p = .43$). Last, no differences were found between individuals with either chronic skin condition, their SOs, and controls regarding social threat-related words ($p \geq .40$).
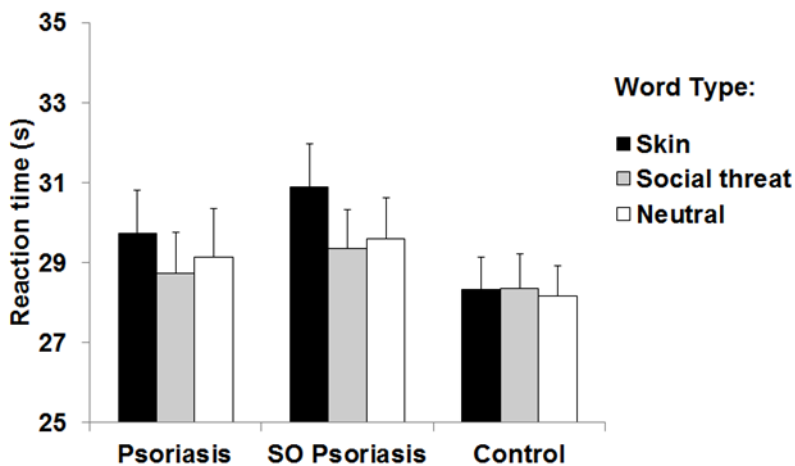
(1a)
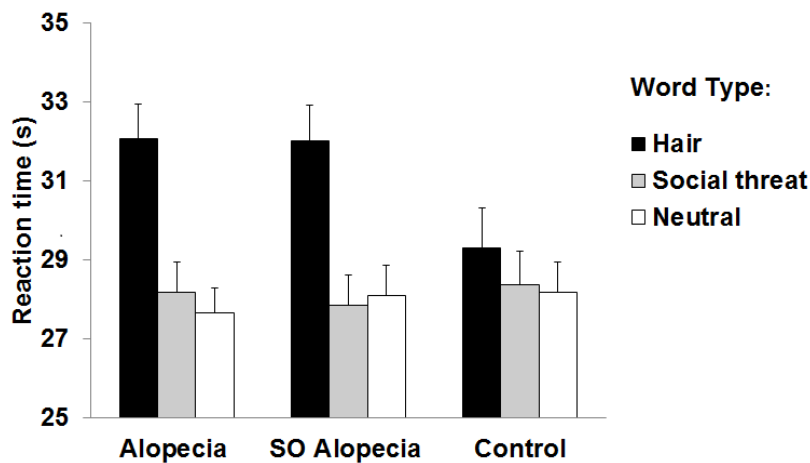
(1b)

Figure 1. Modified Stroop task: average color-naming reaction times in seconds (±SEM) for (a) alopecia, significant others, and controls, and (b) psoriasis, significant others, and controls. *Note.* SO = significant others.

Behavioral bias: approach-avoidance tasks

Mean RTs and AAT-effects for the disease-related and social threat-related AATs can be found in Figure 2 and Tables S5 and S6, respectively. In the disease-related AAT, people with psoriasis and their SOs did not differ from controls regarding their approach-avoidance reactions to psoriasis-related and neutral pictures ($p \leq .73$). In the social threat-related AAT, people with alopecia and their SOs did not differ from controls regarding their approach-avoidance reactions to emotional faces ($p \leq .68$). Similarly, no differences in approach-avoidance reactions to emotional faces were found between people with psoriasis, their SOs, and controls ($p \leq .46$). In the case of disgusted faces, specifically, participants with psoriasis and their SOs were quicker than controls to avoid than approach disgusted faces ($p = .047$, $\eta_p^2 = .03$), while participants with alopecia and their SOs did not differ from controls ($p = .71$).
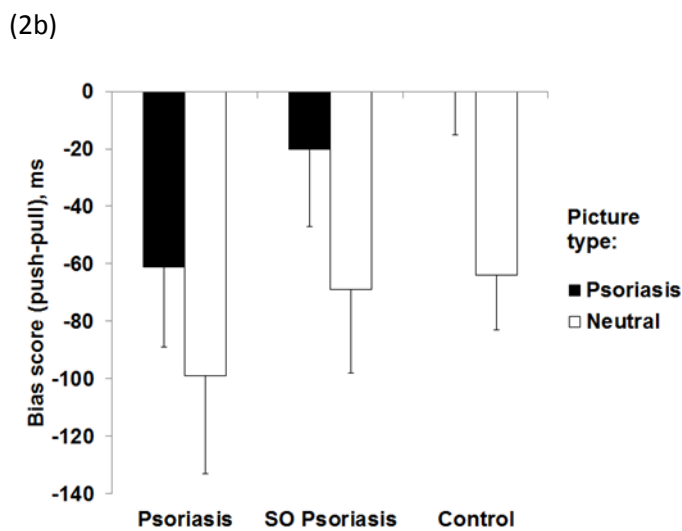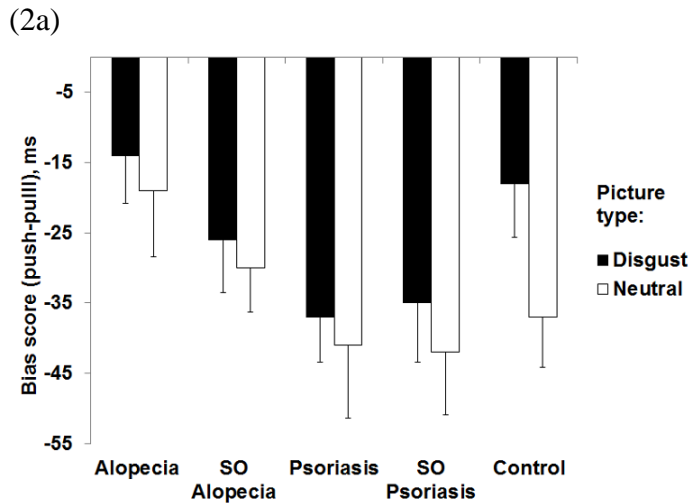
59

(2a)

(2b)

Figure 2. Approach-Avoidance Tasks: average approach-avoidance task (AAT) effects (push-pull) in milliseconds (±SEM), depending on group and picture type, for (a) social threat-related AAT, and (b) disease-related AAT. *Note.* SO = significant others.

DISCUSSION

This study examined implicit bias to social threat-related and disease-related stimuli in relation to two chronic skin conditions. In people with alopecia and their SOs, compared with controls, an attentional bias to disease-related words was found, but no behavioral avoidance bias for social threat-related pictures. The opposite was found in people with psoriasis and their SOs (again compared with controls): no attentional bias, but indications of a behavioral avoidance bias. These results provide preliminary support for the idea that people with skin conditions and their significant others differ from healthy controls regarding their implicit reactions to stigmatization-related stimuli. Furthermore, in contrast to what was initially expected, these processes may differ between specific skin conditions.

In contrast to a previous study [11], an attentional bias was found in individuals with alopecia, but not with psoriasis. This may be because of the relatively mild disease severity and lower levels of fear of negative evaluation (FNE) in psoriasis compared with alopecia, and the lower levels of disease severity, anxiety, and depression among participants than in the previous study [11]. It may also be because of inherent differences between the two skin conditions. Skin lesions in psoriasis may provoke social avoidance responses because of these being viewed as "unclean" or "contagious" [3]. In contrast, hair loss in alopecia may provoke fewer direct social responses, as the majority of patients tend to hide their condition. However, the significant disease-related distress and illness-related cognitive preoccupation reported in this patient group suggest that alopecia patients are psychologically affected by their condition [22], and these psychological effects may be reflected in an attentional bias to disease-related words. The markedly higher levels of FNE further underline the concerns that these people have about being unfavorably evaluated by others, which may be the result of their "hidden stigma." No attentional biases to social threat-related words were found for any of the groups. In a pilot validation study, these words were selected based on their high ratings of stigmatization combined with their negative emotional valence. However, as words were not specifically selected on ratings of individual threat, they may have been insufficiently threatening in comparison to words used in previous research [11].

Behavioral avoidance bias was examined using social threat-related and disease-related stimuli. In the disease-related AAT, no differences were found between people with psoriasis, their SOs, and controls. Instead, for people with psoriasis, the stigmatization experience seems to be better captured by their fear and avoidance of disgust reactions of others. Indications toward a social threat-related bias were found in psoriasis, but not in alopecia. This is in line with the idea that disgust reactions are more relevant in psoriasis and with the finding that the neural response of people with psoriasis to disgusted faces is consistent with an avoidance-based coping mechanism [15]. The fact that biases were also observed in SOs corresponds with a study showing increased bias to skin irregularities in people who knew someone with a skin condition [2]. Equally, however, this could reflect the burden of chronic conditions on SOs [18].

Limitations of this study include the differences between groups in certain sociodemographic and psychological characteristics; this limits the comparability of the groups and calls for a cautious interpretation of results. In contrast with previous research [e.g., 23], relatively low distress levels were found in participants with chronic skin conditions. As this study was the first of its kind, further studies are needed to examine the psychometric properties of the implicit measures used. While the reliability of the AATs was good, the validity of these and other implicit measures should be further established [e.g., 24]. Another possible limitation was that this study used several stimulus categories in each task. As responses on each stimulus may influence subsequent responses, we cannot exclude the possibility that this confounded the results. A simpler design, for instance only including disgusted and neutral faces in an AAT, could perhaps be considered to examine specific hypotheses in future research.

To conclude, an attentional bias for disease-related stimuli was found in people with alopecia and their SOs, while indications of a behavioral avoidance bias for disgusted faces were found in people with psoriasis and their SOs. These results provide preliminary support for the idea that, compared with healthy individuals, people with chronic skin conditions show different implicit cognitive and behavioral reactions to stigmatization-provoking stimuli. Furthermore, these processes may differ between skin conditions, with people with psoriasis being more affected by reactions of others, and those with alopecia being more affected by disease-related cues relating to self-stigma. Future research should focus on extending these results in other samples (e.g., people with other skin conditions, other somatic conditions, or elevated levels of social anxiety), to help unravel the underlying mechanisms and to examine their clinical relevance.

Online Supplemental Material: supplemental methods

Participant recruitment and inclusion criteria

People with skin conditions were recruited through two patient associations, the Dutch Alopecia Association and the Dutch Psoriasis Association, and by contacting participants from previous studies on alopecia and psoriasis who had given permission to be approached for future studies. People with alopecia and psoriasis were asked to invite a significant other (partner, family member, or friend) to participate. Study participants from the general population were recruited by contacting a subsample of the Nijmegen Biomedical Study, a population-based survey (www.nijmegenbiomedischestudie.nl). Inclusion criteria for patients were a diagnosis of alopecia or psoriasis, age ≥ 18 years, and a sufficient understanding of the Dutch language. Exclusion criteria for patients were psychiatric conditions, current psychological treatment, and co-morbid medical conditions that had a larger self-perceived impact on patients' daily lives than their skin condition. Exclusion criteria for SOs and controls were having a chronic skin condition. All participants had normal or corrected-to-normal vision. The regional medical ethics committee indicated that the study did not need formal approval due to its non-invasive nature. Written informed consent was obtained from each participant.

Materials & procedure

In this study, several implicit tasks and self-report questionnaires were administered in a laboratory setting. Table S2 shows the order in which the tasks and questionnaires were administered.

Attentional bias: modified Stroop task

To assess attentional bias for word stimuli, a modified Stroop task [20] was used. Participants are instructed to name aloud the print color of the words presented, as quickly and accurately as possible. The assumption of the task is that the saliency of words interferes with the color-naming task and results in longer response latencies, indicating an attentional bias. In the current modified Stroop task, disease-related words (i.e. hair-related words for alopecia and skin-related words for psoriasis) and social threat-related stigmatization words were administered, along with three word categories taken from the Dutch Emotional Word list [25]. The aim was to assess processing of words without emotional or disease-related content (neutral), threatening emotional words (negative), and non-threatening emotional words (positive; see Table S3). Disease-related words were chosen as self-stigma stimuli as they most closely relate to the participants' skin conditions. The individual's reaction times to these stimuli are therefore indicative of the individual's implicit reaction to skin conditions. People with skin conditions may show longer reaction times to disease-related words, which would indicate an implicit emotional reaction. This 'negative reaction to the self' closely relates to the concept of self-stigma, in which an individual endorses stereotypes about a

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discreditable attribute (e.g., damaged or flawed skin) that he or she has and applies these stereotypes to him/herself.

Disease-related and social threat-related stigmatization words were validated in a pilot study consisting of 43 people with skin conditions, healthy individuals, and medical psychology professionals. The pilot study examined both the extent to which stimuli reflected the underlying constructs and their emotional valence. Words were presented against a black background, in random order, in a blocked design: 1 screen per word category, containing 8 words repeated 5 times. The distribution of word colors was the same for each category. The experimenter, who was blind to word category, recorded response latencies (automated via mouse click at start and end of category), and number of errors (hand-scored) per category.

Behavioral bias: approach-avoidance tasks
To assess approach-avoidance tendencies regarding disease-related and social threat-related stimuli, two irrelevant-feature zooming approach-avoidance tasks (AATs) were used [21]. Disease-related pictures were chosen as self-stigma stimuli. The reasoning behind this was similar to that for disease-related words, as presented above (see 'Attentional bias: modified Stroop task'). Social threat-related pictures showed disgusted faces (for rationale, see 'Introduction'). For these tasks, participants were seated behind a 19-inch computer screen (resolution: 1024x786 pixels) and instructed to respond to each picture on the screen, as quickly and accurately as possible, with a joystick that was tightly fastened to the table. Depending on an irrelevant stimulus feature, participants had to either push the joystick away (avoidance, picture size decreases) or pull it towards them (approach, picture size increases). Whether participants had to push or pull in response to the irrelevant feature was determined randomly. If the participant responded correctly, the picture disappeared when the joystick was pushed or pulled by approximately 30 degrees.

For the disease-related AAT, stimuli were pictures of psoriasis and neutral control pictures of structured fabric resembling skin. The pictures of psoriasis had been previously validated in the pilot study described above; the neutral control pictures had been used in previous research [17]. Participants had to respond with push or pull according to whether the picture was tilted to the left or to the right. The task was introduced by 10 practice trials (pictures of empty frames), followed by 200 experimental trials distributed across two blocks. The reliability of each picture category and the response direction of the disease-related AAT was found to be good (Cronbach's alpha = .88 - .91). Due to the specific nature of the picture stimuli, this AAT was only administered to people with psoriasis, their SOs, and controls.

For the social threat-related AAT, the stimuli were pictures of emotional facial expressions: disgusted (main hypothesis), sad (bias to other negative emotional stimuli), smiling (bias to positive emotional stimuli), and neutral faces (as comparison). The pictures were selected from the Radboud Faces Database [26]. Participants now had to respond with push or pull according to whether the picture color was grey or sepia. The task was introduced by 10 practice trials (checkerboard pictures), followed by 324 experimental trials distributed

across two blocks. The reliability of each picture category and the response direction of the social threat-related AAT was found to be good (Cronbach's alpha = .85-.91).

Questionnaires

Self-reported questionnaires were administered regarding disease severity, self-perceived visibility, psychological distress, social anxiety, and fear of negative evaluation. In addition, a general checklist was used to assess participants' gender, age, educational level, and marital status.

People with alopecia indicated their degree of *hair loss* as alopecia areata (circular patches of hair loss), androgenetica (female pattern baldness), totalis (total loss of hair on scalp), or universalis (total loss of hair on scalp and body). Disease severity in psoriasis was assessed with the commonly-used, valid, and reliable *Self-Administered Psoriasis Area and Severity Index* [SAPASI; 27]. This consists of an anterior and posterior silhouette on which people mark their affected areas, and three scales on which patients score the redness, thickness, and scaliness of their affected areas (range = 0 [complete remission] - 72 [most severe psoriasis]). *Self-perceived visibility* was assessed verbally, by asking: "To what extent do you think that your condition is generally visible to other people?" (range = 0 [never] - 4 [almost always]). To assess psychological distress, social anxiety, and fear of negative evaluation, three questionnaires were administered: the *Hospital Anxiety and Depression Scale*, the *Liebowitz Social Anxiety Scale*, and the *Fear of Negative Evaluation Scale*. The *Hospital Anxiety and Depression Scale* [HADS; 28] contains seven items measuring anxious symptoms and seven measuring depressive symptoms, rated on a 4-point scale. The total HADS score (range = 0-42, α = .80 in the current study) was used as a global measure of psychological distress, with higher scores reflecting higher distress. Previous research indicates that the HADS is valid and reliable [e.g., 29] The *Liebowitz Social Anxiety Scale* [LSAS; 30] is a measure of social anxiety that assesses fear and avoidance across different social situations. On a 4-point scale, participants rate their levels of anxiety (from none to severe) and avoidance (from never to always) of 24 social situations. The total LSAS score (range = 0 - 144, α = .94) was used, with higher scores indicating higher levels of social anxiety. The brief version of the *Fear of Negative Evaluation scale* [BFNE; 31, 32] is a 12-item questionnaire that assesses fear of negative evaluation (FNE) on a scale from 0 to 4, with higher scores reflecting higher levels of FNE (range = 0 - 48, α = .89). Research supports its validity and reliability [33].

Data preparation

In the *preparation of Stroop data*, data of one participant in the Alopecia SO group were excluded as an extreme outlier (participants' mean reaction time [RT] across Stroop categories was 83.4 seconds, compared to the group mean RT of 28.8 ± 4.9). All other participants were included in the analyses, to provide the most accurate description of unaltered data. Repeating analyses on log-transformed variables, and on log-transformed variables in which outlying cases were given the value of the next-highest score, did not alter

levels of significance. In the *preparation of AAT data*, individual trials with extreme RTs ($<$ 300ms or $>$ 2000ms, $<$ 2% of trials) were removed before aggregating the data, in line with previous studies [e.g., 34]. Participants' median RTs were then calculated for all categories, to prevent outlier effects, and the mean of these median RTs (dependent variable) was calculated for each group [e.g., 21]. In addition, AAT-effects were calculated by subtracting participants' pull RTs (approach) from their push RTs (avoidance) for each picture category; a positive AAT-effect indicated relatively stronger approach than avoidance, while a negative AAT-effect indicated relatively stronger avoidance than approach [e.g., 21]. In the *psychological questionnaires*, one person with alopecia showed outlying scores on two of the questionnaires (mean LSAS score = 129, HADS = 31, $>$ 4 SD from group mean). These results were reported unaltered to provide an accurate description of the sample used for analyses. The same individual did not show outlying scores in Stroop or AAT data, and excluding this person from between-group analyses on questionnaire data did not alter levels of significance.

Statistical analysis

To examine whether people with chronic skin conditions and their SOs showed implicit biases as compared with controls, repeated-measures ANOVAs were conducted. These compared the reaction times (RTs) of the chronic skin condition groups and their SOs with those of controls with regard to all picture categories (AATs) or word categories (modified Stroop task). In the modified Stroop task, if the participants with chronic skin conditions and their SOs showed a slower reaction time to hair-related or stigmatization-relation words than to neutral words, as compared with controls (i.e. a significant word category*group effect, followed by post-hoc analyses showing slower reaction times to hair-related and/or stigmatization-related words than to neutral words in these groups), this was taken as indicative of larger attentional bias in these groups. In the two AATs, significant picture category*response direction*group interactions, with quicker avoidance reactions to disease-related or disgust-related pictures in chronic skin conditions and SOs compared with controls, were taken as indicative of larger behavioral bias in those groups. If significant effects emerged, post-hoc tests were conducted to examine for which specific groups and/or conditions the effects were significant. In the case of significant between-group differences on sociodemographic variables or self-report questionnaires regarding psychological variables, these variables were controlled for in secondary analyses.

Online Supplemental Material: supplemental results

Sample characteristics

Table S1 shows further details on the characteristics of the sample. Of the people with alopecia, 54% had alopecia universalis, 18% alopecia totalis, 26% alopecia areata, and 2% alopecia androgenetica. People with psoriasis had a relatively mild disease severity (SAPASI mean $\pm$ SD = 4.56 $\pm$ 2.31). More females were present in the alopecia group than in the

alopecia SO, psoriasis, and control groups ($p \leq 0.04$), and the alopecia group scored higher on FNE than the control group ($p = 0.001$). Furthermore, the psoriasis group was less highly educated than the alopecia group and the healthy controls ($p \leq 0.008$).

Attentional bias: modified Stroop task

Mean reaction times for the modified Stroop task are presented in Table S4. In people with alopecia, groups differed in their RTs to specific word categories ($F(8,262) = 3.13$, $p = .002$, $\eta^2_p = .09$). Both people with alopecia ($F(1,97) = 13.24$, $p < .001$, $\eta^2_p = .12$) and their SOs ($F(1,86) = 9.73$, $p < .001$, $\eta^2_p = .10$) were slower than controls to name colors of hair-related words compared to neutral words, while people with alopecia and their SOs did not differ from one another ($p = .61$). A main effect of word category ($F(4,131) = 20.02$, $p < .001$, $\eta^2_p = .38$) indicated that RTs differed across word categories, with participants overall being slower on hair-related words ($F(1,134) = 74.88$, $p < .001$, $\eta^2_p = .36$) and negative words ($F(1,134) = 5.04$, $p = .03$, $\eta^2_p = .04$) than on neutral words.

In people with psoriasis, groups differed in their RTs across word types ($F(8,280) = 2.21$, $p = .03$, $\eta^2_p = .06$); people with psoriasis were significantly faster to name the colors of negative words than of neutral words, compared with both SOs and controls ($F(2,143) = 3.67$, $p = .03$, $\eta^2_p = .05$), but no differences were found for skin-related words ($p = .43$). In addition, RTs tended to differ between word categories across groups ($F(4,140) = 2.23$, $p = .07$, $\eta^2_p = .06$), with marginally slower RTs on skin-related words than on neutral words ($p = .054$).

No differences were found regarding social threat-related stigmatization words for participants with either skin condition, SOs, or controls ($p \geq .40$).

Behavioral bias: approach-avoidance tasks

Mean RTs and AAT-effects for the disease-related and social threat-related AAT can be found in Tables S5 and S6, respectively.

Disease-related behavioral bias

When people with psoriasis, their SOs, and controls were compared, the groups did not differ regarding their approach-avoidance reactions to psoriasis-related and neutral pictures ($p \leq .73$). Participants' RTs were generally slower on psoriasis-related pictures than on neutral pictures ($F(1,145) = 25.78$, $p < .001$, $\eta^2_p = .15$), and quicker to push (avoid) pictures than to pull (approach) them ($F(1,145) = 14.79$, $p < .001$, $\eta^2_p = .09$). AAT-effects (i.e. pull RTs − push RTs) were less pronounced in psoriasis-related than in neutral pictures, possibly due to the near-zero AAT-effect in controls ($F(1,145) = 14.64$, $p < .001$, $\eta^2_p = .09$). Due to the specific nature of the picture stimuli, this skin-related AAT was not administered to people with alopecia and their SOs.

Social threat-related behavioral bias

When people with alopecia, their SOs, and controls were compared, the groups did not differ in their approach-avoidance reactions to pictures of emotional faces ($p \leq .68$). Participants were generally slower to respond to neutral faces than to the other faces ($F(3,140) = 13.88$, $p < .001$, $\eta^2_p = .23$), and quicker to push (avoid) pictures than to pull (approach) them ($F(1,142) = 26.59$, $p < .001$, $\eta^2_p = .16$), with this effect being statistically significant for disgusted, smiling, and neutral faces (all p-values $< .001$), but not for sad faces ($p = .89$). The push/pull response differed across picture categories ($F(3,140) = 12.16$, $p < .001$, $\eta^2_p = .21$); the avoidance tendency towards disgusted faces was more pronounced than towards sad faces ($p < .001$), less pronounced than towards neutral faces ($p = .04$), and did not differ from smiling faces ($p = .25$).

When people with psoriasis, their SOs, and controls were compared, groups did not differ in their approach-avoidance reactions to pictures of emotional faces ($p \leq .46$). Similarly to the alopecia group, participants were generally slower to respond to neutral faces than to other faces ($F(3,142) = 11.21$, $p < .001$, $\eta^2_p = .19$), and quicker to push (avoid) pictures than to pull (approach) them ($F(1,144) = 50.13$, $p < .001$, $\eta^2_p = .26$). Participants showed relatively more avoidance of disgusted and neutral faces than of sad and smiling faces ($F(3,142) = 12.77$, $p < .001$, $\eta^2_p = .21$).

Regarding the specific hypothesis for disgusted faces, explorative tests were performed specifically comparing people with skin conditions and their SOs to controls with regard to their RTs in pushing and pulling disgusted faces. In line with the hypothesis, people with psoriasis and their SOs were found to be quicker to avoid (push) than to approach (pull) pictures of disgusted faces, compared with controls ($F(1,146) = 4.01$, $p = .047$, $\eta^2_p = .03$). People with alopecia and their SOs did not differ from controls ($F(1,142) = 0.14$, $p = .71$).

Confounder analyses

In the *modified Stroop task*, the significantly slower RTs to hair-related words than neutral words in people with alopecia and their SOs, compared with controls, remained significant when controlling for gender, education, and fear of negative evaluation. In the *social threat-related AAT*, the significantly faster avoidance than approach of pictures of disgusted faces in people with psoriasis and their SOs, compared with controls, remained significant when controlling for fear of negative evaluation ($p = .04$), and became marginally significant when controlling for gender ($p = .051$) and education ($p = .06$).

Online supplemental material: supplemental tables

Table S1. Sociodemographic and psychological characteristics

Characteristic	Group				
	Alopecia ($n = 50$)	SOs Alopecia ($n = 47$)	Psoriasis ($n = 50$)	SOs Psoriasis ($n = 50$)	Control ($n = 50$)
Age (M (SD))	52.20 (14.25)	49.66 (15.55)	56.88 (12.91)	53.28 (15.47)	56.84 (12.08)
Gender (f (%))	42 (84)	31 (66)	23 (46)	27 (54)	23 (46)
Education (n (%))					
Primary	0 (0)[a]	1 (2)	1 (2)[a]	1 (2)	0 (0)[a]
Secondary	22 (44)[a]	16 (34)	36 (72)[a]	29 (58)	18 (36)[a]
Tertiary	28 (56)[a]	29 (62)	12 (24)[a]	20 (40)	29 (58)[a]
Missing	0 (0)[a]	1 (2)	1 (2)[a]	0 (0)	3 (6)[a]
Disease duration	20 (16)	*n.a.*	*22 (16)*	*n.a.*	*n.a.*
Disease visibility	1.69 (1.58)[b]	*n.a.*	2.48 (1.29)[b]	*n.a.*	*n.a.*
HADS (M (SD))	7.53 (5.70)	8.26 (4.15)	7.33 (4.96)	8.71 (4.17)	6.73 (4.56)
LSAS (M (SD))	28.10 (21.57)	28.00 (14.95)	21.50 (16.06)	24.42 (14.58)	21.26 (13.19)
BFNE (M (SD))	22.54 (11.69)[c]	19.56 (8.37)	16.80 (7.69)[c]	17.48 (7.70)[c]	16.20 (6.91)[c]

Note. f = number of females, BFNE = Fear of Negative Evaluation scale - brief version, HADS = Hospital Anxiety and Depression Scale, LSAS = Liebowitz Social Anxiety Scale, M = mean, SD = standard deviation, SOs = significant others.

[a]Lower educational level in psoriasis than in alopecia and healthy controls, $p \leq .008$

[b]Greater visibility in psoriasis than in alopecia, $p < .01$

[c]Higher BFNE scores in alopecia than in all other groups, except for SOs alopecia, $p \leq .01$

Table S2. Order of administering tasks and questionnaires

Alopecia, SOs Alopecia	Psoriasis, SOs Psoriasis, Control
Social threat-related AAT[a]	Disease-related or Social threat-related AAT (random)[a]
Name Letter Task (NLT)[a,b]	Name Letter Task (NLT)[a,b]
Implicit Association Test (IAT)[a,c]	Disease-related or Social threat-related AAT (random)[a]
Modified Stroop task[1]	Modified Stroop task[a]
Questionnaires	Questionnaires

Note. AAT = approach-avoidance task, SOs = significant others.

[a]The NLT, IAT, two additional categories of words in the modified Stroop task (acceptance-related and itch-related), and four additional picture categories in the AATs (pictures of itch,

ambiguous skin conditions, and empty frames in disease-related AAT, checkerboards in social threat-related AAT) were administered for research questions unrelated to this paper. [b] [35], [c] [19].

Table S3. English translation of the word stimuli used in the modified Stroop task

Social threat	Hair[a]	Skin[b]	Negative	Positive	Neutral
Insecure	Alopecia	Skin disorder	Bombs	Good-humored	Mug
Shame	Hair loss	Rash	War	Friendly	Kettle
Inferior	Downy hair	Scaling	Fight	Honest	Nutcracker
Bullying	Hair growth	Eczema	Grenade	Helpful	Refrigerator
Unhappy	Scalp hair	Flaking	Pistol	Funny	Kitchen
Secluded	Baldness	Psoriasis	Murder	Polite	Tablecloth
Not understood	Hair falling out	Blisters	Violent	Nice	Light bulb
Vulnerable	Wig	Bumps	Explosion	Cheerful	Doorknob

Note. All words were single words in Dutch and matched in length between categories.
[a]This category was not administered to people with psoriasis and their significant others.
[b]This category was not administered to people with alopecia and their significant others.

Table S4. Modified Stroop task: average color-naming reaction times in seconds (with standard deviations) for each group and word category

Word category	Group				
	Alopecia	SOs Alopecia	Psoriasis	SOs Psoriasis	Control
Social threat	28.17 (5.32)	27.84 (4.82)	28.72 (7.17)	29.36 (6.63)	28.35 (6.04)
Hair	32.06 (6.10)	31.99 (5.74)	*n.a.*	*n.a.*	29.29 (7.05)
Skin	*n.a.*	*n.a.*	29.73 (7.40)	30.90 (7.49)	28.34 (5.58)
Neutral	27.66 (4.40)	28.08 (4.76)	29.14 (8.39)	29.60 (6.99)	28.16 (5.32)
Negative	28.57 (5.73)	28.69 (4.67)	28.10 (6.97)	30.33 (8.82)	28.47 (5.87)
Positive	28.18 (4.50)	28.95 (4.98)	29.27 (7.72)	30.41 (7.19)	27.84 (5.52)

Note. SOs = significant others, *n.a.* = not applicable.

Table S5. Disease-related AAT: Means of median reaction times (and standard deviations) in milliseconds depending on group, picture type, and response direction, including AAT-effects

Picture type	Response Direction	Group		
		Psoriasis	SOs Psoriasis	Control
Psoriasis-related	Pull	971 (448)	975 (391)	872 (244)
	Push	910 (344)	955 (388)	871 (279)
	AAT-effect	**-61 (196)**	**-20 (189)**	**0 (108)**
Neutral	Pull	946 (404)	908 (300)	861 (251)
	Push	847 (313)	840 (276)	797 (199)
	AAT-effect	**-99 (237)**	**-69 (204)**	**-64 (136)**

Note. AAT-effects were calculated by subtracting participants' pull RTs from their push RTs for each picture category, with a negative AAT-effect indicating relatively stronger avoidance than approach. AAT = approach-avoidance task; SOs = significant others.

Table S6. Social threat-related AAT: Means of median reaction times (and standard deviations) in milliseconds depending on group, picture type, and response direction, including AAT-effects

Picture type	Response Direction	Group				
		Alopecia	SOs Alopecia	Psoriasis	SOs Psoriasis	Control
Sad	Pull	700 (135)	699 (120)	687 (109)	721 (151)	713 (94)
	Push	703 (135)	699 (122)	682 (96)	697 (118)	708 (102)
	AAT-effect	**3 (45)**	**1 (41)**	**-5 (50)**	**-24 (70)**	**-5 (52)**
Disgusted	Pull	705 (143)	704 (118)	702 (107)	720 (142)	717 (92)
	Push	691 (150)	678 (119)	667 (100)	685 (126)	699 (109)
	AAT-effect	**-14 (48)**	**-26 (50)**	**-37 (44)**	**-35 (59)**	**-18 (54)**
Smiling	Pull	708 (142)	702 (126)	700 (111)	719 (139)	716 (90)
	Push	692 (130)	689 (117)	680 (103)	699 (126)	702 (100)
	AAT-effect	**-16 (51)**	**-13 (42)**	**-20 (44)**	**-20 (44)**	**-14 (44)**
Neutral	Pull	723 (139)	716 (124)	714 (112)	734 (144)	737 (90)
	Push	704 (159)	686 (118)	680 (101)	692 (133)	701 (103)
	AAT-effect	**-19 (67)**	**-30 (42)**	**-41 (72)**	**-42 (62)**	**-37 (50)**

Note. AAT-effects were calculated by subtracting participants' pull RTs from their push RTs for each picture category, with a negative AAT-effect indicating relatively stronger avoidance than approach. AAT = approach-avoidance task; SOs = significant other

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