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Supplementary information

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Voluntary attention regulates acute immune responses in humans

In the format provided by the authors and unedited

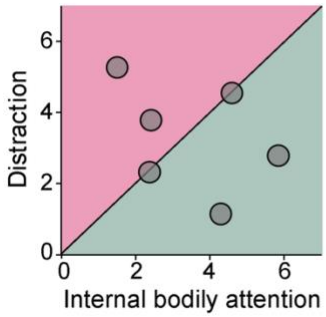
Supplementary information

Table of Contents

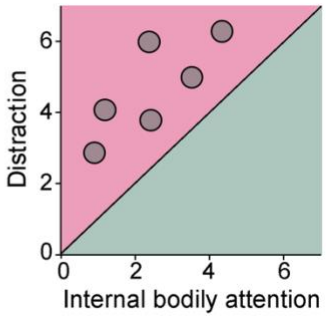
General note: visualizing within-subject effect magnitude

Throughout the paper and supplementary analyses, we chose to visualize the within-participant effect magnitude using a scatterplot with a unit-slope (x=y) reference line. In these plots, each dot represents one participant's responses under two conditions (e.g., internal attention, x-axis, green; distraction, y-axis, pink). The diagonal line indicates equal response across conditions. The extent to which data points fall consistently on one side of the line reflects the proportion of participants showing the same directional effect, illustrating both the consistency and robustness of the within-subject effect magnitude.

Non-significant effect (participants spread equally on both sides of the diagonal)



Significant and highly consistent effect (all participants fall on one side of the diagonal)

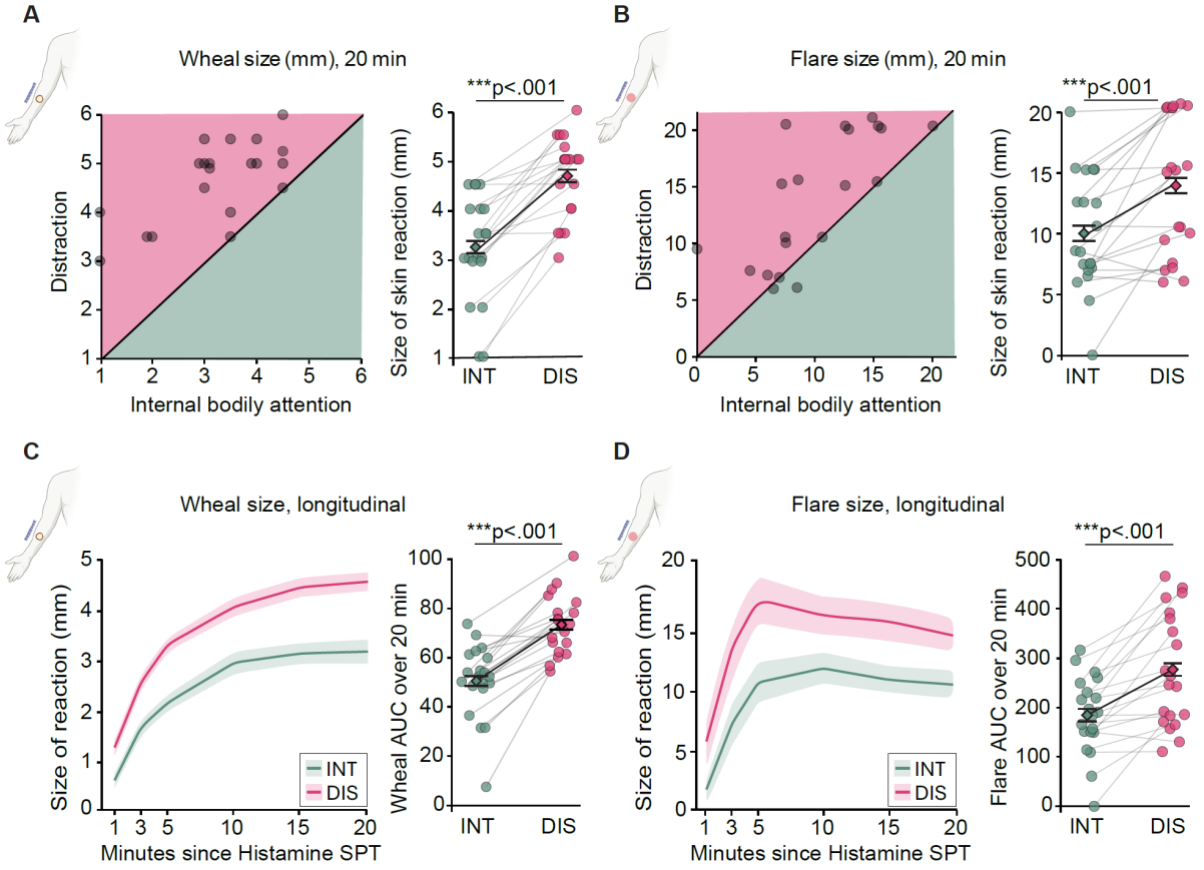


Next to these figures, you will find paired dot-plots illustrating the same data, with grey lines connecting within-subject responses. For clarity, the mean response in each condition is marked with black diamonds and error bars indicate SEM. Bold black lines connect the means across conditions to depict the overall trend between conditions.

Section S1: Voluntary attention vs. distraction regulates acute cutaneous inflammation in vivo (Experiments 1 and 2) – Extended information and Statistics

The regulatory effect of internal attention versus distraction was tested in two independent cohorts (Experiments 1 and 2; see Methods). The main text presents results from Experiment 1, which were replicated and extended in Experiment 2 (Fig. S1.1). In Experiment 2, visual input and task demands were matched across conditions, replacing video distractors used in Experiment 1. This design isolated the role of attentional engagement itself in inflammatory regulation. Detailed statistics for both experiments are provided in Tables S1.1-S1.4, including within-participant comparisons of inflammatory responses at the 20-min peak (Table S1.1), across the full time-course (Tables S1.2-1.3), and analyses of response resolution (Table S1.4).

Fig. S1.1. Voluntary attention versus distraction regulates acute cutaneous inflammation under matched visual input and task demands (Exp. 2).



(A-B) Wheal (A) and flare (B) responses at 20 min. Scatterplots and paired dot plots visualize within-participant inflammatory responses under internal attention (INT, green, x-axis) versus distraction (DIS, pink, y-axis). Points above the diagonal indicate larger responses under distraction, illustrating the consistency of this effect across participants, a pattern evident in the paired plots as well. Two-sided paired Student's t-test showed smaller wheal responses under internal attention t_{19}=8.0, p=1.641×10^{-7}, *Cohen's d*=1.79, 95% CI [1.07,2.50]) and smaller flare responses (t_{19}=4.4, p=3.228×10^{-4}, *Cohen's d*=0.98, 95% CI [0.43,1.51]). **(C-D) Time courses (left) and area under the curve (AUC; right) analyses** demonstrate smaller inflammatory responses under internal attention for both wheal (**C**) and flare (**D**). For wheal, repeated measures ANOVA (left) showed a significant; Condition x Time interaction ($F_{3.0,57.7}$=4.6, p=.006, $\eta^2_{partial}$=0.20), and AUC (right) was smaller under internal attention (two-sided paired Student's t-test; t_{19}=8.3, p=9.530×10^{-8}, d=1.86, 95% CI [1.12,2.58]). For flare, repeated

measures ANOVA (left); showed a main effect of Condition ($F_{1,19}$=28.1, p=3.969×10^{-5}, $\eta^2_{partial}$=0.60), but no Condition x Time interaction ($F_{2.7,51.1}$=1.0, p=.410, $\eta^2_{partial}$=0.05). AUC (right) was also smaller under internal attention (two-sided paired Student's t-test; t_{19}=5.2, p=4.922×10^{-5}, d=1.17, 95% CI [0.59,1.73]). The significant Time x Condition interaction for wheal size over time, together with a significant mixed-effects slope analysis of the resolution phase, indicated a faster decline toward baseline (mixed-effects slope analysis Time × Condition interaction: t=2.1, p=.040; Distraction slope=0.05, 95% CI [0.03, 0.07]; Internal attention slope=0.02, 95% CI [4.951×10^{-4}, 0.05]; Tables S2.1-S2.2). Post-hoc paired comparisons confirmed progressively increasing differences over time (Tables S1.1-S1.4). N=20. Schematics were created in BioRender. Liron, R. (2026) https://BioRender.com/e8gishz.

Table S1.1. Wheal and flare responses at the 20-min peak are more regulated under internal attention than distraction, as reflected in paired comparisons within participants.

Exp	Inflammatory response parameter	Internal attention M±SD (mm)	Distraction M±SD (mm)	t(df)	*p*	Cohen's d	95% CI
Exp.1 (N=37)	Wheal	3.5±1.1	5.0±0.7	7.9(36)	<.001	1.30	[0.86,1.73]
	Flare	10.6±8.3	14.0±8.0	2.5(36)	.015	0.42	[0.08,0.75]
Exp.2 (N=20)	Wheal	3.2±1.1	4.7±0.8	8.0(19)	<.001	1.79	[1.07,2.50]
	Flare	10.0±4.8	14.0±5.7	4.4(19)	<.001	0.98	[0.43,1.51]

Table S1.2. Area under the curve (AUC) analyses show smaller cumulative inflammatory responses under internal attention for both wheal and flare.

Exp	Param-eter	Internal attention M±SD (mm)	Distraction M±SD (mm)	t(df)	*P*	Cohen's d	95% CI
Exp.1 (N=37)	Wheal	61.2±12.1	77.5±13.4	6.7(36)	<.001	1.11	[0.69,1.51]
	Flare	239.1±138.7	304.0±145.7	2.7(36)	.012	0.44	[0.10,0.77]
Exp.2 (N=20)	Wheal	50.5±15.0	73.4±12.1	8.3(19)	<.001	1.86	[1.12,2.58]
	Flare	184.9±78.3	277.4±115.7	5.2(19)	<.001	1.17	[0.59,1.73]

Table S1.3. Inflammatory responses follow different time courses under internal attention compared to distraction, as reflected by repeated-measures ANOVA.

Exp	Para-meter	Condition			Time			Time x Condition		
		F(df)	*p*	ηp^2	F(df)	*p*	F(df)	*p*	ηp^2	ηp^2
Exp.1 (N=37)	Wheal	50.9 (1,36)	<.001	0.59	277.8 (2.4,85.2)	<.001	0.89	8.7 (2.3,81.6)	<.001	0.20

	Flare	8.7 (1,36)	.006	0.20	7.4 (1.9,67.6)	.002	0.17	1.3 (3.1,110.3)	.284	0.03
Exp.2 (N=20)	Wheal	67.3 (1,19)	<.001	0.78	120.2 (2.2,41.5)	<.001	0.86	4.6 (3.0,57.7)	.006	0.20
	Flare	28.2 (1,19)	<.001	0.60	17.2 (2.6,49.6)	<.001	0.48	1.0 (2.7,51.1)	.407	0.05

ηp^2 - partial η^2, reflecting effect size of the repeated measures ANOVA.

Note that flare responses showed significant main effects of Condition (green-shaded cells), reflecting consistent differences between attention and distraction throughout the time course. In contrast, wheal responses exhibited significant Condition × Time interactions in both experiments (blue-shaded cells), indicating differences in the response trajectory over time. To follow up on these effects, we conducted post-hoc paired t-tests (Table S1.4). For visualization of response trajectories see Fig. 1.1C,F (Exp.1) and S1.1C,E (Exp.2).

Table S1.4. Wheal response trajectories diverge over time, showing smaller magnitudes and a faster return to baseline under internal attention than distraction.

Experiment	Time	Internal attention M±SD (mm)	Distraction M±SD (mm)	t(df)	*p*	Cohen's d	95% CI
Exp.1 (N=37)	1 min	0.8±0.7	1.1±1.0	1.7(36)	.105	0.27	[-0.06,0.6]
	3 min	2.3±0.7	2.9±0.8	4.0(36)	<.001	0.65	[0.29,1.00]
	5 min	3.0±0.7	3.6±0.9	4.0(36)	<.001	0.65	[0.29,1.00]
	10 min	3.6±0.8	4.4±0.9	5.2(36)	<.001	0.85	[0.47,1.22]
	15 min	3.7±0.8	4.7±0.7	6.7(36)	<.001	1.10	[0.68,1.50]
	20 min	3.5±1.1	5.0±0.7	7.9(36)	<.001	1.30	[0.86,1.73]
Exp.2 (N=20)	1 min	0.6±0.6	1.2±0.7	3.3(19)	.004	0.74	[0.24,1.23]
	3 min	1.7±0.7	2.6±0.7	4.8(19)	<.001	1.07	[0.51,1.62]
	5 min	2.2±0.7	3.4±0.6	7.5(19)	<.001	1.68	[0.98,2.36]
	10 min	3.0±1.0	4.2±0.8	5.9(19)	<.001	1.31	[0.70,1.91]
	15 min	3.2±0.9	4.6±0.9	8.4(19)	<.001	1.88	[1.14,2.61]
	20 min	3.2±1.1	4.7±0.8	8.0(19)	<.001	1.79	[1.07,2.50]

Note increasing t values and effect sizes over time, reflecting growing differences between conditions.

Section S2: Analyses of wheal response resolution (Experiments 1 and 2)

To assess recovery, we first examined whether wheal size stabilized or declined during the final phase of the response. For each participant, wheal change from 15-20 minutes was coded as either stable/decreasing or increasing, and conditions were compared using McNemar's test. In Experiment 1, a markedly higher proportion of participants showed stable or declining wheal under internal attention (89.2%) than distraction (46%; p=.0004, 95% CI [24.1%, 62.4%]; Fig. 1D). In Experiment 2, this categorical comparison showed the same pattern but did not reach significance, likely reflecting reduced power.

We then tested recovery more formally using linear mixed-effects models restricted to the 10-20 min resolution phase. In both experiments, the significant Time × Condition interaction (Table S2.1) confirmed that wheal trajectories differed between conditions. Condition-specific slopes showed that wheal size continued to rise under distraction but flattened under internal attention, consistent with stabilization and faster recovery (Table S2.2). Thus, both categorical and model-based analyses converge to indicate faster inflammatory resolution under internal attention.

Table S2.1. Mixed-effects model of wheal resolution.

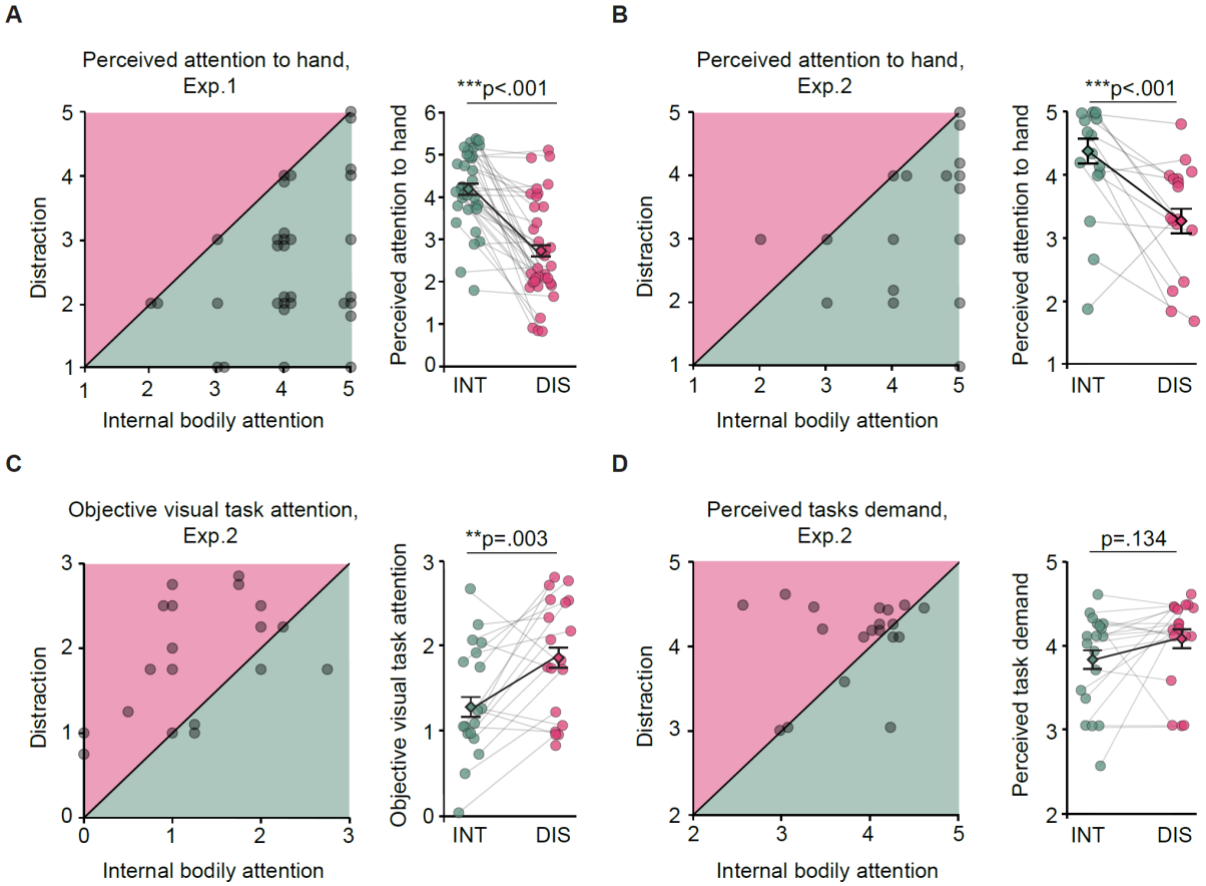
Experiment		Estimate	SE	*t*	*p*
Exp.1	Intercept	3.816	0.167	22.790	<.001
	Time	0.012	0.021	1.767	.079
	Condition	0.003	0.167	0.017	.987
	Time x Condition	0.036	0.011	3.356	<.001
Exp.2	Intercept	3.243	0.198	16.349	<.001
	Time	0.037	0.009	4.141	<.001
	Condition	0.443	0.128	3.463	<.001
	Time x Condition	0.014	0.007	2.102	.040

Table S2.2. Condition-specific slope estimates: faster wheal resolution under attention.

Experiment	Condition	Time (slope)	95% CI
Exp.1	Distraction	0.057	[0.026, 0.089]
	Internal attention	-0.015	[-0.047, 0.017]
Exp.2	Distraction	0.051	[0.029, 0.073]
	Internal attention	0.023	[4.951×10^{-4},0.045]

Section S3: Verifying attention manipulation success (Experiments 1 and 2)

Fig. S3.1. Subjective and objective manipulation checks.



(**A-B**) Reported attention to the hand (inflammation site) in Exp.1 (distraction as videoclips, N=37) and Exp. 2 (distraction as visual shape task, N=20). Scatterplots (left) and paired dot plots (right) show consistently greater perceived attention to the hand under internal attention (green) vs. distraction (pink). Two-sided paired Student's t-test confirmed this effect in Exp.1 (t_{36}=7.8, p=3.456×10^{-9}, *Cohen's d*=1.28, 95% CI [0.83,1.71], N=37) and Exp.2 (t_{18}=4.0, p=7.945×10^{-4}, *Cohen's d*=0.92, 95% CI [0.37,1.46], N=19). (**C**) Objective shapes task scores in Exp.2 were higher during distraction than internal attention, confirming greater task engagement in the distraction condition (two-sided paired Student's t-test; t_{18}=3.5, p=.003, *Cohen's d*=0.80, 95% CI [0.27,1.31], N=19). (**D**) Perceived task demand showed no significant differences in reported cognitive load between internal and distraction conditions (log-transformed scores; two-sided paired Student's t-test: t_{18}=1.6, p=.134, *Cohen's d*=0.36, 95% CI [-0.11,0.82], N=19). See also Table S3.1.

Table S3.1. Subjective and objective manipulation checks.

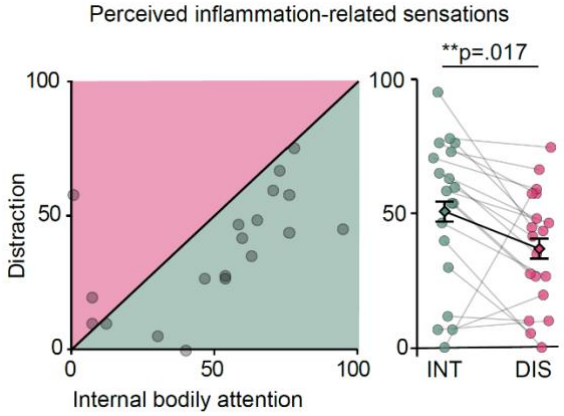
Experiment	Measure	Internal attention	Distraction M±SD (mm)	t(df)	*p*	Cohen's d	95% CI

		M±SD (mm)					
Exp.1 (N=37)	Perceived attention to hand	4.2±0.8	2.7±1.1	7.8(36)	<.001	1.28	[0.83, 1.71]
Exp.2 (N=19)	Perceived attention to hand	4.4±0.9	3.3±1.1	4.0(18)	<.001	0.92	[0.37, 1.46]
	Objective visual task score	1.3±0.7	1.9±0.7	3.5(18)	.003	0.80	[0.27, 1.31]
	Perceived task demands	3.8±0.6	4.1±0.5	1.6(18)	.134	0.36	[-0.11, 0.82]

Section S4: Perceived inflammation-related sensations (Experiments 1 and 2)

In Experiment 2, perceived inflammation-related sensations were quantified using numerical ratings (visual analog scale 1-100) of several sensations including itch and burning. Their composite score was compared between conditions. Perceived inflammation-related sensations were significantly stronger under internal attention than distraction (Fig. S4.1).

Fig. S4.1. Perceived inflammation-related sensations are stronger under internal attention than distraction.

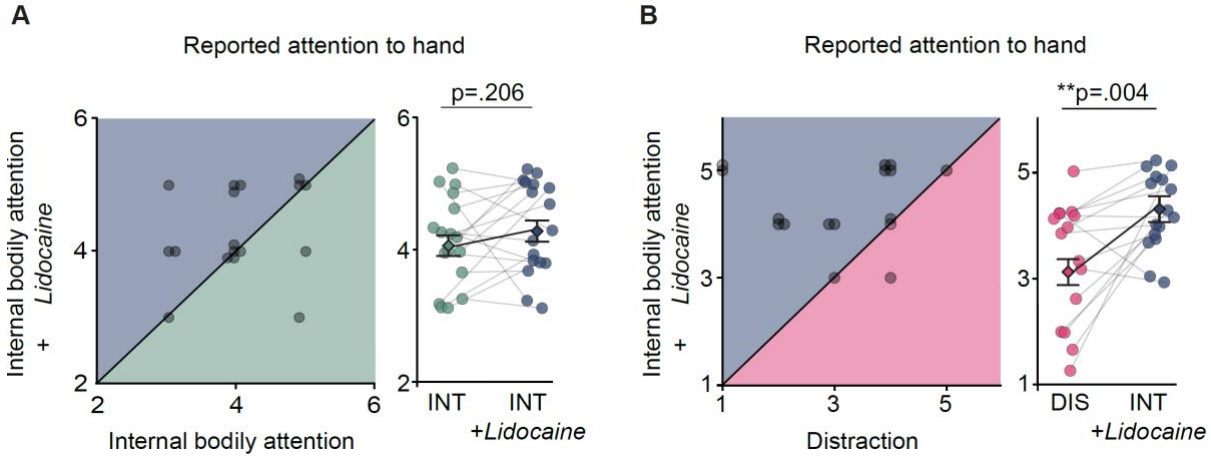


Scatterplot and dot plot demonstrate greater perceived inflammation-related sensations (itch, burning) in internal attention (green) versus distraction (pink) (two-sided paired Student's t-test: 51.4 ± 27.4 vs. 37.0 ± 21.7; t_{18}=2.6, *p*=.017, *Cohen's d*=0.61, 95% CI [0.11, 1.09], N=19).

Of note, in Experiment 1 participants provided open-ended reports rather than numerical ratings. A similar pattern emerged: 54.4% reported stronger sensations at the test site during internal attention, with an additional 16.2% describing stronger general bodily sensations, compared with 10.8% and 2%, respectively, under distraction. Twenty-seven percent reported no perceptual difference between conditions.

Section S5: Inflammatory responses and manipulation check (Experiment 3: lidocaine)

Fig. S5.1. Reported attention during sensory attenuation (lidocaine).



(**A**) Scatterplot and paired dot plot demonstrate no significant difference in reported attention to the hand (inflammation site) in internal attention (green) and internal attention with lidocaine (blue). Two-sided paired Student's t-test: 4.1±0.8 vs. 4.4±0.7, t_{16}=1.3, *p*=.206, *Cohen's d*=0.32, 95% CI [-0.17,0.80], N=17. (**B**) Greater reported attention to the hand in internal attention with lidocaine (blue) vs. distraction (pink). Two-sided paired Student's t-test: 4.4±0.7 vs. 3.1±1.2, t_{15}=3.5, *p*=.004, *Cohen's d*=0.86, 95% CI [0.28,1.43], N=16.

Table S5.1. Wheal response at the 20-min peak is more regulated under intact internal attention than internal attention with lidocaine and distraction, as reflected in paired comparisons within participants.

Comparison	Internal attention M±SD (mm)	Internal attention + lidocaine M±SD (mm)	Distraction M±SD (mm)	t(df)	*p*	Cohen's d	95% CI
INT, INT+lido	3.1±1.0	4.0±0.6	4.9±1.0	4.3(16)	<.001	1.04	[0.44, 1.63]
DIS, INT+lido				4.9(16)	<.001	1.19	[0.55, 1.80]

INT= internal attention, INT+lido=internal attention with lidocaine, DIS=distraction. N=17.

Table S5.2. Wheal responses follow different time courses under internal attention with lidocaine compared to intact internal attention and distraction, as reflected by repeated-measures ANOVA.

Comparison	Condition			Time			Time x Condition		
	F(df)	*p*	ηp²	F(df)	*p*	ηp²	F(df)	*p*	ηp²
INT+lidocaine, INT	2.5 (1,16)	.133	0.14	149 (2.4,37.7)	<.001	0.90	3.8 (2.6,41.0)	.023	0.19

INT+li-docaine, DIS	26.6 (1,16)	<.001	0.62	173.8 (2.1,34.0)	<.001	0.92	0.86 (2.7,43.0)	0.457	0.05

INT= internal attention, INT+lidocaine=internal attention with lidocaine, DIS=distraction. ηp^2 - partial η^2, reflecting effect size of the repeated measures ANOVA. N=17.

Following a significant Time x Condition interaction in the repeated-measures ANOVA for wheal responses under lidocaine vs. intact internal attention (Table S5.2, blue-shaded cell, Fig. 2E), we detail below the post-hoc paired t-test results. Note that this interaction was not significant for lidocaine vs. distraction (Table S5.2), thus no post-hoc tests were conducted.

Table S5.3. Wheal response over time showed smaller magnitude under intact internal attention compared to internal attention with lidocaine.

Time	Internal attention with lidocaine M±SD (mm)	Intact internal attention M±SD (mm)	t(df)	*p*	Cohen's d	95% CI
1 min	0.6±0.6	0.7±0.7	-0.3(16)	.740	-0.08	[-0.56,0.40]
3 min	2.2±0.8	2.1±0.7	0.8(16)	.448	0.19	[-0.29,0.67]
5 min	2.8±0.7	2.7±0.7	0.8(16)	.442	0.20	[-0.28,0.68]
10 min	3.4±0.5	3.5±0.8	-0.3(16)	.768	-0.07	[-0.55,0.40]
15 min	3.8±0.5	3.5±0.9	1.9(16)	.074	0.46	[-0.04,0.96]
20 min	4.0 ± 0.6	3.1±1.0	4.3(16)	<.001	1.04	[0.44,1.63]

N=17.

To assess recovery patterns under sensory attenuation, we applied the same approach described in Section S2. For each participant, a dichotomous variable was created at the last time interval (15-20 min): a decrease or no change in wheal size was coded as 1, and an increase as 0. We then compared the experimental conditions (internal attention with lidocaine, intact internal attention, distraction) using McNemar's test. Results are presented in Table S5.4, with visualization in the main text Fig. 2F.

Table S5.4. Significantly slower wheal recovery when sensory signaling attenuated.

Comparison	Intact internal attention (%)	Internal attention with lidocaine (%)	Distraction (%)	Difference (%)	95% CI of difference (%)	*p*
INT+ lido, INT	100	64.7	41.2	35.3	[12.6,58.0]	.031
INT+ lido, DIS				23.5	[-58.2,11.2]	.344

INT= internal attention, INT+lido=internal attention with lidocaine, DIS=distraction. N=17.

Section S6: Sympathetic indices and state anxiety (Experiments 1 and 2)

Table S6.1. Sympathetic indices comparison between internal bodily attention and distraction (Exp. 1 and 2).

Parameter	Internal attention M±SD	Distraction M±SD	t(df)	*p*	Cohen's d	95% CI	N
Skin conductance	0.2±0.4	0.2±0.4	-0.4(52)	.707	0.05	[-0.22, 0.32]	53
Heart rate (Beats per minute)	74.6±11.3	74.9±11.2	-0.2(53)	.828	0.03	[-0.24, 0.30]	54
Skin temperature	30.9±1.1	30.9±1.05	-0.1(43)	.923	0.02	[-0.28, 0.31]	44
Perceived anxiety (before-after)	-0.06±0.4	-0.09±0.4	0.4(55)	.685	0.06	[-0.21, 0.32]	56

Fig. 3 in the main text.

Section S7: Participants' accuracy in identifying the study purpose

Table S7.1. Participants' guesses about the study purpose were largely wrong.

Category	N	%
Correct: attention and immune response / allergy test	8	14.0
Attention and general physiology / performance (e.g., concentration, divided attention)	11	19.3
Cognition / psychological states and bodily or task outcomes (e.g., manipulation of sensations, stress, general psychological effects)	7	12.3
Environment and sensory context (e.g., videos, visual stimuli, body awareness)	23	40.4
Irrelevant / uninterpretable (e.g., "it was interesting")	8	14.0

Responses were coded into thematic categorie[34]. A total of 14% of participants correctly identified the study's aim (attention-immune link). Their physiological response patterns did not differ from the rest of the sample.

Section S8: Non-parametric tests

Table S8. Non-parametric tests (Wilcoxon-Rank) for study's variables that deviated from Shapiro-Wilk test of normality.

Exp.	Parameter	Internal attention M±SD	Distraction M±SD	Internal attention with lidocaine M±SD	Z	*p*	Rank-Biserial Correlation (effect size)	95% CI
Exp.1 (N=37)	Wheal (mm, 1m)	0.8±0.7	1.1±0.9		1.3	.182	0.28	[-0.13, 0.61]
	Wheal (mm, 5m)	3±0.7	3.6±0.9		3.5	<.001	0.74	[0.49, 0.88]
	Wheal (mm, 10m)	3.6±0.8	4.4±0.8		4.2	<.001	0.92	[0.82, 0.96]
	Wheal (mm, 15m)	3.7±0.8	4.7±0.7		4.9	<.001	1.0	[1.0, 1.0]
	Wheal (mm, 20m)	3.5 ± 1.1	5.0±0.7		5	<.001	1.0	[1.0, 1.0]
	Wheal AUC	61.2 ± 12	77.4 ± 13.4		5.1	<.001	0.96	[0.91, 0.98]
Exp.2 (N=20)	Wheal (mm, 1m)	0.6±0.6	1.2±0.7		2.5	.015	0.74	[0.35, 0.91]
	Wheal (mm, 5m)	2.2±0.7	3.4±0.6		3.7	<.001	1.0	[1.0, 1.0]
	Wheal (mm, 10m)	3±1	4.1±0.8		3.5	<.001	1.0	[1.0, 1.0]
Exp.3 (N=17)	Reported attention to hand	4.1 ± 0.8		4.4 ± 0.7	1.2	.235	0.44	[-0.25, 0.84]
Exp. 1+2	Perceived anxiety (N=56)	3.4±0.5	3.5±0.8		0.2	.890	0.03	[-0.31, 0.36]
	HRV (CVrr) (N=49)	0.08±0.02	0.07±0.02		2.4	.013	0.40	[0.10, 0.63]

Section S9: Individual differences and attentional qualities show limited influence on attentional immune regulation

The effect of attentional immune regulation was highly robust, with 90% of participants demonstrating the effect across two independent cohorts, and no participant showed the opposite pattern (i.e., a larger immune response under internal attention; Fig.1, Fig. S1.1). While the within-subject design inherently controls for stable individual differences, we examined whether such differences may modulate the magnitude of the effect.

Analyses were conducted on the combined sample from Experiments 1 and 2 (N=57; 70.2% women, M_{age}=26.6±3.6), with individual-difference factors included as between-subject variables in repeated-measures ANOVAs of attentional modulation of inflammatory responses. All main effects and interactions of condition and time were consistent with the primary analyses, and therefore are not repeated here.

Demographic factors (sex, age). Sex did not significantly influence the wheal response (all p >.128, Table S9.1). For flare, a trend-level Sex x Condition interaction (p=.054) was observed. Post-hoc comparisons indicated that attentional modulation was significant in both men and women, but the effect was stronger in men (women: t=-3.0, p=0.017; men: t=-4.3, p<.001). Age did not significantly modulate attentional effects on wheal (all p > .369) or flare (all p > .176; Table S9.2).

Table S9.1. Effects of sex on attentional modulation of inflammatory responses.

Parameter	Sex main effect		Sex x Condition		Sex x Time		Sex x Time x Condition	
	F(df)	*p*	F(df)	*p*	F(df)	*p*	F(df)	*p*
Wheal (mm)	0.35 (1,55)	.559	0.00 (1,55)	.944	2.02 (2.4,130.1)	.128	0.88 (2.5,137.0)	.435
Flare (mm)	1.57 (1,55)	.216	3.88 (1,55)	**.054**	0.75 (2.0,112.1)	.475	1.89 (3.1,171.1)	.130

Table S9.2. Effects of age on attentional modulation of inflammatory responses.

Parameter	Age main effect		Age x Condition		Age x Time		Age x Time x Condition	
	F(df)	*p*	F(df)	*p*	F(df)	*p*	F(df)	*p*
Wheal (mm)	0.10 (1,55)	.756	0.82 (1,55)	.369	0.73 (2.4, 131.8)	.507	0.46 (2.5,139.5)	.676
Flare (mm)	1.2 (1,55)	.271	0.03 (1,55)	.871	0.32 (2.0,111.5)	.733	1.67 (3.1,167.9)	.176

Qualitative differences in internal attention. We next examined whether variability in how participants engaged with internal attention contributed to immune responses. Internal attention can take multiple forms, ranging from evaluative or stress-related engagement (e.g., worry, tension) to more non-judgmental, acceptance-based engagement. To capture these dimensions, we examined two candidate factors.

Stress-related engagement was captured by the change in state anxiety (STAI[1]; post - pre) during the attention condition, and acceptance-based engagement was defined as the mean of three items reflecting bodily attention and attunement ("I felt present in my body", "I listened to what my body was telling me", "I was attuned to the sensations elicited"; items adapted from [2]) during the attention condition. Participants were divided into high and low levels of each measure and examined as between-subject factors in analyses of inflammatory responses, both within the attention condition and across conditions.

Stress-related engagement did not modulate wheal or flare responses, either within the attention condition or across conditions (all p > .213; Tables S9.3-S9.4).

Table S9.3. Effects of stress-related engagement within the attention condition.

Parameter	Stress engagement main effect		Stress engagement x Time	
	F(df)	*p*	F(df)	*p*
Wheal (mm)	0.15 (1,54)	.702	0.32 (2.8,150.6)	.793
Flare (mm)	0.23 (1.54)	.634	0.11 (2.5,133.1)	.927

Table S9.4. Effects of stress-related engagement across conditions.

Parameter	Stress engagement		Stress engagement x Condition		Stress engagement x Time		Stress engagement x Time x Condition	
	F(df)	*p*	F(df)	*p*	F(df)	*p*	F(df)	*p*
Wheal	0.11 (1,54)	.747	1.59 (1,54)	.213	0.32 (2.4,129.6)	.768	0.44 (2.5,135.1)	.690
Flare	0.29 (1,54)	.595	0.00 (1,54)	.963	0.14 (2.0,109.9)	.871	0.43 (12.1,27.9)	.737

Acceptance-based engagement did not significantly influence the wheal response, either within the attention condition (all *p* >.386) or across conditions (all *p*>.162). For flare, a significant Engagement × Time interaction was observed within the attention condition (*p*=.011; Table S9.5). Post-hoc comparisons indicated smaller, more regulated responses in the first minute of the effect in participants reporting higher acceptance engagement (*p*=.015), but not in other timepoints (all *p* >.122; Table S9.6). Across conditions, acceptance-based engagement also modulated flare trajectories, with a significant Engagement × Time interaction (*p*=.011), with

a similar pattern as reported above. In addition, a Condition × Engagement interaction (p=.028) was observed, with post-hoc comparisons indicating that attentional modulation was significant in both high- and low-acceptance groups, but the effect was stronger among participants reporting higher acceptance-based engagement (low group: p=0.017; high group: p<.001; Tables S9.7-S9.8).

Table S9.5. Effects of acceptance-based engagement within the attention condition.

Parameter	Acceptance-based engagement		Acceptance-based engagement x Time	
	F(df)	*p*	F(df)	*p*
Wheal (mm)	0.24 (1,55)	.624	1.01 (2.8,154.4)	.386
Flare (mm)	0.26 (1,55)	.612	4.15 (2.5,139.4)	.011 ηp^2=0.07

ηp^2 - partial η^2, reflecting effect size of the repeated measures ANOVA.

Table S9.6. Post-hoc comparisons for acceptance-based engagement x time interaction on flare responses within internal attention condition.

Time	Low acceptance engagement M±SD (mm)	High acceptance engagement M±SD (mm)	U	*p*	Rank-Biserial Correlation (effect size)	95% CI
1 min	8.8±9.8	3.1±6.3	537.0	.015	0.33	[0.04, 0.57]
3 min	12.7±9.2	9.4±9.3	469.5	.284	0.17	[-0.14, 0.44]
5 min	13.4±8.9	14.1±7.7	346.5	.369	0.14	[-0.42, 0.16]
10 min	11.5±8.1	13.7±6.4	306.0	.122	0.24	[-0.50, 0.06]
15 min	10.6±8.5	11.4±5.6	331.5	.254	0.18	[-0.45, 0.12]
20 min	10.3±8.3	10.5±6.0	363.5	.531	0.10	[-0.38, 0.20]

Normality tests indicated a deviation from normality (*Shapiro-Wilk*, p<.021), therefore *Mann-Whitney* tests are reported.

Table S9.7. Effects of acceptance-based engagement across conditions.

Parameter	Acceptance engagement		Acceptance engagement x Condition		Acceptance engagement x Time		Acceptance engagement x Time x Condition	
	F(df)	*p*	F(df)	*p*	F(df)	*p*	F(df)	*p*
Wheal	2.01 (1,55)	.162	1.45 (1,55)	.233	0.54 (2.4,131.6)	.617	1.69 (2.5,138.3)	.181
Flare	0.42 (1,55)	.518	5.12 (1,55)	.028 ηp^2=0.09	4.57 (2.1,116.9)	.011 ηp^2=0.08	0.72 (3.1,168.6)	.544

ηp^2 - partial η^2, reflecting effect size of the repeated measures ANOVA.

Table S9.8. Post-hoc comparisons for the acceptance-based engagement × condition interaction on flare responses across conditions.

Group	Internal attention M±SD (AUC)	Distraction M±SD (AUC)	t(df)	W	*p*	Effect size	95% CI
Low acceptance engagement	217.6±142.1	263.3±128.5		127.0	.017	0.49 (Rank-biserial Correlation)	[0.13, 0.73]
High acceptance engagement	223.1±98.3	332.0±136.5	4.9 (25)		<.001	0.96 (Cohen's d)	[0.49, 1.42]

Tests were selected based on normality (Shapiro-Wilk). The low-acceptance group deviated from normality (p=.028; Mann-Whitney tests reported), whereas the high-acceptance group did not (p=.946).