Appendix S1

MATERIALS AND METHODS

Aims

The present study had 3 aims. First, we wanted to determine the degree to which itch can be induced by auditory stimuli in the absence of peripheral stimulation. This hypothesis was evaluated by comparing the amount of itch induced by listening to scratching sounds, as compared to rubbing sounds (which act as a high-level baseline). A second aim was to evaluate whether the amount of induced itch varies linearily as a function of high frequency volume in the sound recordings (decreased by 10 *dB*, original, increased by 10 *dB*). Finally, we asked whether people with psoriasis, where itch and associated scratching are a common problem, show an altered response to these experimental manipulations, relative to healthy controls.

Sample

Sixty-four participants were recruited to each experimental group. This sample size was chosen because it is sufficient to detect an effect in a between-group design that is at least of medium size or greater (Cohen's $d \geq 0.5$) with a probability of 80%, as indicated by an *a-priori* power analysis (S1). Experimental group inclusion criteria were: (*i*) self-reported history of psoriasis, (*ii*) age ≥ 18 years, (*iii*) normal or corrected-to-normal hearing and (*iv*) access to an Internet-enabled computer, with the capability to play sound. Since this was an online study, we had no control over the volume setting or particular sound setup participants were using on their computer. However, the experimental manipulation was realized within subjects. Thus, the difference in sound intensity between experimental conditions remains stable, regardless of the particular sound setup of each computer. Inclusion criteria for the control group were identical except control participants had to be without any history of psoriasis and not currently experiencing itch. Mean age did not differ significantly between groups [psoriasis group: mean ± SD 39.42 ± 10.6; control group: mean ± SD 39.89 ± 10.6; $t(126)=0.25$, $p=0.80$], nor gender distribution (psoriasis group: females $n=25$, control group: $n=31$, $\chi^2=1.14$, $p=0.29$). Participants in the psoriasis group had been living with the condition for a mean of 10.1 years (range 0–61 years, SD 11.1).

Materials

Stimuli were audio recordings of scratching or rubbing. Different targets were scratched or rubbed for 20 s, including 3 body (beard, hand, leg) and 3 non-body (polyester, denim, leather) targets. High frequencies (HF) above 1,000 Hz were then either increased or decreased in volume by 10 *dB* using PRAAT (version 5.3.52, www.praat.org) resulting in 3 different versions of each sound file: HF volume –10 *dB*, HF volume unchanged and HF volume +10 *dB*.

To assess the amount of experienced itch within the last 14 days, all 128 participants completed the 5D itch scale (10) which provides estimates for 5 dimensions of itch (degree, duration, direction, disability, and distribution), as well as an overall score. The overall 5D score can vary between 5 (no itch) and 25 (most severe itch). Finally, participants in the psoriasis group assessed their symptom severity using the Self-assessed Psoriasis Area and Severity Index (SAPASI) (11). This instrument requires participants to indicate the body surface area affected by psoriasis, followed by a severity rating of a typical psoriatic lesion with respect to colour, thickness and scaliness. The resulting overall SAPASI index varies between 0 (no psoriasis on the body) and 72 (the most severe case of psoriasis).

Procedure

The experiment was conducted using a secure website. After giving informed consent, participants completed the study in the following order: Completion of the 5D; completion of the SAPASI (psoriasis group only) and auditory itch induction. For the latter part, healthy participants and people with psoriasis listened to the sound recordings of either scratching or rubbing sounds. After each sound, participants were asked to rate the intensity of itchiness (if any) induced by the preceding sound. The rating scale ranged from 1 (not at all) to 7 (extremely), with 4 indicating moderate itchiness. The 36 sound stimuli were divided into 3 blocks, with the constraints that (a) each block contained an equal number of sounds from each condition, and (b) each block contained only one of the 3 variants of each particular sound (e.g., Block A would contain 'leg_rub_original', Block B 'leg_rub_HF_volume_increased' and Block C 'leg_rub_HF_volume_decreased'). Sound order within each block was randomized. Participants completed all 3 blocks, with block order counterbalanced across participants. Participants had the opportunity to complete the study one block at a time, and could take a break if they wished. Most participants (60 out 64 in the psoriasis group, 58 out 64 in the control group) chose to complete the study on a single day.

Design and data analysis

Sound rating data were analysed using a Mixed 2 × 2 × 2 ANOVA, including the effect of HF Volume modelled as a linear effect (linear effect present vs. absent), Movement Type (rub, scratch) as a categorical within-subject factor, as well as group (psoriasis, control) as a between-subject factor. For all main comparisons, Cohen's *d* is given as an effect size measure, using the pooled variance between conditions as a standardizer (S2).

SUPPLEMENTARY REFERENCES

S1. Cohen J. A power primer. Psychol Bull 1992; 112: 155–159.
S2. Dunlap WP, Cortina JM, Vaslow JB, Burke MJ. Meta-analysis of experiments with matched groups or repeated measures designs. Psychol Methods 1996; 1: 170–177.