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The Influence of Negative Expectancies on Itch-related Avoidance Behavior

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Objective: Itch expectancies play a key role in itch perception and may elicit avoidance behaviors to prevent itch, even when it is costly. Despite theoretical evidence that expectancies can influence avoidance behaviors, no studies have empirically investigated their association in the context of itch. The aim of this study was to investigate whether negative expectancy manipulation led to more costly itch-related avoidance behavior.

Methods: This study was conducted using a within-subjects repeated measures experimental design. Thirty-four participants underwent an instructional learning and conditioning procedure in which a sham experimental solution paired with a "high" quantity of cowhage spicules was used to induce high itch-expectations. A control solution paired with a medium quantity of cowhage spicules was used to induce medium itch-expectations. Subsequently, participants learned that by effortfully gripping a dynamometer above a certain level, they could avoid strong itching. In anticipation of two other itch stimuli after reapplication of the experimental solution and the control solution, average grip strength (reflecting costly itch-avoidance behavior) was measured.

Results: Results indicated that negative itch expectations were successfully induced ($p < 0.001$, $d = 1.16$). However, while participants engaged in avoidance behavior in both experimental and control trials, negative expectancy learning did not lead to more costly avoidance behavior ($p = 0.74$, $\eta_p^2 = 0.003$).

Conclusion: Results suggested that acute itch induced avoidance behavior regardless of expectations toward itch. Extending the research on the role of avoidance and its impact on itch may shed light on new approaches for itch management.

Key Words: pruritus, cowhage, expectancies, avoidance

Abbreviations: **ANOVA** = analysis of variance, **MEMORE** = mediation and moderation for repeated measures, ***N*** = number of participants, **NRS** = Numerical Rating Scale, **SD** = standard deviation, **SPSS** = Statistical Package for Social Sciences

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Itch is a somatic sensation that can invoke the urge to scratch.[1] The perception of itch is influenced by a number of biopsychosocial factors such as inflammation, stress, attention, and stigma.[2] In the chronic phase, itch can be particularly debilitating as treatments used to break the itch-scratch cycle are not always effective.[3] While itch is a common symptom of chronic skin conditions,[4] the occurrence and intensity of itch can be difficult to predict based on disease severity alone. Recently, a growing number of studies have shown how psychological factors, specifically expectancies, can play an important role in the itch-scratch cycle.[5] These expectancies can be acquired through learning mechanisms such as Pavlovian, instrumental, and instructional learning.[6] Once acquired, expectancies can alter the perception of itch. For example, in clinical populations, positive expectations of treatments may lead to significant clinical itch reduction,[7] whereas negative itch expectancies have been shown to induce higher levels of evoked itch in healthy individuals.[8]

As expectancies can exacerbate itch, it can subsequently also influence behaviors that may stop or prevent itch.[5,9] Scratching can be seen as a notable example of escape behavior in itch, as it is often performed *after* the itch has occurred. However, individuals with an itch may also try to *prevent* the itch from occurring by avoiding triggers of the itch. This can manifest in various ways, such as not wearing clothing made out of wool and avoiding exercises that produce sweat.[10] Although these avoidance behaviors are supposedly performed to prevent itch, they may be costly and could, in the long term, lead to negative effects.[11] For instance, too much refraining from physical activities or exercise to prevent itch may instead increase the risk of developing other health problems, such as cardiac and musculoskeletal disorders.[12] In

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addition, tensing the muscles to avoid itching and scratching may instead invoke pain and fatigue, and avoiding social activities can lead to isolation. Thus, itch-avoidance behaviors could become dysfunctional, yet the factors influencing these costly avoidance behaviors have not been clearly identified.

There is evidence that expectancies, particularly when related to fear, may influence avoidance behavior.[13–15] It has been proposed that somatic symptoms, like itch, can change based on expectancies that are formed through the combination of prior experience and incoming sensory input, which subsequently influences avoidance behavior.[14] In other words, by knowing what to expect, one can learn to avoid certain stimuli, which further reinforces the expectation that avoidance prevents an aversive outcome and maintains fear beliefs. This expectancy-avoidance relationship can be seen in different settings, both in experimental studies as well as in daily life. For example, those with spider phobia tend to show more avoidance behavior when they have higher expectancies of encountering an inanimate spider.[16,17] Similarly, in pain, individuals tend to engage in more avoidance behaviors when they expect to feel more pain.[18] However, the causal link between expectancy and avoidance has never been investigated in the context of itch, and the evidence on the costs of itch-related avoidance is still scarce. Considering that itch perception may be influenced by the interaction between expectancies and avoidance behavior,[14] it is imperative that these mechanisms be further investigated.

The primary aim of this study was to investigate whether a negative itch expectancy manipulation via verbal suggestions and conditioning led to more costly itch-related avoidance behavior. We hypothesized that if participants expect to receive a high itch stimulus (experimental condition), they are more likely to engage in more costly avoidance behavior (defined as effortful gripping) compared with when they expect to receive a medium itch stimulus (control condition). Our secondary aim was to investigate whether induced negative expectancy mediates the relationship between condition (experimental vs. control) and avoidance behavior. Furthermore, we explored the intercorrelation among factors such as itch, urge to scratch, expectancy, fear of itch, and avoidance to examine possible related factors in itch.

METHODS

Participants

Based on power analysis using G-power for a repeated measures analysis of variance (ANOVA), a total of 34 participants were required to obtain a medium-sized effect ($f = 0.25$, power = 0.80, alpha = 0.05). Participants were included in the study if they were between the ages of 18 and 35 years old and were fluent in English. Based on self-reports, participants were excluded if they had severe medical or psychiatric conditions, a diagnosis of chronic itch or chronic skin conditions (e.g., psoriasis, atopic dermatitis), used recreational drugs more than 3 times per month, reported a disability in the upper body, uncorrected visual impairments, or were pregnant or breastfeeding at the time of the experiment.

Ethics

This study was approved by the Psychological Research Ethics Committee at Leiden University (approval code: 2023-06-29- A.W.M. Evers-V1-4880). This study was also preregistered in the Open Science Framework Registries following the template from AsPredicted.org (https://osf.io/d2yhv/?view_only = 7c6dd4c1c85447fa90c268d8b4c95c98). Data collection for this study was conducted from March 2023 until September 2023.

Design

The current study was conducted using a within-subjects repeated measures design. Each participant underwent a total of 4 phases, namely the baseline phase (to measure itch and itch expectancy in response to the baseline itch stimuli), the expectancy acquisition phase (to induce negative itch expectancies), the avoidance acquisition phase (to learn the costly itch-avoidance behavior), and the avoidance test phase (to test whether negative expectancies led to more itch) (Figure 1A). The expectancy acquisition phase and avoidance test phase both consisted of 2 trials, namely the experimental trial (to induce negative itch expectancies) and the control trial. Both the order of the trials and the location of the application were semi-randomized between participants to reduce bias (Figure 1B). Randomization of the order and location of the trials was done by an independent researcher.

Procedure

Interested participants were invited to the research lab. Upon arrival, participants were briefed about the study verbally and given the information letter. All participants who agreed to participate in the study signed a consent form. Afterwards, participants were asked to complete a set of online baseline questionnaires (see the *Materials and Measures* section and Supplemental Digital Content 1, http://links.lww.com/PSYMED/B112 for a complete overview of questionnaires). Once the baseline questionnaires were completed, participants received a total of 6 applications of itch stimuli: 3 on the ventral side of each arm. Different sets of cowhage spicules (i.e., hairs of a tropical bean that can induce itch) were used to induce low (i.e., small set: 15 ± 5 spicules), moderate (i.e., medium set: 25 ± 5 spicules), and relatively high itching (i.e., large set: 45 ± 5 spicules) throughout the experiment. The number of spicules for each set was determined based on pilot tests and previous studies.[19–22] Each set of cowhage spicules was counted under a microscope (Bresler, Rhede, Germany) and prepared using negative grip tweezers (Dumont Style N5 Inox 2) before the start of the study. Before receiving the itch stimuli, all 6 application areas were marked with a marker that was safe to use on skin. Then, 4 pieces of 3M Transpore White tape were attached around the 1.5 cm×1.5 cm application areas before each trial.

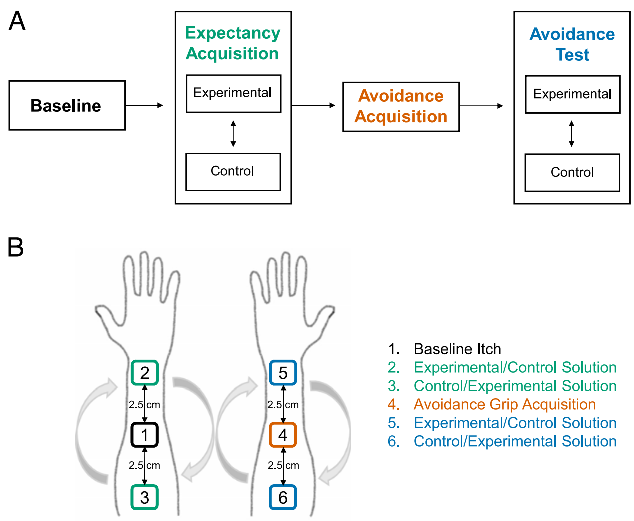

FIGURE 1. Design overview, randomization, and location of trials. Subfigure A depicts the order of the 4 phases, while subfigure B depicts the location of the cowhage application for each trial. The colors indicated on subfigure B depict different phases of the experiment. The avoidance acquisition and avoidance test trials were always applied on the participant's dominant hand. Color image is available only in online version.

Baseline Itch

Once the application areas had been marked, a baseline measurement of the induced itch stimulus was taken. To do so, the medium set of cowhage spicules was applied. The cowhage spicules were rubbed into the application area for 45 seconds and remained on the arm for 3 minutes.[21] This procedure of cowhage application was repeated for each trial using different sets of spicules. Within those 3 minutes, participants were asked to rate their itch and urge to scratch every 30 seconds using a 0 (no itch/urge to scratch) to 10 (worst itch/urge to scratch imaginable) numerical rating scale [Numerical Rating Scale (NRS); see also the "*Self-report Questionnaires*" section]. Participants were told not to scratch the application area, but if they really must scratch, then they may do so by rubbing outside of the application area. After 3 minutes, the spicules were removed using a 2.5 cm wide 3M Transpore tape.[21] Then the wait period began for the itch to subside to an itch level of 2 or lower on the NRS. During this 5-minute wait period, participants were asked to rate their itch levels after every minute. If participants still felt a high itch after 5 minutes, then the wait time was extended in 1-minute increments until participants reached an itch level of NRS 2 or lower or until 10 minutes had passed since removal of the spicules, whichever came first. No participants exceeded 10 minutes during the wait period. At the end of this phase, participants who were not sensitive to the cowhage itch stimuli (i.e., those whose cowhage-induced itch mean rating at baseline was < 0.5 on the NRS ranging from 0 indicating no itch to 10 indicating worst itch imaginable), and participants who were too sensitive to the cowhage itch stimuli (i.e., with a baseline cowhage-induced itch mean rating as 6 and above on the NRS) were excluded.

Expectancy Acquisition

After baseline itch application, the expectancy acquisition phase began. In this phase, participants were shown two bottles containing water-based solutions. Participants were told that a bottle with the label "Cyclosol" (the experimental solution that was applied during the experimental trial) would worsen their itch, while the "Hydro solution" (the control solution that was applied during the control trial) bottle would not affect the itch level. In truth, neither solution contained any itch-inducing properties. In addition to the verbal explanation, participants watched a tailor-made video based on the one used by Weng et al[22] that explained the science behind the itch-inducing compound to increase the believability of the experimental solution. Subsequently, the solutions were applied to the participant's arm on 2 separate trials. For each separate trial, participants were asked how much itch they expected to feel and how afraid they were of the itch stimuli after the solutions had been applied. After 1 minute, the large set of cowhage spicules was applied on the participant's arm in one location during the experimental trial to induce high itching, and the medium set of cowhage spicules was applied to the participant's arm on another location to induce medium itch. Itch and urge to scratch levels were again measured multiple times during cowhage application. Afterwards the spicules were removed. Similar to the baseline itch phase, participants' itch had to reach an NRS of 2 or lower within 10 minutes before each new trial. All participants reached an itch rating of < 2 on the NRS within 10 minutes.

Avoidance Acquisition

During the avoidance learning phase, participants were told that clenching their fists above a certain threshold could decrease itch because it blocked certain itch-inducing pathways, and that the stronger they gripped, the less itch they would feel. In other words, participants could avoid feeling medium-to-high levels of itch by gripping above a certain threshold. To determine the participants' individual thresholds, participants were given the dynamometer to hold and were told to grip the dynamometer as hard as possible for 3 seconds. Then, participants' individual thresholds were calculated (see the *Avoidance Measure* section). Once the individual thresholds were calculated, participants' itch-expectancy and fear of itch were again measured before the cowhage spicules were applied. However, 2 types of expectancies were measured in this phase. Participants were asked how much itch they expected without gripping on a scale of 0 (no itch) to 10 (worst itch imaginable), and how much itch they expected while gripping on the same scale. Subsequently, the small set of cowhage spicules was rubbed on the participant's arm to induce low itch, therefore giving the impression that the gripping could reduce itch. As soon as the cowhage spicules were applied, participants were told to start gripping the dynamometer above their individual threshold for a period of 30 seconds. Participants were able to see their own threshold line on a computer monitor placed in front of them. In addition, participants' itch and urge to scratch levels were measured multiple times during cowhage application. After the participants performed the avoidance behavior, they were asked a question about how effective they thought the hand gripping was in reducing itch on a scale of 0 (not effective) to 10 (extremely effective).

Avoidance Test

During the avoidance test phase, the experimental and control solutions were applied again to the participant's dominant arm in 2 separate trials. Again, itch expectancy and fear of itch were measured before the application of cowage spicules. In this phase, participants only received the medium set of cowhage spicules and were given the dynamometer to hold. While the spicules were being rubbed onto the arm, participants were told that they may grip the dynamometer as hard as possible above their individual threshold for 30 seconds to reduce their itch after the spicules have been applied; however, it was their decision whether they wanted to grip, how strongly they were gripping, and how long they wanted to grip. After 30 seconds, participants were told that they could stop gripping (Figure 2). Itch and urge to scratch levels were again measured multiple times during cowhage applications. At the end of the experiment, participants were compensated through research credits or monetary payment and debriefed about the true aims of the study verbally and through a debriefing text that was displayed on a monitor.

Materials and Measures

Self-report Questions

Baseline Questionnaires

Baseline questionnaires consisted of demographic questions including the participant's age, gender, and education level. In addition, participants completed a set of questionnaires for educational purposes in the context of a bachelor's thesis project. Results from the questionnaires were not analyzed in this study. For the full list of questionnaires, see Supplemental Digital Content 1, http://links.lww.com/PSYMED/B112.

Expectancies and Fear

To measure itch expectancies, participants were asked to verbally rate how much itch they expected to feel on an NRS of 0 (no itch) to 10 (worst itch imaginable). Similarly, to measure fear of itch, participants were asked to verbally rate how afraid they were of the upcoming itch stimuli on an NRS of 0 (not at all afraid) to 10 (extremely afraid). The ratings were recorded using a Qualtrics survey (Qualtrics Inc., Provo, UT) by the experimenter. Both itch expectancies and fear of itch were measured during the expectancy acquisition phase, avoidance acquisition phase, and avoidance test phase once before each cowhage application.

Itch and Urge to Scratch

Participants were asked to verbally rate how much itch they were experiencing on an NRS of 0 (no itch) to 10 (worst itch imaginable). Subsequently, participants were asked to rate how much they would like to scratch their itch on a scale of 0 (no urge to scratch) to 10 (worst urge to scratch imaginable). The itch and urge to scratch ratings were again recorded using a Qualtrics survey by the experimenter. Both itch and urge to scratch were measured every 30 seconds for a duration of 3 minutes after each set of cowhage spicules had been administered.

Expectancy Stimuli

Two dropper bottles were filled with water-based solutions. Different labels were attached to each of the bottles. One bottle containing an itch-inducing compound called "Cyclosol" was labeled as "Cyclosine solution" and was used as the experimental solution to induce high itch expectancies. This bottle contained a mix of water and a drop of water-based lotion. Another bottle labeled as "Hydro solution" was used as the control solution to induce no itch expectancies. This bottle only contained water.

Avoidance Measure

Avoidance was defined as effortful gripping measured using an isometric hand dynamometer (BIOPAC Systems Inc.). Individualized grip thresholds were calculated at 55% of participants' maximum grip strength while gripping the dynamometer as hard as possible for three seconds. This threshold was selected based on a pilot study, which showed that this was the proportion of the maximum grip strength that is effortful to continuously maintain within a span of 30 seconds.[23,24] It should be noted that for 2 participants, the participants' maximum grip value was displayed on the monitor as opposed to their individual threshold value. Therefore, these participants may have unintentionally had a more effortful grip as they may have tried to grip as hard as their maximum grip rather than their threshold grip within the 30-second window during the avoidance acquisition and test phases.

Statistical Analysis

Self-report and grip data were prepared using RStudio version 2022.07.0 and computed using Statistical Package for Social Sciences (SPSS) version 29.0 for Windows (SPSS Inc., Chicago, USA). Normality of residuals for all data were assessed by calculating skewness and kurtosis *z*-scores, and sphericity was checked using the Mauchley test. Before testing the primary hypothesis, a manipulation check was performed to test whether negative expectancies were induced. For this, paired sample *t* tests were conducted on the itch-expectancy ratings during experimental and control trials, both in the expectancy acquisition phase and the avoidance test phase. We also performed additional paired sample *t* tests on the itch and urge to scratch ratings during experimental and control trials during the acquisition phase to check whether the conditioning procedure generated the intended itch-related effect.

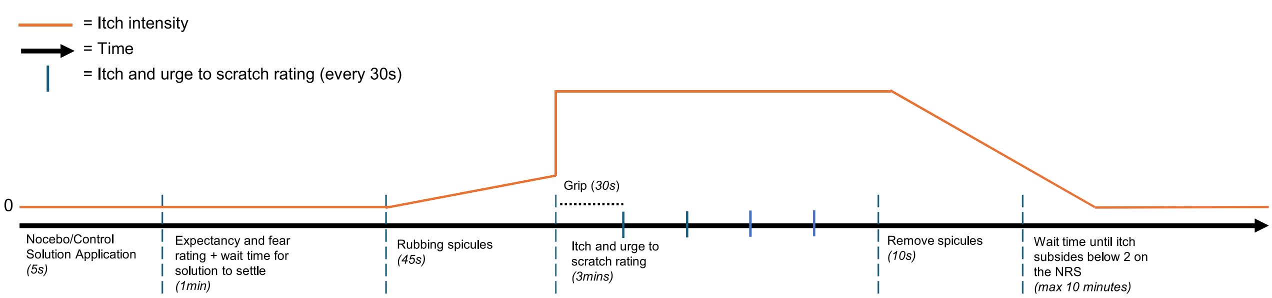

FIGURE 2. Timeline of trials in the avoidance test phase. Participants underwent 2 trials with a similar procedure as above during the avoidance test phase, namely the experimental trial (in which the experimental solution was applied followed by a supposedly large set of cowhage spicules, which was in fact a medium set) and a control trial (in which the control solution was applied followed by a medium set of cowhage spicules). Color image is available only in online version.

To test the primary hypothesis, a repeated measures ANOVA was conducted with average grip strength in both experimental and control trials during the avoidance test phase as the within-subjects variable. Participants' grip scores were logged as zero at any period that they did not grip within the 30-second window. Assumption checks indicated that the data violated the assumption of normality. As both log and square root transformations did not adjust for normality, a sensitivity analysis was conducted with the same variables using the Wilcoxon signed-rank test. In addition, total grip strength (i.e., area under the curve) and peak grip strength within a 30-second window were also calculated as a measure of avoidance. Correlations using 1000-sample bootstrapping between the 3 avoidance measures were assessed. Due to high correlations between the average grip and total trip, and average grip and peak grip (all $r \geq 0.80$, $p < 0.001$), analyses were conducted with average grip strength as the only avoidance outcome.

To test the secondary hypothesis, a mediation analysis was performed using the mediation and moderation for repeated measures (MEMORE) macro[25] on SPSS to assess whether itch expectancy mediated the relationship between condition and avoidance behavior. Model 1 and the percentile bootstrap confidence interval method were selected with 1000 samples. The within-subject condition was dummy coded (experimental vs. control) and used as the predictor variable, average grip as the outcome variable, and itch expectancy as the mediator. Expectancy was specified as the itch-expectancy ratings after the application of the experimental versus control solution during the avoidance test phase. It should be noted that the raw average grip scores per condition during the avoidance test phase were used instead of a difference score between conditions, as stated in the preregistration. This decision was taken in consultation with a statistician, as the within-subject conditions were already included as the predictor variable.

Furthermore, Pearson correlation coefficients were calculated to explore the correlation between avoidance (average grip) and itch-expectancy, and other itch-related measures (i.e., fear of itch, average itch, and average urge to scratch) in the avoidance test phase. For each of the variables included, difference scores were calculated by subtracting the scores of the control trial from the experimental trial during the avoidance test phase. Positive scores indicate an increased sensitivity to itch, while negative scores indicate a decreased sensitivity to itch. As the assumption of normality was not met for avoidance, correlations were performed with 1000 sample bootstrapping. In addition, the assumptions of linearity between itch-expectancy and fear of itch were not met; therefore, Spearman rho was reported for this correlation.

Finally, as post hoc exploratory analyses, we conducted paired sample *t* tests on itch and urge to scratch ratings during both the experimental and control trials in the avoidance test phase to explore whether itch and urge to scratch ratings differed between the experimental and control trials. In addition, we calculated descriptive statistics for each of the outcome measures in each phase to explore general patterns. For all analyses, 2-sided tests were computed with the level of significance set at $p < 0.05$.

RESULTS

Participants

A total of 50 participants were recruited for the study. Of those participants, 16 were excluded after the baseline phase due to low or nonsensitivity to the itch stimuli (see also the *Baseline Itch* and *Methods* section). Therefore, the final sample consisted of 34 participants ranging between the ages of 18 and 35 ($M = 23$, SD = 4.04), with the majority of participants (76%) identifying as female. Regarding education level, participants had recently completed either secondary education (17.6%) or tertiary education (82.4%). Due to experimenter error, one participant unintentionally did not undergo the conditioning procedure during the avoidance acquisition phase, but still received verbal suggestions regarding the grip behavior. In addition, one participant participated in the study using a false identity, which may have led to falsified data. These participants were included for all analyses, but follow-up sensitivity analyses were conducted with both participants removed.

Manipulation Check

Itch Expectancy During Expectancy Acquisition Phase

A paired sample *t* test indicated that participants expected more itch after the application of the experimental solution compared with the control solution during the expectancy acquisition phase (Table 1, $t_{(33)} = 9.33$, $p < 0.001$, $d = 1.60$). Similarly, a paired sample t test also indicated that participants expected more itch after the application of the experimental solution compared with the control solution during the avoidance test phase ($t_{(33)} = 6.74$, $p < 0.001$, $d = 1.16$). The results indicated that negative expectations were successfully induced during the expectancy acquisition phase and were still present during the avoidance test phase (Table 1).

Itch Level During Expectancy Acquisition Phase

A paired sample t test also indicated that participants reported more itch ($t_{(33)} = 4.05$, $p < 0.001$, $d = 0.70$), and a greater urge to scratch ($t_{(33)} = 3.96$, $p < 0.001$, $d = 0.68$), after the application of the experimental solution compared with the control solution during the expectancy acquisition phase, indicating that different itch and urge to scratch levels were successfully induced between the 2 conditions.

Effortful Gripping During Avoidance Test Phase

To explore whether participants engaged in effortful gripping, the proportion of gripping during the experimental and control trials in the avoidance test phase relative to maximum grip was calculated across participants by calculating a percentage. Indeed, on average, participants engaged in effortful gripping as their average grip was around 50% of their maximum grip strength (see Table 1 and Figure S1, Supplemental Digital Content 2, http://links.lww.com/PSYMED/B113).

Primary Outcomes

Based on the repeated measures ANOVA, there was no significant effect of condition on avoidance behavior ($F_{(1, 33)} = 0.12, p = 0.74, \eta_p^2 = 0.003$), which indicated, in contrast to our hypothesis, that participants did not grip harder after the application of the experimental solution compared with after the application of the control solution in the avoidance test phase. Results of the nonparametric Wilcoxon signed-rank test also confirmed a nonsignificant relationship ($z = -0.42$, $p = .68$). In addition, we conducted sensitivity analyses without the participant who unintentionally only received verbal suggestions during the avoidance acquisition trial, and without the person who used a false identity. These results confirmed the results of the full dataset and can be found in Supplemental Digital Content 1, http://links.lww.com/PSYMED/B112.

Secondary and Post Hoc Outcomes

As there was no significant effect of condition on avoidance behavior, mediation analyses were not conducted to assess whether there was an indirect effect of condition on avoidance through expectancies. In addition, in line with our preregistration, due to low variability in fear ratings (Table S1, Supplemental Digital Content 2, http://links.lww.com/PSYMED/B113), no mediation analyses were conducted to assess whether fear mediated the relationship between condition and avoidance behavior. Furthermore, we found no significant correlation between avoidance and expectations, and fear, itch, and urge to scratch, during the experimental trial in the avoidance test phase (see Table S2, Supplemental Digital Content 2, http://links.lww.com/PSYMED/B11. A paired sample t test also indicated that participants did not report significantly more itch after the application of the experimental solution compared with the control solution during the avoidance test phase ($t_{(33)} = 1.28$, $p = 0.21$, $d = 0.22$), indicating no significant itch difference between the 2 conditions. Similar findings were also found for urge to scratch ratings ($t_{(33)} = 0.98$, $p = 0.34$, $d = 0.17$). Full descriptive statistics of expectancy, itch, urge to scratch and average grip can be found in Table 1. Additional descriptive statistics of fear, peak grip, and total grip can be found in Table S1 in Supplemental Digital Content 2, http://links.lww.com/PSYMED/B113.

TABLE 1. Descriptive Statistics of Outcome Measures

Variables (*Number of Cowhage Spicules*)	N	Mean(SD)	Min.	Max.
Baseline cowhage induction (*25 cowhage spicules*)				
Average itch	34	3.4 (1.5)	1.0	5.8
Average urge to scratch	34	3.1 (1.7)	0.0	6.3
Expectancy acquisition—experimental (*45 cowhage spicules*)				
Expectancy	34	7.1 (1.9)	0.0	9.0
Average itch	34	4.7 (1.9)	0.3	8.2
Average urge to scratch	34	4.3 (2.0)	0.0	7.5
Expectancy acquisition—control (*25 cowhage spicules*)				
Expectancy	34	2.8 (2.4)	0.0	8.0
Average itch	34	3.0 (2.3)	0.0	7.0
Average urge to scratch	34	2.8 (2.3)	0.0	7.2
Avoidance acquisition (*15 cowhage spicules*)				
Grip threshold (in kg)	34	8.8 (3.7)	5.0	23.3
Expectancy (while gripping)	34	2.8 (1.9)	0.0	6.0
Expectancy (without gripping)	34	4.1 (2.2)	0.0	7.0
Average itch	34	1.5 (1.7)	0.0	6.5
Average urge to scratch	34	1.2 (1.7)	0.0	6.7
Average grip (in kg)	34	9.7 (3.7)	3.8	18.6
Effectiveness of grip	34	7.2 (3.4)	0.0	10.0
Proportion of average grip relative to maximum grip (%)	34	64.6 (14.3)	34.8	111.4
Avoidance test—experimental (*25 cowhage spicules*)				
Expectancy	34	5.1 (2.3)	0.0	9.0
Average itch	34	2.8 (1.9)	0.0	6.8
Average urge to scratch	34	2.3 (2.1)	0.0	7.0
Average grip (in kg)	34	7.4 (4.1)	0.0	20.3
Proportion of average grip relative to maximum grip (%)	34	49.9 (22.4)	0.1	86.8
Avoidance test—control (*25 cowhage spicules*)				
Expectancy	34	3.2 (1.8)	0.0	7.0
Average itch	34	2.4 (2.0)	0.0	7.7
Average urge to scratch	34	2.0 (2.0)	0.0	7.8
Average grip (in kg)	34	7.2 (4.4)	0.0	21.9
Proportion of average grip relative to maximum grip (%)	34	47.9 (22.3)	0.2	93.9

N = number of participants; SD = standard deviation.

Units for itch, urge to scratch, and expectancy are on a scale of 0 to 10, with higher numbers indicating more itch, urge to scratch, and expectancy. Average grip was calculated based on the participant's grip strength within a 30-second window for each trial.

DISCUSSION

The impact of itch on daily life is often underestimated, despite studies reporting that the psychological and behavioral impact of chronic itch is comparable to that of chronic pain.[2,26,27] The results of the current study demonstrate that acute itch can trigger avoidance behavior. However, avoidance behavior was not influenced by the magnitude of itch expectancies. In addition, fear of itch, itch, and urge to scratch were neither associated with avoidance behaviors nor with expectancies.

The Role of Expectations and Other Factors in Itch-related Avoidance

Negative expectations were successfully induced via instructional learning and Pavlovian conditioning. This was in line with previous studies evaluating the influence of experimentally induced expectancies on itch.[6,8] However, despite having significantly different levels of itch expectations and experienced itch, participants not only reported moderate levels of itch for the medium set of spicules, but also for the large set of spicules. In other words, the conditioning procedure only induced on average medium itch for both medium and high sets of spicules, which, albeit significantly different, did not match their high itch expectations before the conditioning procedure. This may explain why participants performed an equal amount of avoidance behavior across the experimental and control trials. It could be the case that participants may have learned that the itch caused by the experimental solution was neither aversive nor harmful enough to warrant extra gripping.

Furthermore, there were 2 types of expectations at play during the avoidance test phase: the expectation of how much itch participants would feel after the application of the 2 solutions, and the expectation of how much gripping could reduce their itch. Therefore, having a lower itch experience coupled with 2 competing expectations may have led participants to engage in a "better safe than sorry" strategy,[28] because participants knew that gripping was effective at reducing itch. That is to say, participants may have wanted to ultimately prevent any itch regardless of expected intensity. Relatedly, it was also observed that the level of itch for both experimental and control trials was overall lower than the level of itch during the expectancy acquisition phase. This may indicate that the gripping behavior may have caused a decrease in sensitivity to itch.

Nevertheless, it is important to note that, while participants gripped equally hard in the two trials of the avoidance test phase, they did not grip harder than their threshold level. This may suggest that although participants tried to avoid itch, the threshold level, assessed based on 3 seconds of maximum gripping, may have been too difficult to sustain for the participants despite their best efforts at maintaining it during the 30-second trials. Regardless, most participants did perform some effortful gripping compared to their maximum grip, which further indicates that itch is a somatic sensation that people do not want to experience, even when expecting a moderate intensity.

Considering that negative expectatancies was not the main driver of costly avoidance, other psychological mechanisms may be involved in itch avoidance. For example, in line with the fear avoidance model, higher levels of fear may have been needed to drive more avoidance.[29–31] In the current sample, most participants showed low levels of fear toward the itch stimuli. This may be due to participants believing that there is no risk of harm with the induced itch. Studies from other fields, such as pain, have shown that fear is highly related to the risk of harm, therefore motivating avoidance behavior.[30,32,33] Perhaps also in itch, participants would have avoided more if they had higher levels of fear or if they believed that they are at risk of harm. However, to date, studies investigating the role of fear and perception of harm in itch are still scarce.

Strengths, Limitations, and Future Directions

To our knowledge, this was the first study to examine costly avoidance behavior in the context of itch. The avoidance measure that we used also bears some ecological value, as many individuals tend to clench their fists or tense their muscles to prevent scratching.[34,35] In addition, as the trials within participants were semi-randomized, an order effect can likely be eliminated. However, our study is also not without limitations. First, as participants could grip multiple consecutive times at a level that could cause arm fatigue, participants may not have been able to grip as strongly in the second trial compared to the first trial in the avoidance test phase. Although this was partly counteracted by counterbalancing the trials, the level of energy in the participants' arms may have interfered with their grip strength. If this study were to be replicated, longer intervals before and between avoidance trials would be beneficial to ensure an unbiased grip rating. Second, although different levels of expectancies were induced, the high set of spicules did not induce the high level of itch as intended. Having higher levels of itch in future studies may lead to higher levels of expectancies and different levels of avoidance. Finally, the current sample consisted of young adults without chronic itch with high levels of higher education; therefore, our results may not be generalizable to the general population or the clinical population. Future research could investigate how established itch expectancies due to long-term itch could impact costly avoidance behaviors in the general population and in individuals with chronic itch due to chronic skin conditions.

In fact, some studies have also shown that individuals with chronic itch may try different strategies to avoid itch[10,11], yet, it is still unclear to what extent these avoidance behaviors are influenced by expectancies and to what extent it can be costly. Extending this research line and exploring the costs to itch-related avoidance behaviors in the clinical population may shed some light on how itch persists.

CONCLUSION

Negative itch expectancies can be acquired through verbal suggestions and conditioning, but these negative expectancies may not be the main driver of costly avoidance behavior in itch. Healthy participants seem to perform an equal amount of effortful avoidance behavior regardless of itch expectancy and previous itch intensity. However, as this was the first study to investigate costly itch avoidance behavior, more studies are needed to evaluate the different factors that might influence avoidance behavior. If we can establish that individuals do engage in costly avoidance behavior, it could potentially change how we approach treatments for chronic itch. For example, by incorporating more cognitive behavioral–based therapy, such as exposure therapy[36] and habit reversal.[37] However, despite evidence that a biopsychosocial approach is needed to understand (chronic) itch, there is currently a lack of an empirically supported theoretical model that can explain how psychological, somatic, and behavioral mechanisms in itch influence one another. Further studies are needed to fully understand the impact of both expectancies and avoidance, and their potential interaction on itch.

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Transparency and Openness Disclosures: The data used in this study will be made available through a complete publication package in the DataverseNL repository at https://dataverse.nl/. These datasets can then be accessed by the public upon request.

This study and its accompanying analysis have been preregistered through the Open Science Framework following the template from AsPredicted.org before the start of the study: http://osf.io/d2yhv/?view_only = 7c6dd4c1c85447fa90c268d8b4c95c98.

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